KD8CGH

An Introduction to the uSDX

There is a new open source, home brew multi band, multi mode QRP transceiver that grew out of the QRP Labs QCX. Through some serious wizardry it retains an efficient class E RF amplifier for SSB and digital modes. It crams impressive SDR capabilities into an Arduino.

This has an interesting international development process conducted on https://groups.io/g/ucx/topics with contributions by many, including the usual gang of suspects: Hans Summers G0UPL, Guido Ten Dolle PE1NN, Barbaros Asuroglu WB2CBA , Manuel Klaerig DL2MAN, Kees Talen K5BCQ, Allison Parent KB1GMX, Jean-Marie T'Jaeckx ON7EN, Ashhar Farhan VU2ESE, and Miguel Angelo Bartie PY2OHH. I apologize to the many others whose names I didn't list. A summary is in the WIKI https://groups.io/g/ucx/wiki.

The basic work uSDX appears to have been accomplished by Guido Ten Dolle PE1NNZ. It uses pulse width modulation of the PA supply voltage to transmit modes other than CW while retaining class E efficiency and uses a direct conversion SDR receiver.

The basic idea behind Class E nonlinear amplifiers is that transistors have little loss when they are switched fully on or off. The losses occur when devices are limiting power flow in linear amplifiers. The idea behind a Class E amplifier is to use transistors in a switching mode to generate a square wave to drive a resonant circuit to generate RF power.

This method is used in the popular QCX QRP CW transceiver kit line developed by Hans Summers and sold through QRP Labs https://qrp-labs.com/. More than 10,000 of these great transceiver kits have been sold (I built one). There is a good discussion of the circuit and particularly of the class E amplifier in the excellent QCX documentation https://www.qrp-labs.com/images/qcx/assembly_A4-Rev-5e.pdf.

The QCX was the base for the QCX-SSB which starts with a QCX and modified the circuit and software to add SSB capabilities. The wizardry that Guido accomplished uses pulse width modulation of the PA supply voltage to control the amplifier in an Envelope Elimination and Restoration (EER) technique https://core.ac.uk/download/pdf/148657773.pdf. To generate SSB a DSP algorithm samples the audio input and performs a Hilbert transformation to determine the phase and amplitude of the complex signal. The phase changes are transformed into temporary frequency changes which are sent to the clock generator. This result in phase changes on the SSB carrier signal and delivers a SSB-signal with the opposite side-band components is attenuated.

On the receive side a direct conversion SDR receiver is used with the I and Q signal digitized

and all further processing carrying out digitally. Attenuators are included to help not overload the ADC range. Documentation is at https://github.com/threeme3/QCX-SSB . In addition to a good description of the theory and hardware mod there is also a good description of the software command menu.

uSDX.docx