

The Bodger's Guide to Amateur Microwaves



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RadCom GHz Bands
columnist

www.microwavers.org



- **Bodger – (noun)**
 - A highly skilled itinerant wood-turner, who worked in the beech woods on the chalk hills of the Chilterns, in England
- **Bodging (Br. Slang)**
 - an inexpertly or roughly done job, typically in the field of DIY.



The Bodger's Guide to Amateur Microwaves

- What are the Microwave bands?
- A bit of history
- Breaking the myths
 - Ah, but it's all line of site and hill topping!
 - And it's very expensive!
 - And it's too technical for me!
- Propagation
- Things that help



The Bands

• “Microwave”

- 1240 - 1325MHz (23cm) Secondary
- 2300 – 2302MHz (13cm by NoV)
- 2310 - 2350MHz (13cm) Secondary
- 2390 – 2450MHz
- 3400 - 3410MHz (9cm) Secondary
- 5650 - 5680MHz (6cm) Secondary
- 5755 - 5765MHz Secondary
- 5820 - 5850MHz Secondary
- 10000 -10125MHz (3cm) Secondary
- 10225 -10475MHz Secondary
- 10475 -10500MHz Secondary
satellite only

• “Millimetre wave”

- 24.000 - 24.050GHz (1.2cm)
Primary shared with ISM
- 24.050 - 24.150GHz
Secondary (with written permission)
- 24.150- 24.250GHz Secondary
- 47.000 - 47.200GHz Primary
- 75.500 - 81.000GHz Primary
- 122.25 - 123.00GHz Secondary
- 134.00 - 136.000GHz Primary
- 136.00 - 141.000GHz Secondary
- 241.00 - 248.00GHz Secondary
- 248.000 - 250.000 GHz Primary

A bit of history

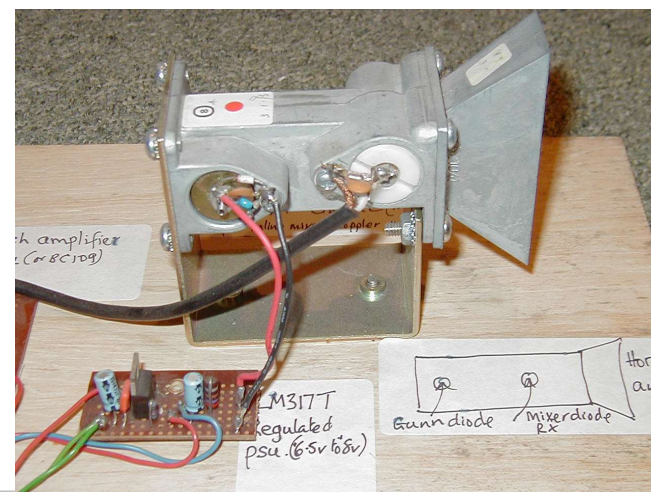
- **The first UK amateur microwave contact**
- The first recorded 10GHz contact in the UK was in Jan 1950
-
- (G3LZ > G3BAK/VK5ZO, 1.75miles)



- This was back in the days when virtually all equipment was home constructed, and very little test gear was available!
- This early work used klystrons

A bit of history

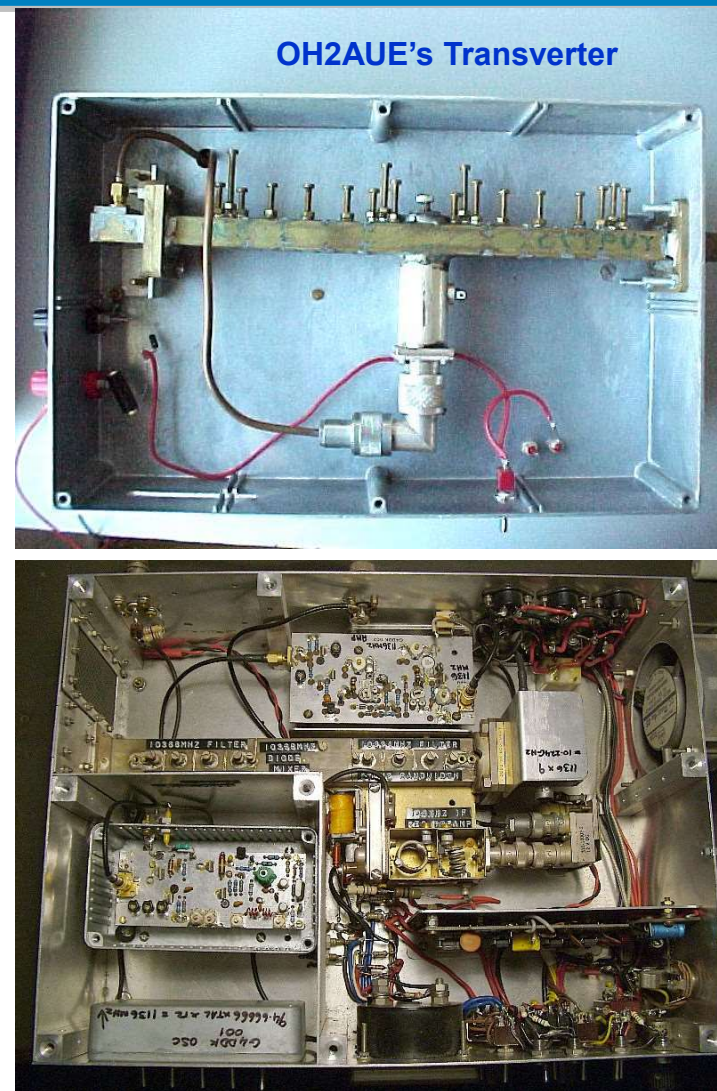
- It was all klystrons in the 1960s-70s
- and then
- Gunn diodes in the 70s-80s



A bit of history

- **Then along came narrowband**
- In the 1980s G3JVL developed a 10GHz cw/ssb transverter in waveguide
- Bulky and low power (0.5mW) ... 8dB NF

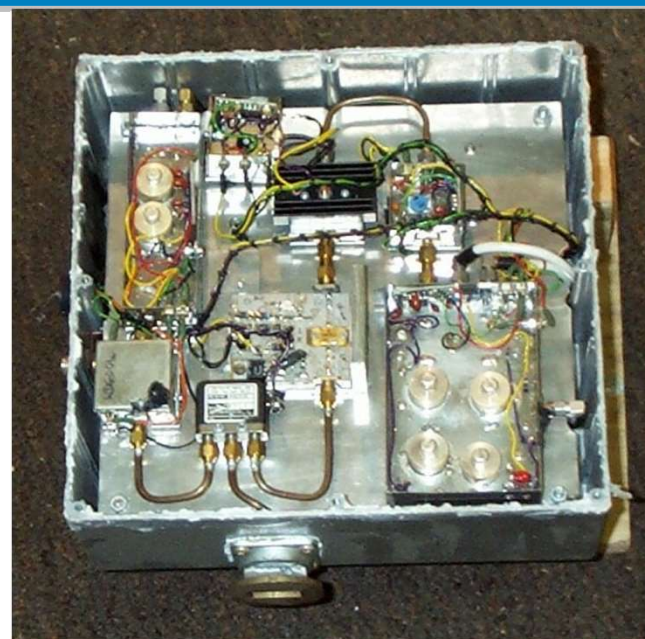
VK2ALU's transverter



A bit of history

Then along came PCBs and Microstrip

- In the early 1990s, Charlie Suckling, G3WDG, developed modules based on PCB circuitry.
- These were made available in kit form and revolutionised UK 10GHz operating!

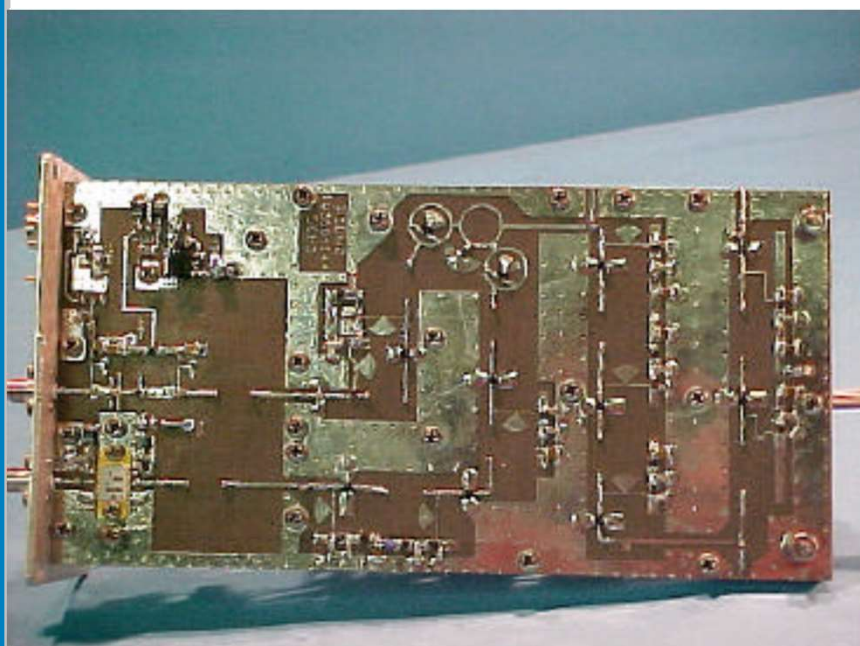


A bit of history

And now

Not **black boxes**, but “silver boxes”

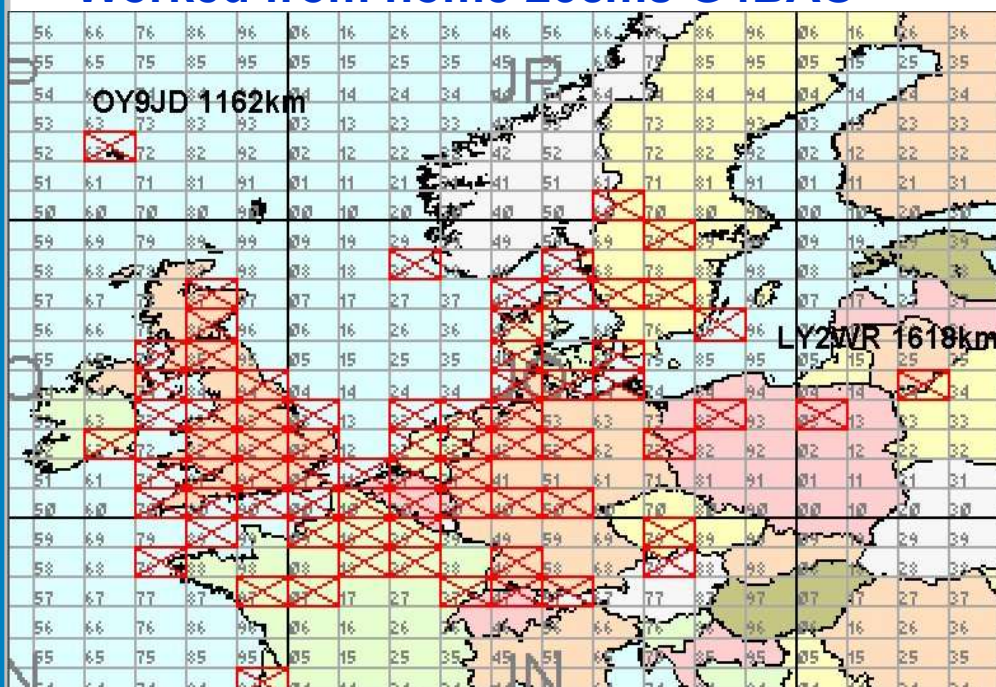
- DB6NT transverter range
- DEMI – Down East Microwave



Breaking the Myths

#1 - But it's all line of site and hill topping!

- Worked from home 23cms G4BAO

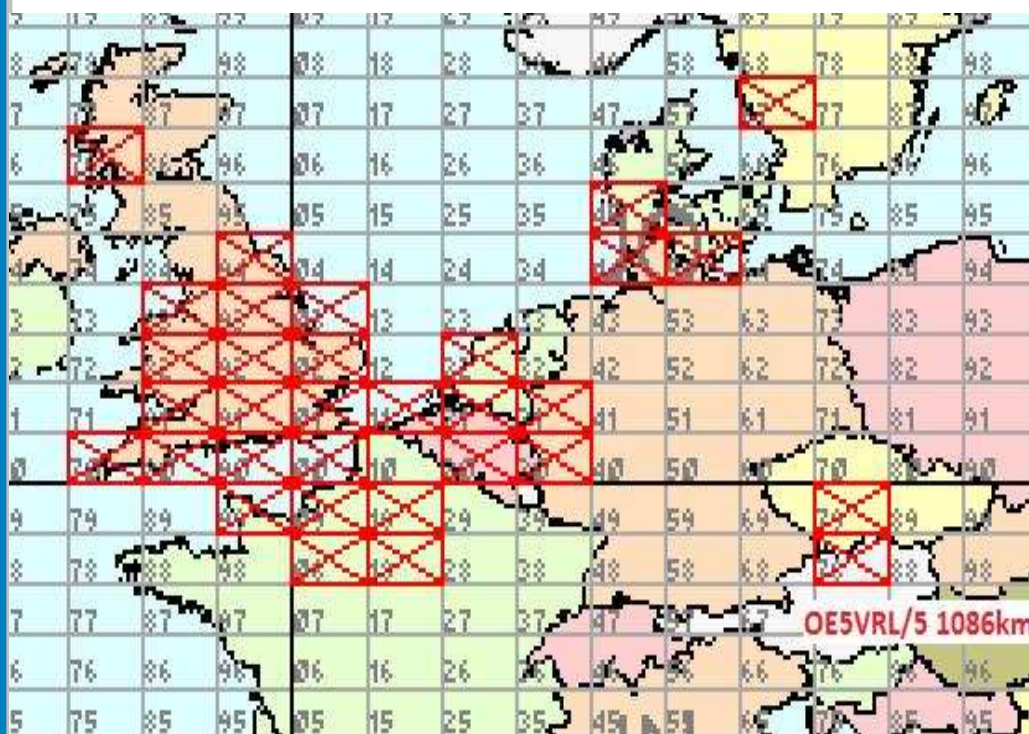


- 4 metres above sea level!
- Mainly with 35 Watts or less

Breaking the Myths

#1 - But it's all line of site and hill topping!

- Worked from home 3cms G4BAO



- 4 metres above sea level!
- 1 Watt output to a Sky Dish

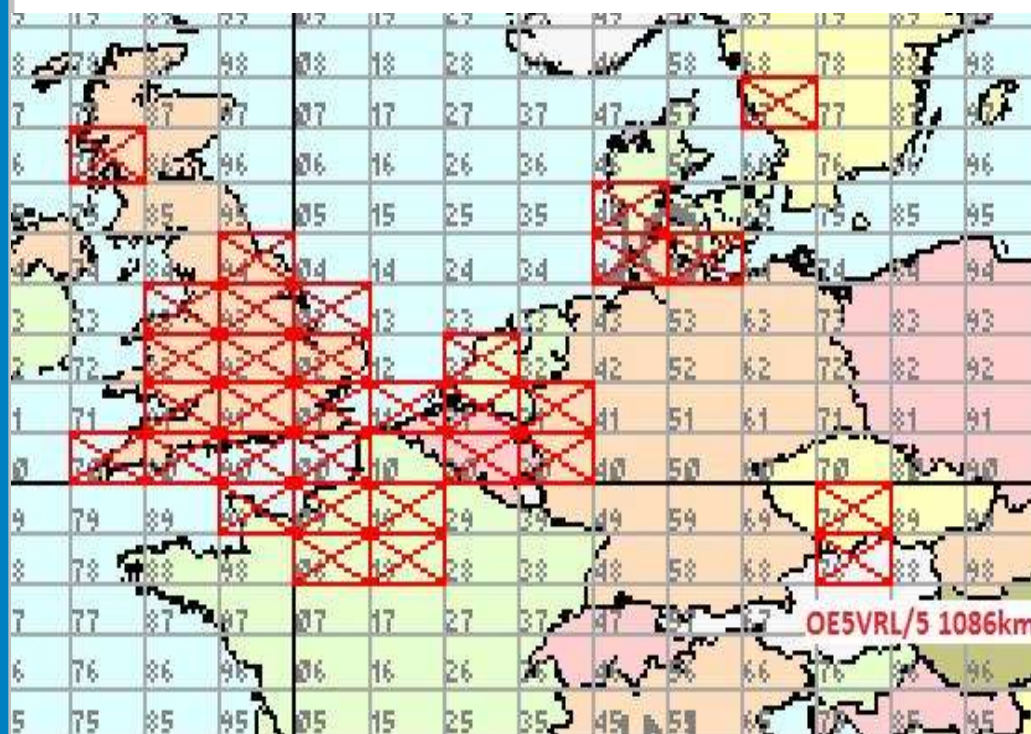


Breaking the Myths

#1 - But it's all line of site and hill topping!

- Worked from home 3cms G4BAO

UK terrestrial records August 2008



1.3GHz	2617km
2.3GHz	1329km
3.4GHz	980km
5.7GHz	1244km
10GHz	1429km
24GHz	408km
47GHz	203km
76GHz	129km
134GHz	17.7km
145GHz	1.29km
Light (red)	129.1km

- 1 Watt output to a Sky Dish

Breaking the Myths

#2 - But it's Really Expensive!

- **Microwave equipment - New**
- (approx. prices June 2015 assuming you have a 2m multimode driver)

1296/144 MHz 18W minikits.co..au transverter kit	£250
23 element Tonna yagi + coax	£90
Total cost	£340
DB6NT 10GHz transverter	£400
Surplus coax relay	£10
Waterproof Box to put it all in	£10
Surplus Sky dish and homemade feed	£10
Total cost	£440

Breaking the Myths

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A new D - STAR Setup?

Icom ID-31E handheld	£385
Comet GP-1 antenna	£70
Total cost	£455

A decent WARC Bands setup?

Cushcraft A3WS beam	£500

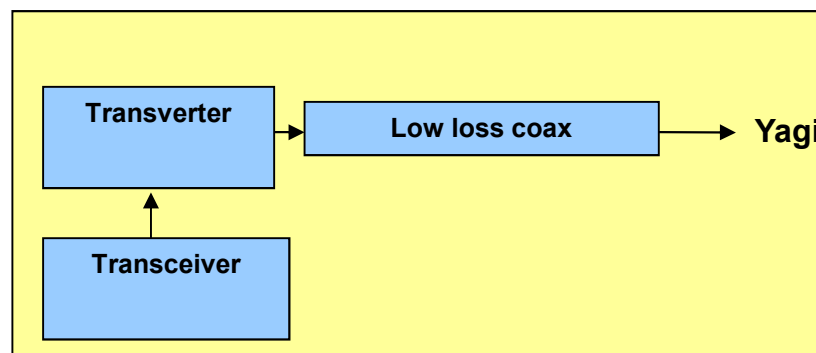
Wideband Scanning?

Bearcat BC-15X	£250
Diamond D190 Discone antenna	£100
Total cost	£350

Breaking the Myths

#3 - But its Too Technical for me!

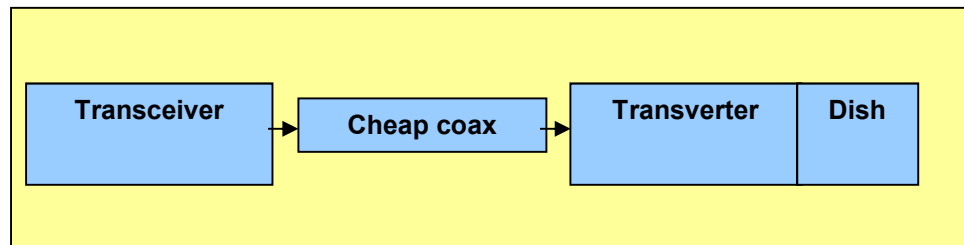
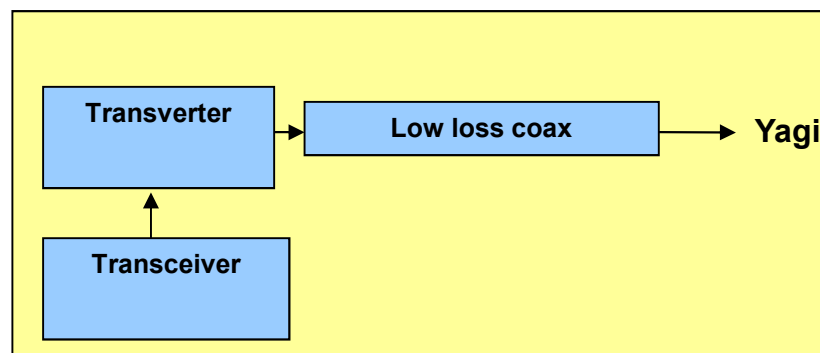
- **Beginners setups**
- **23cms and 13cms**
 - JUST the same as 2m as far as equipment is concerned.
 - A transceiver, (a transverter) and a Yagi



Breaking the Myths

#3 - But its Too Technical for me!

- **Beginners setups**
- **23cms and 13cms**
 - JUST the same as 2m as far as equipment is concerned.
 - A transceiver, (a transverter) and a Yagi
- **Higher bands**
 - Difference is that transverter needs to be close to the antenna.
 - Waterproof box and power feed
 - Small dish antenna



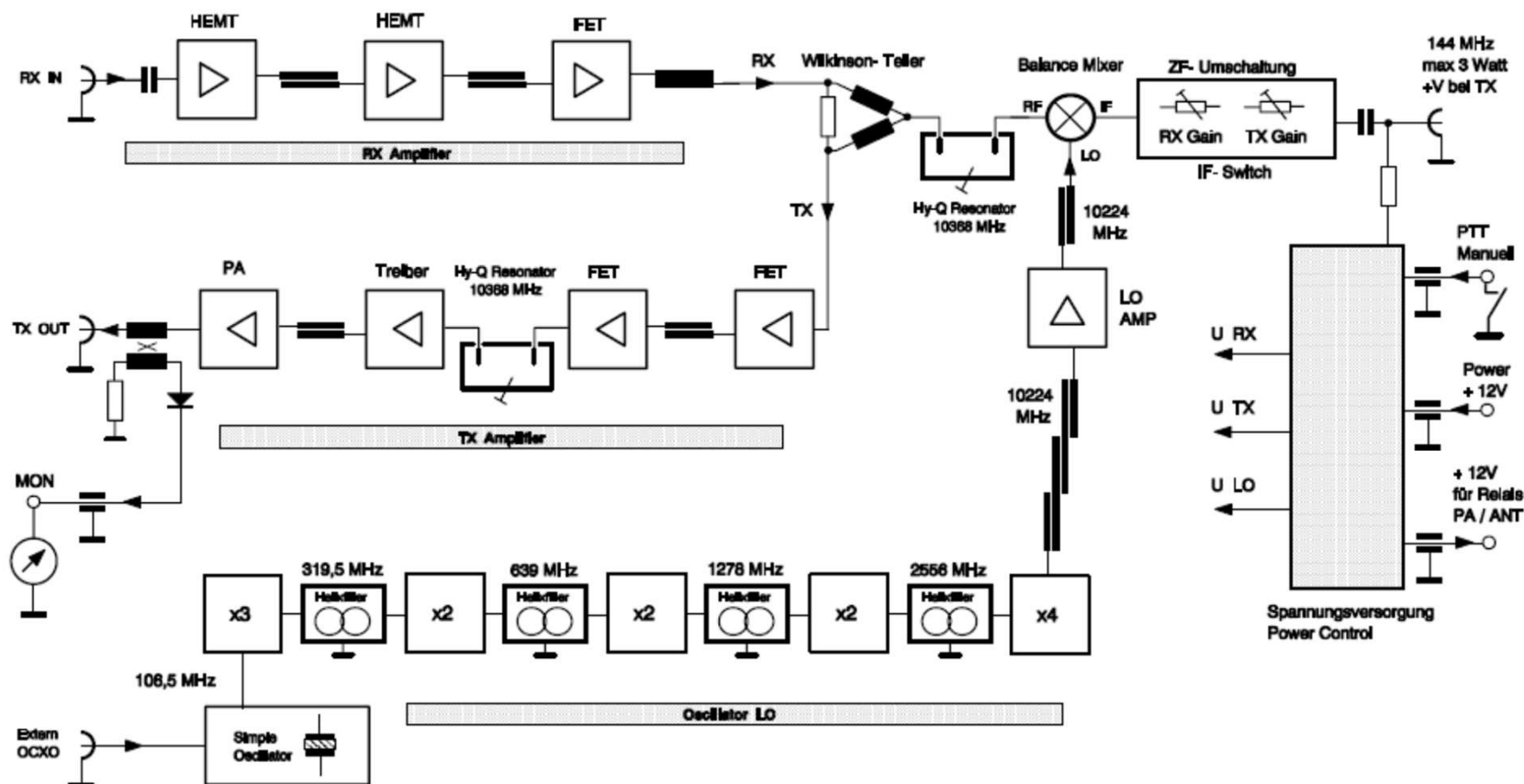
Breaking the Myths

#3 - But its Too Technical for me!

10 GHz Transverter MK2 DB 6 NT 11.2003

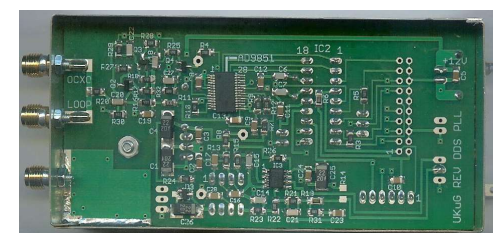
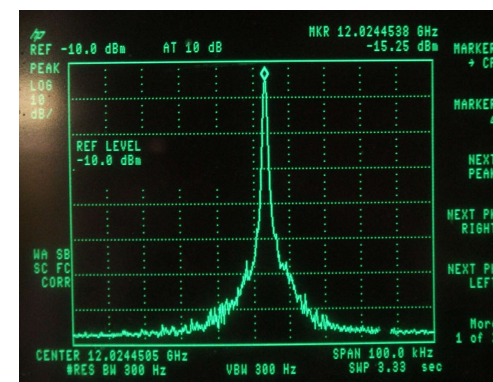
10368 / 144 MHz

Bild / Figure 1



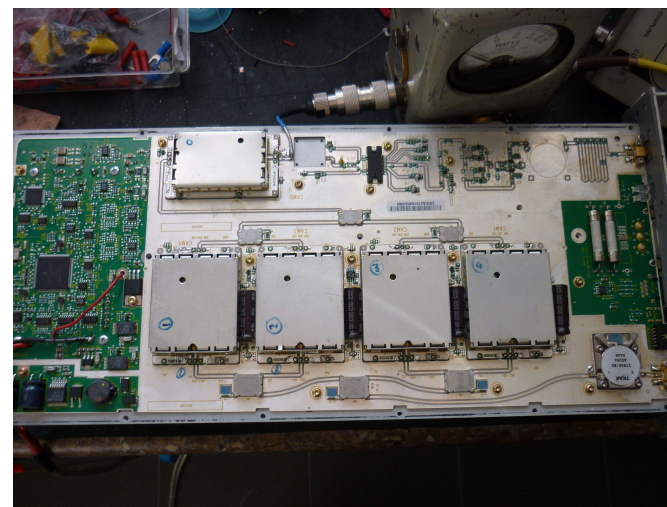
Key Technology Drivers

- Low phase noise references
 - G4DDK Butler Oscillator/Multiplier
 - G8ACE OCXO
 - GW4DGU “Distaw” Oscillator
- Frequency locking
 - Many cheap surplus 10MHz sources available from Ebay
 - OCXO, GPSDO, Rubidium
 - Reflock board
 - Luis Cupido CT1DMK
 - “Reverse DDS”
 - Andy Talbot G4JNT, John Hazell G8ACE
 - ZL PLL
 - <http://zl2bk.com/projects/zlpll/>



Key Technology Drivers

- Low noise Amplifier kits
 - G4DDK VLNA2 sub-£50 kit
 - < 0.3dB noise figure on 1296MHz
 - < 0.3dB noise figure on 2320MHz
 - < 0.45dB noise figure on 3400MHz
- Surplus Solid State PAs
 - Andrew ILAM/IPAM
 - 200 Watts+ on 2320MHz
 - Ionica PA module
 - 18W on 3400MHz
 - Ferranti “TWT replacement”
 - 12 Watts on 5760MHz

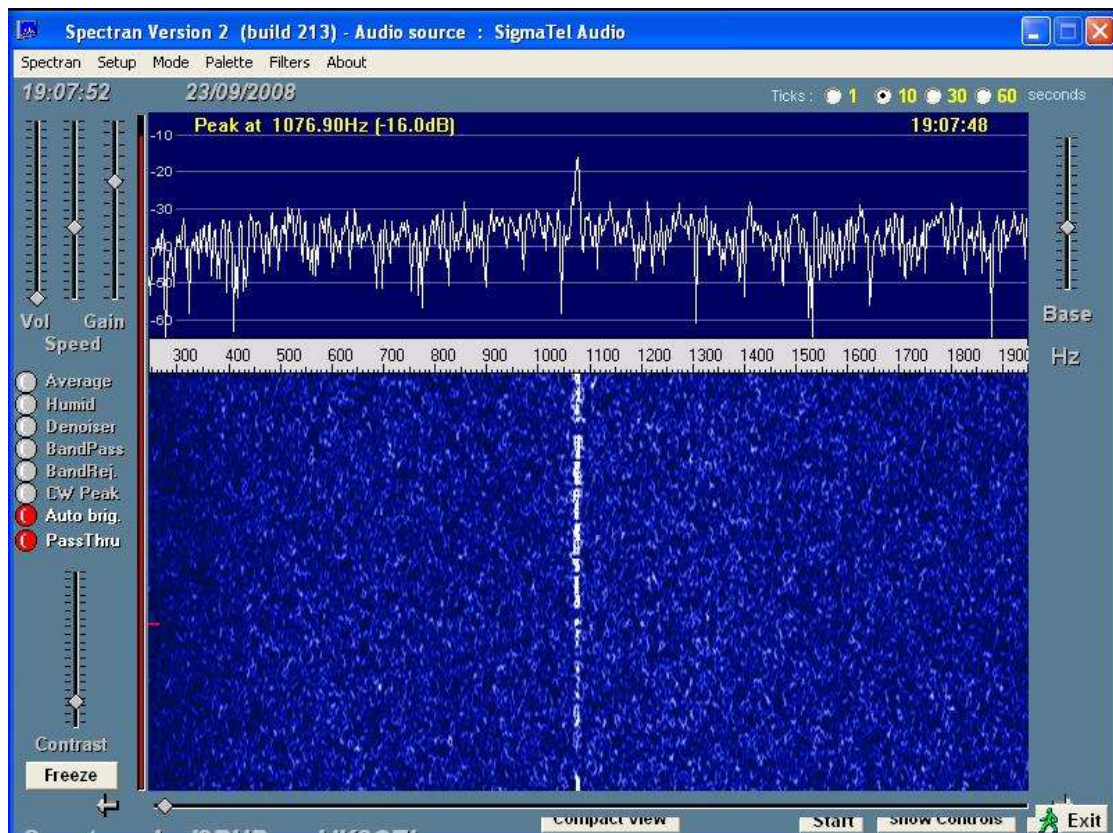


Propagation

- Optical
 - 24/7
 - Line of sight – hilltop to hilltop
- Tropospheric enhancement and Ducting
 - Weather-dependent
 - Enhanced range up to 2500km
 - BIG ADVANTAGE NEAR THE COAST
- Tropo Scatter
 - 24/7
 - Over the horizon up to 500km
- Rain Scatter
 - Weather-dependent
 - Over the horizon up to 800km
- Aircraft Scatter
 - 24/7
 - Over the horizon up to 800km

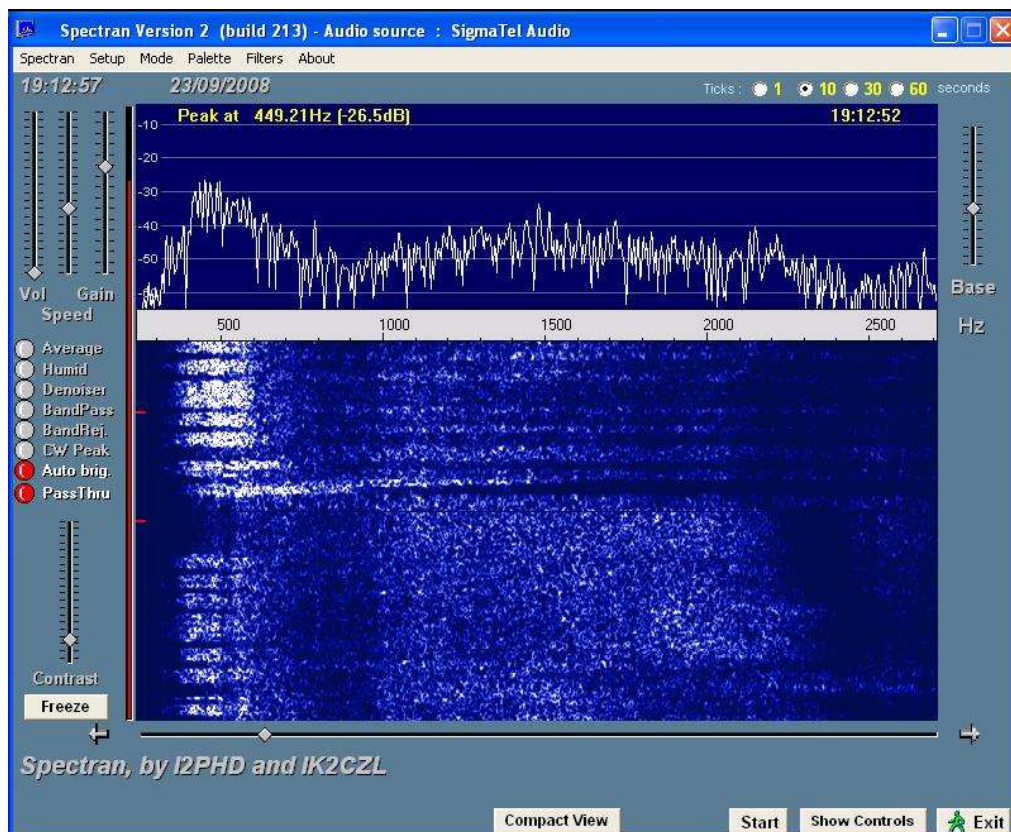


Tropo



LY2WR on 23cms via Tropo

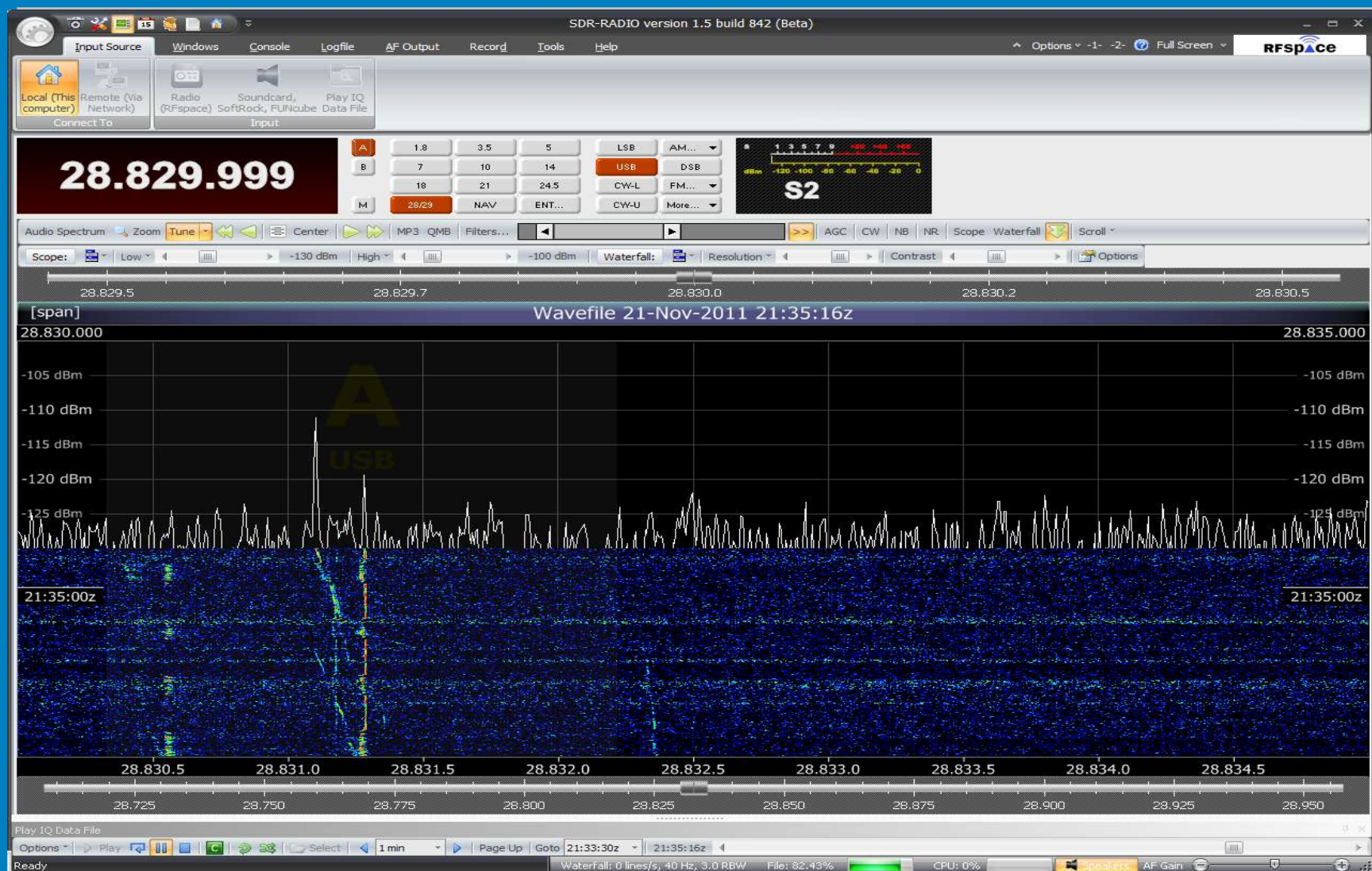




Rain scatter



Aircraft Scatter



Things that help

- **Low band talkback**

- 144.175 is popular

- All these things should only be used for co-ordination, not for confirming QSO details!

- **ON4KST Chat**
– www.on4kst.info

- **Know your frequency**
- **know the beam heading**

- **Local beacons**

- **GB3PKT 3cm**

- **GB3CAM 3cm & 24GHz**

- **GB3MHZ 1.3 to 24GHz**

The GHz chat (by ON4KST) Web 2.0 version - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://www.on4kst.info/chat/index.php

Google

MENU Send G4BAO

UTC	CALL/NAME	GHz MESSAGE	High lat. AU warning
17:05:30	G3CWI Richard 2m/3cm	G8DKK Ready - pse tx on 100.	
17:04:58	F6HTJ michel 23/13/3	(F6BVA) Salut Michel , Jean F1RJ/p qrv vers 21h	
17:02:18	G3CWI Richard 2m/3cm	G8DKK Rgr QRX1	
17:02:05	G8DKK bryan	(G3CWI) Hi Richard, still seeing XGH/b in Spectran but weaker now - can test if u like	
16:59:10	G3CWI Richard 2m/3cm	(G8DKK) Hi Bryan U still hearing XGH - can test? Meep if OK.	
16:38:00	F5DOK Marcel up 2_3	Sure J-C -- far more profitable for you !	
16:37:25	F5BUU Jean Claude	>DQK, still more than 30 degrés overhere. May be better for me to go to swimming pool !	
16:36:12	F5DOK Marcel up 2_3	Possible J-C. Here only 16°C	
16:35:47	F5BUU Jean Claude	>DQK rrr, believes too cold in yr area	
16:34:36	F5DOK Marcel up 2_3	J-C, nothing copied on my little Procom !	
16:32:37	F5DOK Marcel up 2_3	Rr jean-Claude	
16:32:19	F5BUU Jean Claude	>ALL cqng .120 on JN05XK	
16:29:01	F5BUU Jean Claude	(F6DKW) ga Maurice, just for fun, can we try JN05XK ?	
16:20:48	F5DOK Marcel up 2_3	Ebenfalls danke Claus - Heute Nix zu machen !	
16:20:11	DL7QY Claus 1-47GHz	(F5DQK) tnx fer Report Marcel 73 cul	
16:18:40	F5DOK Marcel up 2_3	LX1DB/b now dead here - bisjetzt leider nix	
16:14:41	F5DOK Marcel up 2_3	OK claus ich monitoriere	
16:14:14	DL7QY Claus 1-47GHz	(F5DQK) I still cq .100 nw	
16:12:27	F5DOK Marcel up 2_3	Here now the same rpt of 41S. Was stronger 15 minutes ago	
16:11:51	DL7QY Claus 1-47GHz	(F5DQK) ok from me 300km and I can hear the beacon nw 41s	
16:11:22	F5DOK Marcel up 2_3	Can U listen to it ?	
16:10:31	F5DOK Marcel up 2_3	About 260 Km	
16:09:56	DL7QY Claus 1-47GHz	(F5DQK) how far is the bn from you?	
16:09:27	F5DOK Marcel up 2_3	That'spossible Klaus, you have more experience than me !	
16:09:05	F5DOK Marcel up 2_3	But LX1DB/b about 41s to 51s	
16:08:53	DL7QY Claus 1-47GHz	cq f5dkg Hallo Marcel, scpts all too low I guess	
16:06:59	F5DOK Marcel up 2_3	Nothing Klaus for the moment !!	
16:02:36	DL7QY Claus 1-47GHz	cq via jn39au.100	
15:55:28	F5DOK Marcel up 2_3	(G4EAT) Hello John. Do U want to try via scp JN09vq ?	

30 of 2515 registered users			UTC SPOTTER QRG	DX	INFO
F6BVA	JN33AD	Michel	1655 w4dj	14728500.0 4S7WVP	IRLP Contact on now
F9OE	IN78QG	Claude	1636 g8dkk	10368810.0 GB3XGH/B	53s IO83WO->IO91VX
G4BAO	JO02CG	John	1616 g4aly	5760060.0 F1XAO/B	549
ONSTA	JO20ET	Eric 13-6-3 cm	1611 g4aly	10368905.0 GB3SCX/B	53S over 40 degs beamwidth
SM7LCB	JO86GH	Ulf (1/2/10/24G)	1610 g4aly	5760905.0 GB3SCC/B	55S but heard over 040-130deg
DH1NFI	JO50VF	Tom	1607 g3vkv	10368810.0 GB3XGH/B	52s IO83WO>IO81XV
DK1KR	JO53HW	Walter 23-13-3	1524 g0ewn	10368760.0 GB3CAMB	52S IO92VM>IO93FK Heavy fronts
DL6NCI	JO50VI	Lorenz	1520 g0ewn	10368760.0 GB3CAMB	52-54S
DL7QY	JN59BD	Claus 1-47GHz	1444 f5dkg	10368892.0 LX1DB/B	529S via scp JN29kc
(F1BZG)	JN07VU	Phil 23-13-6-3cm	1353 gw3tkh	5760920.8 GB3FNM/B	+15dBm IO91OF>IO81JM QTF 10:
F1PYR	JN19DA	André	1317 i3eme	10368901.0 IZ0CZV/B	jn68mas> jn61mf 55 RS
F5BUU	JN03PO	Jean Claude	1255 eb2gur	24048000.0 EA2BCJ	QRV from IN73ta...
F5DQK	JN18GR	Marcel up 2_3	1254 eb2gur	2320000.0 EA2BCJ	Saturday and sunday GRV from IL
F6ABX	JN03GO	Jean-Louis	0853 g4aly	10368905.0 GB3SCX/B	53S
F6DKW	JN18CS	Maurice	0851 g4aly	5760905.0 GB3SCC/B	55S
(F6HTJ)	JN12KQ	michel 23/13/3	0814 df6na	10368810.0 DB0ANU/B	JN59gg - qrv
G3CWI	IO83WG	Richard 2m/3cm			
G4ALY	IO70VL	Ralph			
G4EAT	JO01HR	John			
G8DKK	IO91VX	bryan			
G8GXP	IO93FQ	David			
GM4LBV	IO86RQ	John			
HB9AMH	JN37GD	Arnold			
LA3PNA	JO59BR	Thomas			
OESVRL/5	JN78DK	Rudi			
(ON4IY)	JO20HT	xtof			
(ON4KST)	JO20HI	Alain (sysop)			
OZ2LD	JO54TU	Chr 23-13-6-3cm			
PA2M	JO21IP	Frank 70-23-3			
PA2XHF	JO32HN	Bert@Hardenber			

Local Activity

- **You have some local signals!**
- GB3PKT beacon, Clacton
 - 3cms 10368.945MHz
- GB3MHL beacon cluster at Martlesham
 - all bands 1296-24048 MHz
- GB3CAM beacon cluster at Wyton
 - 3cms - 10368.755MHz
 - 1.2cms 24048.870MHz
 - Lightwave
- Tuesday night 23cm and SHF UKAC contests
- A selection of near and local activity
 - G4FUF, 23cms, G4ZTR, 23cms, G3ZEZ 10GHz
 - G4BEL Haddenham, Cambs – all bands 23cms-1.2cms
 - G4BAO 23,13, 3,1.2cms G4HJW 3cms (Cambs) plus
 - G4DDK, G4FSG, G3LQR, G3XDY (Suffolk)
 - and
 - Regular contest activity by G3PYE, M1CRO G6TRM



Meeting places

- **“Codgers”**
 - A group of East Anglian Microwavers meet at 0945am on the last Saturday of each month, for breakfast, chat and trading at the Orwell Bridge truck stop on the A14 near Ipswich
- **ON4KST Microwave Chat room**
- **Skype**
- **Your Local Radio Club!**

UK Microwave Group

- Nearly 450 members
- ONLY £6 a year membership
- “Chipbank”
 - Free surface mount components
- Scatterpoint – monthly e-magazine
- Member’s Loan equipment
 - for 5.7GHz, 10GHz, 76GHz
- Beacon Hardware and other project funding available
- Support for clubs wanting to start on the GHz Bands
- Local committee contact is Murray, G6JYB



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Acknowledgements and References

Sam Jewell G4DDK www.g4ddk.com

- for letting me swipe some of his slide content
- The rest of the GB3CAM team
 - G4HJW, GW4DGU, G4AJE
- This presentation and links to additional information are available on
www.g4bao.com

UK Microwave Group

www.microwavers.org

Beaconspot

www.beaconspot.eu

G4HJW's site

<http://www.g4hjwt.metahusky.net>

RadCom August 2007

- *"Getting started on 3cm"*



Photo © RSGB