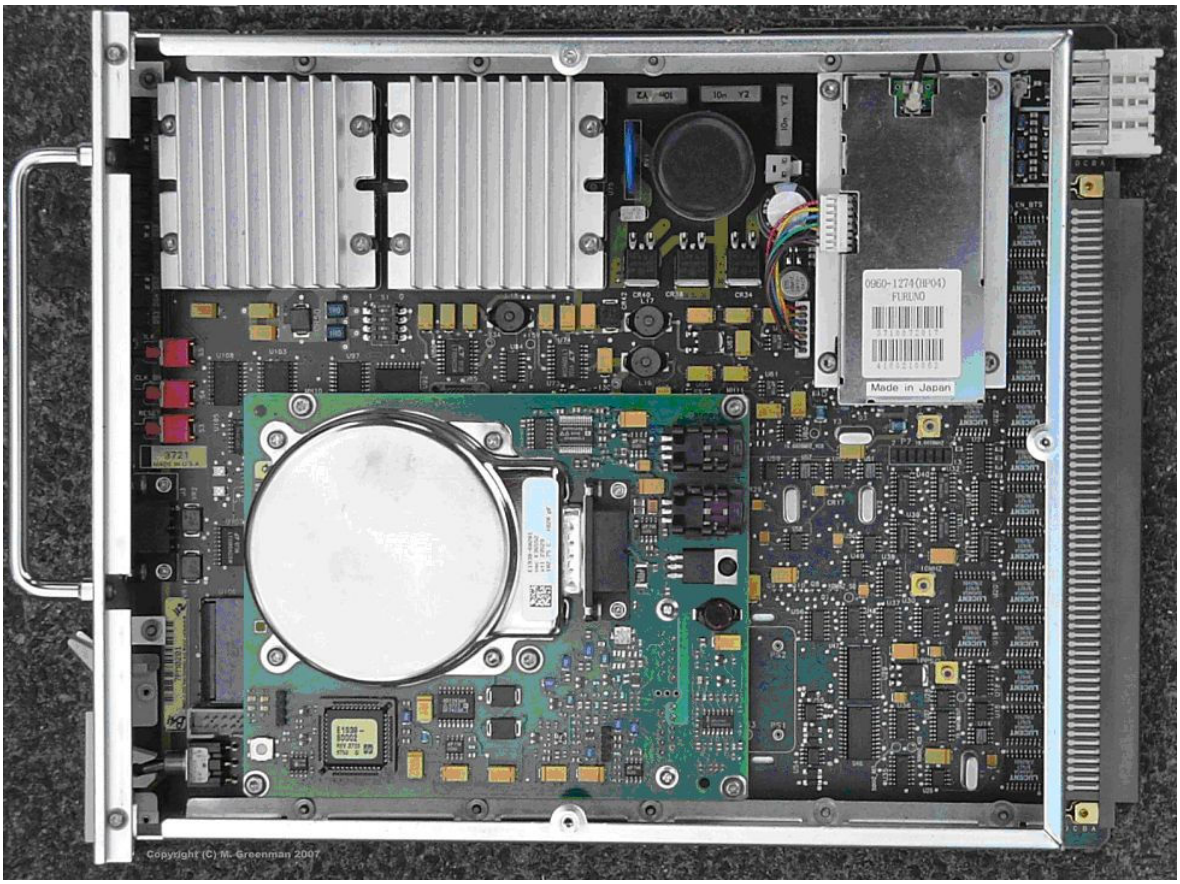
# EXTERNAL GPS FREQUENCY REFERENCE FOR THE FT736

By Jim Forse – VK3II

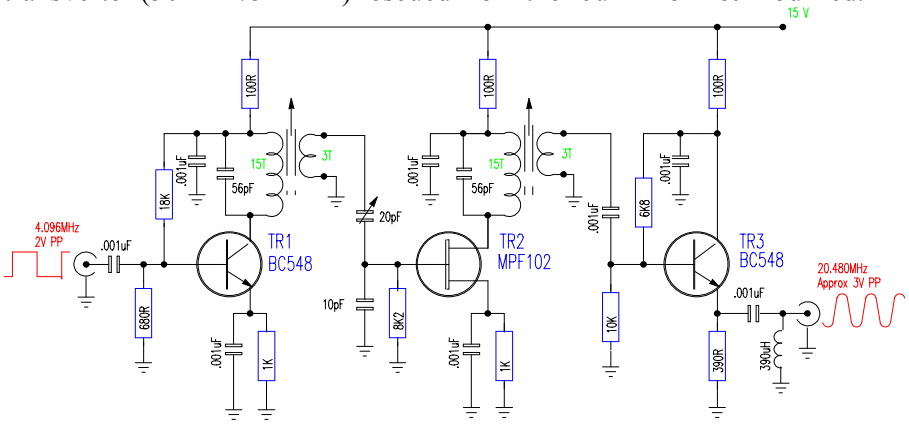
**Based on the HP Z3815 GPS derived Frequency Reference.**




Z3815 GPS generates a number reference frequencies.
One of them being a 4.096MHz. square wave.
4.096MHz is multiplied five times & filtered to produce 20.480MHz.
20.480MHz is the internal FT736 PLL reference frequency.

**Frequency Multiplier to 20.480MHz.:-**

Was originally a 22MHz /24MHz crystal oscillator & buffer amp for a 10mtr to 6mtr home brew transverter (50MHz/52MHz) rescued from the "Junk Box" & modified.




4.096MHz Square Wave to 20.48MHz Sine Wave

Five times frequency multiplier TR1 is biased to give a best RF level at 20.480MHz. from the 4.096MHz square wave i/p.

TR2 FET buffer amplifier produced sharper tuning than a transistor in the TR2 position. Resulting in a cleaner 20.480MHz from the multiplier tuned cct.

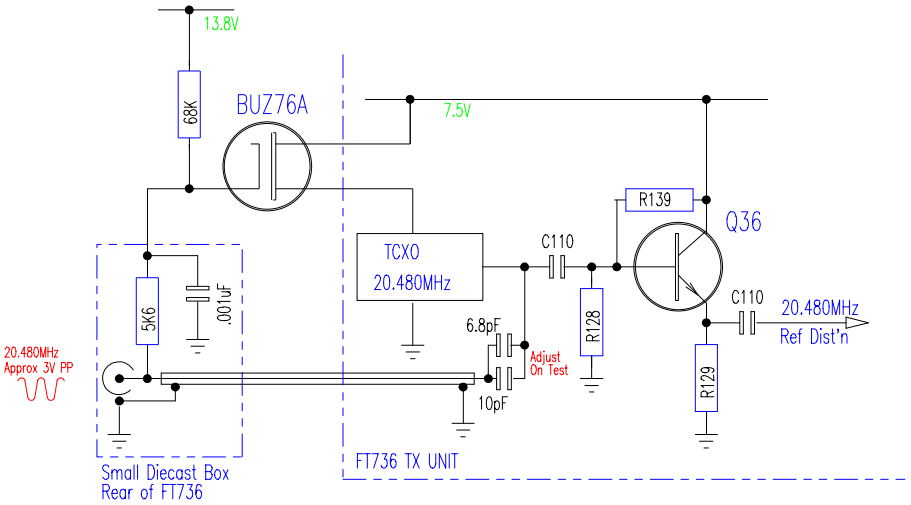
TR2 buffer amplifier is followed by TR3 an emitter follower o/p to the FT736

In order to match RF levels with the FT736 internal frequency reference level.
A variable capacitive voltage divider between TR1 & TR2 gives some control over the multiplier 20.480MHz o/p level.

The 4.096MHz to 20.480MHz multiplier unit is powered from a 24V AC plug pack via a rectifier & a 15V DC voltage regulator.

**FT736 Modifications for the External Frequency Reference:-**

I have basically followed David's (VK3HZ) TS2000/FT847 modifications with my FT736. This modification disables the DC to the internal frequency reference when the external reference is plugged in.




The modification injects the (GPS based) external frequency reference across the o/p of the original internal frequency reference.

This is done through a small coupling capacitor via a short tail of coax cable from the back of the FT736.

When the FT736 is running on its internal frequency reference, the modification wiring does have some capacitive loading effect on the internal frequency reference level.

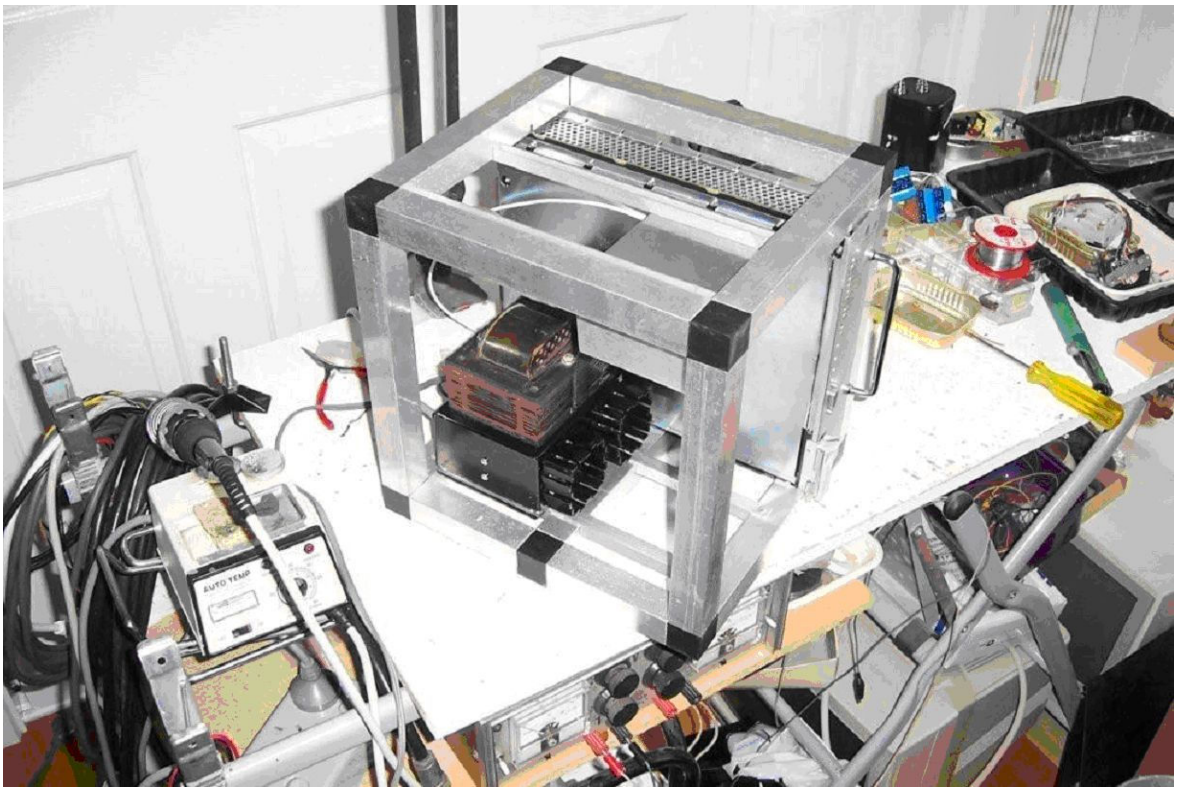
To overcome this the RF level from the external frequency reference was increased, resulting in a decrease of the injecting coupling capacitor size.

This lowered the capacitive loading effect when the FT736 is running back on the internal frequency reference.

**Hum Problems**

The Z3815A operating voltage can be between 20V DC to 56V DC, floats above ground also is polarity independent

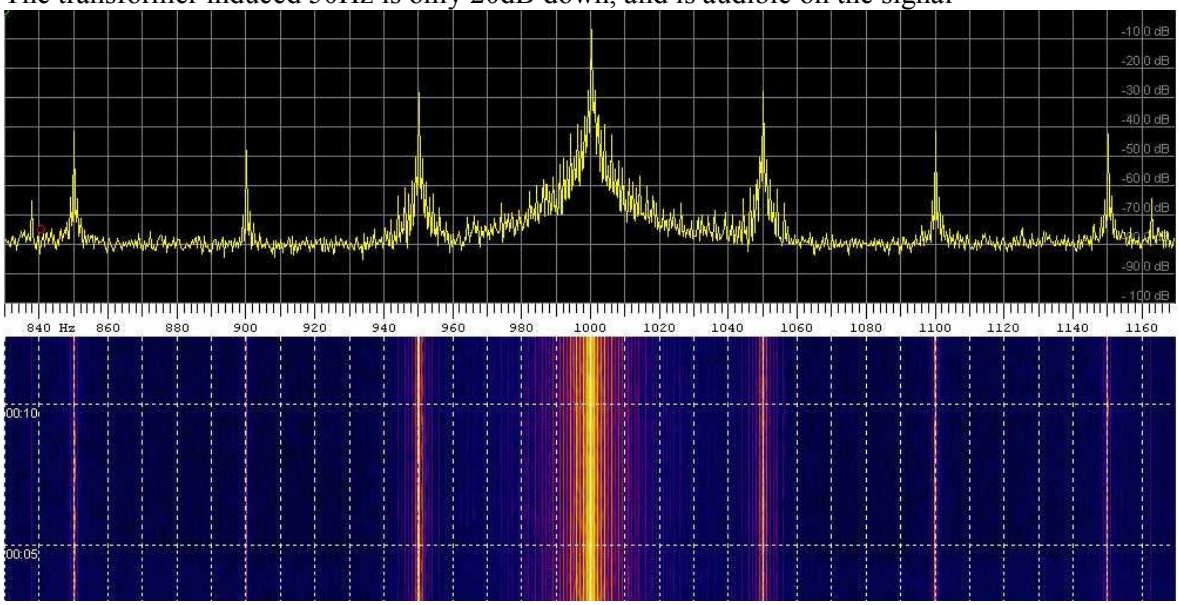
I first powered the  HP Z3815 from an unregulated 30VDC supply.
This produced hum on 20.480MHz reference.



Hum rejection improved by using a linear regulated 24VDC supply.
An aluminium frame was built up to house the Z1835, multiplier & linear supply.

Then the hum problem returned when everything was tidied up.
The magnetic field from the power transformer (rescued from the "Junk Box') was inducing hum into HP Z1835.

**VK3II Carrier on 144.225 monitored by David VK3HZ** using a FT-817 with Spectrum Lab
The transformer induced 50Hz is only 20dB down, and is audible on the signal



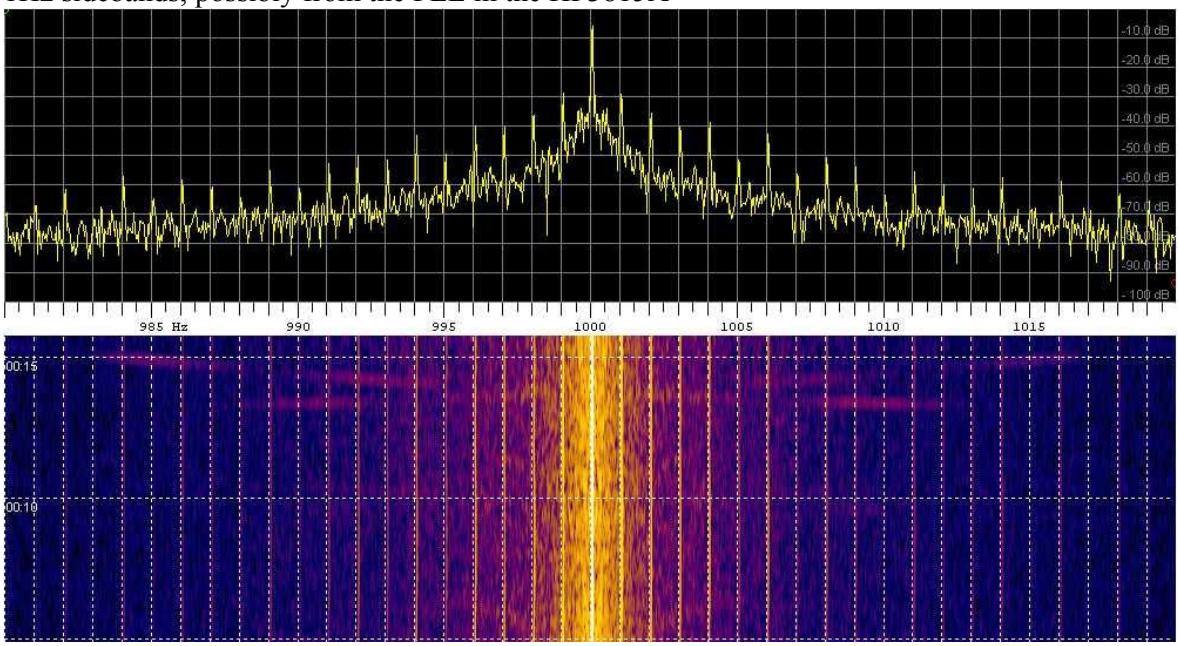

Placing the linear supply on the floor away from the HP Z3815 fixed the problem.

A 24V switch mode supply was tried next along side the Z3815 in the aluminium frame.
This produced HF “Birdie” QRM, requiring extra filtering on both 240VAC i/p & 24V DC o/p to suppress the QRM.

The HP Z1815A runs continuously for best stability.
It has a long warm uptime from a cold start.
FT736 & the multiplier are switched on & off as required along with other station equipment.

**<u>The GPS derived 4.086MHz/20.480MHz has minor sidebands</u>**

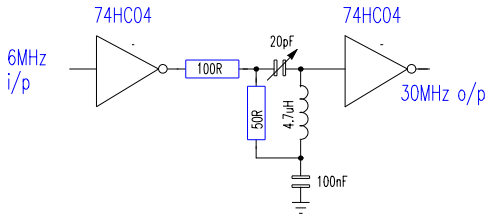
**VK3II Carrier on 144.225 monitored by David VK3HZ** using a FT-817 with Spectrum Lab 1Hz sidebands, possibly from the PLL in the HP3815A



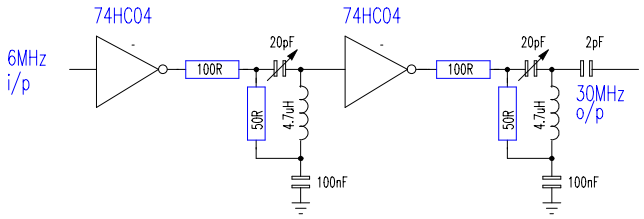
## Other Frequency Multiplier Circuit Ideas

Wenzel Associates web site. http://www.wenzel.com/documents/circuits1.htm

Logic Gates Make Freq Multipliers http://www.wenzel.com/pdffiles1/pdfs/hcmos.pdf




6MHz to 30MHz Inverter Multiplier
Square wave o/p




6MHz to 30MHz Inverter Multiplier
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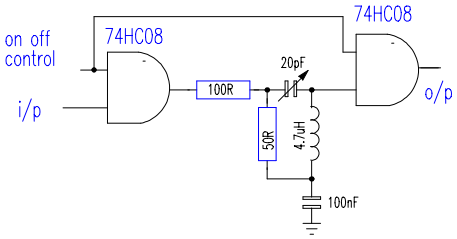


And Gate Multiplier
Remote on off control