Airspy HF+ Discovery

US$169 £199 €219

OVERVIEW

We assessed the Airspy HF+ in last years' *WRTH* and were very impressed by it. The reason for a further review this year was occasioned by the introduction of the HF+ 'Discovery' which on paper represents a further advance on what was a very good low-cost-SDR.

Based on the original design, the Discovery introduces extra pre-selectors for the supported bands and what the company refers to as a 'New DSP Core' to "…optimize the gain distribution and the filtering parameters in real-time and dig deeper in the noise". The signal path is said to include "…very high dynamic range data converters along with high performance passive mixers with an excellent Polyphase Harmonic Rejection structure. The included band-tracking pre-selectors eliminate unwanted interference and preserve the dynamic range of the receiver". The block diagram shows switchable high-pass filters (at 0, 5, 10 and 17MHz) immediately downstream of the antenna followed by switched low-pass (5 or 31MHz) and bandpass (60-118 and 118-260MHz) filtering. These are followed by what the block diagram describes as "stepped AGC", and then come 'tuners' for HF, Band II and Band III and an IF amplifier and filter stage. The ADC is a sigma-delta type followed by an 18-bit DDC. In principle this appears to be a generally similar arrangement to that in the original Airspy HF+.

FEATURES

The new receiver covers 0.5kHz-31MHz and 60-260MHz with a maximum bandwidth of 768kHz. In fact 48, 96, 192, 384 & 768kHz are all available with the caveat that 660kHz is the maximum alias-free bandwidth. Following our review of the HF+ we were mildly taken to task by a few readers who considered that a maximum bandwidth of 768kHz was far too small and limiting for a modern SDR. But to assert this is to miss the point of the Airspy design approach. One of the main intentions of the designer was the achievement of very good strong-signal handling in conjunction with a sensitivity figure appropriate to the coverage. As we said last year, the issue resolves to one of *dynamic range* – essentially the 'window' between the weakest signal the receiver can resolve and the strongest it can handle without some form of overload setting in. A wideband receiver can make use of high sensitivity at the higher frequencies because these are not noise-limited in the same way that frequencies in the AM broadcast spectrum tend to be. What matters at lower frequencies is the ability to handle strong signals without overloading. High values of sensitivity will not generally be necessary (or indeed usable) below about 30MHz and may compromise strong-signal performance.

The original HF+ was a metal box but unusually the 'Discovery' is realised as a plastic box measuring 60 x 42 x 12mm. A receiver of this size is truly a pocketable item and ideal for portable use. There is a single SMA input for the antenna connection and a standard USB socket, the latter of course being used for the controlling software. Being familiar with 'SDR#' we used this on our elderly office PC running a fully patched version of Windows 10. Apart from the limitations introduced by the computer we had no difficulty with this arrangement during the review period. Most listening tests were conducted with the resident Wellbrook loop with various other wire antennas used as required. The main receivers used for comparison testing were a Racal RA3791 and our resident Excalibur Pro, which not so many

years ago defined the state of the art in SDRs.

PERFORMANCE

As with the original HF+, Airspy makes some impressive specification claims for the Discovery. These include typical MDS of -141.0dBm (i.e. 0.02 µV/50 ohms) in a 500Hz bandwidth at HF. This order of performance is remarkably difficult to measure accurately and we would confine ourselves to saying that it is almost certainly correct within a dB or so either way. Although such a figure represents a very commendable technical achievement it is perhaps worth raising the issue of when and whether such sensitivity would ever be usable below about 30MHz. At these frequencies external noise will always be the limiting factor on what can be received, and in an ideal world one might prefer the dynamic-range window to be shifted upwards by perhaps 10dB (i.e. the MDS to be 10dB worse and the limiting parameter for strong-signal handling performance to be 10dB better). However, the strong-signal performance of the Discovery is excellent as matters stand and it is always comforting to know that the weakest of signals will not go unheard. And of course SDR# has manual gain control available.

A figure of -141.5dBm MDS in a 500Hz bandwidth at 60-108MHz is also specified. This may be the case but its relevance is marginal since the number of occasions on which you would want to receive a signal in that frequency range with such a narrow bandwidth must be exceedingly limited. That said, it is again correct to within a dB or so and certainly implies a very sensitive VHF front end. Very similar strictures apply to the "VHF aviation band" (stated as 118-260MHz although the aviation allocation proper only extends to 137MHz) but the claimed -141dBm is once again substantially accurate.

The claimed IPI_3 at maximum gain on HF is given as +15dBm, which on paper compares rather unfavourably with the +26dBm of the HF+. We tend to think that the classical IPI_3 measurement is not particularly useful when assessing an SDR but in actual practice the Discovery clearly has very good odd-order intermodulation performance at HF. Equally, a figure of +13dBm at maximum gain is quoted for the VHF bands which taken together with the MDS figures quoted above suggests a very high dynamic range. This could be very useful for specialist applications.

In our review of the HF+ last year we remarked on the claimed blocking dynamic range (BDR) of 110dB at high frequencies, which is repeated in the manufacturer's specification for the Discovery. Although this is an important measurement in a conventional receiver, Airspy is unique as far as we are aware in stating this parameter in an SDR. The BDR is usually defined as the difference in dB between the level of an incoming signal which will cause 1dB of gain compression to the wanted signal and the level of the receiver noise floor. It is sometimes referred to as the 1dB compression point. A conventional high-grade HF receiver would be expected to exhibit a BDR of somewhere in the region of 110-120dB. Our RA3791, for example, has a BDR of about 118dB at 10MHz and is slightly better than that at higher frequencies. Rather oddly the claimed figure of 110dB for the Discovery appears to be very conservative. Although it is a difficult parameter to measure accurately and requires high-grade test equipment, we estimate that the true figure is around 116dB at 10MHz. This represents strikingly good performance for a low-cost SDR and in fact the Discovery is fractionally better in this respect than our resident Excalibur Pro. In practical terms this implies that the receiver can be expected to give a very good account of itself when used with relatively large antennas and also when operating in frequency bands where very strong signals are adjacent.

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BEST VALUE SDR

Extensive comparative listening tests suggested that both expectations were correct, and comparisons with the Excalibur were particularly revealing insofar as the Discovery and the Excalibur were barely distinguishable in sheer performance terms. Much listening took place in most of the MW and SW bands during both day and night using the Wellbrook loop and several random wires, and we were ultimately forced to the conclusion that the differences were more to do with the controlling software than anything else. SDR Sharp is not as user-friendly in our experience as the WinRadio equivalent and it took a little effort to obtain equivalent results, but for most of the time that is precisely what they were. And like the HF+ it was noted on several occasions that the Discovery sounds remarkably 'quiet' and unfatiguing in use, unlike many SDRs in its overall price class. Some brief tests on the other bands showed that the receiver worked very well and in particular that its frequency setting and stability were both excellent.

CONCLUSION

Overall, we find it remarkable and very commendable that a small and relatively unassuming plastic box should turn out to be a radio receiver with a spectacular combination of performance and versatility. And at its very affordable price point, the ratio of price to performance of the Discovery could fairly be described as stratospheric. It is highly recommended.