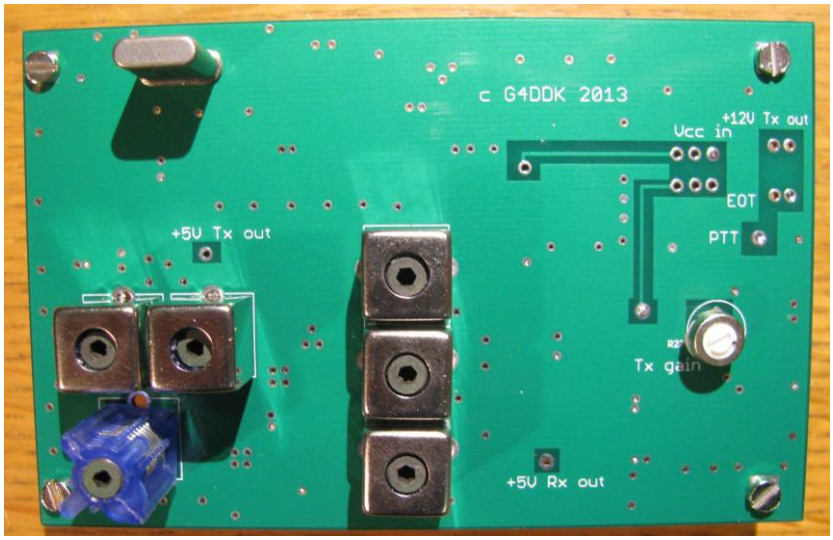
4m amateur band transverter

Featuring a very high dynamic range receive converter and spectrally clean transmit converter module.



A modern 70 MHz/28MHz linear transverter module

Following a very successful and encouraging presentation of the 'Nacton' at the recent RSGB Convention and an award of 'Highly Recommended' in the accompanying Centenary Construction Contest, I have been persuaded to make kits available for the transverter module. They will be available through my web page in the next few months.

At present the plan is to produce 'short kits' for the transverter. These short kits will consist of a PCB (10cm X 6.4cm), 42MHz crystal, set of six Coilcraft tuneable inductors and four SPF5043 MMICs.

You will need to source your own 0805 size resistors, capacitors and inductors as well as the diodes, voltage regulators and transistors.

As there are over 120 parts on the PCB only experienced builders should contemplate building the Nacton transverter.

Brief Circuit description

A common mixer is used for both transmit and receive. This is a high level mixer (ADE1H) requiring +17dBm local oscillator drive at 42MHz.

The crystal oscillator uses the well known two stage Butler design with bipolar transistors using a HC43/U third overtone crystal at 42MHz. Extensive low pass filtering is used after the local oscillator amplifier stage to reduce the chances of harmonic mixing with high level out of band signals at the receive converter input.

3 x 42MHz = 126MHz

126MHz - 28MHz = 98MHz. This is right in the middle of Band 2 FM!

A known transmit issue, using a 42MHz LO, is that the 5th order product at 4x28MHz - 42MHz = 70MHz. A spurious output may be apparent if the transmit IF input is overdriven. This may be a problem with some other 4m transverter designs. Using a high level mixer and slightly under-driving it at 28MHz largely eliminates this problem in the Nacton transverter.

Modern transverters require much higher frequency stability than in the past. This is catered for by providing an external input/output that can be used in a number of ways to achieve the required stability [1]. For normal, everyday use, the basic transverter uses a high quality Krystally crystal.

On receive the input signal is passed via a low loss single pole filter, at 70MHz, to a P-HEMT MMIC type SPF5043 RF stage where the converter noise figure is established. This device has an exceptionally high input intercept at 4m.

The MMIC RF output passes via the PIN switch to a three stage 70MHz band pass filter. This filter establishes the pass bandwidth of the transverter. From the filter the signal passes to the mixer and then via an attenuator to another PIN diode switch before reaching the post mixer amplifier and 28MHz output band pass filter. Overall gain is 15dB with input third order intercept (extrapolated) of up to +9dBm. Extrapolation is always prone to uncertainties, but the measured input 1dB compression point (IPP1dB) is -6dBm, which with P HEMT technology typically giving IIP3 around 15dB above P1dB, seems to indicate that this number is probably quite close to the true IIP3. This is consistent with previous measures on a stand-alone preamp using the same device. The measured noise figure for the overall transverter receive converter is 3.5dB

On transmit the incoming 28MHz IF signal is first terminated and then attenuated to the correct level for the mixer. The attenuator is made adjustable to allow for drive levels between +6dBm and +27dBm. Some transceivers, such as the ICOM 756Pro3 have an output level of just -20dBm. In this case a small add-on amplifier (such as the forthcoming one in Radcom) can be used to bring the level up to something more manageable. A later version of the Nacton may have this additional TX IF gain built in.

After passing the PIN diode switch the transmit IF signal passes to the mixer, is up-converted and then filtered in the common 3 stage Chebyshev band pass filter to remove all out of band signals, leaving the required 70MHz to be PIN switched to the dual SPF5043 transmit amplifier that takes the output level up to over +20dBm (if required). A further two stages of 70MHz filtering is used between the two transmit amplifier stages to ensure compliance with spectrum purity requirements.

Two methods of transmit/ receive switching are incorporated. Either common earth to transmit (PTT ground) or high impedance + voltage on the transmit IF input will cause the transverter to switch from receive to transmit.

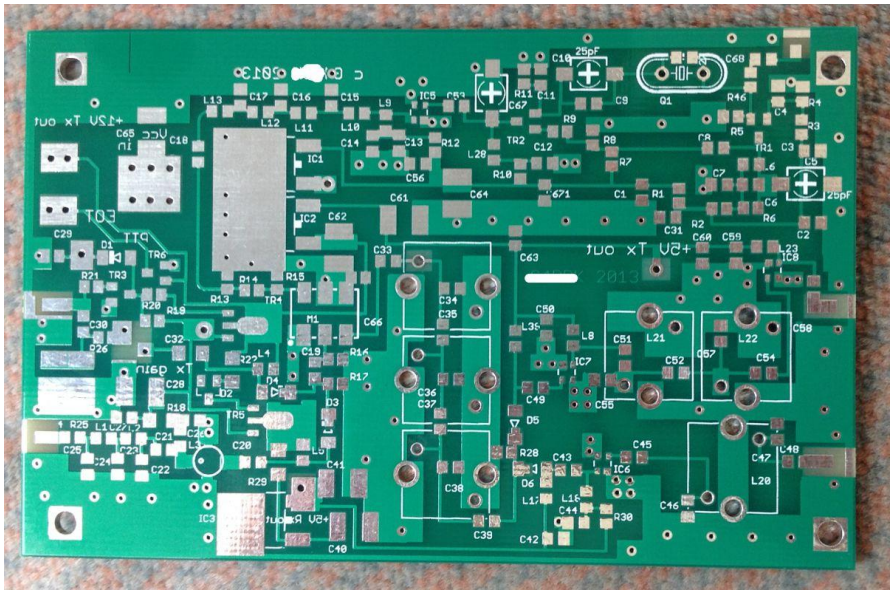
Flexibility is incorporated by providing an external MOS FET earth on transmit (EOT) output as well as a current limited +12 and +5V transmit outputs. A +5V on receive output is also provided on the board.

Separate voltage regulators are provided for the local oscillator chain (+8V) and the receive and transmit amplifiers (+5V).

Transverter operating voltage is from +10V (it will work down to as low as 6.5v, but gain is very low) and up to +15V. Nominal supply current is 13.5V at 200mA on receive and 300mA on transmit. The complete transverter with PA takes less that 1.5 Amp at full output.

A level of 100-200mW should be sufficient to drive any of a number of RF MOS power amplifier modules. The Mitsubishi RA07H0608M is recommended and will provide up to 10W output (3-4W PEP recommended). A PCB for this module complete with low pass filter is planned. A higher power module could also be driven from the Nacton output, if required, but the availability of ready built, higher power (over 160W!), RF MOS amplifiers at reasonable cost and that require no more than 3-4W drive, are readily available.

The number of boards in the first PCB batch is strictly limited and most have already been spoken for. there are still a few available at the moment. More boards (Issue B) are about to be ordered.



It is expected that the short kit will cost under £50. The remaining components for the transverter module should not cost more than about £20 - £25. The short kit price is to be confirmed.

A suitable Hammond case is available for about £12

I will indicate the availability and price of the short kits on my web page in the near future.

A 144MHz version of the transverter has already been successfully produced. If it works as expected, 144MHz Nacton short kits will be made available in due course.

Full construction details will be provided as a PDF on this web page in due course.