



CHEESE BITS

W3CCX
CLUB MEMORIAL CALL

ARRL
Affiliated
Club



Volume L

June 2009

Number 6

PREZ

SEZ:

In the blink of an eye, five years has flown by since I got the call from Doc W3GAD, chief cook-and-bottle-washer of the nominating committee,

asking me to take over the club gavel. It was a challenge and an honor, for at the time I had been a Packrat for only 7 years, but I had served on the board and edited Cheese Bits for 5 years. I had grown to know the club and the active cast of characters fairly well. Now five years later, I have grown to know the gang so much better, and I am grateful for all the kind and unselfish service that all the supporting cast has provided for the benefit of all the club members.

Turnabout is fair play, and after Doc asked me to accept the nomination for club president, I said that I would, if he accepted the position of Cheese Bits editor, which he did. Now, several years later, with himself again on the nominating committee, along with K1JT and NE3I, he is in the fine position of having been nominated for club president. Most all of the other officers have accepted re-nomination, and there will be two new board members elected this month at Otto's on June 18th.

Looking back on some of the issues over the last five years, there have been some outstanding highlights. We have bridged many minor crises, grown our membership, carried out a fine schedule of club activities, and continue to have a strong and cooperative organization. In the finest Packrat spirit there are plenty of Elmers helping others—from the basics of loaning a rig to get active—to the finer points of

constructing and installing 24GHz gear for our top performing single and multi-op stations. We transitioned our website when the previous host failed us, moved our meeting place when the Southampton Library was not available, and grew our treasury to be sure we're prepared for rainy days. We have a fledgling membership committee (looking for help for NE3I) and have continued to support the nets on a weekly basis through many changes of net control ops. We have moved to almost total computerization of logging and station support for the June contest, and have several more club members active on higher bands and EME. Where more senior folks have slowed down some of their radio activity and attendance, others have stepped right in to maintain a vigorous monthly program, complete with Mario Raffles, silent auctions of estate items, construction projects and great refreshments. We continue to host an annual VHF Conference, HAMARAMA, and ran a fantastic Microwave Update in 2007.

I must pause to give thanks to each and every member who has contributed to the club's success. I recognize the groundwork laid down in the 1950's that got the gang started, and the energy and talents that have kept it vibrant over the years. The Packrats is one of those organizations that is of the members, by the members and for the members, in addition to being for the entire amateur radio community. I am delighted at the teamwork and spirit by which each task is undertaken. The sharing of knowledge and wisdom for those on the learning end of the spectrum has been of such great value. It has been a pleasure to serve.

Last week I ventured down to the new

Pack Rats **CHEESE BITS** is a monthly publication of the
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PACKRAT BEACONS - W3CCX/B

FM29jw Philadelphia, PA
50.080 144.284 222.064 432.286 903.072 1296.245 MHz
2304.043 3456.207 5763.196 10,368.062 MHz (as of 1/08)

MONDAY NIGHT NETS

TIME	FREQUENCY	NET CONTROL
7:30 PM	50.145 MHz	K3EOD FM29II
8:00 PM	144.150 MHz	N3ITT FN20KI
8:30 PM	222.125 MHz	K3TUF FN10WE
8:30 PM	224.58R MHz	W3GXB FN20JM
9:00 PM	432.110 MHz	WA3EHD FN20K
9:30 PM	1296.100 MHz	K3TUF FN10WE
10:00 PM	903.125 MHz	W2SJ FM29LW

Visit the Mt Airy VHF Radio Club at: www.packratvhf.com or
www.w3ccx.com

... continued from p. 1

digs of WA3GFZ to make sure my microwave gear was ready to rove. There were some doubts about the 2304 rig, but all tested out fine. What was most exciting was to see Paul's technical bench and the microwave gear that has been integrated with his SDR1000 for the June contest. I know that we will have a lot of visitors into the microwave truck to check it out, and this will also be a great learning opportunity for those who have not yet seen the capabilities of the SDR rigs and the point and click capabilities of finding signals, doing automated band changes with WriteLog, and having the luxury of voice and CW keying built-in to the computer programs to drive the rigs.

Randy NR6CA has been busy all winter and spring assembling additional microwave rover-type rigs, and we are expecting to have a few newcomers to roving cut their teeth by roving from the local grids. Once we see how this works out on the basic four bands and a few of the microwave bands, we can start to expand and enlarge rover operations.

I must point you all to the memorialization of the HK1TL EME Expedition that is being constructed by Ron W3RJW on our website. Packratvhf.com. There are some fantastic memoirs and pictures of this event, the first EME operation from South America, organized and carried out by the Packrats and their Columbian compatriots. Check it out!

OK, I know you were all waiting to hear about my EME pursuits....perhaps not, but if you've read this far, keep reading! I towed my trailer back to my QTH from its winter storage at the K3VEQ QTH. I fixed the interface of the trailer lights with a newly installed replacement. At the same time I noted two marker lights were not functional, and I am waiting for my back to feel a little better before I crawl underneath and check out the wires and grounding. Next, I need a helper to assist me in placing the long yagis on the cross-boom for 2mEME, and making sure everything checks out before I place the preamp in line and crank 400 watts out. Once 2m EME is successful, I'll need a bit more assistance to get the 10' dish onto the mount, get the feed optimized, and then get the RF flowing to and fro on 1296MHz. Who's around this summer and can lend a hand and learn along with me? And might you have a spot where I can pull up and operate? **73, Rick, K1DS**

This month our feature article is a description of how a 1296 beacon can be created using available parts and modules. Our author, Kevin Murphy, ZL1UJG focuses particular attention on LO stability and noise since this block is the heart of any transmitter. This beacon is a work in progress. We hope to see updates from Kevin as they are developed

Developing a 1296 MHz Beacon

By Kevin Murphy, ZL1UJG

Stage Functions

Oscillator Module
Multiplier Module
Amplifier Module
Keyer
PSU Module
Circulator/Filter

Oscillator Module

A good start for an oscillator module is something that is available as a kit, or already built. There is little point in going to the time and expense of creating a PCB, and purchasing components, unless you are doing original development work for a special unit.

A circuit in common use is the 2 transistor Butler Oscillator. This has been around since the valve days, and has been seen in RSGB Balloon Board, G4DDK oscillator series * and the Mini-Kits EME65 variants **, as well as in some commercial designs.

* www.btinternet.com/~jewell/

** www.minikits.com.au

There are better oscillators, such as the Driscoll VHF oscillator and variants of the design such as the DISTAW, by Chris

Bartram GW4DGU.

I will go into detail about the oscillator module, because of its importance in the overall unit.

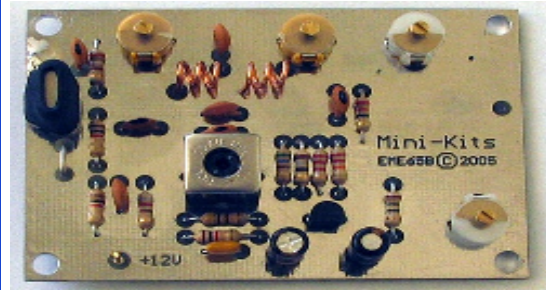


Image copyright Mini-Kits

The EME65B kit from Minikits in Australia was selected, due to its value for the money.

The oscillator circuit in the EME65 (B) appeared around 1981 in RSGB publications in the Microwave source of that era (www.microwave-museum.org/exhibits/mwm0018.htm).

The RSGB oscillator circuit was liberated from a Plessey AMETS design used in balloons. The RSGB board was nicknamed the "Balloon board"

The original use was with fairly wide FSK (frequency shift keying), and the component values are associated with that.

The circuit hasn't really changed in the last 28 years (!)

This is the standard EME65B unit as received from Minikits. There were minor changes from the first EME65 version, with additional regulator filtering and a shielded coil for tuning the crystal oscillator. The oscillator circuit consists of the Butler 2 transistor crystal oscillator. The second transistor collector is tuned to the 3rd Harmonic and the next transistor is

used as a further x2 multiplier. Output from the PCB is ~ + 10 dBm (10 mW). The voltage regulator regulates the oscillator transistors. The final multiplier and PTC thermistor for the crystal is run off the incoming +12V

I have looked at this circuit, done some experiments and measurements and minimised unwanted noise and also improved frequency stability. Note that minimising unwanted noise improves frequency stability.

Sources of noise

- Regulator noise
- Resistor noise
- Low Loaded Q of crystal.

Improving frequency stability

- Regulation of all stages
- Improved crystal heater

Miscellaneous changes

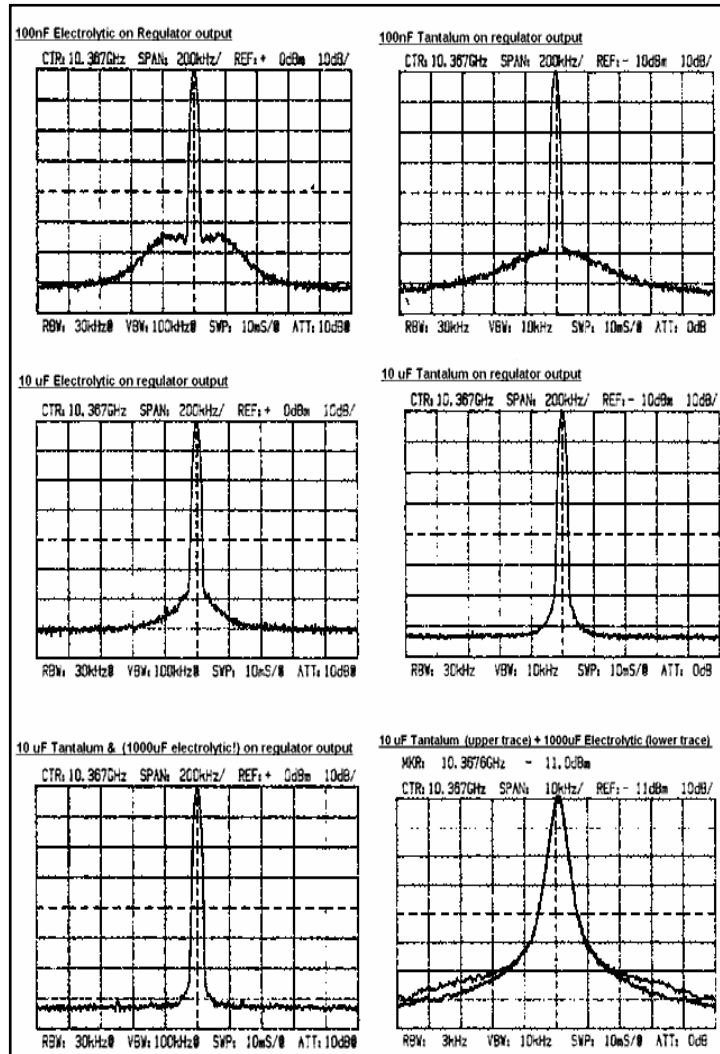
- Different biasing
- Changes to interstage coupling

The images right are from the output of a 10 GHz source. The equipment consisted of G4DDK004 Crystal Oscillator/Multipliers with RF output on 2.5 GHz.

The multipliers are x3,x2,x2,x2 This is then multiplied by a further x4 multiplier to provide output on 10.368 GHz.

There is a 78L08 regulator for the 2 Bipolar Transistor Butler Crystal oscillator plus base bias for the following x2 multiplier.

The images show the effects of different decoupling around the 78L08 regulator.



Regulator Noise

Typical Voltage regulators (78 and 317 series) are sources of unwanted noise due to the use of unfiltered zeners inside the regulator. Additional filtering is used to reduce this.

Resistor Noise

There are several sources of resistor noise in the circuit. This is especially important

around the Oscillator itself, as once the noise is there it can't be removed. The causes may be due to inadequate filtering and placement of resistors. Replacement of some resistors with inductors, improved filtering, and additional inductors have shown improvements.

Low Loaded Q of crystal.

The limiting of the amplitude is done by the transistors themselves, which drives the oscillator transistors out of class A, thereby increasing the source and load impedances seen by the crystal, hence degrading Q. Addition of clamping diodes across the tuned circuit removes the limiting function from the transistors bringing them back to class A. The low Loaded Q increases phase noise.

(Unloaded Q is what the crystal is capable of, as an individual component, while loaded Q, is when the crystal is in circuit.)

Regulation of all stages.

If the supply volts change, then this changes operating points of unregulated stages, which changes the load on the oscillator, which can cause frequency shifts. Supply Volts changing can also result in output level variation.

Improved crystal heater

Crystal with no temperature control shows ~ 3 kHz drift when multiplied up to 1152 MHz when temperature goes from 10 to 50 ° C

The use of the typical PTC thermistor as shown on the previous image, is useful as a first attempt. This should only be used on crystals specifically made to operate on that temperature (~ 55 ° C). It operates best if ambient temperature is constant, otherwise variation of thermistor temperature is high. 47 to 67 degrees C when ambient varies from 5 to 50 C.

Checks with a W6PQL heater showed significant improvements, however there were stability issues. W6PQL Circuit was reworked, with operation similar to G8ACE design now showing improved results. About 3 to 4 degrees variation, with ~ 100 Hz variation at 1296 MHz

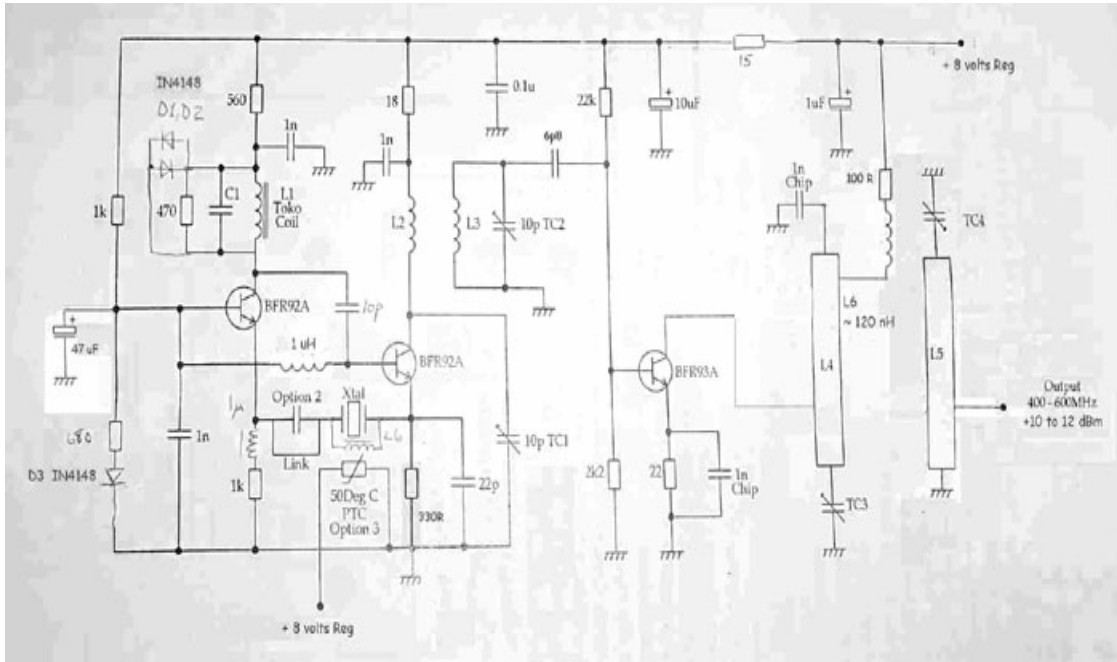
Miscellaneous

Changes to biasing and interstage coupling to optimise operation of oscillator and multiplier.

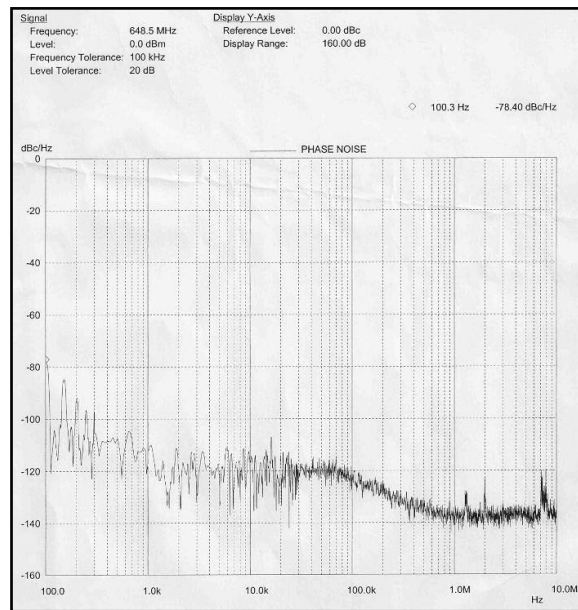
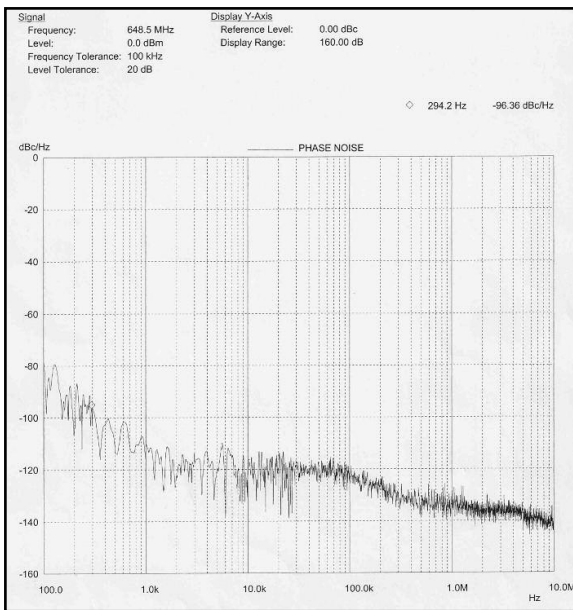
Information now on Mini-Kits website (www.minikits.com.au)

The Crystal oscillator runs at 108 MHz and is multiplied by 6 times to 648 MHz. There is at least 15.5 dB extra noise added because of this multiplying process. This was taken via a Spectrum Analyser with Phase Noise Capabilities and results are probably compromised by the limitations of the instrument (1 kHz to 100 kHz or more). However the area between 100Hz and 1 kHz away from carrier shows significant change as the following images show.

Mini-Kits Local Oscillator

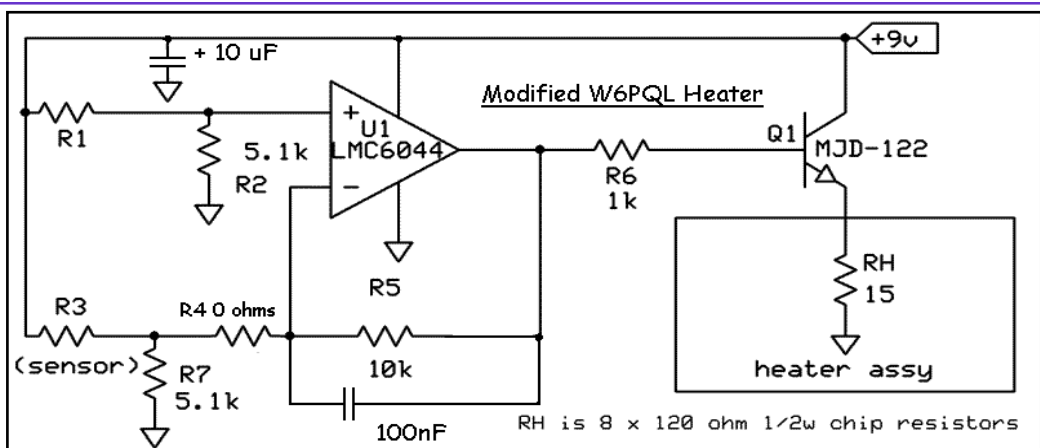


EME 65 500 MHz Local Oscillator



The original configuration had voltage gain of 50 to 100 times, a ~ 0.03 degree (1 ohm) change gave ~ 0.25 volt swing on output. This is very touchy indeed!! The circuit shown on the next page, has similarities to the circuit used by G8ACE in his OCXO's .

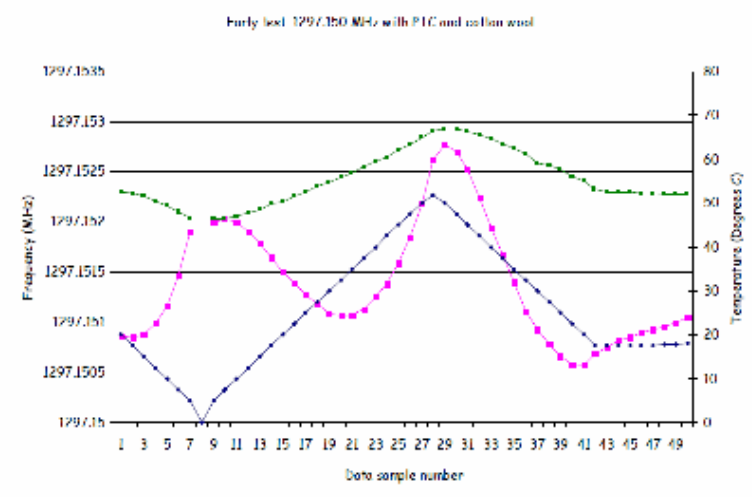
Another modification I tried to the original W6PQL heater was just changing R4 to 100k ohms and R5 to 2.2 Mohms. The additional 100nF (as shown in the schematic) on the U1 opamp is still recommended however. The change in resistor values reduces the gain by a factor of about 10x. Bypass capacitors near the opamp supply pins are recommended to keep the IC stable.



Insulation around the oscillator is highly recommended. Jim W6PQL also recommends that the PCB be insulated from the chassis by using insulators. This reduces the tendency of the temperature exchange between the

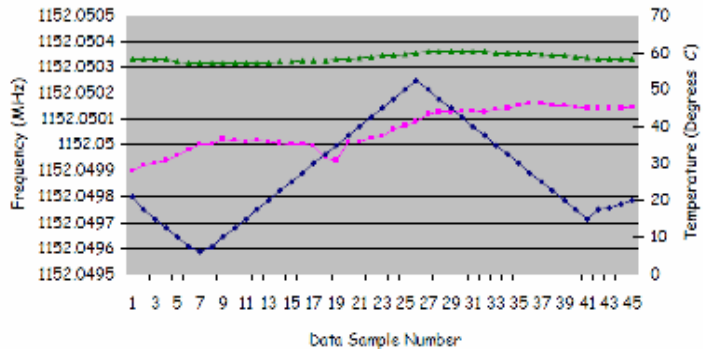
enclosure and the PCB. I found T0220 insulators, and nylon supports useful in my application. I had tried nylon nuts and screws but they tended to bind, and break, after repeated use. Additional insulation around the oscillator enclosure is **very** worthwhile, as this reduces the enclosure temperature change with ambient temperature variation, as well as minimizing heat loss.

The graphs shown are two attempts at stabilization. Left is an early test with cotton wool and a positive temperature coefficient thermistor. Below is a graph of the response using a modified

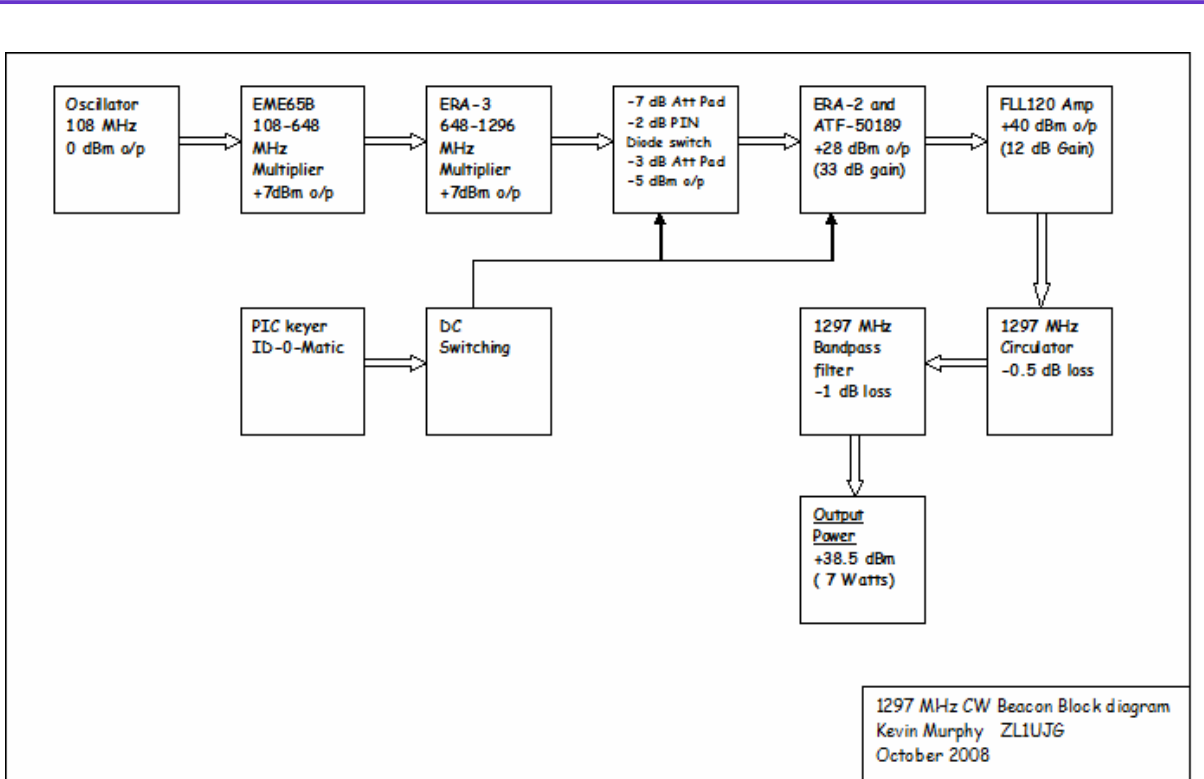


W6PQL heater and a negative temperature coefficient thermistor next to the crystal. In both graphs the green (top line) is temperature of crystal, the Blue (lower triangular line) is temperature inside Peltier chamber, the pink (central line) is the drift of the oscillator output.

No 2 Temperature run of unmodified EME65B & modified W6PQL heater with NTC Thermistor next to crystal



The left graph shows ~ 2.3 kHz drift over 0 to 50C temperature range. The right graph shows drift due to temperature cycling ~ 100 Hz. Quite an improvement!



Block diagram of the complete beacon

Discussion of Functional blocks

Oscillator

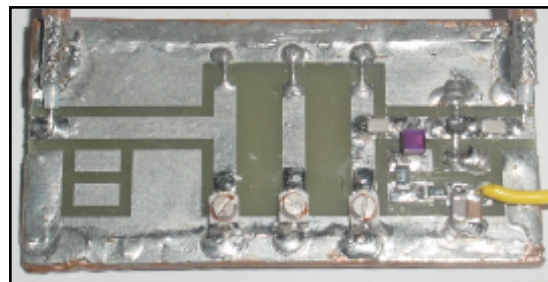
The oscillator is configured, so that ~ 100 MHz @ ~ 0dBm is present on the output of the EME65B PCB. This allows replacement with units such as the G8ACE unit, and reduces interaction between oscillator and multipliers. There is some small frequency control, using a varicap, to allow for frequency adjustment, due to crystal aging, or to allow disciplining. Regulators are off the Oscillator enclosure, so that only heating is done by the W6PQL unit alone.

108 to 648 MHz multiplier

A modified EME65B (i.e. minus the crystal) is used as the 108 to 648 frequency multiplier. The modifications as discussed before are still mostly applicable to reduce noise and improve voltage stability. A small attenuator pad is used to reduce level and set impedances. (Alternatively the amended EME65B could be used as the oscillator/multiplier source.)

648 to 1296 MHz multiplier

Uses ERA-3 MMIC, on a Waikato VHF Group filter PCB (right). Power is ~ +7 dBm or 5 mW.



Attenuator/PIN switch

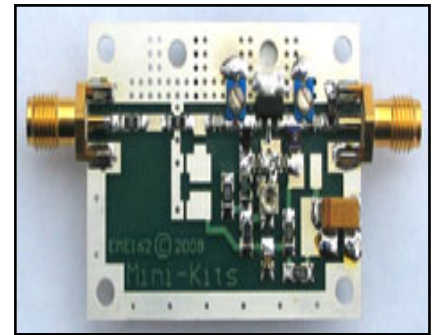
This first attenuator is used to set drive levels for the subsequent stages.

A PIN switch is keyed to reduce drive level in the off state, and additionally it ensures that the following active stages don't have RF on them, during keying.

An attenuator is on the output of the PIN switch reducing the output impedance change when the PIN switch is keyed.

1 Watt Amp

The Mini-Kits EME162 Amplifier (right) allows a drive stage to be added, and in this application, a ERA-2 MMIC was added for additional gain. There is some minor changes to increase volts on the Output FET slightly. Power output in excess of +29 dBm. These 2 stages are switched on and off by the keying. Cooling is by a stick on heatsink. This could be used as the final stage, however for more power...



(Image copyright of Mini-kits)

Output Amplifier

The RF Device could be either a Mitsubishi MGF0907 or Toshiba FLL120 10 watt FET.

(available at low(ish) cost on the surplus market) Positive DC Supply was going to be keyed with DC current set to ~ 2A, but changed so that device is biased in Class AB, and driven up with RF Drive. Greater efficiency than a Mitsubishi Power Module.(~ 50 % vs 25 % !). You should plan to have a PSU interlock so it will not put Drain Volts on without – 5 volts, otherwise FET will very quickly become a 3 legged fuse. NOTE: Mitsubishi DO NOT recommend frequent ON-OFF keying of their power modules. LDMOS FET's ,kits and surplus amplifiers are also available.

Circulator and Bandpass filter (BPF)

I have circulators and BPF's from surplus equipment. The circulators will retune to 1296 MHz, with strong magnets from faulty PC Hard-drives!! The BPF's have multipole construction, and tunable notches that can reduce adjacent 108 MHz products further.

Keyer

I was looking for a suitable keyer, with multiple features. I came across the ID-O-Matic, which can be (re)programmed via a PC Serial Bus Features as follows:

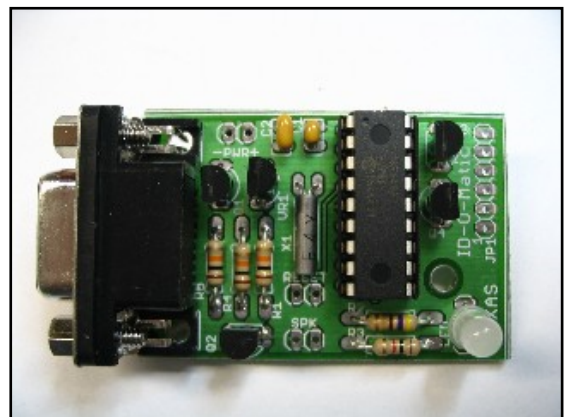
Variable keying speed

Programmable delay

Audio (MCW),CW and PTT Outputs

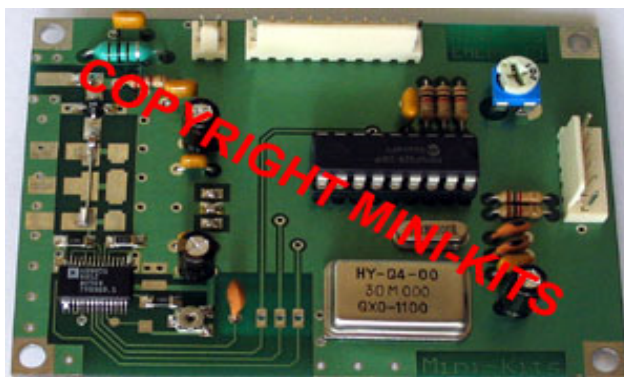
Also useful in Repeater Applications

\$20 from NOXAS, <http://www.hamgadgets.com/>



Regulators

Most of the regulators are conventional 7808 or 7805 regulators, however the regulator for the PA, should be LDO (Low Drop Out), due to higher voltage (10v). The current requirements are higher so a LM1085 3A version, or LM1084 5A version is selected. You must ensure adequate heatsinking. I have seen regulators show thermal shutdown, if run for as little as 15 to 30 mins .



If you intend to attempt additional stability you can try used GPS Disciplined Oscillators (GPSDO) such as the Trimble Thunderbolt shown left; Rubidium sources can be used in an Oscillator locking scheme such as suggested by G4JNT (<http://www.g4jnt.com/LckdSrcs.pdf>) . The use of a DDS like that by Mini-kits will be necessary in this application. Alternatives are RE-FLOCK units by CT1DMK and VE1ALQ

Events

For inclusion, please direct event notices to the editor.

ARRL June QSO Party - June 13-14. The big event approaches! Please plan on attending! Even one day's help will be appreciated

W2QW Techfest - June 20. See www.w2qw.org

ARRL EPA Section Convention + Fire-cracker Hamfest - July 4. Bressler PA. see hrac.tripod.com

Valley Forge Hamfest & Computer Fair - July 12. See www.marc-radio.org

CQ WW VHF Contest - July 18-19. see <http://www.cqww-vhf.com/>

Central States VHF Conference - July 23-25 Elk Grove Village IL. Spr: Central States VHF Soc. See www.csvhfs.org/conference/index.html

Events continued.....

ARRL UHF Contest - August 1-2. See www.arrl.org/contests/calendar.html for details.

ARRL 10GHz & up Contest - August 15-16. See www.arrl.org/contests/calendar.html for details.

JSARS Hamfest - Aug 16. See www.jsars.org

Pocono Area Hamfest - Sept 12 . See www.qsl.net/n3is/hamfest/index.html

Mid-Atlantic VHF Conference - Sept 26 with Hamarama 9/27. Spr. Packrats. Mt Carmel Club /Mariott Hotel. Complete details at www.packratvhf.com/VHF%20Conf/vhf%20conf.html. Registration is now open.

ARRL Sept. VHF QSO Party - September 12-13. See www.arrl.org/contests/calendar.html for details

Events continued from p. 10.....

ARRL 10GHz & up Contest 2nd Weekend- September 19-20. See www.arrl.org/contests/calendar.html for details.

Red Rose Repeater Assoc Hamfest- Oct 3. See w3rrr.org

OMARC Hamfest - Oct 4. See www.omarc.org

RF Hill ARC Hamfest - Oct 18. See www.rfhill.ampr.org

MUD - Oct 25 The Westin, Dallas Fort Worth Airport 545 West John Carpenter Freeway Irving, Tx 75063. See www.microwaveupdate.org

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Editors Column

Our next meeting will be **June 18** at Otto's Brauhaus 233 Easton Rd, Horsham, PA, in the Biergarten. The Dutch Treat dinner starts at 6:30PM and the meeting starts at 8PM. This is the June Pack Rat elections meeting. Come early, have fun, discuss the VHF contest results and enjoy some liquid refreshment. It's open to spouses, significant others and guests. There's no accounting for taste, but this is my favorite meeting of the year. Hope to see you there.

Even if you have not signed up, please plan on coming over to Camelback for the **June VHF QSO Party June 12-15**. You can help set up, help tear down/clean up, do some cooking or **do some operating on first class**, high power vhf/uhf/ microwave rigs connected to super antenna arrays. If you have a laser rig, bring it along, it's good for 8 points!

Thanks to **Kevin Murphy, ZL1UJG** for converting his 1296 Beacon powerpoint presentation into a nicely fleshed out feature article for this months issue. We look forward to progress reports on his beacon development. 73, Lenny W2BVH

Ham Radio URL of the Month

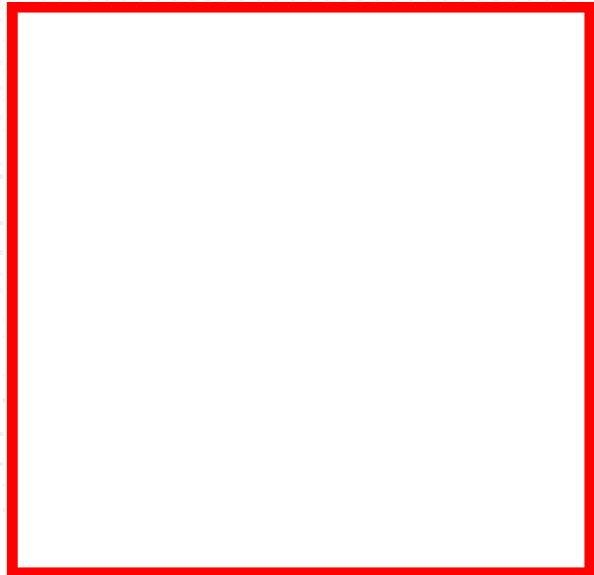
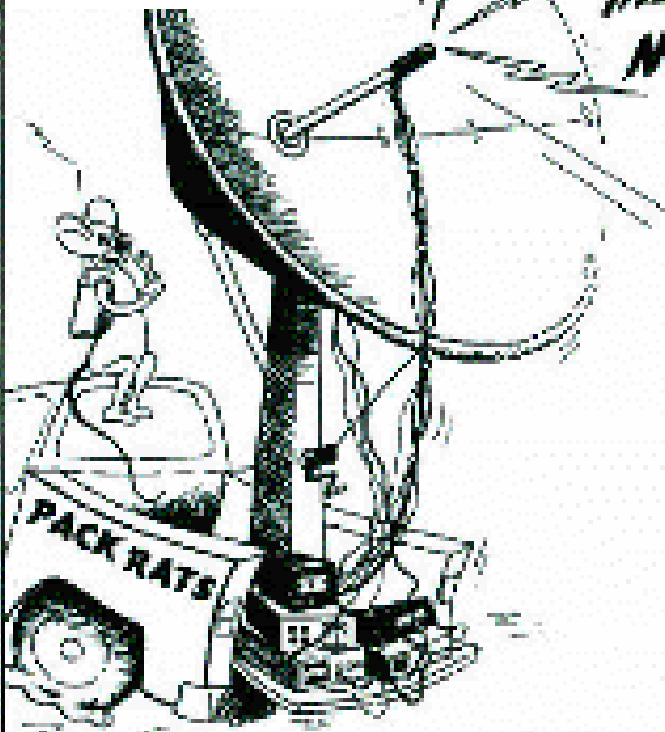
Ever need to calculate path loss between 2 points? I didn't. Until recently, when I wanted to estimate the possible effects of WNET's (channel 13) 60 KW transmitter on the 222 MHz transverter I was building. WNET is 21 miles from my qth and I wondered what sort of signal would show up at the transverters antenna port. Would the receive image filter do a decent job? Well the online calculator at <http://www.rac.ca/tca/Received%20Signals.html> helped make short work of that calculation. The only odd thing about the calculator is that it uses mixed units (KM between antennas, but feet for feedline length).

The calculation showed a very large, but manageable signal at my transverter's front end (S9+34db) with my antenna pointed right at WNET.

Similar calculations are useful from time to time if you're near a strong signal source, such as a broadcast, pager or landmobile transmitter or airport or naval base radar set. This calculator will give you a decent estimate of the problem you're up against. Enjoy!

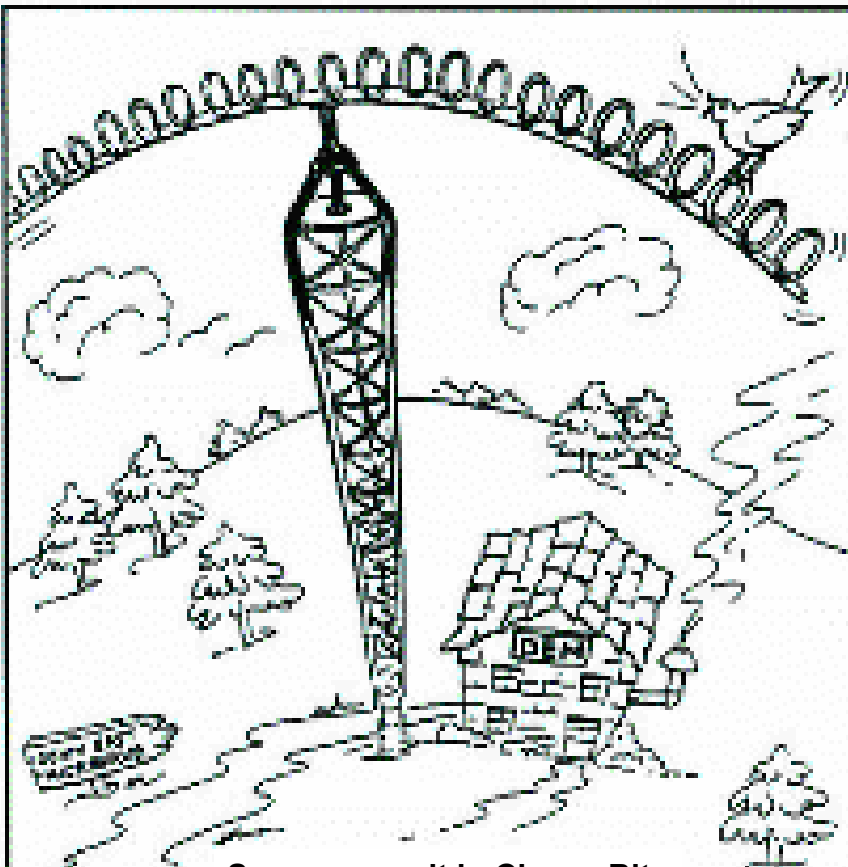
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**MEETING
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