

## Avalanche transceiver test 2013-14

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February 12, 2014

The DAV – Safety Research Group tested all new avalanche transceivers of this winter season. Irrespective of the different technical approaches they use (number of antennas and data evaluation) all commercially available avalanche transceivers were evaluated on the basis of practice-oriented criteria considering the IKAR search phases (signal search, coarse search and fine search) and the additional multiple burial feature. Pinpointing, i.e. probing after fine search, was not considered as this search phase does not concern the transceiver. The weighting of the different test criteria (low, medium and high priority, see summary chart) is an important factor which should be taken into consideration when comparing the various devices. Each individual criterion was rated on a five level scale – ranging from very good over acceptable to insufficient.

In general, apart from their high-end model most manufacturers offer a ‘slimmed-down’ version in the mid-price range having less advanced technical features. Those cheaper devices are less complex and thus easier to handle and provide a very satisfactory performance for the average backcountry user. The special features (e.g. mark function) of the high-end devices are mainly relevant in multiple burial scenarios (signal overlaying due to several devices in the reception range) and can only be efficiently put into practice by an experienced user.

Updates: Nowadays, the software of many transceivers can be updated. Some transceivers that have been on the market for some years are continuously being refined by new software updates. Not only new features were added, but also the basic search functions were improved. It is worthwhile to check the version of the software of your device and, if necessary, replace it by a current version.

State of the art: Digital three-antenna technology may be regarded as the current standard in transceiver technology. During fine search, one of the three antennas is always in an optimal receiving orientation with respect to the transmitting antenna, so that accuracy and speed of search increase considerably. Nevertheless, Pieps still offers the device “Freeride” which is the only device on the market that uses the outdated one-antenna technology. In particular during fine and coarse search, the “Freeride” showed significant weaknesses and therefore cannot be recommended.

Search strip width: Caution! Some manufacturers claim a search strip width of up to 60 m! The test has shown that in particular when the antennas end up in an unfavorable position, the claimed range is by far too wide to reliably locate all transmitters. Only experienced searchers who know their device very well, may deviate from the recommended search strip width of 20 m - the consequences of missing a buried person during signal search are most definitely fatal.

Despite the high degree of technical sophistication of most avalanche transceivers the old mantra still holds true: *Any device is just as good as its user!!*

### ***Updates in detail***

**Arva** introduces two new models: The „ProW“ being the high-end device and the „Neo“ the slimmed-down version. However, in our test, both during coarse search and in case of multiple burial, the „Neo“ did better than the „ProW“.

The company **bca** was unable to provide us with a test version of the announced „Tracker3“ before the deadline of this article. It is still unclear whether the device will be available this winter.

**Mammut** offers a software update for its „Pulse“, version 4.0. The main innovation of this update is a guided fine search in which the user is guided by arrows via the two axes for fine search. Further the signal maximum for pinpointing using the probe is determined by the device.

**Pieps** withdraws the device „Vector“ from the market and pays the difference in money to an alternative Pieps device to their customers. The reason is malfunctions of the device which may occur under certain practical conditions. Two new devices, „DSP Pro“ and „DSP Sport“, were launched as successors in the DSP Series and include new electronics and software. In signal search and coarse search the devices are very accurate and reliable. There are still shortcomings, however, in multiple burial scenarios. The devices „DSP“ and „DSP Tour“ are still available and being further updated.

**Ortovox** introduced the software update 2.0 for the device „S1+“, software update 2.1 for the device „3+“ and the software update 2.0 for the device „Zoom+“. These updates slightly improve the fine search. All three devices are equipped with a Recco reflector within the housing as a backup system. Additionally, all of them detect the spatial position in order to transmit using the most horizontal antenna (smart antenna technology).

## Safety Warning

The marking functions of avalanche transceivers that help to solve multiple burial scenarios have their limits and do not always function reliably. During recent tests, the DAV – Safety Research Group discovered a safety problem that had not been known until now. The mistake happens when two or more transmitters are far apart (60 meters or more) so that their signals do not overlap. After marking the first transmitter, the marking function also suppresses the signals of all other transmitters so that their signals cannot be detected. While doing the signal search this mistake cannot be identified. The affected models are:

- Pieps “DSP Sport”
- Pieps “DSP Pro”
- Arva “Evolution +”
- Arva “Evo 3”
- Arva “Evo 3+”
- Arva “3 Axes”

The mistake does not have an effect on the sending mode or single burial scenarios.



**Pieps offers two solutions to the problem:**

**1) Install the firmware update v1.5**

The free firmware update (version v1.5) will be available at every PIEPS Service Center after Feb. 17, 2014. Addresses can be found on [www.pieps.com](http://www.pieps.com).

**2) Adapt your search strategy**

**For users who cannot make use of the firmware update immediately:**

Mark the first transmitter and follow the new strongest signal on your display to the second buried person. If there is no other signal shown in the display although further persons are being missed, delete the marking ("DEMARK" or "SCAN" or quickly switch from "SEARCH" -> "SEND" -> "SEARCH"). Then continue with the signal search in the recommended search strip width.

**Arva recommends following strategy in order to solve the problem:**

If the display shows "CE" for longer than three seconds after marking the first transmitter (i.e. no other signal nearby), unmark the first transmitter so that all signals are received again. In order to detect further transmitters, other strategies have to be applied to separate a second signal in the recommended search strip width.

**Note:** All models from Arva's "Evo" family and Arva's "3 Axes" can mark **one** transmitter only.

**Additional note regarding search strip width in the case of multiple burials:**

After marking, the receiving range can be reduced and sometimes the marking function is not stable (i.e. the marking gets undone or marked transmitters get mixed up) or another marking is not possible. Despite this, marking does help solving a multiple burial. In order to accommodate the restrictions to the marking functions we recommend sticking with a search strip width of 20 m so that no further transmitter will be missed.

## Test criteria

### Signal search

The range of the receiving antenna of an avalanche transceiver plays an important role when searching for the first signal. Generally, the range can be divided into three axes based on the orientation of the transmitting antennas, i.e. the x-, y- and z- direction (Fig. 1). We defined the maximum range of the receiving device as the distance from the transmitter which still resulted in a constant signal. When testing, the distance ranges in all three antenna orientations were determined. The average value resulting from the x-, y-, and z-direction as well as the respective minimum value are considered in the chart for assessing the category 'range'.

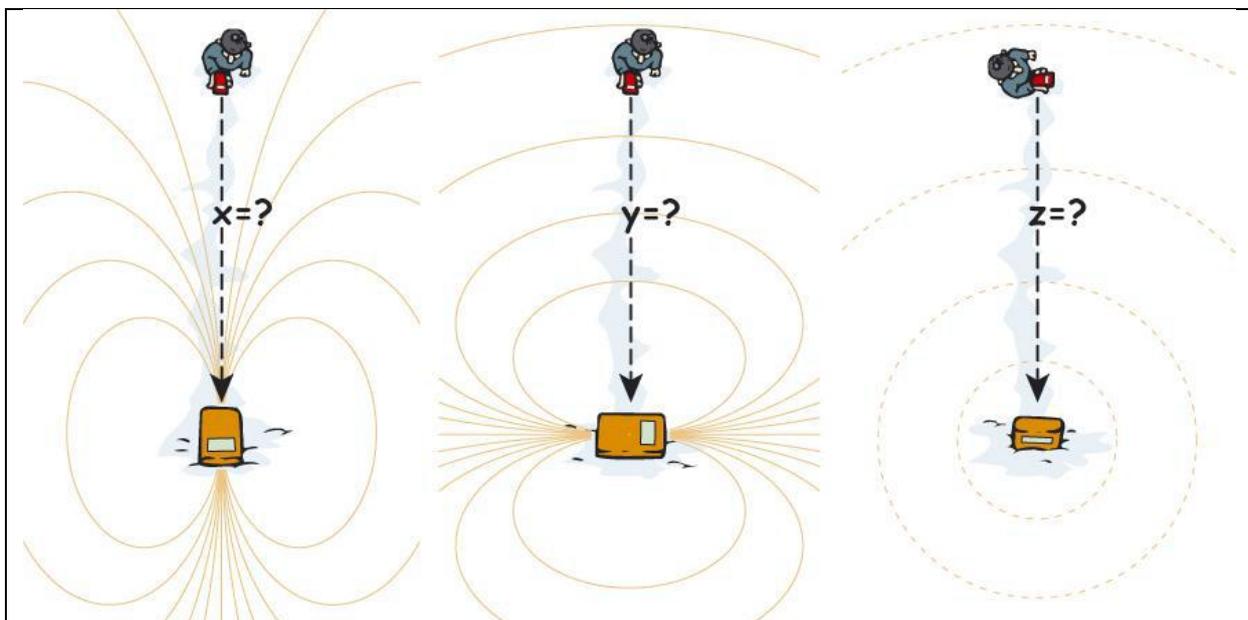


Figure 1. Signal search. Determining the maximum range in all three axes.

### Background information:

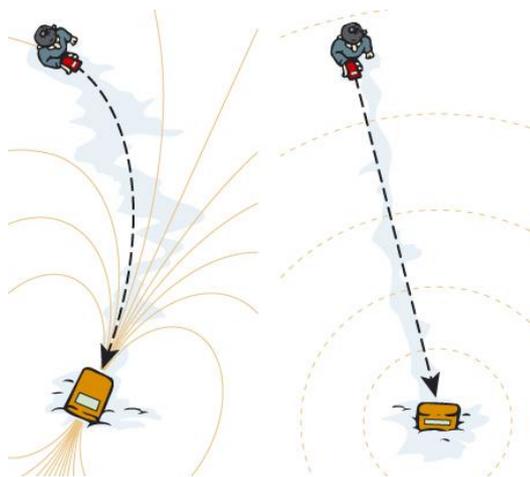
In reality the values of the three ranges (x-, y-, and z- direction) are mixed, since the searcher is moving across the avalanche search field and therefore the orientation with respect to the transmitting antenna changes. Generally speaking, the maximum range of a transceiver should not be overrated. A large range is not very useful if the signal cannot be followed clearly after detecting it (see 'Fuzzy Range' in section 'Coarse Search').

Be careful with respect to manufacturer indications regarding their search strip width, in particular as some devices show weaknesses in the y- and z-direction. Also, a snow and ice covered ground has to be taken into account. When testing on a glacier, part of the received field lines pass through the ice. Measurements on glaciers have shown that snow or ice may reduce the transmitter range by up to 30%. It is thus advisable to stick to the search strip width of 20 meters recommended by the DAV in order not to miss a buried person.

## Coarse search

This search phase starts after initially detecting the signal and ends after approaching the buried transceiver to a distance of approximately 5 meters (see display indications). We rated the traceability of the transmitted signal along the field line with a horizontal and vertical orientation of the antenna of a buried transceiver (Fig. 2.).

During coarse search the performance of the tested transceivers varied strongly. Good devices are characterized by a reliable indication of the search direction after a signal has initially been detected. From then on a clear, steady and straightforward directional guiding leads into the near range of the buried person, independent of the antenna orientation of the transmitter. There were large differences between the various devices in the far range during coarse search when the displayed distance exceeded 20 to 25 meters; at a shorter distance almost all devices performed very satisfactory. It is thus very important to do specific training to get to know your device.



*Fig. 2 – Coarse Search:*

*Approaching a horizontal and a vertical transmitter from the point of reception of the first signal.*

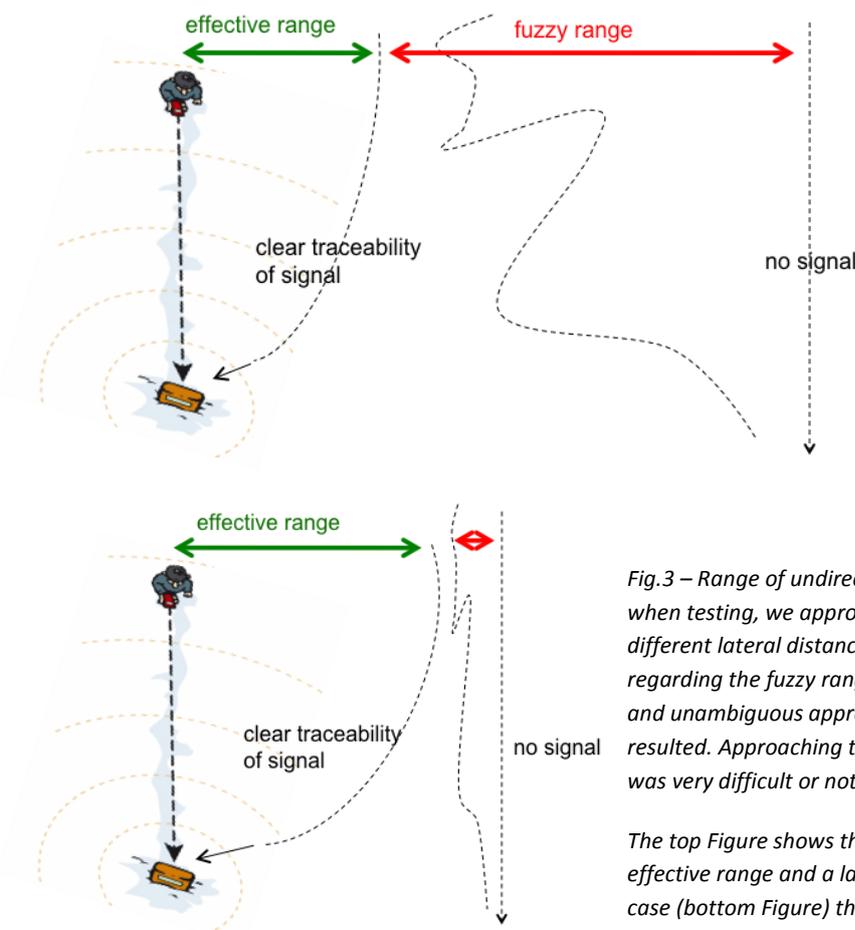
### Test criteria:

- Is the path of approach in the `far range` (after reception of the first signal) unambiguous and effective?
- Do time-consuming direction-finding errors into wrong directions occur?
- Is the first signal lost again?
- Are distance values correct or do they show misleading increases?
- Do leaps in distance values occur, e.g. from 17 to 6 meters?
- Does the acoustic information correspond to the optical information?
- How large is the fuzzy range (range of unidirectional guidance) in which directional guidance is ambiguous?

To receive the rating `acceptable`, the approach to a transmitter, which was offset 15 m from the direct walking path, had to be reliably possible.

### Range of Unidirectional Guidance (fuzzy range)

Even if a device has a large maximum range, this does not necessarily mean that the signal may be effectively traced towards the transmitter. There are in particular problems in the phase right after the reception of the first signal, which is why we chose to focus on this aspect of rating. To be able to evaluate this phase more precisely, we defined the 'range of unidirectional guidance' as a test criterion, in which approaching the transmitter is not possible in a straightforward manner (Fig.3). We regarded display values without directional arrows, directional guidance which does not approach the transmitter, signal loss or any combination of said aspects as unclear or ambiguous. A good device is defined by a small range of unidirectional guidance. Among the high-end devices, the range of unidirectional guidance was well below 5 meters. With weaker devices, this fuzzy range of unidirectional guidance partially exceeded 15 meters. To reach a buried person fast and reliably under time pressure and stress, a stable and unambiguous directional guidance after receiving the first signal is of utter importance. An early signal reception usually is at the expense of a clear directional guidance and is thus not very helpful for the searcher. In particular in case of a vertically positioned transmitter some devices still showed weaknesses in this respect.



*Fig.3 – Range of unidirectional guidance (fuzzy range): when testing, we approached the transmitter from different lateral distances in offset. Large differences in size regarding the fuzzy range and the offset from which a clear and unambiguous approach was possible (effective range) resulted. Approaching the transmitter from the fuzzy range was very difficult or not possible at all.*

*The top Figure shows the unfavorable case of a small effective range and a large fuzzy range, while in the ideal case (bottom Figure) the fuzzy range is almost negligible and the effective range is large.*

## Fine Search

Here, using two scenarios (burial depth of 0.5 m with a horizontal transmitter and burial depth of 2.5 m with a vertical transmitter, see Fig. 4) the devices were rated according to the following criteria:

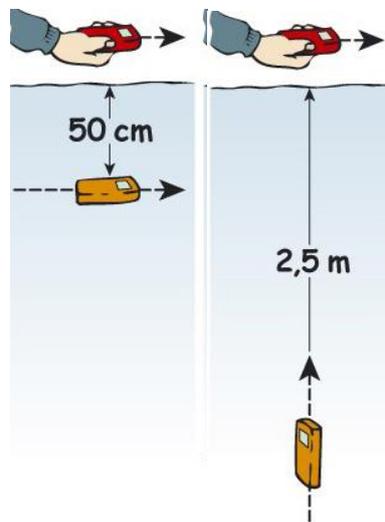


Fig. 4 – Fine Search: Determination of the burial position by cross-bracketing with a shallow and deep burial with a horizontal and vertical transmitter position, respectively.

### Test Criteria:

- Is the transition from coarse to fine search indicated appropriately?
- Are wrong distance values displayed in cross-bracketing?
- Are there misleading directional arrows?
- How fast do the distance values adapt when moving the device?
- Does turning or rotating the device influence the displayed values?
- Is the accompanying acoustics supportive?
- Do the display values on the search axes decrease uniformly until the device is located directly above the transmitter and do they then increase again?

In fine search, meanwhile all available three-antenna devices operate effectively and reliably, even with deep burials. Very good devices are further characterized by high-speed signal processing and a clear stepped profile of the display value on the axes of fine search in combination with a good acoustic support.

### Attention!

Most mistakes are made and most time is lost in this search phase. Most frequently observed mistakes are that the device is moved too fast, that the first straight line in cross-bracketing is not followed far enough or searched too frequently. In particular in this search phase, every searcher has to adapt exactly to the optimal operating speed of the used device. Training and experience is very important here!

## Multiple Burial (MB):

This search phase is the most complex assessment category in the test. On the one hand, it was assessed whether a device is capable of detecting a multiple burial scenario and whether the user is given important information in this respect (number of received transmitters, distance, direction).

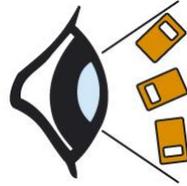


Fig.5: Detecting a MB

Further, the devices were compared with respect to their approach and functionality regarding direct tracing in a test scenario (Fig. 6).

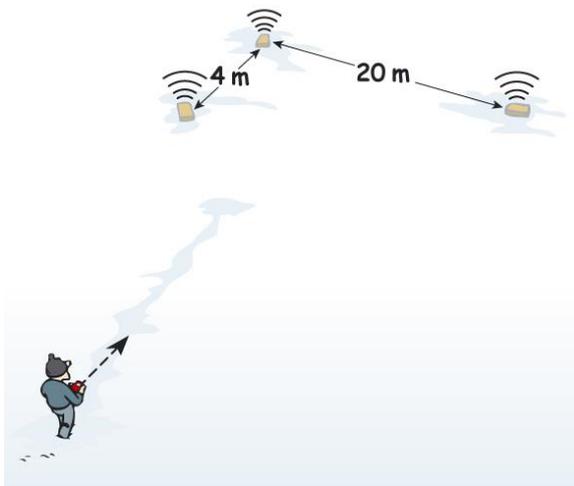


Fig. 6: MB in scenario 2-1

An assessment was made as to whether a direct tracing is possible, whether “marking” of a located transmitters is done rapidly and reliably, whether marked transmitters accidentally change back into the search mode, whether all transmitters are detected and how fast and reliable the device is in this situation.

All in all, solving a complex multiple burial scenario is definitely the most intricate technical challenge for an avalanche transceiver. The function should not be overrated, however, as according to the findings of the DAV Safety Research Group, complex multiple burials rarely occur (in approximately 3% of accidents). In case of a multiple burial, also a different strategy may be adequate (three-circle method or micro-search-strip search). It is very important here, that a device provides exact information on the overall burial situation so that the correct approach can be chosen by the user.

## Summary

In our opinion, apart from information on the burial situation, the approach (coarse search) and, in particular, the performance during cross-bracketing (fine search) are the most important features of an avalanche transceiver. A basic prerequisite is, above all, for the operation of a transceiver to be stable and fast.

## Characteristics of the devices in detail



### **Arva „ProW“ (software 4.0) *new***

The „ProW“, successor of the „Link“, was being praised as the new top device of the Arva family, but was clearly inferior to his little brother, the „Neo“, in some of the tested categories.

**Signal search:** The good values regarding maximum range are relativized by a small effective range.

**Coarse search:** A large fuzzy range, problems regarding directional guidance and an erratic display of distance values in particular in case of a vertical transmitter leave quite some room for improvement in coarse search. Approaching a horizontal transmitter gave satisfactory results.

**Fine search:** The device enters the fine search mode very late, so that with deep burials the coarse search arrows do not disappear. The acoustically supported guidance towards the probing position is good, as well as the stepped profile of the display values.

**Multiple Burial:** As soon as the signals have been separated, the marking function is fast and stable. Separating the signals may take a long time in some cases, however, so that a further buried person may be missed. A less effective directional guidance towards the second and third buried persons was noted after the signal of the first one had been faded out. All in all, also complicated multiple burial scenarios may be solved using the device if the signals are separated.



### **Arva „Neo“ (software 2.0) *new***

The „Neo“ received the best results among Arva devices in our test and can definitely compete with other brands.

**Signal search:** The „Neo“ shows a very good reception range and is on a par with other high-end devices available on the market.

**Coarse search:** In particular when approaching the horizontal transmitter, the “Neo” is characterized by a small fuzzy range and a large effective range. As with the „ProW“, however, problems occurred in the far range with a vertical transmitter. In some cases, extensive signal leaps and a confusing directional guidance occurred.

**Fine search:** In the fine search mode, the „Neo“ is about as effective as the „ProW“.

**Multiple burial:** Once the signals have been separated, the marking function is fast and stable, but this may take some time so that a signal may be missed. The „Neo“ does not have an analogue tone like the „ProW“, so that there is no possibility of detecting this error. Directional guidance after fading out the signals of already found transmitters is far more reliable than using the „ProW“. Most multiple burial scenarios could be solved well, only approaching the 3<sup>rd</sup> transmitter required an experienced searcher.



### Arva „Evo3+“

The oldest model by Arva has meanwhile been outdone by many of its competitors. In particular the marking function is no more state-of-the-art. Also regarding criteria like range and coarse search in case of a vertical transmitter, the „Evo3+“ is located only in mid-range. (Attention: notice the safety warning on page 3/4!)

**Signal search:** The values regarding range acquired by the „Evo3+“ are nothing but average.

**Coarse search:** Obviously, the display of the „Evo3+“ is not as clear as the display of newer devices, but this is not the reason why the coarse search is so confusing after receiving the first signal. Frequent signal loss and change of direction only get better with a decreasing distance to the transmitter. The further approach with a decreasing distance to the transmitter is very good.

**Fine search:** The device has to be moved very slowly during this phase and the confusing direction-indicating arrow unfortunately disappears very late. Acoustic support and display of distance values is perfect, however.

**Multiple burial:** The „Evo3+“ indicates a multiple burial scenario on its display and offers a stable marking function with two transmitters. It is a problem, however, if the buried persons are too close to each other or if a third transmitter comes into play. In this case, marked transmitters were displayed again and in some cases the third transmitter was not detected at all.



### **bca „Tracker 2“ (software R04)**

The „Tracker 2“ is in particular characterized by its fast processor, i.e. the distance display indicates the current distance value very quickly and interruptions of display values hardly occur.

**Signal search:** The range is acceptable. A large range in the optimum receiving orientation is unfortunately neutralized by weaker values in the other two inferior orientations.

**Coarse search:** Due to the large range in x-direction, the approach after receiving the first signal has become more difficult. In this respect, the „Tracker 2“ shows weaknesses. Only with display values below 30 meters is the approach with both a horizontal and a vertical transmitter excellent. A smaller x-range in favor of solid directional arrows after receiving the first signal would be desirable.

**Fine search:** Due to the third antenna, the „Tracker 2“ offers very exact values with burial depths up to 2.5 meters. In particular the display speed of current distance values is excellent.

**Multiple burial:** The „Tracker 2“ offers a display for multiple burial scenarios. If the symbol lights up, several transmitters are located in the reception range. If the symbol flashes, several transmitters are within a radius of five to seven meters from the receiver. Thus, a reliable and effective decision may be made, whether a certain strategy (three-circle method or micro-search-strip search) should be followed after finding the first transmitter or not. An experienced user may still directly follow two to three transmitters in a limited angle of view of approx. 75% using the SP function and thus get an overview over the burial situation. It has to be noted here, however, that this method may not be regarded as intuitive and requires intensive training to be able to use it effectively.



### **Mammut „Pulse“ (software version 4.0) *Software Update***

Being one of the high-end devices on the market, with its new update the „Pulse“ offers support in fine search.

**Signal search:** The „Pulse“ fulfils almost all requirements regarding range. Only the slightly decreasing range in z-direction in practice leads to minor restrictions with vertical transmitters.

**Coarse range:** In this search phase, the „Pulse“ is one of the best devices. In particular its excellent guidance after receiving the first signal and the small fuzzy range are to be noted here, despite slight problems in case of a vertical transmitter. The fuzzy range was still small here, but the effective range was smaller than in case of a horizontal transmitter.

**Fine search:** Also here, the „Pulse“ acquired good or very good results, the display is clear just like the acoustic support. The main innovation is a guided fine search („intelligent search‘). The searcher is guided by arrows via the two axes of fine search and the signal maximum for pinpointing using the probe is determined by the device. The system works well, but a person experienced in fine search using other devices will take some time to get used to it, in particular with deep burials. If you do not

know that from a burial depth of 1.5 m the device searches the axes of fine search twice (until the signal becomes weaker and back again) you might lose trust in the device.

If you deviate from the directional arrow, fine search may become problematic.

**Multiple burial:** Our positive assessment in this category was spoiled by the time the device took in some constellations for separating the signals. As a consequence, a further buried person might be missed. Apart from that, the performance of the „Pulse“ is exemplary in this category. Its marking function is one of the best among currently available devices and it is very reliable and stable. Guidance even towards several transmitters, if separated, is direct and clear. The advantage of the „Pulse“ as compared to the „Element“ is the analogue tone in the advanced mode which enables an experienced user to recheck the digital display. That way, the presence of a transmitter may be detected which is not displayed „digitally“.



#### **Mammut „Element“ (software version 1.0)**

Despite being the slimmed-down version of the „Pulse“, the „Element“ still provides a very convincing performance in all tested categories. It even provides some advantages for beginners who prefer a simple, solid device: Only one button, no time-consuming menu navigation and all in all a device which may be operated very intuitively.

**Signal search:** In our test, the „Element“ acquired almost identical values to the „Pulse“.

**Coarse search:** The „Element“, together with the „Pulse“, were among the best devices in this search phase. Excellent guidance from receiving the first signal and a small fuzzy range are to be noted here despite slight problems with a vertically positioned transmitter.

**Fine search:** In this category, the Element is even one step ahead of the Pulse. This is due to the limitations caused by the new “intelligent search” of the „Pulse“ in case of deeper burials and a vertical transmitter.

**Multiple burial:** Our positive assessment in this category was spoiled by the time the device took in some constellations for separating the signals. As a consequence, a further buried person might be missed. In contrast to the „Pulse“ it unfortunately has no analogue tone, so that there is no possibility of detecting this error. Otherwise, the „Element“ performs exemplarily in multiple burial scenarios. Its marking function is one of the best among currently available devices and it is very reliable and stable. Guidance even towards several transmitters, if separated, is direct and clear. For the occasional user, this device seems to be the simplest to use.



### **Pieps „DSP Pro“** (software version 1.2) *new*

The new high-end device by Pieps achieved ratings from good to very good in all categories but Multiple Burial. (Attention: notice the safety warning on page 3/4!)

**Signal search:** With respect to range, the „DSP Pro“ just like the classics by Pieps „DSP“ and „DSP Tour“ are among the best devices.

**Coarse search:** In this search phase, the new devices by Pieps (the „DSP Pro“ and the „DSP Sport“) are clearly superior to their predecessors. Regarding coarse search, the „Pro“ is currently the strongest device on the market. In particular with a vertical transmitter, it showed a large effective range and an exemplarily small fuzzy range.

**Fine search:** A very satisfactory performance with only minor deficiencies in case of deep burials and a vertical transmitter – in that case, the device did not change into the fine search mode. Acoustic support during fine search was only poorly differentiated.

**Multiple burial:** The device reliably indicates a multiple burial, but problems may occur when trying to solve the situation. Direct tracking usually works well with two to three transmitters. Occasionally, the device mixes up an already marked transmitter with a currently followed transmitter. A user who knows this weakness and can deal with it may call a solid avalanche transceiver his own. In some cases, the 3rd transmitter could not be found, although all 3 burials were indicated. And in those cases in which the 3rd transmitter was found, it was only possible with great difficulties (unclear direction indication, signal leaps between already marked transmitters, complicated guidance).



### **Pieps „DSP Sport“** (software version 1.2) *new*

The „DSP Sport“ is only slightly inferior to the top device by Pieps, the „DSP Pro“, regarding coarse search. Regarding all other tested criteria they are on a par. (Attention: notice the safety warning on page 3/4!)

**Signal search:** With respect to range, it is one of the best devices, just like the „DSP Pro“.

**Coarse search:** Due to a slightly larger fuzzy range in case of a vertical transmitter, the „DSP Sport“ did not perform as well in the category of coarse search as the „DSP Pro“.

**Fine search:** With deeper burials and a vertical transmitter, the acoustic support was only poorly differentiated, the transition into the fine search mode (no more directional arrows) only resulted with a displayed distance value of below 2 m. These deficiencies in fine search do not occur with the

classic Pieps devices („DSP“ and „Tour“). All in all, both the „DSP Sport“ and the „DSP Pro“ achieved good results in fine search.

**Multiple burial:** As with the „Pro“ a multiple burial scenario was indicated early and reliably, just like the correct number of buried persons. When solving the situation, however, the same weaknesses resulted as when using the „DSP Pro“.



### **Pieps „DSP“ (software version 8.2)**

Being the first transceiver which used three-antenna technology, it has become the classic.

**Signal search:** With respect to range, it is still one of the best devices.

**Coarse search:** There are slight problems regarding directional guidance in terms of receiving the first signal. If you follow any change of the directional arrow in this phase, you are guided on an angular path. This problem is intensified in case of a vertical transmitter. In particular in case of a vertical transmitter, the fuzzy range is clearly larger and the effective range is by far smaller than with the new Pieps devices. As soon as you further approach the buried person, however, the „DSP“ securely and directly guides you towards the transmitter.

**Fine search:** The „DSP“ with its reliable display achieved good to very good results in fine search. The smallest distance value is not differentiated clearly enough. Acoustic support is implemented in a much more differentiated way than with the new devices by Pieps.

**Multiple burial:** The device reliably indicates a multiple burial scenario. Using the scan function, the distance and number of received transmitters (even with old Ortovox transmitters) may be determined reliably. In the normal search mode, however, the number of buried persons is not reliably indicated if the transmitters are old devices by Ortovox (F1, M2, X1, Patroller). Devices comprising a new software at least indicate this problem by a flashing display. Fading out already found transmitters may be somewhat difficult and requires patience. Direct tracking works well with two to three transmitters. Sometimes, however, the device mixes up an already marked transmitter with the currently followed one. A user who knows this weakness and can deal with it (briefly change into the scan mode) may call a solid avalanche transceiver his own.



### **Pieps „DSP Tour“ (software version 8.2)**

Being the „slimmed-down“ version of the „DSP“, the „DSP Tour“ is not provided with the scan mode as a supporting feature in a multiple burial scenario, reaches identical results as compared to the „DSP“ in the remaining test categories, however.

**Signal search:** Just like the „DSP“, also the „DSP Tour“ is designated by an excellent range.

**Coarse search:** In coarse search, the same problems like with the „DSP“ occur and make this search phase more difficult in terms of receiving the first signal. Slightly diffuse directional arrows impede a fast progress in this phase. With a vertical transmitter this problem is even aggravated and accompanied by a large fuzzy range and a relatively small effective range. As soon as you get closer to the buried person, however, the Pieps „DSP Tour“ securely and directly leads you to the transmitter.

**Fine search:** The „DSP Tour“ with its reliable display achieved good to very good results in fine search. The smallest distance value is not differentiated clearly enough.

**Multiple burial:** The device reliably indicates a multiple burial scenario. In contrast to the „DSP“, the „DSP Tour“ is not provided with the scan mode, however. In the search mode, it consequently provides no reliable indication of the number of buried persons if the transmitters are old devices by Ortovox (F1, M2, X1, Patroller). Devices comprising a new software at least indicate this problem by a flashing display. Fading out already found transmitters may be somewhat difficult. Direct tracking works well with two to three transmitters. Sometimes, however, the device mixes up an already marked transmitter with the currently followed one. In this case you have to briefly change into the „transmission mode“ to delete the old mark-up.



**Pieps „Freeride“** (software 2.6)

A digital one-antenna device which is sufficient in order to be found but not to effectively search for your fellow companions.

**Signal search:** Its range of 25 meters in the x-direction is quite poor. In the y-direction, the range is even only 7 meters!

**Coarse search:** Approaching the transmitter is very difficult using this device. It has to be turned into the different directions due to its one-antenna technology and reacts very slowly and in a delayed manner. If you are too fast, you easily reach operational limits of the device.

**Fine search:** Also in this category, the „Freeride“ gives a poor performance due to its one-antenna technology. Distance maxima have to be interpreted correctly and this leads to a considerable time loss when searching.

**Multiple burial:** The device does reliably detect a multiple burial scenario, but cannot give information on neither number nor distance of the received transmitters. Alternative strategies (three-circle method or micro-search-strip search) need to be used to solve a multiple burial.



### **Ortovox „S1+“ (software version 2.0) *Software Update***

The top device of the Ortovox family. If it did not show obvious weaknesses in coarse search, this year`s version of the „S1+“ could clearly compete with other top devices available on the market. It is designated by an automatic variation of the transmission antenna, which always causes a horizontally positioned antenna to transmit (smart antenna). Thus, the „S1+“ may be received earlier by the other receivers and makes it easier for the searcher to approach the transmitter. A new feature is the Recco reflector integrated in the housing as a backup system.

**Signal search:** With respect to range, the „S1+“ may well compete with other devices. Its range with a vertically positioned transmitter antenna is 25 meters, which is quite large, but the receive signal in this distance is not yet as constant as with other devices which have a large range in z-direction.

**Coarse search:** A relatively large fuzzy range unfortunately neutralizes the large maximum range. After receiving the first signal, directional guidance is often confusing and signal loss frequently occurs. These problems in particular occurred when trying to approach a vertical transmitter. In the near range, i.e. with a distance display of below 25 meters, the „S1+“ is a good device featuring a fast and direct guidance towards the transmitter.

**Fine search:** In this category, the „S1+“ acquired good or very good test results. The fine-tuned acoustic support and display are very helpful in cross-bracketing.

**Multiple burial:** The scenario simulated in the test was mostly solved well using the „S1+“. In some cases problems occurred trying to find the more remote transmitter after the first two had been marked. Unfortunately, the device features no analogue tone anymore which would be helpful to detect that a transmitter has been digitally missed. The mark function is excellent and works fast and reliably.



### **Ortovox „3+“ (software version 2.1) *Software Update***

The „3+“ is a basic three-antenna device having weaknesses in coarse search as they also occurred with other Ortovox devices. It is characterized by the automatic variation of the transmission antenna which always causes a horizontally positioned antenna to transmit (smart antenna). Thus, the „3+“ may be received earlier by the other receivers and makes it easier for the searcher to approach the transmitter. A new feature is the Recco reflector integrated in the housing as a backup system.

**Signal search:** The range is good in x- and y-direction but clearly decreases in z-direction.

**Coarse search:** In the far field, directional guidance is not clear and effective due to signal loss or leaps on the distance display. This is a problem in particular with a vertical transmitter. In the near range (from approx. 15-20 meters) approaching both a horizontally and vertically positioned transmitter is no problem.

**Fine search:** In fine search, the device got good to very good results. The range of the z-antenna is sufficient, so that even with deep burials and a vertical transmitter no wrong maxima occurred. The excellent acoustic support is very helpful in this search phase.

**Multiple burial:** Detecting several transmitters works well. If several signals are detected in the reception range, however, directional guidance in the coarse search phase is not as effective and the device guides the searcher on a serpentine path into the near range. The marking function is fast and reliable. In some cases, after marking the first two transmitters, the third one was detected very late nor not at all.



### **Ortovox „ZOOM +“ (software version 2.0) *Software Update***

The „ZOOM+“ is so to speak the further development of last year's model, the „ZOOM“, comprising a software update and newly integrated Recco reflector. It includes 3 antennas and uses the smart antenna technology, which is also applied in the other two Ortovox models.

**Signal search:** In particular in y- and z-direction the „ZOOM+“ shows a limited range, which clearly restricts an effective signal search.

**Coarse search:** In the coarse search mode and in particular in the far range the device shows clear weaknesses. In particular with a vertical transmitter, the fuzzy range is large. A straightforward and effective approach was only possible here from a distance of below 15 meters. After having successfully received the first signal, the „ZOOM+“ effectively guides the searcher towards the transmitter.

**Fine search:** In the fine search mode, the „ZOOM+“ got quite satisfactory results. As compared to the „S1+“ and „3+“, the optical and acoustical support is not as clearly graded.

**Multiple burial:** Despite comprising a digital 3-antenna technology, the „ZOOM+“ has no feature for multiple burials. Only a symbol on the display indicates a multiple burial scenario, without giving further information on the number of buried persons, however. What is problematic is, that a multiple burial is sometimes even indicated when only one transmitter exists. If you use the „ZOOM+“, you should be familiar with the three-circle method or micro-search-strip search.