Backyard Microwave EME
An Update

Microwave update 2007

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Remember from last year?

- Inspired for a long time by the KD5RO article in MUD Proceedings 1989 “Microwave EME using a Ten Foot TVRO antenna”

Searched for a dish for a long time with no success, then one day N5PYK announced he was moving to College Station donated his dish

C band satellite polar mounts are nowhere near Polar mounts. Need modification

Fight to eliminate every little loss. With a small dish every 0.1dB counts

Lock L.O. to GPS to maintain frequency stability

If not concreted to ground make sure lots of weight on dish mount legs
Current Equipment 23cm

- WD5AGO preamp on G4DDK PCB. 0.26dB NF
- 20 year old 2x2C39A EME Electronics PA 200W
- 70’ LDF4 TX feeder
- G4DDK Xverter (2 IF outputs)
- RA18H1213G Predriver (7W)
- FT847
- PIC Sequencer
- VK3UM Autotracker
1296 Dish Configuration
TH338 Amp
TH338 Amp: Cathode Cooling
After many “punch throughs” realised HB9BBD was correct:-

Use Kapton NOT PTFE for anode insulator

15W in 330W out with 1700V on load. Above this voltage TUBE arcs

Sticking to 200w till get 100 grids!
Original Actuator mount
Then came the wind

May 2: 81mph winds (and driving rain/thunder/lightning)
Sleeve holding actuator to post slipped. Actuator slipped
Dish swung vertical, bent rim in 4 places damaged 4 panels
Following morning bought 3 G clamps, steel angle, spent 3 hours straightening dish
Add muffler clamps…wont slide
When not in use added extra brace
Results so far: 1296MHz CW

G4CCH   K5SO   VE6TA   K9SLQ   G3LTF   K5JL   F2TU   K2UYH   W5LUA   K4QI   OZ6OL   OZ4MM   ZS6AXT   F6KHM   LX1DB(SSB)   LA8LF   K5GW   OK1CA   RW1AW   IK2MMB   HB9Q   OK1DFC   JR4ZZS   IW2FZR   ES5PC   PA3CSG   SM3AKW   OE9ERC   CT3/DL1YMK   KL6M   VK3UM   SM6CKU   OK1KIR   ON7UN   DL1YMK   K0YW   WA6PY   HB9BBD   SM4DHN   HB9SV   K1RQG   N2IQ   N2UO   K5PJR   W7BBM   NA4N   WB2BYP   GW3XYW   ES6RQ   8N1EME   AD6IW   DF3RU   N0OY   AL7RT   WA5WCP   KH7X   TF/DL1YMK   G3LQR   RW3BP   WA5WCP/WY   WA5WCP/UT   WA5WCP/ID   SM2CEW   W2UHI

123 Qs 62 Inits 4 Cont 28 DXCC 40 Grids 19 States

Still some left to work! (9 ESCAPEES so far)
Results so far: 1296MHz JT65C

SM5LE   VK7MO    G4DDK    RW3BP
G4DZU   G4CCH    OK1KIR   VA7MM
OE9ERC  PA0BAT   ES5PC    K2UYH
GW3XYW  ES6RQ    UR5LX    W5LUA
PA3FXB  PA3DZL

18 Initials  12 DXCC  17 Grids  2 States!
Original Equipment 13cm

- WD5AGO preamp 0.55dB NF
- Spectriam Amplifier mounted at dish (160W max). 48V operation.
- Homemade VE4MA Superfeed using copper tube mailed by PA3CSG. Tuned for “reasonable” return loss
- DB6NT Xverter For 2304/2320. IF is FT847
- For 2424MHz RX use ADC7133 Satellite down converter to FT847 IF at 168MHz
Original 13cm Feedpoint Configuration

WD5AGO NE32584/ATF10136 0.55dB NF DEMI 0.6dB second stage (Xverter in shack 70’ away). SMA protection relay.
G4DDK realisation of W5LUA 1999 MUD preamp. ATF36077 device 0.33dB NF

Note input circuitry in air not on PCB.

Sun noise up 1dB
Current Feedpoint configuration

G4DDK preamp. ATF10135 2nd stage
Equipment changes: 13cm

- Spectrian Amplifier now using 27V.
- Internal 48/26.5V converter folds back if too much current...drops from 26.5 to 17.7V below)
- Breaker trips at 37A...don’t keep key down (or remove breaker)

![Spectrian Input v Output Graph](image)
13cm Results so far (cw)

- 2-Apr-06 VE6TA DO33
- 8-Apr-06 OK1CA JO70
- 8-Apr-06 F2TU JN38
- 8-Apr-06 W5LUA EM13
- 8-Apr-06 OK1KIR JN79
- 8-Apr-06 OZ4MM JO55
- 9-Apr-06 G3LTF IO91
- 11-Apr-06 OE9ERC JN47 (SSB)
- 16-Sep-06 K5GW EM13
- 17-Sep-06 K2UYH FN20
- 17-Sep-06 PA3CSG JO21
- 17-Sep-06 RW1AW KO33
- 21-Apr-07 SM3AKW JP92
- 21-Apr-07 KL6M BP51
- 22-Apr-07 ES5PC KO38
- 19-May-07 TF/DL1YMK HP64
- 11-Aug-07 LX1DB JN39

31 QSOS
17 INITIALS
13 Grids
14 DXCC
3 States
6 Escapees

Plus W5LUA and VK7MO on JT65C
Independent RX from Xverter

Obtained a GR-1236 noise measuring meter. Retuned to centre on 28MHz

Added MCL 50 ohm to 400 ohm matching transformer on input

Need 2\textsuperscript{nd} output from DB6NT MKU23MK2 transverter to feed GR-1236

Tried tapping off signal from RX level pot
Independent RX from Xverter

Need 2nd output from DB6NT MKU23gMK2 transverter to feed SDRIQ

Tried tapping off signal from RX level pot

1W 144MHz IN

-12dBm OUT to RX

Not good
Independent Rx from Xverter

Add isolation relay. Terminates RX in 50 ohms on TX. 144 level –75dBm
Remote Spectrian monitoring
The need!

During 13 sked with G3LTF he was not responding to Rs
Went and measured output. None.
Found Isolator output terminal vaporised.
Replaced Isolator. Full output restored.
Worked ES5PC and OZ4MM.
Got called by K5GW but he also did not respond to report
Went and measured output. None.
Obviously need to remote monitor AMP from shack!
Remote Spectrian monitoring
An aside!

Found Isolator output terminal vaporised and substrate missing from track at isolator output. Also hot heliax connector.

(Worked RW1AW and G3LTF with 60W, but not KH7X)

Once told if replace Spectrian output board should replace input board as they are matched pair
Order red combiner/splitter pair (and some spare isolators)
Replaced just output board….120W output
Replaced input board as well…back to 160W…advice was correct
Note from specification sheet the Spectrian isolators are only rated at 125W
Remote Spectrian monitoring (Power)

While replacing output board found what appeared to be RF detectors feeding a 6 pin connector

- Pin 1 produced 5V when 200W “forward”
- Pin 2 produced a reflected power voltage
- Pin 3 8V supply to detectors
- Pin 4,5,6 Ground
Power Detector Connector (Output combiner PCB)
Power output connector
Other end of cable on Micro Board
Remote Spectrian monitoring (Temperature)

Each of the 4 PA modules has a temperature monitor output (10mV/ degree F)
All 4 temperature voltages appear on J4 of the power distribution board
I chose to just monitor just the temperature of the centre final amp module

<table>
<thead>
<tr>
<th>Module</th>
<th>Module Pin</th>
<th>J4 Pin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Driver</td>
<td>9</td>
<td>20</td>
</tr>
<tr>
<td>Amp 1</td>
<td>1</td>
<td>22</td>
</tr>
<tr>
<td>Amp 2</td>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td>Amp 3</td>
<td>1</td>
<td>32</td>
</tr>
</tbody>
</table>
Temperature monitoring
All temps appear on this connector
Remote Spectrian monitoring (Current)

Uses Allegro current monitor chip as Paul Wades “Lossless current monitor”
I modified circuit to have non floating output and provide 0-5V output for 0-75A
Remote Spectrian monitoring
Remote Spectrian monitoring
Interface to outside world
SDRIQ

- 0.5kHz – 30MHz
- AM, WFM, USB, LSB, N-FM, DSB, CW demod
- Can record up to 190kHz of spectrum
SDRIQ 1296MHz Interface

- FT847
- G4DDK 1296MHz XVERTER
  - 144MHz
  - 10MHz
- G4DDK 144/28 RX MIXER
  - 28MHz
  - 116MHz
- SDRIQ
- GPS LOCKED 10MHz
  - 10MHz
- DFS116
DFS116
Dubus contest 1296MHz
29 Aug 0440z

K5SO F2TU

W5LUA W5LUA ECHO
SDRTX

G3PLX's software IQ tx

Audio Input Level

Mike input soundcard

Transmit mode

Amplitude Bal.
0.0

Phase bal.
0.0

Modulation

Crystal WDM Audio

Crystal WDM Audio

USB

LSB

FM

AM

Auto Mike Gain

Modulation

Microphone

1kHz tone

Corner beat tone
9cm

• Activity weekend announced Jun 16.

The Plan:-

• Scaled 1296MHz VE4MA feed to 3456MHz using 2.5” copper tube
• Activity on 3400 and 3456MHz: Too much separation for one IF
• Use DB6NT tropo xverter, will retune it to change bands if needed
• Built 3400MHz receive converter for Xband
• DEMI preamp 0.65dB/16dB
• Mount 50W Toshiba Amp at feedpoint
• Amp powered with two Vicor 48/12V 150W converters mounted at feedpoint
1st weekend(1)

3400/144 Rx converter

DB6NT 3456/144 Xverter
3456MHz Feed

Scaled VE4MA 1296MHz feed
1st weekend(2)

Right: Toshiba Amp   Lower: 48/12V DC/DC   Center: DEMI Preamp 0.65dB NF

Heard G4NNS and W5LUA but they couldn’t hear me

Most activity on 3400MHz!
1st weekend(3)

Removed equipment from feedpoint overnight

Next morning after putting PA on feed big lightning strike 10’ from dish

PA not producing output. Inside showed charred components and wiring

Luckily Xverter (still on shack floor) not damaged

Had sked with VE4MA. Found RW89 TWT which gives 15W. Put it in Kennel

Nothing heard either way on sked

Decided not to put any amps at feedpoint in future, accept feeder loss!

Must be a feed problem so reviewed return loss: couldn’t measure circularity
Rig for VE4MA sked after lightning hit!

RW89 TWT 15W o/p (note bpf on output of DB6NT xverter, spurious <-30dbC)
9cm

• As the first weekend was enjoyed by so many a 2nd weekend was arranged for July 8.

• Converted 3400/144MHz Rx converter to 3400/144 Transverter by adding sma relay, IF pin switch and ERA3, 50mW output

• Toshiba amp fed by 12.6V mains PSU mounted in kennel on ground
DDK009 L.O. Triple balanced mixer. Collins surplus filter. G4DDK IF pin switch. Old W5LUA ATF10136 preamp (0.6dB NF!) ERA 3 TX Amp. 12V SMA relay splits rx and tx paths
2nd weekend(1)

Top: Toshiba Amp
Middle: 3400MHz/144 Xverter. 3456/144MHz xverter
Bottom: 12.6V 20A PSU
2nd weekend(2)

Worked G3LTF on sked: not as loud as 1\textsuperscript{st} weekend
Heard VK3NX, W5LUA and VE4MA on skeds, but they couldn’t hear me
Could see G4NNS on Spectrian and he could see me but not loud enough for QSO. Condx not as good as 1\textsuperscript{st} weekend
Just when I though would only make 1 QSO worked LX1DB, just before his moon set
Took feed to W5LUA to measure; circularity acceptable

Looking forward to next activity period!
Triplets!

Left to right 1296MHz  2304MHz  3456MHz
432MHz

- Return after 8 years. 4xFO25 refurbished

BEFORE: 10 BANDS
AFTER: 1 BAND
Next Dish Projects

- 902MHz: EIA feed built, 250W output
- Hydrogen line observations @1420MHz
Acknowledgements

• To G4DDK, K5GW, W5LUA, PA3CSG for advice and assistance
• To K1RQG for getting my VK3UM tracker board going after 15 years!
• To Meg for encouraging me to decorate the backyard with the oversize garden ornament
• Finally to N5PYK for moving and donating the dish
More information

- DFS9096: http://g4fre.com/dfs9096.pdf
- 1296MHz: http://g4fre.com/1296eme.htm
- 13cm: http://g4fre.com/13cm_eme.htm
- 9cm: http://g4fre.com/3456eme.htm
- 2nd Rx: http://g4fre.com/DB6NT2ndrx.htm
- Spectrian monitoring: http://g4fre.com/Spectrian.htm
- SDRTX: http://www.scrbg.org/g4jnt/SDRTxSW.htm