432 AND ABOVE EME NEWS
OCTOBER 2003 VOL 31 #10

EDITOR: AL KATZ, K2UYH; ENGINEERING DEPARTMENT, THE COLLEGE OF NEW JERSEY, PO BOX 7718 EWING, NJ 08628
TEL (W 609-584-8424) OR (H 609-443-3184), FAX (609-631-0177), E-MAIL a.katz@ieee.org
PROD/MAIL: BRIAN MULLANEY, KB2TIS (609-883-6390), E-MAIL mullaney@mccc.edu
NETNEWS EDITOR: G4RGK, DAVID DIBLEY, E-MAIL g4rgk@hdeng.freeserve.co.uk (based on K1RQG's Netnotes)
EME NETS: 14.345, 10 AM ET SATURDAY AND SUNDAY (AFTER VARO NET ENDS ON SUNDAY)
NET CONTROL AND SKEDS CORDINATOR: JOE, K1RQG, TEL (207-469-3492), E-MAIL k1rqg@aol.com
EME DIRECTORY: http://www.dl4eby.de/, DL4EBY/DK0TU, KLAUS TIEDEMANN, TEL (49-30-7955467), E-MAIL: <tklaus@berlin.snafu.de>
E-MAIL LIST CORD: WARREN, W2WD wbutler@comcast.net /NL DISTRIBUTION: SCOTT, KD4LT <cscott@surfsouth.com> [TXT OR PDF]
EME STANDINGS: DAN GAUTSCHI, HB9CRQ/HB9Q E-MAIL hb9crq@hb9q.ch OR SEE HIS WEBPAGE AT www.hb9q.ch.
THE NL WEB VERSION IS PRODUCED BY W6/PA0ZN AND AVAILABLE AT <http://www.nitehawk.com/rasmit/em70cm.html>

CONDITIONS: This Sept included some important firsts. OK1UWA provided the first 24 GHz QSO with central Europe and joined the exclusive ranks of successful 24 GHz EMEers by contacting W5LUA. DL3OCH brought 1296 EME to Corsica and Sardinia with a very successful one person EME dxpedition – see his report below. The activity weekend again was not spectacular, but as discussed last month this is primarily the result of the spreading of skeds and related activity across month. By all indications the ARRL EME Contest (first weekend - Oct 18/19) will be outstanding. The JW/SM2BYA dxpedition/EME Test is taking place the same weekend as the contest and will be a great attraction and help to increase this year's activity – see their report.

JW/SM2BYA DXPEDITION SITE

DL3OCH: Bodo's DL3OCH@t-online.de *small station* 23 cm dxpedition to the islands of Corsica and Sardinia worked better than he expected! Despite very low moon declination and weekday times, Bodo completed all his skeds. He worked OE9XXI on random at all 3 locations. All QSOs were on JT44 using DJ9YW's HB 59 el yagi (5.08 m/19.7 dBd) horizontally polarized, SSPA with 82 W output and .28 dB LNA at the feed. He began operation with the call TK/DL3OCH/p in JN42kn on 8 Sept and QSO'd at 2100 OE9ERC (O/O), 2125 OE9XXI (O/O) and 2150 DJ9YW (O/O), and on 9 Sept at 0100 K2UYH (O/O). He then moved to Sardinia, but lost a day because missed the ferry. Bodo wrote that -- Everything here looks so small and tiny, but you need one hour for just 15 miles. He used the IS0/DL3OCH/p in JN40sx and on 10 Sept he QSO'd at 2130 OE9ERC (O/O), 2200 DJ9YW (O/O) and 2330 OE9XXI (O/O), and on 11 Sept at 0230 K2UYH (O/O). Bodo then moved to JN41QE still on Sardinia and used the same call. (He had wanted to go to IM0, but there was insufficient time.) He QSO'd on 11 Sept at 2004 PA3CSG (O/O), 2115 DJ9YW (O/O), 2201 OE9ERC (O/O) and 2220 OE9XXI (O/O), and on 12 Sept at 0232 K2UYH (O/O). This dxpedition provided the first 23 cm QSOs from TK to OE, DL and W, and from IS0 to DL, OE, PA and W.

DL7UDA: Dietmar dl7uda@t-online.de writes – On 21 Sept I was QRV on 70 cm for some hours. I only heard OE9ERC and K1FO. Both had good signals. OE9ERC sent me a QRZ, but then disappeared. I am still running 4 x 21 el yagis and a GI7B PA with 300 W. I may be miss setting my Doppler shift when replying to calls. [Even if you have no interest in JT44. Joe's program gives excellent values for the Doppler frequency offset. When you put your grid square in the station called box, it will show the Doppler shift of your echoes. If you set your RIT to this offset, your echoes also echoes will be heard by the station you are receiving on the same frequency as he hears his own echoes.] I also observe that stations (especially the big guns) do not use 2.5 min sequencing. [This is true. 2.5 min sequencing is used only during skeds. During random operation there is no rule.] In Sept I got an GS23B cavity. Now I have to do some mechanical and power supply work to get it on. Unfortunately there is not enough time to have it ready for the ARRL EME Contest. So I hope for very good conditions and to work at least JW/SM2BYA!

DL0AO WILL BE QRV IN THE CONTEST
THEIR 432 EME IS AT TOP OF THE BUILDING

F2TU: Philippe F2TU.Philip@guideo.fr wants to pass the word that he will be QRV for the ARRL EME Contest. He plans to operate primarily on 70 and 23 cm during the first part. Although, Philippe may try 13, 6 and 3 cm, if he finds activity. During the second part he plans to be on all bands, especially on 13, 6 and 3 cm.

FY5DG: Chris sylvie.albrieux@wanadoo.fr reports that he will be out of FY land in Oct and thus not make the 1st part of the ARRL EME Contest. He will be back on 23 Oct and does plan to be active on 70 cm for the 2nd half.

G0MRF: David G0MRF@aol.com has been invited to join a major dxpedition in scheduled for late March/early April. He is a satellite operator, but is considering upgrading 70 cm AO-40 station to allow operation also on EME. He is presently running a 19 el Tonna yagi and a 100 W masthead amplifier, and is looking for advice. [I have already responded that he can work a few stations with what he already has.]

G3LTF: Peter 100633.1656@compuserve.com was only able to QRV for one day in Sept – I was active on 20 Sept on 23 cm. It was very quiet, but I did work LA8LF, ZS6AXT, IK2MMB, GW3XYW, and WA6PY. I had a near miss with OM6AA. After a lot of QRZs, I got his call and then copied OR. I sent MR, but never got final RRRs. Hopefully I'll catch him during the contest. [OM6AA plans to be on.] The only other news is that I have fitted new, professional, connectors to the 50 m of 1 5/8" coax that feeds my dish. This change is giving improved VSWR and slightly reduced losses at 2.3 GHz. I also fitted a new declination drive motor. I picked up a 2.5 m 0.75 f/d fiberglass dish with a fine embedded mesh surface, which is making me think seriously about 3 cm EME. I will mount it on a semi-mobile polar mount with limited coverage. I intend to be on for the contest and operate on 2m, 70, 23 and 13 cm.

G4RGK: Dave had nothing for the Netnotes this month, but does report that his home building work is nearly finished -- I have been QRT for 3 months now, but its slowly coming back together and I hope to be on for the Oct contest weekend.

HB9Q: Dan dan@hb9q.ch wants to announce that his group will be QRV on 18/19 Oct on 144, 432 and 1296 MHz – We will be active starting at 0000 to 1315, and from 22.15 to 1400 on the 19th. We will be on 144.040 all the time, but will switch between 432.020 and 1296.016. If there is QRM, we will move up several kHz. Please let us know if you would like to work us on one of the bands. If you would like to get a last minute update of our activity, please email us. Our webpage is www.hb9q.ch.

JA6AHB: Toshio ja6ahb@nifty.com is now QRV on JT44 as well as CW on SSB and is look for stations to sked on 70 and 23 cm. Toshio (PM53) is using his 7 m dish and 300 W on JT44. His webpage is http://homepage3.nifty.com/JA6AHB/.

JW/SM2BYA: Gudmund (SM2BYA) sm2bya@telia.com sends the latest news on the JW/SM2BYA 432 EME Tests – The receiver chain (antenna relay, preamp, 6 m of RG-213, postamp, transverter) was put on a HP8970A NF system and measured in at Tsys=33 K (0.47 dB NF). All heavy equipment has now been packed in 3 transport crates and will be handed over to a shipper for air freight to Spitsbergen well ahead of time. We will leave Kiruna by car on 13 Oct for Tromso, Norway and will fly out of there to Spitsbergen on 14 Oct. It is still unclear as to when we can start installing the 432 gear. In the very best case, we may get access to the antenna around noon on Friday (17th), but there is no guarantee. Time on the 17th between 1800 and 2400 will be reserved for working QRP and/or not fully EME capable stations ONLY;(stations with < 20 kW EIRP, or limited to on a rising/setting moon, or if you never had a EME QSO). JW/SM2BYA will call CQ on 432.073 and listen for replies from 432.075 to .080. If signals are marginal, we will go into strict 1 minute sequencing and expect the other party to follow suit. For this to work out, we need the full cooperation of the established EME community. Everyone will have plenty of time to work us later, so please, please give the first-timers and little pistols a chance by keeping your fingers off the paddles! We were all newcomers once. In the Americas the moon is still below the horizon during this time interval. So we won't be able to offer our American QRP friends the same opportunity, but you shouldn't give up! There are some simple things you can do to maximize your chances of getting through even in the thick of the contest. Some excellent advice given by the VE3ONT crew back in 1994 bears repeating here: If you do not have full elevation capability, fix your antenna about 2 degrees below the maximum moon elevation at upper culmination at your location. That way, you can track the moon for at least two hours using azimuth rotation only, plus it minimizes ground and man-made noise pickup on receive. Avoid the European window if you can. Remember, we are so far north that the moon is above our horizon all the time. Call us at the upper end of our receive band, if your rig can work at a 7 kHz split.

K7XQ: Jeff k7xq@elite.net has had a slow summer on 1296 EME – I haven't worked anyone on 23 cm since May! I found no activity on the band. On 1296 I run a 3.1 m dish with 150 W from a 2 x 2C39 water-cooled PA. The problem is probably my minimum dish elevation is 20 degrees. By the time I get moon from my CA QTH most of the crowd has already gone QRT. I think I miss most of the activity during the activity weekends. I am up to initial #22 and would like to have some more. So please stay around for me. I also have 2 x 9 wl yagis and 800 W from a 2 x 4CX400A7 PA on 432 and initial #5, but am not currently QRV there. My home page is http://www.elite.net/~k7xq/k7xq.html.

KM5A: Steve smw@rapidnet.com has been working to improve his station and should be QRV on 70 cm for the contest. He purchased a new preamp from WD5AGO and reports that it made a remarkable improvement in the system NF. If his measurements are correct, the system noise temp fell from 93 to 43 degs K. He also lifted the entire array up to a second story deck and is replacing the booms. Unfortunately Steve broke an N connector on his power splitter and is now waiting for its return from the manufacturer.

N3FTI: Steven n3fti@yahoo.com updates the status of his 10 GHz EME project -- The dish mount is now at the fabricator for some modifications. I am hoping to get it back within a couple of weeks. I'd like to be QRV for at least the 2nd part of the ARRL EME Contest, but things are taking longer than first anticipated.

OK1UWA: Josef sveceny@ges.cz has joined the elite ranks of successful 24 GHz EMEers – I successfully QSO'd W5LUA on the 24GHz band. We worked on 24 Sept (M/O) and repeated the next day with same reports. This was the first 24 GHz EME QSO between central Europe and the USA. My station consists of a 3 m dish (f/d 0.35) designed for 18 GHz only, a TWTA with 30 W output and DB6NT LNA (NF 1.35 dB). Both the LNA and TWT (with 14 kV power supply) are mounted at the antenna focal point for minimal lose. I receive 1.35 dB of Moon noise. I'm using a HB transverter (OK1UWA design) with an YAESU FT-1000MP IF with the large IF SSB filter. The narrow CW 500 Hz or 250Hz filters are unusable. See my webpage www.ok1uwa.com for more details and audio wav files of the QSO. [Dish is at end of NL]

OK1UWA AT 24 GHz FEED/AMPS ON HIS 3 M DISH

OM6AA: Rasto's om6aa@stonline.sk report on his Sept 1296 activity follows -- I have installed a new CCD camera system and I have replaced old coaxial cable 7/8" with new 1¼" line. I was on the air only on 28 Sept. I worked OZ4MM (559/429) and DJ9YW (O/O). I plan to be next active during the ARRL EME Contest.

PE1ITR: Rob rob@itr-datanet.com is trying to get started on 70 cm EME. Currently he has 2 x 28 el 8.5 wl yagis and a 4CX250 PA. Because of his small system Rob wants to start with JT44. He has copied his echoes using the echo more and now wants to try so me skeds.

SK0UX: Hans (SM0MXO) gustavsson.hans@bredband.net reports that his group is just about QRV on 23 and 13 cm with a 6 m dish from JO99bm -- We did the first echo testing, with 60-70 W at the feed and could hear our echoes rather good at times. We are still missing an ac motor for the elevation drive. During the echo tests we lifted it manually and used different lengths of AL tubing to hold it at the right elevation! Not so very high-tech but it worked. We hope to be QRV with everything running in the second leg of the ARRL EME Contest. [See photo on the next page!]

SM5IOT: Chris sm5iot@chello.se made several QSOs on 70 cm EME with 4 yagis and then decided to expand his array. He went to 12 x 25 el I0JXX yagis, but signals were weaker with the new array! Chris ended up dismantling his whole tower and the 12 yagis. He brought a new larger tower that would clear the trees (believed to be part of his problems) and rotators (new stronger elevation-unit from PRO.SIS.TEL). He also built a new H-frame and switched to 8 new DJ9BV 26 el "OPT" yagis. Chris hopes to be operational again by 18 Oct for the EME contest.

WA6PY: Paul pchominski@Jaalaa.com has many projects to improve his station in progress -- I mover the heaviest parts of my 584 radar pedestal to the hill. I welded bottom and top sections of the supporting short (5') tower. Next I will weld "legs" joining the top and bottom. This is slow progress, but it is moving along. On 24 GHz I am getting about 17 dBm of output power from my transverter, and I measure about a 9 dB NF at the RX input. My NF measurements are not calibrated and are based on the ENR written on the HP346A noise head for 18 GHz. I will try some tropo with local hams in order to verify frequency and that I did not make any big mistake. I am using two PLL's based on a 10 MHz OCXO. For 5.76 GHz, my transverter, LNA with a NF of about 1 dB and Chaparral feed are ready. I did not check how much power I can squeeze out from my TWTA. I do not think that my current 8' dish with its bad shape will give me good results on 5.76 GHz. I plan to be in the contest on 144 and 432 with my dish feed only. I may also be on 1296 and 2304.

WA8ULG: Ted ted@7vsb.com in Scottsdale, AZ reports on his progress toward 10 GHz EME -- We are building up a 10 GHz EME station from a 12' solid dish and Scientific Atlanta mount/positioner. Our goal is to be active by year's end. We are looking for a source for a YD1270 to plug into a cavity we have. I can be reached by e-mail or tel at +928-998-2007.

ZS6AXT: Ivo zs6axt@global.co.za reports -- On Saturday 20 Sept I had family problems, and thus was QRV on 23 cm only on Sunday. Activity was very poor again. I worked G3LTF, OE9XXI, IK2MMB, GW3XYW, LA8LF, G4CCH and WA6PY. All had good signals. Paul's signals had fast QSB, peaking 569! I'm not sure why. My dish was steady with no wind. The idea of a separate EME microwave contest has my full support. Let's make something and adjust it after we have some experience. My suggestion is to allow a station to be worked again after a certain amount of time has passed (2, 4, 6 hours or so) to make up for the low count of stations. I also suggest no more than 2 bands per day or weekend. I am not sure my view on digital stuff is widely known. I am not taking any part in discussions on this issue elsewhere. I will not operate it myself. Others are welcomed to do so. I have a proposal, that the initials made by WSJT should be separated from CW/SSB initials like this: #200 + 10 for 200 CW/SSB and 10 WSJT. In my opinion this would be fair and certainly will meet with approval of majority. If any EME contest will mix the modes, I will just not take an active part in it. Otherwise I finished the plumber delight waveguide up on my tower and made first 3 cm tropo QSO over 30 km with ZS6JON. With only 90 mW into a 20 dB horn signals were 59 on SSB, and this was not line of sight. Installed is now second waveguide which will minimize losses, since I will use only one SMA relay with preamp and 1W SS PA on the top. I mention this because with just 2.2 dB loss in 10 m of such waveguide (22 mm I.D. copper tubing with three 45 degree couplings, two straight ones and two coax/WG transitions), it will be possible to have the 3 cm EME equipment in the shack and run about 15m of such double WG to the EME dish. There will then be just preamp, SSPA and SMA relay, all at a reasonable price. But I am still only in design stage with drives for the dish. I'm still looking for some *el cheapo* and simple ideas for these.

SK0UX's 6 M DISH TO BE USED ON 23 AND 13 CM

K2UYH: The Sept activity weekend is an example of the multiple opportunities and consequent conflicts of modern life. The Sept part of the ARRL's 10 GHz Contest and the Sept activity weekend coincided. I also had another commitment (bicycle marathon) on Sunday morning. My EME activity was the loser and consequently minimal. I was QRV on 70 cm on 20 Sept and QSO'd at 1100 DL0AO (O/O) in a sked for initial #663. DL0AO's signals seemed weaker than I heard from them before. Tom (DJ5RE), the op at DL0AO, reported that Murphy was around and that just at the time of our sked the moon was block by their 2 m array – [see picture on page 1]. I heard few other signals on 432 at the time and had only a QRZ at 1150 and one other QSO at 1130 with K1FO (569/559). Back on 20 Aug I QSO on 70 cm S53J (26 dB/O) on JT44 for #662. I was on 1296 earlier in the Sept for DL3OCH's dxpedition. Because of the southern moon declination success was far from a sure thing. I decided to switch to linear pol to improve signal levels. Since Faraday rotation is minimal on 1296, I did not need a polarization rotator. I mounted a dual dipole feed right on the lip of my 1296 MA type horn feed and set it to the angle predicted by the VK3UM moon tracking program. One issue was the definition of positive and negative angle. After some thought and a little calculation, I concluded the VK3UM pol angle looking at the front of the antenna is positive for clockwise rotation. (Note this is the opposite of the definition of positive for a trigonometric angle.) During the first sked on 9 Sept at 0100 the moon was about 60 percent blocked by trees. Bodo also told me the WX turned bad and he lost visual moon just before our sked. Nevertheless TK/DL3OCH's JT44 signal was visible from the start and peaked to –22 dB, but decoding full call took nearly 20 minutes for initial #212 and DXCC 42. Two days later at IS0/DL3OCH, the moon was higher and almost clear of the trees. We worked much more quickly at both Sardinia locations with signals peaking to –20 dB for #213 and DXCC 43 and #214. Bodo's JT44 signal was also easily detected by ear. This let me to do some echo testing. I was surprised that using the linear feed, I was able to hear echoes with 1 W in the shack!

FOR SALE: **AD6A** passes word that three 300 W 13 cm PAs available for $667 each. They are Specrian SCPA1063W amps. Details can be found at http://www.nr6ca.org/spectrian.html **WA8ULG** is looking for a YD1270 – see Ted's report. He can be reached at ted@7vsb.com or tel at +928-998-2007.

TECHNICAL: At the end of this NL is the continuation and final part of F5VHX's Graham.D@wanadoo.fr a two-part article on his Zero IF Radiometer. The first part appeared in the June NL. My apology for the delay in the publication of this material.

JT44 REPORTING: One of the key requirements of a QSO is the transmission of some form of unknown information in addition to calls (which are known in the case of a schedule). This requirement is normally fulfilled by the exchange of signal reports. This is one of the reasons both 'M' and 'O' reports have always been retained on 432 MHz and above EME. Although small, the difference between an 'M' and 'O' must still be perceived and is a true unknown. In the case of JT44, the report has been simply an 'O'. Yet with JT44's greater information transmission ability, it would seem that something more should be required. Even reverting the M's and O's would be better, where 'M' could stand for very marginal conditions. I have been sending the peak signal level in dB as an additional report. Where JT44 may indicate –24 dB, I would send repeatedly "24dB". A better report would be the average sync level, which is more or less comparable to readability in SSB, and the peak signal level. Thus, I propose the use of the average sync level and peak signal level as the JT44 EME report. For example an average sync of 4 and a peak signal level of –24 dB would be sent as "4/24" repeatedly. If signals are very marginal, "M" could be used for the report. I do not see the need to send "O", but it could still be retained for those who do not want to use the proposed system.

ALL TIME HIGH ARRL EME CONTEST SCORES: Jan (OK1VAO) <ok1vao@quick.cz> reports that the OK1KIR group has taken on the task of maintaining a record of the high scores in the ARRL EME Contest. He has sent the latest table of scores and notes that we should thank Tonda, OK1DAI, who did most of the research for the table. This table has been corrected to show F6KSX as a 10 GHz record holder. With the contest this month, it seems appropriate to include this table in the NL again.

ARRL International EME Competition Contests Records.

Band	Single operator			Multi operator			Non-Amateur Equipment		
	score	call	year	score	call	year	score	call	year
Multiband	3,263.500	OE5JFL	1993	2,921.100	HB9Q	2001	6,496.000	VE3ONT	1993
50 MHz	8.000	K6QXY-K6MYC	1993						
144 MHz	1,920.000	SM5FRH	1999	1,563.500	KB8RQ	1999	1,554.800	VE3ONT	1994
222 MHz	5.600	K9HMB	1982-1	3.000	WB0TEM	1982-1			
432 MHz	827.200	SM4IVE	1993	632.100	OH2PO	1997	307.100	OK1CA	1994
902 MHz	100	KD5RO	1988						
1296 MHz	343.000	K5JL	2000	255.600	K2DH	1997	24.700	KL7RA	1985
2304 MHz	18.200	OE9ERC	1998	6.400	OK1KIR	1991	9.000	SK6WM	1988
3456 MHz									
5760 MHz	200	OE9XTW-I6PNN	1995	600	OK1KIR	1999			
10.368 MHz	15.400	DJ7FJ	1994	19.800	F6KSX	2001			
24.192 MHz									

FINAL: There is no NETNEWS section this month, because there were no Net Note reports to consolidate. We all hope this situation is only temporary as the K1RQG's Net Note reports have become an important exchange for EME information.

Work on the EME2004 Conference is moving along. Hotel details are now up on the webpage at http://www.qsl.net/eme2004/travel.htm under Travel Information with a link to the hotel. [Reload if you have already visited the web page]. Hotel reservations should be done directly with the hotel. The conference registration form is still not yet up on the webpage, but it should be there before the end of the month. We have been working on the budget and can report that the registration fee including banquet will be less than $80. We are still waiting for the price of printing the Proceedings before setting the final figure. To ease the problem of funds transfer, we have arranged for Dominique, HB9BBD to be the conference's European Treasurer. The registration fee can be sent to him by check in Euros or other appropriat e European currency. If you are coming to the conference please let Marc or me know. We want to put a list on the web page of those planning to attend.

You will note that HB9Q's Top Ten List has returned this month. Please keep Dan up to date on your initial's status. I note that my tally is almost

Also this month we have a summary of all time high ARRL EME Contest scores, and some thoughts about JT44 signal reporting. I would appreciate comments on this proposal from others experimenting with JT44.

The SETI 1296 EME Beacon is off the air for SSPA repairs. I am told it is unlikely that it will be back on in time for the contest.

Just for the record, next month the EME contest dates will be 15/16 Nov.

We had more technical material than I realized last month, [Tnx Graham], but we still need more! Please keep the tech information and reports coming.

I am hoping for good WX all around the world for the EME contest, and I shall be looking for you off the moon. 73, Al – K2UYH

HB9Q's TOP LIST

Pos.	Callsign	Band	Initials	Updated
1	DL9KR	432	784	2003.08.17
2	K2UYH	432	649	2002.02.22
3	K1FO	432	606	2002.11.03
4	DK3WG	432	393	2003.04.16
5	SM2CEW	432	382	2002.03.03
6	G3LTF	432	364	2002.02.20
7	SM3AKW	432	363	2003.05.23
8	OK1KIR	432	358	2002.04.01
9	KU4F	432	332	2003.08.30
10	K0RZ	432	312	2003.08.02

Pos.	Callsign	Band	Initials	Updated
1	OE9ERC	1296	271	2003.07.17
2	W5LUA	1296	215	2003.03.06
3	F2TU	1296	208	2003.04.19
4	OZ4MM	1296	207	2003.06.15
5	K2UYH	1296	197	2002.01.21
6	G3LTF	1296	194	2002.02.20
6	HB9BBD	1296	194	2003.08.20
7	OK1KIR	1296	189	2002.04.01
8	ZS6AXT	1296	188	2003.06.15
9	G4CCH	1296	179	2003.09.28
10	SM3AKW	1296	176	2003.05.23

Pos.	Callsign	Band	Initials	Updated
1	OE9ERC	2304	58	2003.07.17
2	W5LUA	2304	50	2003.03.06
3	OZ4MM	2304	42	2003.06.15
4	OK1KIR	2304	41	2002.04.01
5	F2TU	2304	34	2003.04.19
6	ZS6AXT	2304	31	2002.02.22
7	SM3AKW	2304	28	2003.05.23
8	JA4BLC	2304	26	2001.06.01
9	G3LTF	2304	21	2003.02.20
10	WA6PY	2304	13	2002.11.19

Pos.	Callsign	Band	Initials	Updated
1	OE9ERC	5760	25	2003.07.17
2	W5LUA	5760	21	2003.03.06
3	OK1KIR	5760	17	2002.04.01
3	F2TU	5760	17	2002.12.03
4	CT1DMK	5760	16	2003.01.25
5	ZS6AXT	5760	13	2003.06.19

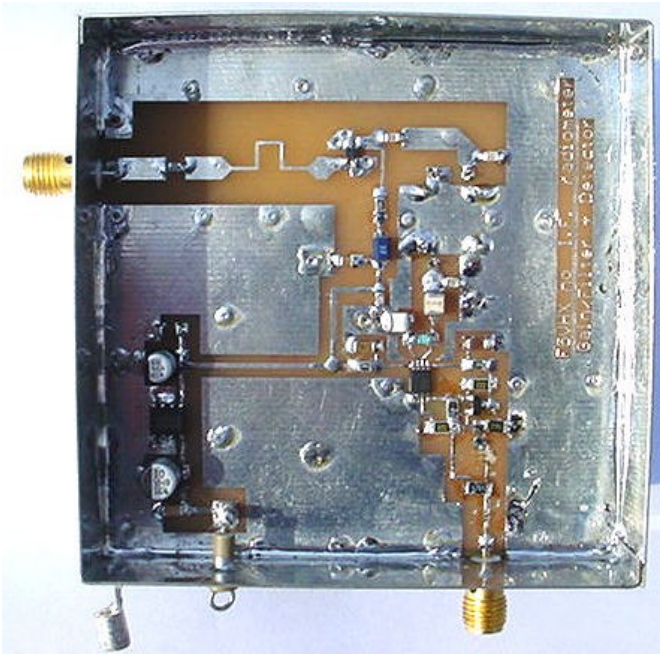
Pos.	Callsign	Band	Initials	Updated
1	W5LUA	10000	46	2003.03.06
2	F6KSX	10000	39	2002.12.28
3	AA5C	10000	34	2002.07.02
4	F2TU	10000	26	2002.12.03
5	OK1UWA	10000	25	2002.07.25
6	CT1DMK	10000	22	2003.01.25
7	OK1KIR	10000	19	2002.04.01
8	I4TTZ	10000	16	2002.11.25
8	G4NNS	10000	16	2003.05.26
9	W6HD	10000	13	2002.03.10
10	PA0EHG	10000	11	2002.11.25
10	OE9ERC	10000	11	2003.07.17

ZERO I.F. RADIOMETER – CONTINUED BY F5VHX/G8MBI:

Next come the 'in shack' modules. Here is a picture of the Gain & Attenuator box.

The input is on the left, the first active device is an Agilent MMIC MGA86563. This is followed by another two stage helical filter (not visible because it is on the opposite side of the PCB) and is then followed by the PCB layout for a 4 PIN diode electronically controller attenuator. In the current prototype these attenuator components are not installed. The intention of the attenuator layout is to give control over the 'range' of output from the radiometer by driving the electronically controlled attenuator by a DC voltage (0 to 5 V) generated from PWM out of the microcontroller. This design offers an insertion loss of about 3 dB and an attenuation range of 0 to 40 dB. Finally, there is another MGA 86563 amplifier.

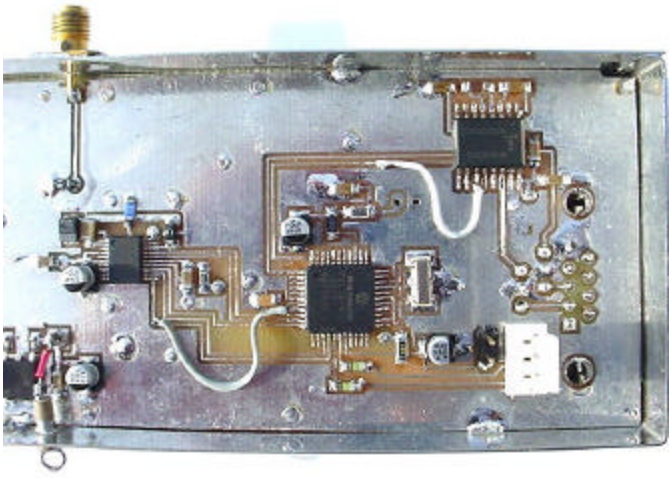
Next is the Gain & Detector module:



The RF entry is on the top left. The first device (centre top) is another MGA 86563 amplifier. It is followed by a two stage helical filter (not visible as it is on the other side of the PCB). The detector chip itself is the final stage. On the left is the 5 V0 regulator and associated components. The SMA connector at the bottom is the exit for the DC voltage. I have performed some testing on this module to try and determine the linearity and accuracy of the Analog Devices chip. The specification states within 1 dB for 60 dB dynamic range. It would appear that this specification is very conservative. Testing over a 40 dB dynamic

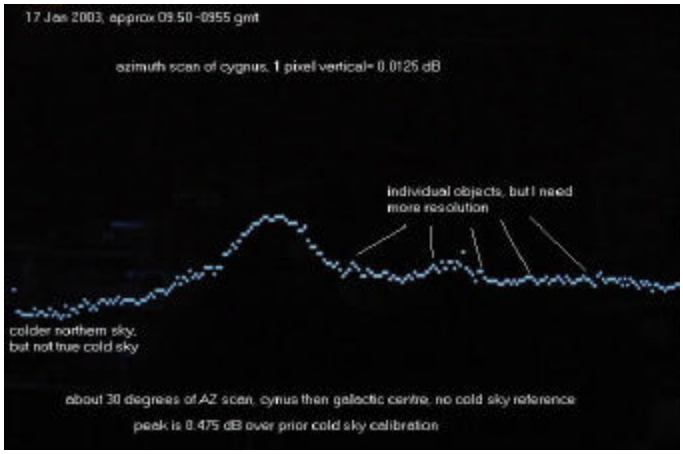
range has indicated a linearity better than 0.2 dB, which is more than sufficient for cold sky to all objects apart from sun at 1296 MHz. Over a 1 dB range, the errors appear to be < 0.01 dB. In addition drift over time is of the same order or less. One difficulty in performing exhaustive testing when you arrive at these kind of levels is that it is hard to decide/find the test gear to be used! I have decided to use the dB slope set at 20 mV/dB. I have attempted to adjust this using the on chip facilities, but could not reach 40mV per step at 1296 MHz. (This slope is variable according to the frequency). I also played with including a small transistor driver as the chip DC output is only capable of very small currents, this however degraded linearity. One could also use an op-amp to spread the range available, however it would be necessary to employ a high precision instrument type to minimise drift and ensure good linearity. In the interests of keeping the radiometer as simple as possible at this time and reducing the opportunities for errors to creep in, I have simply decided to use the output as is. It is more than sufficient as a test instrument for amateur radio, although it may prove necessary to add complexity to attain the higher resolutions necessary for pure Amateur Radio Astronomy.

Finally is the controller and PC interface section of the radiometer. The DC output from the detector enters via the SMA on the top left. The 14 bit analog to digital converter (ADC) chip is on the left (by Maxim). It is controlled by the Microcontroller in the center (44 pin QFP chip). The white socket on the right is the in-circuit programming connector for the micro. It is hooked temporarily to the software development system to upgrade and load the firmware. Finally on the top right is a 5 V serial to RS-232 level converter chip. Bi-directional data input/output is via a standard DB9 connector (not visible) to a PC
.



This module, whilst not strictly necessary as a simple DC Voltmeter, can be attached to the output of the detector module. It offers some advantages. Currently the developed software for the microcontroller is somewhat primitive. A request via the RS232 serial port is met with the response of a 16 bit number representing the current voltage presented at the ADC. The ADC has 14 bit resolution and the upper voltage limit and reference voltage is set by a 4.096 volt precision reference. It can be seen that 16,384 steps of measurement are available. This provides a resolution of 4.096/16,384 = .00025 volt steps. Recalling that 1dB of change at the input provides 20 mV of change at the detector DC output, then the current resolution available in dB steps is 0.25 mV/20 mV = 0.0125 dB steps. Using a simple three digit digital millivolt meter to monitor the detector output, you can resolve only to the nearest whole millivolt or 1/20th of a dB = 0.05 dB steps. This is more than adequate for radio amateur type performance - checking Y factor for example.

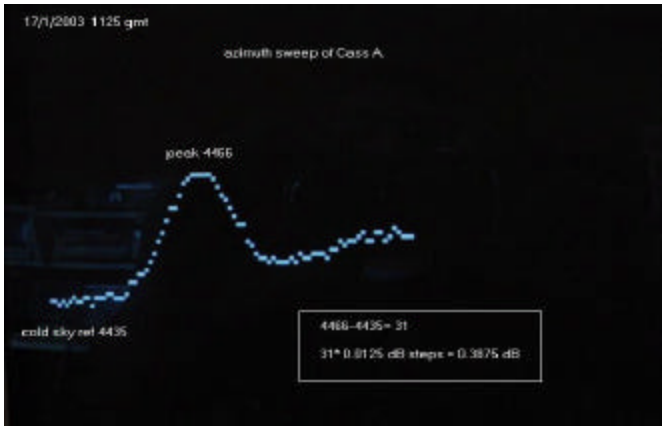
RESULTS: The following are reproductions of various plots taken with the instrument. The first is a very early plot from simple software written in Qbasic on my PC, no axis, little scaling and the data is not well integrated or averaged, but it did work!

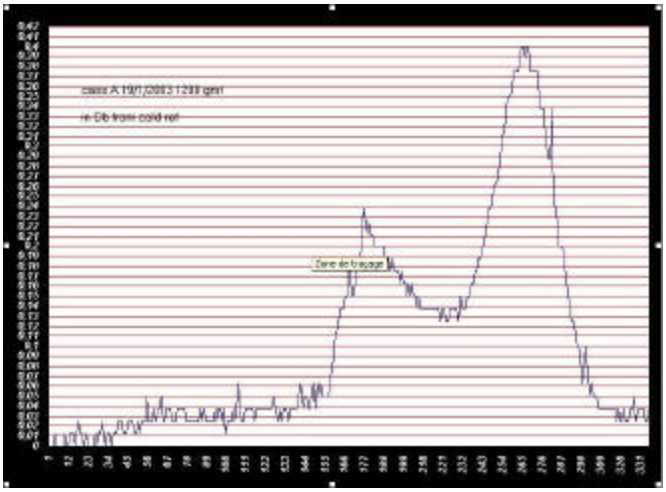


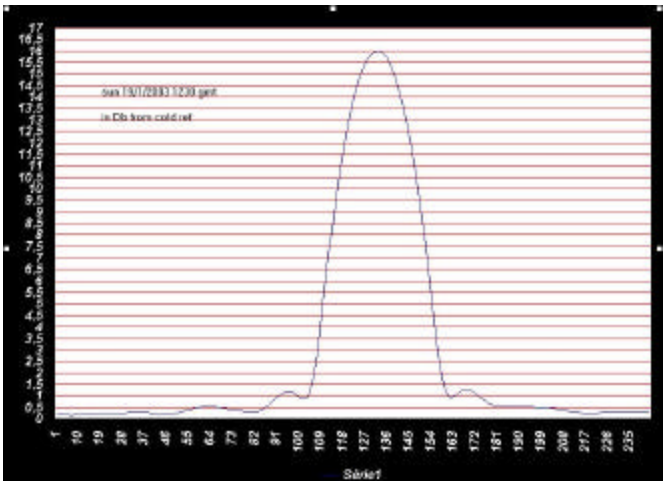
This next graph is another early plot, with a calculation added to show that I was receiving about 0.4 dB of Cass A when referenced to cold sky. This is followed by results from slightly more sophisticated PC software that wrote the collected data to a file and allowed it to be imported in Excel and manipulated and plotted. I have Y axis in calibration of dB. Next is the Sun through my dish's first lobes. The final graph shows what can be achieved by adding extra averaging in my PC software and using Excel's plot smoothing facilities.

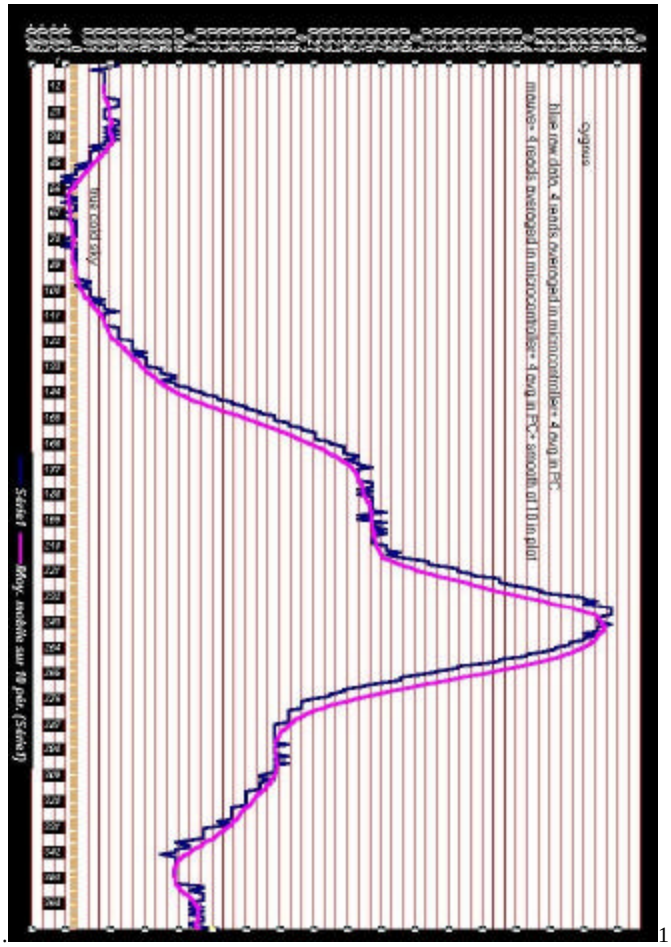
CURRENT STATUS:

As can be readily seen the system is working well at the current resolution. There are a number of areas where the hardware can be improved. The PCB artworks need a number of small changes to be implemented before I try to build a second model. At this moment I have not decided whether to make professionally produced PCBs so that the project can become available to other hobbyists. If there is sufficient interest, I may do so, if you have some interest to build this system or wish to discuss some aspect of it then email me at fg8mbi@rfham.com. It should be noted however that this is not a simple project, many of the components used are not only SMT, but also very small package SMT parts. A steady hand and at least some magnification equipment is essential. Also note that if I do provide any parts of this project for other constructors then the Microcontroller section will be dependant on me for ongoing software development. This will be done at my leisure and if any upgrades are required, it will be necessary for the user to build/buy a small in-circuit PIC programming tool. This is neither hard nor expensive, however further software upgrades will be adding 'bells & whistles' rather than required functionality. The current firmware functionality is basic, but adequate and could be all that many people would require.









1

THE FUTURE: I still have a lot of work to do on the microcontroller firmware and the PC interface. The current control and data reading routines are very primitive. I am open to some joint collaboration in this area, if anyone is PIC literate and/or wants to develop some more sophisticated PC end software. I would be happy to release sufficient details to enable them to do so provided I got access to the resulting functionality. I will be increasing the bit resolution of the ADC and possibly reducing the reference voltage as well. Together these will allow me to reach perhaps 0.001 dB steps as a first target. As I increase the resolution by reducing the step size of the ADC then I anticipate that total system gain drift over time will start to become a more significant factor. For true radio astronomy I am considering a dual LNA and dual antenna system, which will allow a gain reference to be available at all times to the microcontroller. In brief this would work by having a fixed horn on the Zenith with one LNA and using the current dish with its LNA as the true measuring antenna. With both antennas pointing at zenith I could then 'normalise' the gain of the two. When moving the measuring antenna, I could switch back to the reference antenna at any moment and see if the reading is constant. In this manner I could make gain drift correction on the main antenna (with the exception of LNA drift). This is only one method to explore, there are others. I will work towards having my antenna tracking system available to a PC on one serial port (http://www.rfham.com/newulti/index.htm) and the radiometer on a second serial port, it would then be possible to develop some very sophisticated sky mapping and measuring software.

OK1UWA'S 3 M DISH