A Review of the
Grundig G8 and Tecsun PL-300WT

The Grundig G8 and Tecsun PL-300WT are among the latest Ultralight Radio (ULR) offerings to become available. Both are manufactured by Tecsun in China, and functionally they are the exact same receiver, with the only difference being Grundig's popular black rubberized finish on the G8, while the PL-300WT comes in black and silver with a smooth plastic finish. Grundig promotional literature is surprisingly inaccurate, making it appear that the G8 and PL-300WT are quite different in size and features; however, these are in fact the same radio, and I will generally refer only to the G8 in this article.

The G8 is now widely available in North America and elsewhere through eBay, Amazon, Universal Radio, C Crane, Radio Shack, and many other outlets. The list price for both is $50, and may include free shipping. As discussed below, the quality control (QC) on the Grundig G8 is noticeably better based on units received to date, it comes with a warranty, and can be returned to a domestic distributor, making the G8 the presumed choice for many DXers. However, the performance of both radios is identical. The owner's manual supplied with both sets is quite brief and only marginally useful. The exception is the manual supplied by some distributors of the PL-300WT, which has been scanned and posted to the Yahoo UltralightDX group. Current and prospective owners of either model should download this version of the manual.

Features of the G8

The G8 covers the following frequency ranges:

LW:	153 to 513 KHz
MW:	520 to 1710 KHz
SW:	3.15 to 21.95 MHz
FM:	64/76/87 to 108 MHz

The shortwave spectrum is broken into several bands for tuning ease, and it remembers where you were in each band; however, the entire range in available using the tuning thumbwheel. There are 200 memories for shortwave, and 100 each for FM, AM and LW. There are no jacks for connecting external antennas (more on that below), and the internal antennas include a 22" whip antenna for FM and SW and a 3.5 inch ferrite for AM and LW. There is no SSB capability or RF gain control.

The radio measures 135 x 86 x 26 mm. (about 5.3 x 3.4 x 1 inches), which just barely fits into my shirt pocket, and so likely represents the largest that a radio could be and still be an Ultralight. It weighs 204 grams (about 7 ounces), which is typical for an ULR. It comes with a nice zippered travel case.

Powering the G8 requires three AA batteries or a 6-volt AC adapter (not supplied with the radio). There is no facility for recharging batteries. Battery consumption appears to be very good, in that a batch of alkaline batteries lasts at least as long the G8 as in most other ULR models; no doubt having three batteries plays a factor here. There is a non-removable capacitor inside, which looks a lot like a large watch battery, to provide back-up power for the clock and memory functions.

The LCD screen displays frequency, band, time, alarm, signal strength and other pertinent information, and I find it quite easy to read. There is even a thermometer which can be selected. A central feature of the design is the large rotary time zone selector, which is convenient for travelers and international DXers who want to know what time it is in a given location. The alarm is fairly loud, and I used it recently while traveling and liked how it worked. There is also a sleep function which turns the radio off after anywhere between 1 and 120 minutes (it can also be set to just stay on).

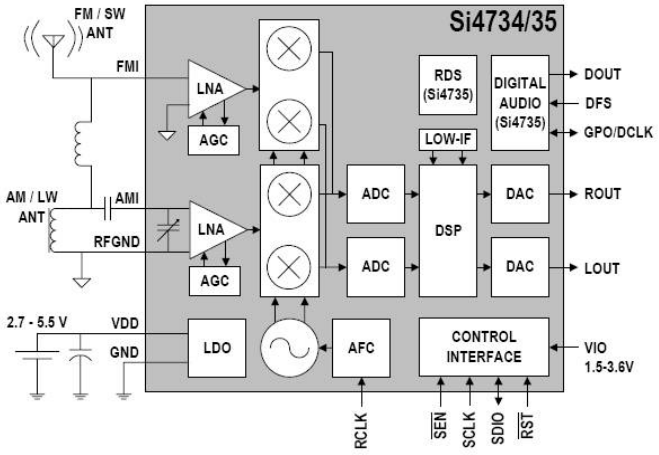
Each push of a button will turn the backlight on and produce a very loud beep. The beep can be disabled (and most choose to do so). The backlight can also be turned on indefinitely, although by default it goes dark about five seconds after the most recent button push in order to prolong battery life. In general, tuning and set-up commands are entered using the various buttons by either a short or prolonged push of a given button, and I found this scheme quite straightforward to use.

The single speaker has fairly robust audio, but don't expect to fill an entire room with sound. The volume control is a rotary knob with 30 détente stops. Audio is very good using headphones, although the supplied ear "buds" are marginal at best. There is a fair amount of hiss when using headphones at low volume levels.

A quick and simple fix for this is to get a headphone volume control (Radio Shack 210-2975 or similar, at right) to provide attenuation. This will allow you to turn up the volume on the radio while still maintaining low volume in your headphones. This volume control is also handy for connecting the G8 to the MIC-level input of a digital recorder.

DSP - Revolutionizing Ultralight Radios

The heart of the G8 is the Silicon Laboratories (SILABS) Si4734 chip which uses advanced digital signal processing (DSP) technology for all receiver functions. While Sony currently manufactures ULR receivers such as the SRF-59 using the CXA1129N chip as the actual receiver part of the radio, the SILABS family of DSP radio chips is truly a breakthrough in performance and low power consumption. The first manufacturers to use the SILABS chips in consumer-grade radios are Tecsun and Kchibo, and I look forward to more manufacturers using this technology.



As can be seen in the functional block diagram at left, a manufacturer only needs to provide a power supply, an antenna input, a display and a final audio section for sound, while the DSP chip takes care of all other receiver-related functions.

A demonstration board is available from Mouser Electronics (part number 634-SI4731-DEMO), which allows you to vary any of the parameters (bandwidth, etc.).

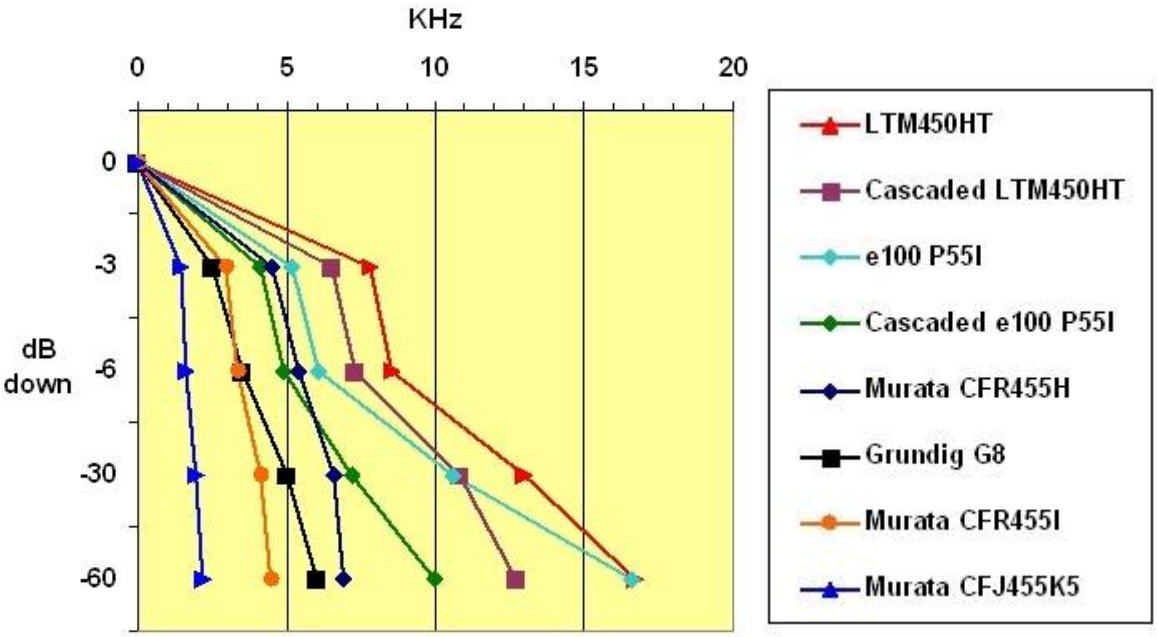
AM Performance

The G8 represents a major step forward in ULR performance. It is very sensitive, and once properly aligned, the sensitivity is as good as any ULR, equaling that of the Eton e100 and Sangean DT-400W, the reigning sensitivity champions. Since the G8 has a single optimum antenna coil on the ferrite, sensitivity is consistent throughout the band.

Of particular interest to DXers is the fact that the G8's selectivity is the best ever measured in a stock ULR, thanks to DSP technology. The low IF architecture, as with the Sony CXA-1129 chip, allows for on-chip IF filtering that would not be remotely possible using a typical 455 KHz IF frequency. The Si4734 chip has five AM bandwidths available (1, 2, 3, 4 and 6 KHz per sideband), and comparisons with the demonstration board show that Tecsun chose the 3 KHz setting for the G8.

Based on some brief testing, which involved simply tuning in 1 KHz increments away from strong local stations in my area and noting the displayed signal strength levels, I was able to confirm that the G8's sensitivity is in fact down approximately 6 decibels at the 3 KHz point. The full results are plotted below and compared with other filtering schemes. I was able to tune up to 5 KHz away on the G8 before the signal levels were obviously suspect, so the latter portion of the G8's selectivity graph is an estimate.

AM Selectivity Comparison



The graph above shows that the G8's selectivity is quite similar to that produced by the Murata CFR-455I ceramic filter, with the Murata having a better shape factor and skirt selectivity. The chart also makes clear that the G8 is *significantly* more selective than the previous ULR selectivity champion, the Eton e100, even with two of the Eton e100's stock P-55I filters cascaded together. Also included for comparison are the LTM-455HT (a good mass-market filter), both individually and cascaded, and two other high-quality Murata ceramic filters.

As a result, for domestic DXing with 9 or 10 KHz frequency separation, the G8 is clearly the best Ultralight available. However, as seen in the chart above and proven by DXers in the field, the Murata CFJ455K5 filter, when transplanted into an Eton e100 or C Crane SWP (left), is still the champion by a comfortable margin in terms of separating trans-oceanic stations spaced only a few KHz from domestic stations.

The new Kchibo D92L and K96L receivers are able to select all five of the DSP filter bandwidths available on the Si4734 chip, and therefore may be more competitive with Murata-equipped receivers.

For tuning, the innovative FAST/SLOW thumbwheel is very user-friendly, and I rarely regret not having a keypad for direct frequency entry. In SLOW, tuning goes in 1 or 9/10 KHz steps, depending on how fast you spin the tuning thumbwheel. In FAST mode, the G8 tunes in 9/10 and 100 KHz steps. I recommend that new users start in SLOW mode until they become accustomed to the way the radio automatically adjusts the tuning rate in dependence upon the speed with which the tuning thumbwheel is turned.

By using the SLOW tuning setting, you can detune 2-3 KHz in either direction to avoid interference and brighten the audio. If you use a passive loop to augment the signal, you can tune 4 KHz away and still allow enough of the carrier frequency in to produce a listenable signal. I have noticed that tuning in 1 KHz increments near/through strong locals may produce an audible "whoop" sound which promptly goes away and doesn't affect reception, indicating that the sound is likely produced by the automatic gain control (AGC) circuit. Detuning even 1 KHz significantly lowers volume, and the SNR reading will drop to zero even though signal strength is still ample signal. As a side note, the signal strength and SNR indicators appear to be relative values, and are not reliable for field strength measurements. Also, the sampling rate of the signal level is quite slow (updates every two seconds or so), so using it as a measure during passive loop usage, phasing or alignments can be difficult.

One issue that many users have noticed is that volume changes can be excessive when a weak station fades up. The Si4734 chip has a soft-muting feature which decreases audio level when signal strengths are low, and restores the volume once a threshold signal strength level is reached (the default level is 25 dB). Based on the abrupt volume change, this apparently indicates that the soft muting algorithm could be better. Some have speculated that the AGC circuit is to blame, although the AGC would actually decrease volume when a station fades up, and therefore is probably not the culprit here. In any event, a passive loop which keeps the signal level up will likely cure this issue.

One design flaw that many DXers have noticed is the present of several heterodynes/birdies towards the top of the MW band. The cause of these is not yet clear. They appear to act like heterodynes, in that tuning approximately 2 KHz above the base frequency (i.e., tuning to 1612 from 1610) will reduce the tone to nearly a zero-beat. The IF for the AM section is based on a 32.768KHz oscillator, which may be the source. Investigations into the G6 model reveal poor shielding of the display circuits that run on a different internal frequency, which may also be part of the cause. In any event, the use of a passive external antenna usually removes the heterodyne/birdie, indicating that sufficient RF signal is able to drown the tone out. I have also noticed tones on low-band frequencies (540-700 KHz) that do NOT behave like heterodynes, in that detuning does not change their pitch; however, they are also removed through the use of an external passive antenna. More research is needed here to determine the actual cause(s).

Another interesting anomaly is that the volume level increases when either of the two buttons below the power button are depressed, which indicates that the AGC circuit is temporarily disabled or bypassed. Supporting this conclusion is the fact that the heterodynes/birdies mentioned just above will often disappear, indicating that the radio is temporarily receiving a much stronger signal. Once the buttons are released, the volume returns back to normal, therefore this is not a significant issue for DXers.

Like the Eton e100, the G8 does not seem to respond well to some passive loops such as the Quantum Stick and other smaller units, so you may want to have at least a Terk Loop, or perhaps a Crate Loop (right) or similar for good results. The C Crane Twin Coil and its small ferrite coupler also works well with the G8.

With the stock internal ferrite antenna, nulls are fairly good, although not on a par with the Kaito WRX-911, the best ULR in this performance category. The G8, unlike the Eton e100, is very immune to overloads, even with large outboard ferrite antennas, making it an excellent candidate for retrofitting a large ferrite antenna (see modifications, below), which results in much better nulls.

The lone alignment issue associated with the G8 is the ferrite antenna. In this regard, the quality control record of the G8 has been noticeably better than that of the PL-300WT based on the many DXers who have reported their findings on as-received units, although my PL-300WT appears to be nearly optimally aligned. An outstanding feature of the DSP chip is that there is a single antenna coil inductance that is the "sweet spot" for the entire MW band, therefore an alignment will often improve performance considerably (discussed below).

Shortwave Performance

Shortwave sensitivity is quite high, perhaps to a fault, since strong local MW stations will produce manifold images on the SW bands and usually cause significant desensitization. Touching and/or retracting the whip antenna sometimes cures this problem, but at the cost of signal strength. There have been different accounts as to how bad this phenomenon is, so there may be differences associated with listener location, individual product quality control, and perhaps other factors. In Europe, where there are not many MW stations left, this issue was not observed, and SW reception was excellent. When used with an external antenna and pre-selector such as the Palstar AA-30, MFJ-1020C, Ameco TPA or similar, AND with both of the antenna leads connected to the G8 (one to the whip and one to a ground off of the battery spring), shortwave performance is quite good.

Selectivity is well chosen for separating stations spaced 5 KHz apart. With the good filter shape and apparently slow AGC on the G8, detuning by 2 or 3 KHz often results in the elimination of selective fading, since one of the sidebands is largely removed; this alternative to synchronous detection, championed by Dr. Phil B., is an under-utilized tool that a DXer can take advantage of.

Longwave Performance

The stock G8 is not a good longwave radio, since the ferrite antenna is optimized for MW frequencies. This results in abysmal sensitivity, as evidenced while DXing in Europe where longwave broadcast stations with hundreds of thousands of watts were received with only adequate signal level. Modification of the ferrite (discussed below) can enable the G8 to be a capable longwave receiver. However, without SSB capability, the G8 is not suitable for serious non-directional beacon (NDB) DXing.

FM Performance

The G8 is a true FM DX machine. It has incredible sensitivity just with the 22-inch whip antenna, the best of any portable receiver regardless of size or price. Additionally, the DSP selectivity, with just the single bandwidth available, is likewise the best of any portable known to man. For example, when DXing in Europe where stations are spaced only 0.2 MHz apart in many cases, I was able to easily separate strong local stations from weaker distant stations at all points on the dial.

The whip antenna swivels in all three axes, which is great for pin-pointing a null. The whip may become loose through prolonged use, but the Phillips-head set screw is easily re-tightened. As noted above, the whip antenna on the G8 is 22 inches long, well short of the quarter-wavelength (approximately 30 inches) associated with the middle of the FM band. Attaching an extra 8 inches of wire with an alligator clip, effectively bringing it to 30 inches in length, results in a noticeable improvement in signal strength and SNR for many stations, at least in my townhouse location. Therefore, transplanting a full 30-inch whip antenna onto the G8 may be a good modification for those who are so inclined. Since the quarter-wavelength corresponding the 88-108 MHz FM band is 27.3 to 33.5 inches, one might consider installing a 33.5-inch whip which could be partially retracted for DXing the upper part of the band.

Another way to increase gain is to turn the G8 into a half-wave dipole, aka "rabbit ears". To do this, which in my experience adds a further 2-3 dB of gain, simply connect 30 inches or so of wire (whatever the length of your whip antenna is) to the battery ground and extending the wire in the opposite direction of the whip, making it into a half-wave dipole. Holding the antennas horizontal will results in higher gain and produce a figure-8 reception pattern, while holding them vertical will result in an omni-directional reception pattern with more modest gain.

It is quite easy to connect to an external FM antenna to the G8 by running a ground wire from the battery spring as one point of connection, with the other connection made with an alligator clip to the base of the whip antenna. I have used a simple dipole and a Moxon antenna in this way, both with good results. It doesn't seem to matter if the whip antenna is retracted or extended, so the external antenna apparently overwhelms the whip. For some reason, disconnecting the ground lead when using a Moxon antenna provides exceptional directivity. Be aware that some stations will come in better off of the whip than with an external antenna.

Further research may determine the optimum connection of a 75 ohm FM antenna, including any impedance matching requirements. The SILABS data sheet quotes a sensitivity figure based on a 50 ohm antenna, indicating that this may be the design impedance for the chip. I have found that retracting the whip allows it to be held against a Moxon antenna's rear reflector for passive coupling.

Tuning on the FM also uses the variable speed tuning that the MW band uses. The SLOW setting tunes in 0.01 or 0.10 MHz steps, depending on how fast you rotate the tuning knob, and the FAST setting goes in 0.10 and 1.0 MHz increments. I note that FM fine tuning on the new Kchibo models such as the D92L (left) is only in .05 MHz increments.

As with MW, I found that this tuning scheme is a great substitute for a direct-entry keypad. One other tuning tip: the memory scan works very well, putting any station that is above a certain threshold automatically into memory, although it will also put IBOC digital sideband frequencies into memory as well in urban areas; in that case, one has to go through and manually delete the digital sideband "false hits".

With either the whip or external antenna, the G8's FM tuner specifications make it very competitive with high-end stand-alone FM tuners. Adjacent-channel selectivity (for stations 0.2 MHz away) is 50 decibels, which is excellent for stock FM tuners and is roughly what an FM DXer can hope for with several cascaded ceramic filters. Adjacent-channel selectivity for typical home tuners and receivers is often not even quoted, and when it is the figure is usually only 10-20 decibels.

The G8's alternate-channel selectivity (for stations 0.4 MHz away) is 70 decibels, which is quite good compared to many home stereos and tuners, although FM DXers may want to see 80-90 dB or more here. However, in my experience the G8 easily keeps stations 0.4 MHz apart completely separated in the urban RF jungle in which I live.

For sensitivity, the SILABS data sheet quotes an FM sensitivity of 1.1 uV (12.2 dbF) for 26 dB signal to noise ratio (SNR) monophonic quieting when a 50-ohm antenna is connected directly the receiver. As a point of comparison, a highly-regarding FM DX tuner, the Onkyo T-9090 II, has a 26 dB quieting sensitivity of 0.8 uV, so the G8 is very competitive. Rarely are tuners quoted as having less than 1.5 uV sensitivity. Per the SILABS data sheet, sensitivity is reduced in the 64-76 MHz range, which may be of concern to DXers in those parts of the world where that frequency range is used.

As for other typical performance measures, AM suppression (the tuner's ability to reject any unintended amplitude modulation that may be present in the FM signal and interfere with proper reception of the signal, which comprises much of the interference and noise in broadcast signals) is quoted as 50 dB; this is typical of a good FM tuner. IF rejection is not quoted, but given the low-IF architecture of the SILABS chip, this is not an issue anyway. The capture ratio is not quoted either.

As with MW, the G8 appears to be very immune to overloads. THD is 0.1%, which is quite good. The overall signal-to noise ratio (SNR) is 58-63 dB, which is below that found on typical home stereos, although quite acceptable for DXing and casual listening.

While the G8 looks like a good FM DX machine on paper, how does it perform in head-to-head competition with a stand-alone tuner? As a point of comparison, I have what is generally acknowledged to be the best FM DX tuner available, the Sony XDR-F1HD (right). Both receivers were connected via a splitter to a Moxon antenna cut for 98 MHz, and tests were conducted here in the fairly congested Seattle area.

Comparing sensitivity on weak signals with no adjacent interference, there were several instances where the Sony had discernible audio while the G8 had next to nothing at all. On marginal signals, again the Sony was the winner, although in some cases the G8 was able to produce the same result.

The sensitivity advantage continued with stronger signals, where the Sony was more readily able to get nearly noise-free stereo audio while the G8 was often still beset with some noise. Interestingly, the G8 sometimes performed much better with one or the other of the antenna leads disconnected, or even just using the whip antenna, so there are obviously more mysteries to solve regarding how to connect an FM antenna to the G8.

As for selectivity, detuning 0.1 MHz on both sets showed that the Sony's adjacent channel selectivity figure (80dB) is clearly better than that of the G8 (50 dB). However, in all my tests, the extra 30 dB of selectivity was never an issue, in that the G8 was always able to separate stations spaced 0.2 MHz apart. For those in Europe and other locations where you actually have stations 0.1 MHz apart, the Sony may really shine, but here near Seattle, there was not a noticeable difference.

I found instances where the Sony was able to discriminate between two stations on the same frequency depending on the nulling position of the Moxon antenna, while the G8 continued to have the same station, indicating that the capture ratio on the Sony is noticeably better. While the G8 was able to discriminate between stations on other selected frequencies, the Sony appears to be the winner here.

In summary, as a DX receiver the G8 doesn't quite compare with the Sony XDR-F1HD, but I thought it did very well nonetheless. It would be interesting to see how the G8 compares to a non-DSP tuner such as the Onkyo T-9090 II mentioned above, since on paper their sensitivity and selectivity are quire similar. Additionally, if the means for connecting external antennas is refined, the G8 will likely be even more competitive.

For program listening, the SILABS data sheet quotes the frequency range as 30-15,000 hertz ± 3 dB, which is fairly decent, though certainly not up to audiophile standards. When comparing the audio from both the G8 and Sony, the G8's audio is decidedly more pronounced in the treble range and a bit less substantial in the bass range. I personally prefer more treble, so it sounded quite good to me. However, those in search of more accuracy will prefer the Sony.

Naturally, FM stations outside of my immediate area sounded better on the more-sensitive Sony because of the reduced noise and the fact that the Sony is able to produce stereo audio at lower signal strengths. As discussed in this review, the Sony's stereo sensitivity is identical to its mono sensitivity, a truly incredible achievement.

Stereo is available on the G8 only through the headphone jack; the “Stereo” indicator does not come on when playing through the speaker. Stereo separation is quoted as 25 decibels, which is rather pedestrian. Adaptive noise suppression incrementally transitions from stereo to mono on weak signals to reduce noise, which I have found to be a great feature.

Alignment and Modification

The only alignment required to optimize receive performance is to tune the ferrite antenna's inductance. The SILABS data sheet indicates that the inductance can be anywhere between 180 and 450 uH for acceptable performance; however, diligent DXers will want to align the set for maximum sensitivity. The required inductance as measured on various as-received models has ranged between approximately 200 and 300 uH, so each unit will have to be individually aligned. A full alignment guide is available on DXer.ca and the Yahoo UltralightDX group. The G8 has much less wax and glue on the ferrite coil than does the PL-300WT, so those looking to align the latter will generally have more difficulty in getting the coil to move.

To increase sensitivity, the single coil design makes ferrite replacement easy. External "Slider-type" ferrites work well on the G8, since it is quite immune to overloading, and the single "sweet spot" means that the external ferrite antenna need not be a "Slider", but merely a fixed-inductance coil. The SILABS data sheet indicates that a low-inductance air core antenna can also be used with a suitable transformer/balun, although serious DXers would likely wind an air core with the full 200-300 uH inductance necessary for optimum performance.

A comparison of the G8, Eton e100 (left) and C Crane SWP with identical eight-inch external ferrite antennas shows that the G8 had the greatest sensitivity of the three by a small margin. As noted above, the Eton and C Crane models, when fitted with narrow Murata filters, are still superior when receiving split-frequency trans-oceanic signals. Further information is available regarding the modification of the G8 and other radios in this way.

An external longwave antenna can also be fitted. The SILABS data sheet states that the inductance should be 2,800 uH; this appears to be a typographical error, in that one DXer has reported that the proper value is actually 1,800 uH.

Finally, because of its superb resistance to overloading, even in urban areas, the G8 is a perfect candidate for modification to add an external antenna port. Such a port allows it to be connected to a Beverage, K9AY or other serious external antenna. A guide to this simple modification is one of many covered in articles found in the libraries at DXer.ca and the Yahoo UltralightDX group.

Good DX to you!

Kevin S., Bainbridge Island, WA
satya(at)sounddsl.com
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