Exploring 136 kHz

Tired of cookie-cutter QSOs and armchair copy? Want to work DX stations a hundred miles away? Like to get up before dawn? Low-frequency hamming is all this—and more! European hams are getting their feet wet on the new 136-kHz band. Will the US be next? Here's a look at what we might expect.

By Peter Dodd, G3LDO

On January 30, 1998, a new ham band—135.7 kHz to 137.8 kHz—was made available in the United Kingdom. The new 136-kHz band, as it's called, produced a lot of activity in the scant few months since its inception. Many UK ops who had gained construction and operating skills at 73 kHz were up and running. [**1**] The Crawley Radio Club, G3WSC (operated by G3KAU, G3GRO and others), have put up a large antenna and, with an output of 700 mW ERP, have worked a lot of DX. At the time of this writing G3YXM, who runs 800 W to produce nearly 1 W ERP is one of the UK's leading 136-kHzDXers. The band has also been allocated in several other European countries (see the sidebar, "**The 136-kHz Bandwagon**").

The ARRL is pursuing a similar LF allocation for American hams, who may soon be joining in the fun "way down under" (see item 2.1 of the **ARRL Executive Committee Minutes** on page 55 of September 1998 *QST*).

A QSO on 136 kHz

It's six in the morning as I walk down to the shed at the bottom of the garden. The small shelter has been converted to my LF shack. Inside is where I'll join the 136 Early Bird Net.

I switch on the TS-850S—which does double duty as my 136-kHz receiver—and slowly tune down from my normal transmitting frequency of 137.6 kHz. The only signals present are a couple of commercial RTTY carriers at 136 and 136.7 kHz, battling through a background of static and the machine-gun rattle of the spurious sidebands produced by a 100-kHz Loran transmitter. There are no amateur stations, so I decide to call CQ.

I check the frequency and drive level on my modified RF signal generator and switch on the audio amplifier, which doubles as a final amplifier. Holding down the key, I adjust the tuning coil's vacuum capacitor for maximum antenna current, which peaks at 4 A. I then switch on the automatic keyer, which is programmed to send CQ, while checking the amplifier's FET current and RF output. The antenna current is varying by 200 mA or so, but I know from experience that the fluctuation occurs because the antenna wires move in the wind. The tuning can be quite critical.

I switch to receive and tune the band. Nothing yet.

But wait. At 136.6 kHz I hear something in the noise. I make out a G, a 4 and an L. I adjust the high and low IF slope tuning on the TS-850S and the signal becomes more readable. It's GW4ALG, an op in a new country, on the new 136-kHz band, giving me a 579 report!

Experimental Equipment

You can't buy a transmitter for this band (at least not yet), so you'll have to build one. Building transmitters for such low frequencies means a trip back to the golden age of radio. It's not difficult, though. In fact, in many respects, low-frequency technology is less demanding than that at HF. A book on the subject has been compiled by the RSGB. [**2**]

Transmitting Antennas

Constructing antennas that can radiate a decent low-frequency signal is a real challenge. A half-wave dipole for 136 kHz—more than 1000 meters long—is rather impractical. The most effective antenna I've used so far is an inductively loaded Marconi.

The problem with LF antennas is that they're only a fraction of a wavelength long, with radiation resistance values as low as 0.01 Ω. When you factor in loading coil and earth resistance, only a small part of the transmitter power is actually radiated.

With some ingenuity and lateral thinking, however, practical antennas can be constructed. Tuned loops, loaded Marconis and short dipoles are all used with some success.

The construction of the loading coil and the antenna. The coil is 1-mm plastic-covered wire wound on plastic lattice fencing, which is rolled into a coil former of the appropriate size (12 inches in this case). The coil is covered by a clear plastic bag to protect it from the weather.

I used a variation of a Marconi antenna, shown in **Figure 1**. It's resonated against the Earth using large inductors. I overcame the problem of coil formers by using plastic lattice fencing, which can be rolled into coil formers of any size. This antenna has been very successful, but even so, I have to use 250 W of transmitter power to achieve an ERP of only 400 mW!

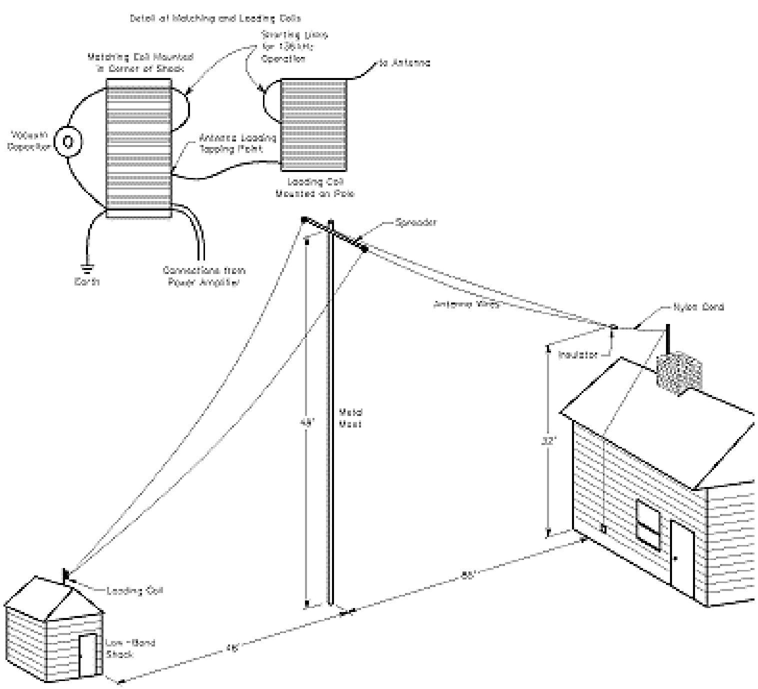


Figure 1—The Marconi antenna variant I use for 136-kHz transmitting and receiving. The layout was determined mostly by the garden and the position of the house and shed (now my LF shack).

Receivers

Because many commercial receivers/transceivers don't cover the LF bands (or if they do, their performance is often poor), most early LF experimenters, particularly on 73 kHz, used converters and communications receivers.

John More, G4GVC, a successful LF experimenter, found that his Kenwood TS-850S performed well on this band. He added all the useful options for LF work: temperature-compensated oscillators and cascaded CW filters (500 Hz bandwidth at 8.83 MHz, 270 Hz at 8.83 MHz, and 500 Hz at 455 kHz). Most of G4GVC's receiving work has been done using a 60-meter-long resonated horizontal wire antenna only 24 feet above the ground.

Transmitters

Although commercial transmitting equipment isn't yet available for the 136-kHz band, it's possible to buy many of the modules required to build a transmitter. Many methods of generating low-frequency signals are in use. Some experimenters use signal generators, while others build oscillators.

One handy feature is that commercial audio amplifiers can be used as RF power amplifiers at this frequency, despite the fact that 136 kHz is many octaves above the limit of human hearing. G3KAU, G3GRO, G3XDV and I use modified 300-W audio amplifier modules. G2AJV went nostalgic and built a simple power amplifier using two 50-year-old CV57 valves in parallel.

Modulation Schemes

Aural CW was favored by early enthusiasts. Other modulation methods include digital modes such as very slow on/off keying, PSK and MSK (at data rates of a few bits per second or less, much like LF military submarine systems). Data rates this low can be generated and demodulated using simple computer equipment.

With a little digital signal processing (DSP) magic, a Fast Fourier Transform (FFT) system can examine the whole band in 6-Hz channels, all in real time. By plotting the received signals on a color "waterfall plot" on the screen (frequency on one axis, time on the other, with signal strength denoted by color/brightness), it's possible to view slow CW on every part of the band simultaneously. See **Figure 2**.

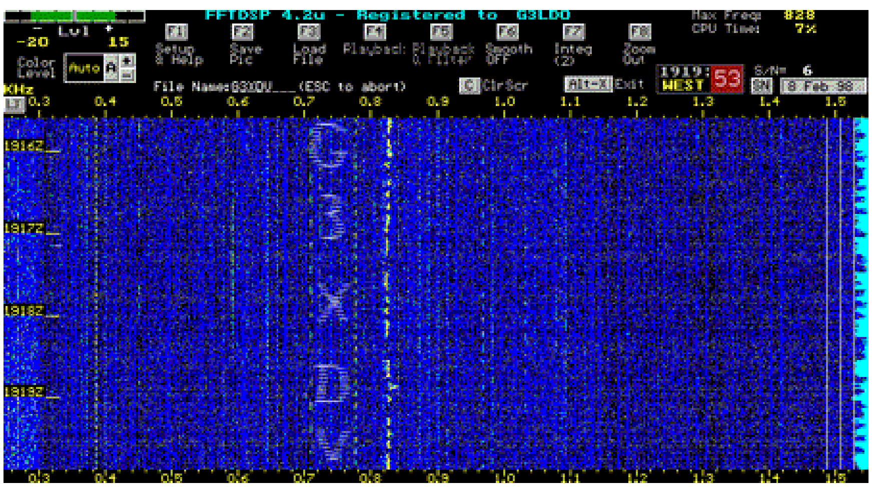
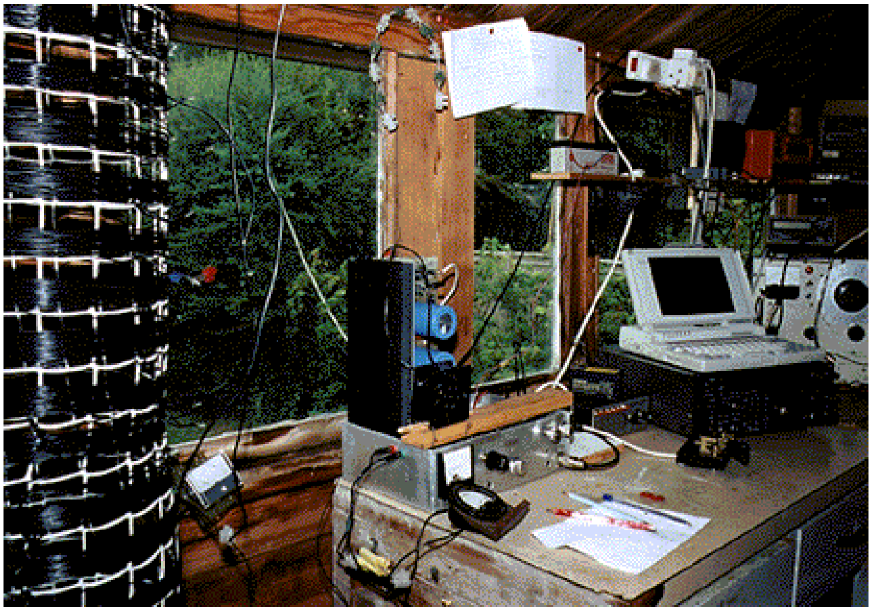


Figure 2—An FFT display using software developed by Mike Cook, AF9Y. On the horizontal scale (along the top) 0.05 = 136.5 kHz and 1.0 = 137.0 kHz. The slow CW signal from G3XDV can be seen at 136.83 kHz (the crude letters of the call sign are superimposed in photo-paint). The vertical dotted lines are spurious sidebands from the 100-kHz Loran transmitter at Lessay, in northern France. [3]

G3XDV and ON7YN recently worked each other using this method, even though ON7YN's ERP was only about 5 mW.

John Wilson, G3LNP, runs more than 1 kW to a 60-foot vertical, resulting in an ERP close to the band's 1-W limit. He's successfully transmitted SSB signals.



Equipment used for 73 kHz and 136 kHz by the author. In the foreground is the tuning/matching coil. The chassis contains a 250-W audio amplifier module (mounted vertically) driven by a modified signal generator. The chassis also contains transmit/receive switching and a tuned input filter for the receiver. The TS-850S is used for receiving and the laptop PC is used for keying the transmitter on very slow Morse transmissions.

You can contact the author at 37 The Ridings, East Preston, Littlehampton, West Sussex BN16 2TW, United Kingdom.

LOWfing in the USA

If you're a US ham, you can't chat on Europe's new 136-kHz band, but you can get your feet wet on the "160-190 kHz Experimenter's Band," which has been populated by hardcore domestic VLF enthusiasts (affectionately called LOWfers) for years.

Power output and antenna restrictions abound, which encourages ops to listen for each other's CW beacons—but contacts are possible, even over relatively long distances. At any rate, with at least the possibility of an American LF allocation you might want to start experimenting in advance.

The Longwave Club of America has long been a focal point for LOWfers. For info, write or e-mail to 45 Wildflower Rd, Levittown, PA 19057; 215-945-0543, **naswa1@aol.com**. Or, check out the club's magazine, *The Lowdown*, and numerous informational offerings at **http://members.aol.com/lwcanews/index.html**.

For information on VLF transmitters and receivers, point your Web browser to Curry Communications' excellent VLF site at **http://www.fix.net/~jparker/currycom.htm**.

The 136-kHz Bandwagon

European administrations that have authorized operation at 136 kHz seem to be adhering to the CEPT-recommended allocation of 135.7 to 137.8 kHz. We've already made international LF QSOs!

The following countries, EI, HB9, I, LA, LX, OH, ON, S5 and SM are understood to have 136-kHz allocations.

The number of stations and countries joining the LF scene is changing rapidly. Sometimes, the first hint that a country has released the band is when an operator from that country shows up on the air.

Ireland

The Republic of Ireland's first 136-kHz permit was issued (just before the band was made available in the UK) to Finbar O'Connor, EI0CF, of Malin Head. Finbar currently holds the world distance record at 136 kHz, set when he worked OH1TN in March this year over a span of 1888.1 km.

Finland

OH ops received 136-kHz access in April 1997. Power output is limited to 100 W on all modes. Reino Anttonen, OH1TN, at Tampere, put out an outstanding signal with his near-quarter-wavelength transmitting antenna. I've worked Reino over an 1870-km path.

Switzerland

Toni Bartschi, HB9ASB, has been active on LF for some time. Toni transmits from near Fribourg on 137.00 kHz. I recently worked him after several months of trying. He also had QSOs with G3YXM, G3WSC, HB9DFQ, HB9DCE and IK1ODO.

Holland

The band was only allocated to Holland in August and already there a few stations active. The most consistant signal from Holland (at the time of this writing) is PA0SE, who has worked several G stations.

Belgium

Rik Strobbe, ON7YD, is very keen and active, but because of a poor LF QTH with high ground losses, has been unable to increase his ERP much above 5 mW. In spite of this, he's had several QSOs with G stations. ON4ZK and ON6ND are also active.

Luxembourg

LX1PD transmits a test signal nearly every Sunday morning and has had QSOs with DA0LF/P and G3YXM.

France

Andy, F6CNI, and I have had many 80-meter crossband QSOs. I understand that official authorization for 136-kHz activity in France may come soon.

Germany

Two special call signs for 136-kHz tests were issued last year. Peter Bobek, DJ8WL (near Frankfurt), held special call sign DA0LF and successfully operated /P. This call was extended until June 1998, but at the time of this writing, these special call signs have been withdrawn. There is a lot of enthusiasm for LF operation in Germany but, at present, German licensing authorities have not given the green light at 136 kHz.

Italy

Marco Bruno, IK1ODO, has received my slow Morse transmissions using the program *Spectrogram*. Marco has also been received in the UK by Andy, G4JNT.—*G3LDO*