Lf Tracking Receivers

These Frequency Standards are intended solely for indoor use and will operate at both Long-Wave (L.F.) and Very Long-Wave (V.L.F) frequencies. The range will often exceed 2500 km. They are compact lightweight instruments that provide outputs, which are phase locked to a standard frequency transmission at a certain frequency. In the US, this will usually be WWVB transmission at 60 kHz. Many such transmitters are traceable to well-recognised national frequency standards via published data “post facto”. This series of standards yield a choice of price/performance trade-offs and is normally able to suit many medium to high frequency and (relative) time applications without having to resort to the expensive acquisition and maintenance of atomic standards. Within reasonable bounds the results are traceable to the appropriate (primary) reference source. In the UK the primary service is radiated from Droitwich with fill-in coverage from transmitters at Aberdeen and Westerglen on 198 kHz. In France, the France Inter transmission on 162 kHz provides excellent corrected Cesium reference

Advantages of the Lf Tracking Receiver

- ✓ Lowest Cost from £600
- ✓ ‘No’ drift corrected by NPL to <5E-12/day
- ✓ Directly traceable to NPL
- ✓ Low Offset <1E-11
- ✓ STS & Accuracy <3E-11
- ✓ No temperature Coefficient (eliminated by active loop antenna)
- ✓ Radio 4 ‘Droitwich’ referenced
- ✓ 25 years of experience
- ✓ Year 2000 design
- ✓ Strategically independent
- ✓ Excellent start up product
- ✓ Ideal for 9 digit counter calibration; Radio test workshop synchronisation; synth signal generator locking etc.

Active Antenna

This invention relates to loop antennas used for sensitive receiving purposes. Because external noise can be quite high relative to thermal noise in the low frequency bands, below for example 30 MHz, such antennas do not need to be as efficient as transmitting types and smaller dimensions can be used. Also wideband operation, over several frequency decades, is usual without tuning.

For a passive loop antenna, in a field of constant strength, the open circuit voltage across its terminals induced by the field is proportional to the frequency. A better characteristic would be an output constant with frequency. Such a characteristic is useful in measuring application or when combining the output of the loop antenna with a monopole for direction finding. This is one aim of the invention. Another aim of the invention is to maximise sensitivity by including an amplifier in the loop to produce a so-called active loop

According to the invention an active device having an input terminal, an output terminal and a common terminal and having a non-inverting gain just below unity is connected to a loop made of transmission line and connected so that positive feedback coupled transversely through the line adds to the longitudinal input signal induced in the loop to produce an amplified output.

The loop is constructed of transmission line such that the longitudinal terminal voltage, proportional to field strength, is applied to a voltage amplifier. The output of the amplifier is connected to the transmission line so as to impress a transverse voltage across it at one end. The transverse voltage arising at the other end of the line, which is terminated substantially in the characteristic impedance of the line, is added to the longitudinal voltage applied to the amplifier input. Thus a positive feedback system is developed with stable gain. Due to the time delay of the feedback system signal travelling along the line there will be a phase difference between the input longitudinal signal and the feedback signal which causes the proportionality between field strength and output voltage to become constant with frequency over a certain frequency range.

From feedback theory it can be derived that the output voltage will be equal to

$$V_{in}.A/(1-e^{-jwt})$$

where V_{in} is the induced input voltage across the loop terminals, ω is the angular frequency in radians, T is the delay time of the line and A is the amplifier voltage gain, typically between .9 and .999. Calculations show that over certain frequency range the characteristic of V_{in} proportional to frequency can be corrected to a voltage output nearly constant with frequency. This characteristic is extended down in frequency range if the amplifier voltage gain is made closer to unity but it must not equal or exceed unity. A typical value of T would be $450/f_{max}$ ns for a single turn air cored loop where f_{max} is the maximum useable operating frequency in MHz.

It so happens that this configuration also improves the sensitivity of the antenna when used with practical devices as compared with conventional configuration without feedback. The advantage tends to be inversely related to frequency

Practical antennas will generally embody additional design details, which will be well known to those skilled in the art. These would include the use of complementary PNP/NPN transistors or push-pull amplifier or amplifiers with other types or combinations of active devices.

Loops of this type where one end is grounded are said to be unbalanced. Balanced antennas of this invention may be constructed, by taking two grounded counter phased loops in closed proximity and combining the outputs in a push pull arrangement. This is a technique also known in conventional antenna design. A single unbalanced antenna may also be made nearly balanced by isolating the whole antenna from the ground and increasing the inductance of the connections to it, as is known. An output interface consisting of a length of transmission line wound on a ferrimagnetic material is one method.