Magnetic Longwire Balun : The Original

by RF Systems

The Magnetic Longwire Balun makes it possible to use a coaxial lead-in cable with all forms of longwire, windom-, or other types of wire antenna. The MLB contains a special impedance matching transformer, which converts any piece of wire between 6 and 20 metres long into a wide-band receiving antenna, without the need for an antenna tuner.

Advantages:

- A coaxial cable lead-in reduces the interference pick-up from nearby fluorescent lights, dimmers,thermostats,and computers to a minimum.
- The Magnetic Longwire Balun offers extremely broadband performance between 100 kHz - 40 MHz without the need for an antenna tuner.
- The Magnetic Longwire Balun is passive. No intermodulation products are generated.
- The Magnetic Longwire Balun offers increased signal strength, thanks to improved impedance matching between the antenna and lead-in cable.
- Signals received by the antenna are transferred to the receiver by means of a magnetic field. This reduces the level of static noise.
- The antenna is directly connected to earth, hence static build-up on the antenna (which can damage sensitive front-end circuitry) is eliminated.

Wire Antennas

Longwire and T-style antennas (which are centre fed) are some of the most tried and tested designs throughout the world. They are simple to construct, and yet providing they are high and long enough, performance is excellent over a large frequency range. They contain no electronic parts which could add extra noise or intermodulation products to the received signal. The longwire type of antenna is less sensitive to the effects of fading, caused by multi-path propagation. But there are also disadvantages. The main problem is that the ideal longwire antenna should be at least three times longer than the wavelength of the lowest frequency to be received. So a longwire antenna for the 49 metre band would have to be at least 150 metres long. In practice, in most suburban situations, such a huge antenna is impractical. But even if space is available, the next problem is the impedance. For frequencies where the length of the antenna is three wavelengths or more, the impedance of the antenna is approx. 600 ohms. That's the reason why coaxial lead-in cable cannot be used: the 50 ohms impedance of this cable short-circuits the high source impedance of the antenna, and no signals are left.

Therefore a single wire should be used as connection between the antenna and the 600 ohms antenna input (if available) on the receiver. The wire must be'carefully mounted on insulated brackets at a reasonable distance from any wail. However, this lead-in wire is extremely sensitive to electric interference generated-in the neighbourhood, such as fluorescent lighting, light dimmers, televisions and computers. Any type of end-fed or T fed wire antenna uses the ground as counterpoise. So a good ground (earth) connection is essential. If this cannot be made, and only the ground from the 110 or 230 Volts mains wiring is connected to the receiver chassis, the signal - to - noise ratio will be severely degraded, as the mains ground is polluted with interference and man-made noise. Last but not least: most wire antennas such as dipoles, G5RV's, windoms and standard longwires are effectively isolated from ground. During very dry weather and with thunderstorms in the vicinity extremely high static voltages are induced, which can damage the sensitive input circuitry of the receiver.

Putting theory into practice In practice

very few short-wave listeners use a full-length longwire antenna, mainly due to space limitations. On the other hand, single wire antennas are cheap to construct, so often a short end-fed wire with a length up to 20 metres (depending of the space available) is used. Although not really correct, these are mostly also called longwires. Reducing the size of the antenna does not mean necessarily poorer reception. The reason is, that for frequencies up to 20 MHz, the atmospheric noise (especially man-made) is high, and even very high on frequencies lower than 5 MHz. Remember that a station can be only heard out of the loudspeaker or headphones, if its signal is stronger than the noise. If the antenna size is reduced, not only is the signal strength of the station lower, but also the level of the received noise. The signal - to -noise ratio remains the same: Even if the size of the antenna is reduced to a single point - an isotropic antenna- the level of the received signals fall only by 2.15 dB, hardly noticeable on the S-meter. This means that the size of a receiving antenna for short-wave is not very important. But with a reduced size, the impedance of the antenna is no longer 600 Ohms. A short antenna behaves as though it were a small resistor in series with a small capacitor. The value of the resistor is not more than a few Ohms (depending on the size and material of the wire) and can be ignored for receiving antennas. The small capacitor forms the internal impedance of the antenna. The impedance of the antenna is therefore dependent of the frequency: very high capacitive for lower frequencies, reducing to low Ohmic values when the antenna length is 1/4 of the wavelength of the received signal. Due to the very high and changing impedance of longwires shorter than 1/4 wavelength, it is not longer possible to connect the antenna to the 50 Ohms antenna input of the receiver. The receiver short-circuits the high impedance antenna, With very bad reception resulting, especially on lower frequencies.

Up until the invention of the Magnetic Longwire Balun, the only solution to this problem was the use of an antenna tuner. An antenna tuner transforms the impedance of the antenna to the 50 ohms impedance of the receiver. Because the impedance of the antenna changes with the frequency, the tuner has to be re - aligned with every change of the listening frequency. Twiddling on three knobs makes computerised- or memory tuning impossible, and the sensitivity of the single lead-in wire for interference remains the same.

THE SOLUTION: THE MAGNETIC LONGWIRE BALUN

The Magnetic Longwire Balun is a compact, weather-proof matching unit. In contrast to cheap copies, the MLB is not just a simple 1: 9 transmission line transformer (unun). This original Magnetic Longwire Balun, invented by RF Systems, is based on an impedance matching transformer with completely separated antenna- and receiver circuits sharing a common ground. The transformer makes use of a special ferrite, developed at RF Systems. This makes It possible to transfer signals with extremely low loss from the antenna to the receiver, only by using a magnetic field. There is no direct connection between the antenna and the receiver. This magnetic transfer technology reduces the overall background noise, caused by statics. The MLB grounds the antenna wire. This ensures that any static charges from nearby thunderstorms can safely leak away to the ground. An important point is that the MLB is mounted in between the antenna wire and the coaxial lead-in cable. The outer screen of the coax is used as counterpoise for the antenna. This changes totally the behaviour of the antenna compared to ,a normal single wire lead-in. The MLB makes use of the fact that the signals on the screen of the coax and the antenna wire never have the same amplitude and phase, hence the name Balun. The RF Systems Magnetic Longwire Balun is designed to give good reception **with short** end-fed or T fed wire antennas.

The MLB is a simple device which you connect to the end of a short longwire antenna (or in the middle of a "T" antenna). The other end of the MLB has an SO-239 socket for the connection of 50 ohms coaxial lead-in cable to the receiver. The advantages are immediate. The lead-in cable is immune from local man-made interference, and doesn't have to be isolated from its supports. There is no reason why the antenna cannot be set up on one side of the house, and a coaxial cable run to the listening location on the other side of the building, or even in the basement. But there is more!

Dipoles, Trap-dipoles such as W3DZZ antennas and even the G5RV give good reception on a single, or a number of frequency bands. In between those frequency bands, the antenna impedance is not equal to the impedance of the receiver, with poorer reception as result. These "sensitivity gaps" are not longer present using a longwire with MLB. The special impedance matching transformer inside the MLB matches the high, capacitive impedance of the short longwire to the low impedance of the coaxial cable and the receiver input. The inductive impedance of the matching transformer changes inversely to the changing capacitive antenna impedance, resulting in maximum signal transfer, practically independent of the frequency. This means that a short longwire (up to 20 metres) has roughly equal sensitivity for all frequencies, without the use of an antenna tuner.

Specifications

Antenna connection:	nickelized brass terminal screw
Coaxial cable connector:	SO 239
Max. coaxial cable length:	50 metres RG 58/u
Frequency range:	100 kHz - 40 MHz +- 2 dB
Transfer loss:	less than 0.5 dB
Dimensions :	8 x 4.5 cm
Recommended antenna length :	12 metres or more
Max. power transfer:	1 Watt, antenna is for reception purposes only
Operating conditions:	waterproof, UV resistant - 30 to + 70 C operating temp.

Instructions

Constructional suggestions

The Magnetic Longwire Balun from RF Systems performs best using at least 12 to 20 metres of wire. You can use a longer length if space permits. This give a better reception on long- and medium wave, but the effects on shortwave (3 - 22 MHz) will only be marginal. The reception above 22 MHz deteriorates slightly with lengths above 20 metres. If you use a shorter length, then performance on medium and long wave drops off, but reception on frequencies above 22 MHz improves. The influence of the length of the antenna wire on frequency response is showed in the diagram.

Antenna wire and insulators The so called "skin effect" does not play a significant role at frequencies below 30 MHz. In principle, any type of wire is electrically suitable for consideration. Iron wire however will quickly rust in most climates and should be avoided. Available in lengths of 25, 42 and 100 metres at your dealer is special RF Systems antenna litze, with 30 stranded cores of pre-stretched oxygen free copper, covered with UV- and air pollution resistant poly-urethane. If the antenna has to be made invisible (to pacify objections from landlords or neighbours) then try 0.8 mm thick massive stainless steel wire used in argon welding operations. Do NOT use the special wire with a core mentionedfor gas-free welding, but the massive type. In Europe this can be bought at many DIY shops. Copper wire with a thickness of approximately 2.5 mm2 and covered with PVC (house-hold installation wire) also makes a good antenna, but note there is a tendency for the copper wire to stretch. Note also that when this type of wire moves much in the wind, it becomes hard and will break.

'REMEMBER: Birds may have difficulty seeing the antenna wire. A few pieces of aluminium foil hung on the antenna wire will prevent them accidently flying into the wire.

The longwire needs to be isolated from its supports! IF Systems heavy duty egg-insulators which can withstand '600 kGf are available at your dealer, but you can use also a piece of plastic piping used for household plumbing. Sizes with a cross-section around 32 mm are ideal. If you want to attach the longwire to a wall, chimney or a tree, use nylon cord available from DIY stores. A thickness of 4 mm is sufficiently strong to withstand heavy gales. Check the nylon wire every year, as it can loose its strength by UV radiation from sunlight.

IMPORTANT NOTE

Never make a solder connection on a wire which is under tension from its own weight. If the antenna is moving in the wind, the hard solder connection will break in a very short time. That's the reason why the MLB has an instrument clamp and not a soldertag.

Hanging the antenna wire

The height of the longwire is important. Better to make it shorter and higher above the ground than the other way round. The reason is that antennas which are a 1/4 wavelength or less above the ground will generally be most sensitive to signals coming in at a fairly high angle. These usually mean one-hop signals, distance within 2000 kms. Transmissions from a longer distance arrive at a much lower angle with respect to the earth's surface, often parallel to it. Wire antennas are more sensitive to such signals when they are higher than 1/4 wavelength above the ground, preferably 1 /2 wavelength or more.

For the 60 metre tropical broadcast band (5 MHz) that means that at least a height of more than 15 metres is desirable, or preferably 10 mtrs if your interests mainly lie in the 20 metre ham band (14 MHz). It is strongly advisable to hang the longwire at an angle of approx. 30 degrees if possible. This gives the antenna a better omnidirectional reception pattern, reduces man-made noise and makes the antenna sensitive for horizontally- as well as vertically polarised signals. Best results are obtained when the MLB is connected to the highest point of the antenna. If the way of mounting as shown in the drawing is not possible, feel free to experiment with other ways of mounting, but remember: as high as possible, and ALWAYS outside the interference field which surrounds any house (approx. 5 metres of the walls and 1 metre above the roof)

Waterproofing the connectors

A PL 259 connector has to be mounted on the coaxial cable between the MLB and the receiver. A PL 259/ SO 239 connection is not waterproof. The easiest way to waterproof the connection is with the RS - 1 protection sleeve from RF Systems. This sleeve i$ pushed over the cable, before the PL 259 plug is mounted. After the plug is mounted and screwed onto the SO 239 connector on the MLB, the whole connection is covered with Vaseline or the special seawater proof MR 7 grease from RF Systems. The sleeve is than pushed upwards over the connection until the bottom of the MLB is reached. The sleeve can be easily removed if necessary. The other way is to wrap self-amalgamating rubber tape over the whole connection and a part of the coaxial cable. Waterproofing is essential! Otherwise the coaxial cable will absorb moisture into the screening braid, with very high loss and bad contact as a result.

Earthing

The coaxial lead-in cable of the longwire Balun, whose outer braid via the plug at the antenna input is connected to the receiver's chassis, must be connected to earth. In practice often the mains earth is used. But this is polluted with interference. You will often get noticeably better results if a separate connection from the receiver to earth is made. This is also much safer as static charges can now flow directly to earth, instead of via the mains wiring in the house. In older houses, the water pipes provided an excellent ground, but with the introduction of PVC piping this is often no longer the case. If your house doesn't have a lightning protection on which an earth connection can be made, you will have to make an earth yourself.

A copper earthing spike is the ideal solution, but you can also use a galvanised steel pipe of at least 1.5 metres length. Bang the pipe into the ground and connect earthing wire (from DIY or electrical stores) with a diameter of at least 4 mm to it. Connect the other end to the EARTH terminal on your communications receiver. This ensures that any static charges that build up on the antenna have an easy path to earth. If you don't do this the receiver's metal cabinet, the antenna lead-in cable, and the mains cable all provide a kind of "artificial-earth", but all electrical equipment in the house will cause interference and the signal to noise ratio will be poorer. If there is absolutely no possibility to make your own earth connection, than use a separate single wire between the earth terminal of the receiver directly to the earth terminal next to the electricity meter.

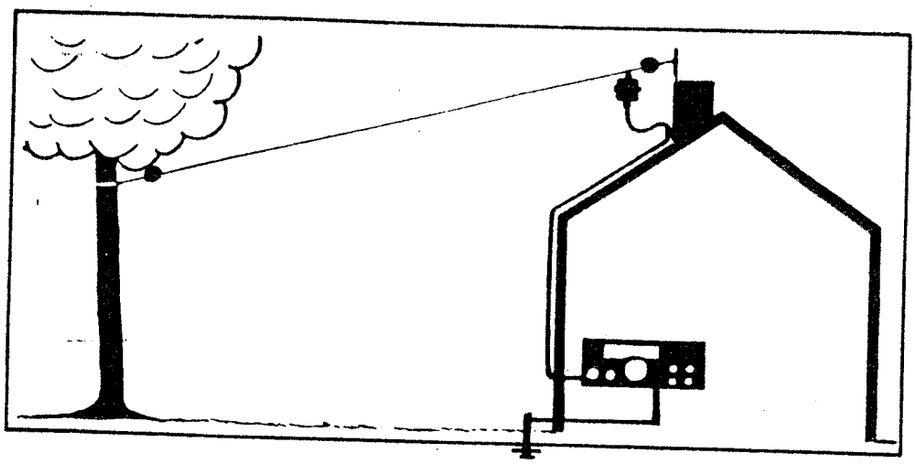
Lightning

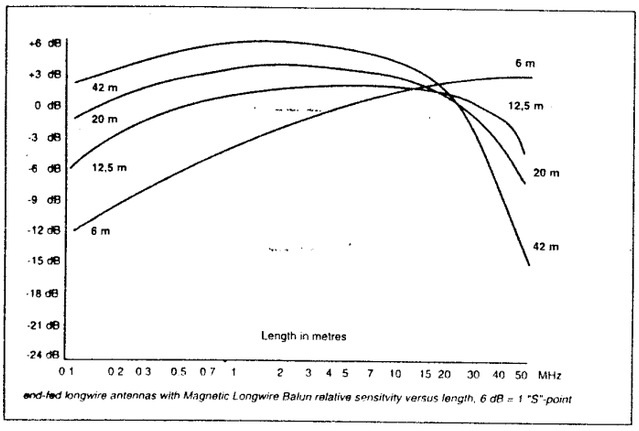
Providing a proper earth is installed, the Magnetic Longwire Balun® will allow static charge to escape to earth without damaging the receiver. However, it cannot offer protection against a direct hit from a lightning strike. If a thunderstorm is in the immediate vicinity, disconnect the antenna from the receiver. Ideally you should hang thecoaxial cable with connector OUTSIDE the house, to avoid offering a conducting path into the house. Use a plastic bag to protect the connector from the rain. Don't underestimate the power of mother nature!

Receiver overload

Remember that a longwire with MLB delivers every signal in the 100 kHz to 30 MHz frequency range to the receiver. Thanks to the high efficiency of the MLB, some signals can be very strong, especially in Europe. Signalstrengths of 10 to 50 Millivolts (up to S9 + 60 dB) in the mediumwave, and the 49 and 49 mtrs bands are no exception. Practically no receiver can handle these signalstrengths without producing intermodulation- and/or overloading effects. These effects can be heard as a heavy noisefloor and/or distorted signals. The easiest way to check if your receiver is overloaded, is listening in the AM mode in the frequency ranges 1.9 to 2.8 and 14.1 to 14.7 MHz. If broadcast stations (sometimes very distorted) can be heard in these frequency ranges, the receiver gets to much signal. The remedy is to use an attenuator wich reduces the signalstrength. Most receivers are equipped with an input attenuator of -10 or -20 dB. (DX - Local switch on some portables). Thanks to the nonlinear behaviour of overloading and intermodulation products attenuation can be of great help to obtain normal reception. If you for instance use 10 dB attenuation, the signal of the wanted station drops approx 1,5 S points, but intermodulation products drop 30 dB (30 times, 5 S points). How strange it may seem, in case of overloading and interrnodulation some attenuation improves reception! If your receiver does not have a proper input attenuator: RIF Systems produces the SP - 2 antennasplitter. The SP - 2 is equipped with a step attennuator from 0, via - 6 dB, -10 dB , - 20 dB and - 30 dB to - 40 dB. This makes fine adjustment of the signallevel to your receiver possible. The SP - 2 is also equipped with a switchable mediumwave suppression filter. This makes it possible to listen with full sensitivity on long- and shortwave, without overloading of the receiver by strong (local) mediumwave transmitters. Besides that, the SP - 2 is a sputter. With the SP - 2 you can connect two receivers to one antenna. Each receiver can be tuned and operated if it is connected to its own antenna. Ask your dealer for the SP - 2 leaflet.

RIF Systems wishes you hours of interference-free listening pleasure!





end-fed longwire antennas with Magnetic Longwire Balun relative sensitvity versus length, 6 dB = 1 "S"-point