Anglian 3L 144MHz transverter

Introduction

Since last year the Anglian transverter has again been redesigned. It was renamed the Anglian 3 and incorporated a number of improvements to improve performance. As a result of feedback (mainly from SM5BSZ) a further number of changes have been introduced and the suffix L added to the numbering. The latest iteration of the transverter is known as the Anglian 3L.

Changes to the design include a different MMIC line up, improved switching, much lower noise local oscillator, optional TX IF amplifier for use with low transverter output transceivers such as that with certain ICOM HF transceivers, sequencing and much lower transmit sideband amplitude and phase noise (composite noise).

No clever digital, unusual or questionable techniques have been used. The project was designed to use solid analogue design to provide a frills-free, easy to use and low cost 2m transverter module that could be used with an existing HF transceiver to produce a high quality signal on 144MHz as well as having excellent strong signal handling performance.

Circuit description

The Anglian 3L architecture is similar to the Anglian 2 previously described. However, the biggest change is in the MMICs. The SPF5043 used in several stages have been replaced by PSA4-5043 MMICs. The new devices have quieter internal bias regulators, the apparent source of the amplitude noise in the Anglian 2. In addition the output MMIC has been changed to an MGA30689 for better IMD and lower gain. The previous transmit amplifier chain had too much gain and this occasionally led to problems.

Low transverter output transceivers, such as some of the ICOM range are catered for by the addition of an IF transmit amplifier, allowing the use of IF input levels down to about -20dBm. However, a word of caution. This stage can introduce unwanted amplitude noise and should not be used unless absolutely necessary. Provision is made to bypass the stage it it's not required. A simple 29MHz bandpass filter cleans up the 28MHz drive as some HF radios can have an unacceptable transverter output spectrum.

Changes to the LO have resulted in much lower phase and amplitude noise on a par with many more expensive transverters and much better than many others.

The diplexer between the LO amplifier stage and the mixer has been removed. After much testing it was found that considerably better receiver IIP3 was achieved without the diplexer to allow more 116MHz LO injection into the mixer. It also saves on a few components!

The change to high impedance P channel MOSFET switching has improved transmit/receive isolation by ensuring that the transmitter chain is completely switched off on receive. This also provided the opportunity to incorporate sequencing. The transmitter chain is delayed by approximately 200mS after changeover is initiated. This is achieved by holding off the transmit MOSFET switch, TR5, until

C64 has discharged through R32. C32 quickly recharges via diode D2 when switching back to receive. LED indicators are fitted to the board to indicate switching.

TR6 MOSFET provides an 'earth on transmit' output that can drive a small relay to +12v or +28V as required, or can enable an external linear amplifier.

The LO can be simply locked to an external high stability 116MHz source at a level between -6 and +3dBm by injection locking. This is a simple method, but highly effective.

Parameter	**Performance**
Receive converter	
Noise figure	1.6-1.8dB
Gain	25-26dB
Input third order intercept (IIP3)	Better than 0dBm
Image rejection (88MHz)	>70dB
LO composite noise	Better than -150dBc/Hz at 20kHz offset
Transmit converter	
Power output (Saturated/P1dB)	+22/+20dBm
Transmit gain	20dB (35dB with optional TX IF stage)
28MHz Drive required for +20dBm 144MHz output	0dBm (-15dBm with IF amplifier)
Harmonic output (2nd/3rd/higher) at saturation	-40dBc/-50dBc/<-60dBc
Image frequency output suppression	>70dBc
LO suppression	>70dBc
Transmit sideband noise	Better than -140dBc/Hz at 20kHz offset

Table 1 Anglian 3L performance

Construction

The double layer PCB is used to mount the 150 or so SMD parts. Tuneable coils L14,L15,L16L20, L21 and L22, together with the fifth overtone 116MHz crystal are mounted on the ground-plane side of the PCB.
A standard size tinplate box is used to house the PCB by seam soldering it into the box as shown on my web page www.g4ddk.com

Feed-through capacitors bring power and PTT into the box and take EOT and +5V on transmit out.

SMA connectors are used for both IF connections and RF connectors.

It is also possible to mount the PCB into a larger box using the four M3 holes provided in the PCB.

Alignment

Alignment is simple and consists of ensuring that the crystal oscillator is aligned and, by temporarily removing R14, at a level of +20dBm. It should achieve this level quite readily and is the secret to the excellent strong signal performance of the Anglian 3L. Replace R14 after making the measurement.

Connect a 28MHz receiver to the receive IF port and tune L14 to L16 for maximum noise. Tune L20 for best signal to noise on a weak signal. The adjustment is quite broad.

On transmit connect a 0dBm drive signal to the transmit IF port. Or -20dBm if the IF amplifier option is fitted. connect a power meter to the transmit output. It should be capable of reading 200-500mW.

Ground the PTT input and check the output level on a 250mW - 1W capable power meter. Adjust L21 and 22 for maximum output. It should reach about +21dBm at saturation.

None of the Coilcraft coil cores will require more than a slight tweak to optimise the performance. If it requires any appreciable adjustment then something is wrong. Use the recommended tuning tool to adjust the coil cores!

PCBs for the Anglian are available in the USA from Kent, WA5VJB. All other parts are available from Mouser, Farnell and Minicircuits Labs. The 116MHz crystal may be obtained from a number of sources although Krystally are highly recommended.

The author may be able to assist with obtaining parts in the event of difficulties. See WWW.G4DDK.COM for more details.

73 de Sam