

# DAV Safety Research: Avalanche Transceiver Test 2022

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Since the last DAV Safety Research test in 2017/18, a few new devices came onto the market, others were revised with software updates, and some also disappeared. In order to find out to what extent the individual models differ and what advantages and disadvantages each individual device offers, the DAV Safety Research team tested the current avalanche transceivers.

The test and evaluation procedure are explained in detail in the *Test Criteria* section. The *Overview table* shows the devices in comparison with regard to various test criteria. Each individual criterion was rated on a five-level scale – ranging from very good over acceptable to deficient. The *Device characteristics* contain detailed information, test results and tips for users on the individual devices. The *Technical Details* table provides an overview of the device data and special functions.

The test itself took place in March 2022. To achieve similar conditions for all test devices, each criterion was tested with all devices in succession. The devices were tested both in terms of their behavior in the search phases (signal search, coarse search, fine search), and in terms of their performance characteristics in a multiple burial (MB). A uniform evaluation of these main criteria can be found in the overview table.

 Deutscher Alpenverein Sicherheitsforschung Avalanche Transceiver Test 2022		 Arva Evo 5 (Vers. 1.8.1)	 Arva Neo BT Pro (Vers. 1.1)	 Mammut Barryvox (Vers. 3.4)	 Mammut Barryvox S (Vers. 3.4)	 BCA Tracker4 (Vers. 6.4)	 Pieps Pro BT/ BD Guide BT (Vers. 2.2)	 Pieps Powder BT/BD Recon BT (Vers. 2.2)	 Pieps Micro Race BT (Vers. 3.2)	 Black Diamond Recon LT (Vers. 1.2)	 Ortovox Direct Voice (Testvers. 2.0)	
	<b>Reception Range</b>	x	46m	62m	57m	55m	42m	49m	50m	50m	43m	32m
	(stable reception)	y	28m	39m	36m	38m	24m	38m	38m	36m	33m	22m
Coarse Search	Horizontal transmitter	z	17m	27m	26m	28m	9m	27m	27m	24m	23m	16m
	Vertical transmitter											
Fine Search	Medium burial depth	0,8 m										
	Deep burial depth	> 1,5 m										
	Search support											
Multiple Burial	Detecting											
	Marking & Tracking											

	very good
	good
	acceptable
	problematic
	deficient

Both the selection of the test scenarios and the evaluations were carried out with a focus on an objective but practical perspective. In addition to the evaluation criteria for the search phases and scenarios, we also reviewed the group check function - which has become a standard feature not only for group leaders and mountain guides. Finally, to take a look at the handling of the devices, intuitive operation, carrying system and real additional functions, we have included usability aspects in the device description.

All models in the test work with three-antenna technology. It is considered state of the art and has completely penetrated the market with a distribution of 96 percent among ski tourers (see "Gerüstet für den Fall der Fälle"; ["Prepared for the worst" in Panorama 1/22](#)). Most of the current avalanche transceivers are also updateable. This is a sensible procedure, since manufacturers can tweak a few things in modern devices with the help of the software, which can then directly affect the performance of the devices. It is worthwhile to check the device regularly to ensure that the software is up to date and to have it updated. In the meantime, a few manufacturers also offer mobile applications of varying scope, which can be used, for example, to check the software status or even update it. In addition, all manufacturers offer an extension of the warranty period upon registration on their homepages. If you already own an older three-antenna device, it is best to have it checked by the manufacturer in the summer to ensure that it is free of faults (maintenance intervals in technical table). Some manufacturers offer this service for free; some charge a fee for it. Especially tour guides and DAV sections with equipment rental should make use of this offer at regular intervals!

For a long time now, some manufacturers have offered one or two cheaper, "slimmed-down" versions alongside their "top device". These devices usually have fewer special features or more limited customization options (acoustics, display, etc.). They are aimed in particular at occasional winter sports enthusiasts who want to spend a little less money or do not have the necessary practice routine to be able to confidently handle the additional functions of the top devices in an emergency.

Despite the high degree of technical sophistication of most avalanche transceivers the old mantra still holds true: Any device is only as good as the person using it. And even more important than the obligatory mastery of one's own avalanche transceiver and the application of the most efficient search strategy depending on the situation (depending on, for example, the size of the avalanche; the number of searchers/shovelers compared to the buried subjects and the burial depth) is a tour selection adapted to the conditions, one's own skills and experience, and adequate risk management on tour. Because: the best life insurance is not to get caught in an avalanche and buried in the first place!

### **Avalanche size, search strip width**

Typical avalanche sizes affecting recreational athletes range from about 4000 to 10,000 square meters (Genswein & Eide 2009). If one wants to derive a typical avalanche search field, i.e., the primary search area below the so-called disappearance point, then this results in a size of about 50x50 meters. Most manufacturers specify a search strip width of 50 meters upwards for their devices. What sounds simple on paper quickly turns out to be a difficult undertaking in reality: People are often only able to estimate horizontal distances to a certain extent and lose track more easily if the search strips are too large. The training alpine sport associations in Germany therefore recommend selecting the search strip width based on local conditions and the available resources ((wo-)manpower). At least 20 meters and in case of few searchers or very large primary search range, this can be extended up to the maximum of the manufacturer's specification. Do you know the recommended search strip width of your device right off the bat? And do you know what this distance means in the outdoor?

## **Burial depths, duration, and multiple burial**

Based on studies of cases in Switzerland, the median burial depth is 80 centimeters (Haegeli et al. 2011) and is valid throughout the Alps. This value is lower for the totally buried survivors (50 cm) and higher for the deceased (100 cm) (Rauch et al. 2020).

Thus, less deep and deep burials occur equally in avalanche accidents. Because weaknesses regarding the exact location of the transmitter below the receiving device as well as the presence of a larger range of the minimum display value become more apparent in deep burials, we also tested these in the fine search. However, they represent an extreme case in an already extreme situation. The fine search with the avalanche transceiver is still the lesser problem at burial depths of over 1.5 meters compared to probing and shoveling!

Individuals who were extricated within the first 15 minutes of burial survived an avalanche in case of total burial at 85 and 90 percent, respectively (Procter et al. 2016). From field tests by *Genswein & Eide 2009* it can be seen that on an average search field already four minutes pass until the search phases signal search to fine search (50 percent of it fine search!) are finished. Another 3.5 minutes are added by probing. So, there is not much time left for gathering together & organizing as well as shoveling out and extricating! Good if you are familiar with your own avalanche transceiver and it works without quirks during the search phases.

Multiple burials (MB) continue to be a central part of the test. *Schweizer & Techel 2017* cited a percentage of 27 percent with more than one person completely buried in fatal accidents in Switzerland over the previous twenty years. The biggest problem on the technical side is MB in confined spaces (Genswein & Harvey 2002). This is still valid today. In training, different scenarios should be practiced and mastered from a certain level of competence (advanced users to multipliers) - however, locating and shoveling out (!) one and two transmitters within the survival curve is most important for the masses.

## **Literature:**

- Genswein, M. & Eide, R. (2009): Effizienz der Kameradenrettung bei minimalem Training; Efficiency of companion rescue with minimal training. In: *Bergundsteigen* 1/09: 40-45.
- Genswein, M. & Harvey, S. (2002): Statistical Analyses on Multiple Burial Situations and Search Strategies for Multiple Burials.
- Haegeli, P., Falk, M., Brugger, H., Etter, HJ., & Boyd, J. (2011): Comparison of avalanche survival patterns in Canada and Switzerland. In: *Canadian Medical Association Journal* 183(7): 789-795.
- ICAR (2009): Recommendation REC L 0009 of the Avalanche Rescue Commission of 24 September 2009 on the terms describing the search phases in an avalanche rescue.
- Procter, E., Strapazzon, G., Dal Cappello, T., Zweifel, B., Würtele, A., Renner, A., ... & Brugger, H. (2016). Burial duration, depth and air pocket explain avalanche survival patterns in Austria and Switzerland. *Resuscitation*, 105, 173-176.
- Rauch, S., Koppenberg, J., Josi, D. et al. (2022): Avalanche survival depends on the time of day of the accident: A retrospective observational study. In: *Resuscitation* 174: 47-52.
- Schweizer, J. & Techel, F. (2017): Avalanche accidents Swiss Alps. Facts & figures of the last 20 years. In: *Bergundsteigen* (98): 44-48.

## **Test criteria avalanche transceiver test 2022**

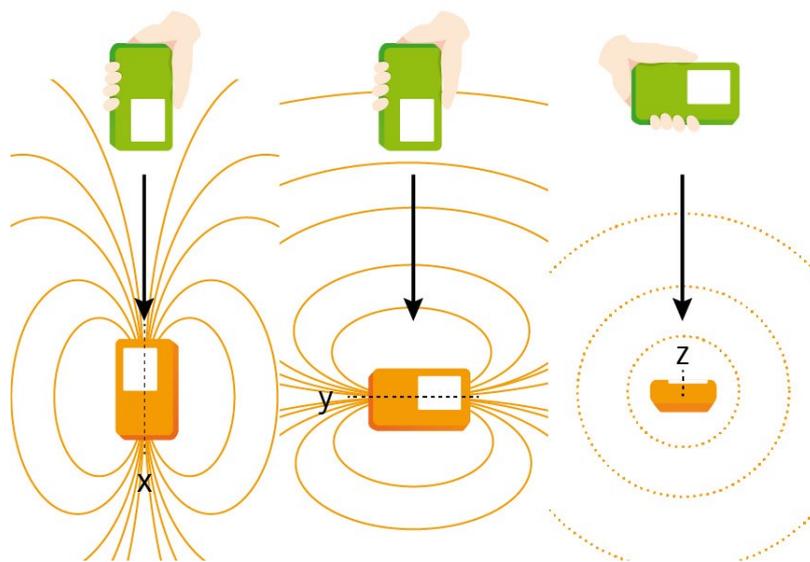
According to the recommendation of the International Commission for Alpine Rescue (ICAR) for search phases, signal search, coarse search, fine search and point search are distinguished from each other (ICAR 2009). The time required for the point search depends on the quality of the fine search, but is not directly influenced by the device and does not play a role in the context of evaluating the performance of avalanche transceivers.

The avalanche transceiver test is consequently divided into the individual search phases of signal, coarse and fine search. In addition, solving the problem of multiple burials was reviewed. Both the test scenarios and the evaluation criteria were chosen with the focus of an objective, practical perspective. Beyond the evaluation criteria, the group check function was checked and a detailed look was taken at the usability of the devices.

### **Signal search**

In signal search, the reception range of an avalanche transceiver plays an important role. The ranges can be divided into three receiving orientations: coaxial or x-antenna, y-antenna and z-antenna receiving orientation. The coaxial position is the best case for the devices, vertical transmitter with receiver rotated by 90° is the worst case, therefore the three ranges were determined in the test (Fig.1). The values given in the overview table are the ranges averaged over three measurements in which a constant and stable signal was present. Earlier single pulses do not increase the stable reception range. Ultimately, however, the range must always be seen in connection with the quality of the coarse search. Receiving the first signal early is only helpful if the signal can then also be tracked well immediately. Movement on the search field constantly changes the relative position between the searching and transmitting avalanche transceiver. In practice, therefore, neither the absolute best nor the worst coupling position (antenna orientation) realistically occurs. However, the measured values are a good indicator of a potential reception area. Early reception of a signal facilitates orientation on the search field and favors approaching the transmitter.

Technically, high ranges often come at the expense of stable signal reception. A challenge for manufacturers is to couple the existing technology or processors (hardware) with good signal processing (software) so that signals are detected and verified from a great distance and also remain stable. This already works well with some devices, but the fuzzy range is somewhat larger with others.



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

### Background Information Search Strips:

For the device-specific specification of the search strip width, there has been an ICAR recommendation since 2009. The idea behind this is to select the search strip width in such a way that it represents the optimal trade-off between short walking distance and reception probability for the most likely burial scenarios. This means that if the specified search strip width is used in the signal search, most avalanche victims will be found more quickly. At the same time, it is accepted here that in unfavorable but more unlikely scenarios, buried subjects may be missed in the initial signal search and therefore may need to be searched for again later.

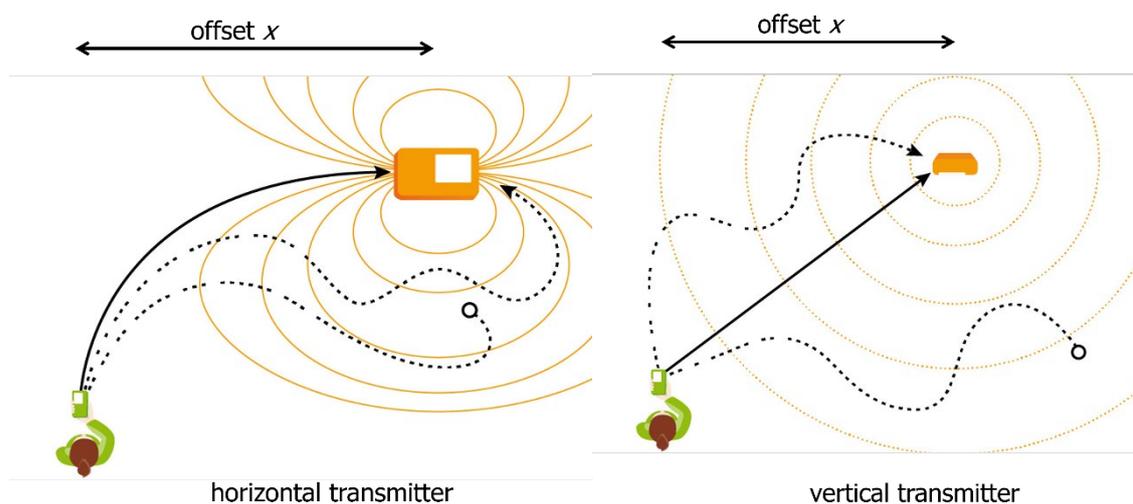
*According to the current recommendation of the German Alpine Sports Associations, the recommended standard search strip width is at least 20 meters. For large avalanches and few searchers, it makes sense to extend this to a maximum of the search strip width recommended by the manufacturer. Experienced users know the search strip width of the manufacturer of their device, have strategies at hand in case an initial signal search does not detect all buried subjects, and know about the device-specific range reduction after marking a transmitter in order to be able to take this into account for the possibly necessary further search.*

### **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.

We rate the traceability of the transmitted signal along the field line with a horizontal and vertical orientation of the antenna of a buried transceiver.

It is recommendable when transceivers can guide to the transmitter at a wide offset – but only if this can be done directly with the help of a stable signal as well as directional arrow. For this purpose, signal verification - i.e., a clear demarcation between signal reception and no signal reception - is advantageous. An unstable signal in the individual limit range of the devices has a disadvantageous effect on the search process, since misleading signals such as incorrect directional instructions and signal losses may leave the searcher at a loss.



*Fig. 2 – Coarse Search:*

*Approach with lateral offset  $x$  to a horizontal (left) and vertical (right) transmitter. Qualitatively exemplary good approach (solid line) and poor approach in serpentine lines and with signal losses (dashed line).*

At the beginning, the coarse search is tested with a lateral offset of 25 meters. If a transmitter cannot be reliably approached with an avalanche transceiver with this lateral offset, the offset is reduced in 5-meter increments in the next run. The goal is to find an offset at which the detection of the transmitter works reliably. Some devices also allow runs with a horizontal transmitter and 30 meters offset. The searching person does not know the position of the transmitter and the sides are alternated randomly.

Criteria:

It is evaluated up to which lateral offset to the transmitter the quality criteria for a reliable approach are completely fulfilled, and up to which they are only partially fulfilled.

The quality criteria are fully met when

- the transmitter is detected,
- a clear and unambiguous directional info is given and
- the approach is possible quickly and directly (arrow + display values stable).

The quality criteria are partially met when

- the transmitter is detected,
- the approach is possible, however
- small leaps of the directional arrow/display values occur.

The evaluation summarized:

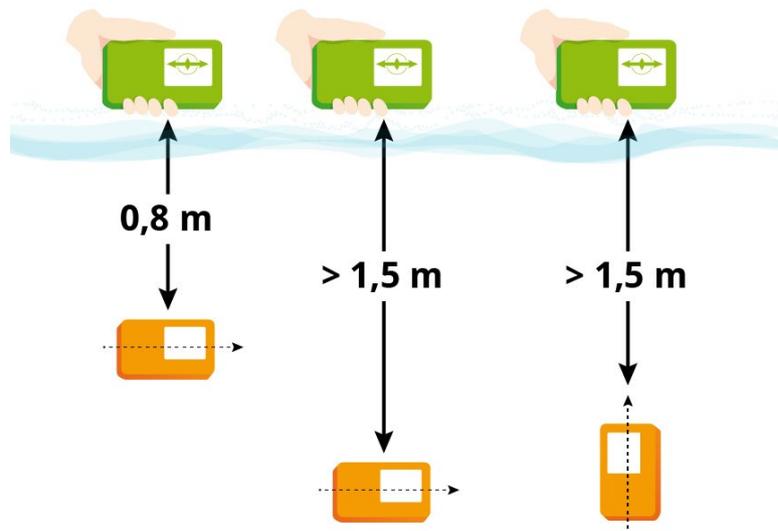
very good	If at 25m offset the quality criteria are fully met.
good	If at 20m offset the quality criteria are fully met and at 25m offset criteria are partially met.
acceptable	If at 15m offset the quality criteria are fully met and at 20m offset criteria are partially met.
problematic	If at 15m offset the quality criteria are partially met.
deficient	If at 10m offset the quality criteria are partially met.

During coarse search the performance of the tested transceivers varied strongly. Good devices are characterized by constantly decreasing, not jumpy display values as well as a reliable direction indication from the point of initial reception of the signal. Clear directional guidance enables a particularly effective approach. Differences between different devices can be seen mainly in the long-distance range of the coarse search at a distance indication of more than 20-25 meters, as well as in general with a vertical transmitter. At close range, the devices usually work reliably - apart from a few device-specific peculiarities.

**Fine Search**

After the coarse search comes the fine search. In the close range (from display values smaller than 3-5 meters), the point with the lowest display value, the so-called distance minimum, is determined. First continue on a straight line until the display value increases again; then return to the point with the lowest value. Here at a right angle, do not rotate the device any longer, cross-bracket laterally to the left and right, and thereby also find the lowest value on the y-axis. Start probing there.

The devices are tested in the fine search in two scenarios and several variants. First, with a burial depth of 0.8 meters and horizontal transmitter position, which corresponds to the value of a typical burial. Second, with a deep burial (1.5 as well as 2.5 meters) with both vertical and horizontal transmitting antenna (Fig. 3).



*Fig. 3 – Fine Search: Determination of the area with the smallest display value (distance minimum) by cross-bracketing in averagely deep and (very) deep burial*

In the various scenarios with different burial depths, the devices are compared with respect to the following criteria:

- Position of the minimum display value under the transmitter
- Size of the area in which the smallest display value (minimum) is indicated
- Deviation of the real burial depth from the displayed value
- Switch to fine search mode
- Stability of the display values when rotating the device

In summary, an evaluation for an average burial depth (0.8 m) and a deep burial (>1.5 m) is generated from each.

In addition, the devices are evaluated in terms of their functions that support fine search. We consider the following criteria:

- Acoustic and visual aids as well as facilitation of the approach to the minimum value
- Speed and readability of the display values at a new position
- Supporting functions or symbols for approach and cross-bracketing
- Guiding the device down to the ground in connection with the carrying system

**Attention!**

Most mistakes are made and most time is lost in this search phase. Most frequently observed mistakes are:

- the device is not guided down to the snow surface
- the device is moved too fast
- the device is not guided on a straight line
- the first straight movement when cross-bracketing is not long or wide enough or the line is searched too often

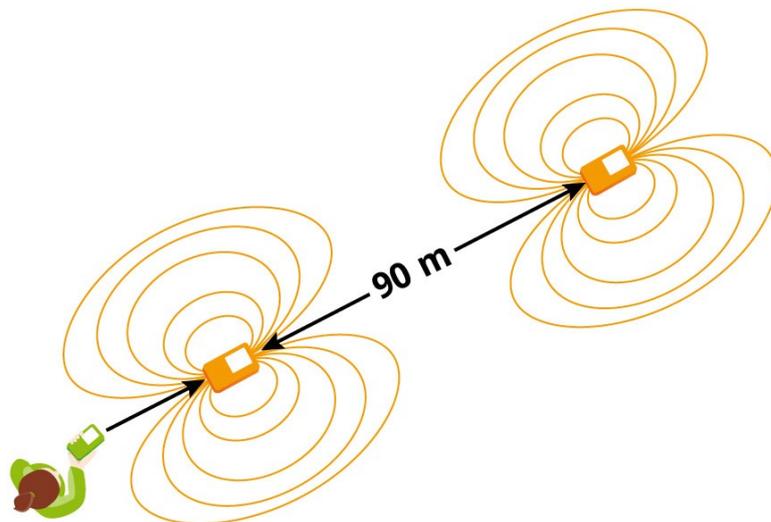
Especially in this phase, each searcher must precisely maintain the optimal working speed and the position of the device used. Training and experience are very important here!

### **Multiple Burial (MB):**

A multiple burial is a situation in which more than one person is buried. This raises questions about the efficient use of resources available to rescuers (primarily the number of searchers and their competence) and the technical limitations of avalanche transceivers. Whereas previously various strategies had to be used to log out of the primary signal and into the next, all devices in the field, with one special exception, have a so-called marking function.

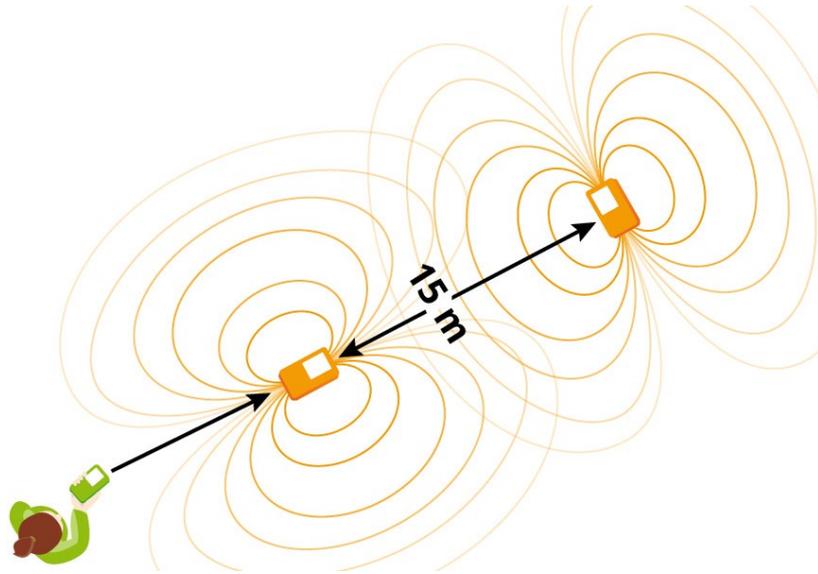
The idea behind it: If there are multiple rescuers, after locating the first distance minimum, the search can continue while others probe and shovel out the first located person. This usually saves time and increases the chances of survival of the other buried people! In the test, this search phase is the most complex evaluation category. Signals may overlap and the processor of the searching device may need some time until another signal is recognized as independent. Also, under certain circumstances, the marking of the previous transmitters may be removed again. Therefore, the devices are tested in three different scenarios and with several repetitions.

In the **first scenario**, two transmitters are found at a distance of 90 meters. The signals from the two transmitters do not overlap. The question is whether the second transmitter can be found after the first one has been marked. In the past, there were devices here that - when marking one device - also suppressed all other transmitters that newly entered the reception range. In the test, all devices detect the second transmitter (Fig. 4).



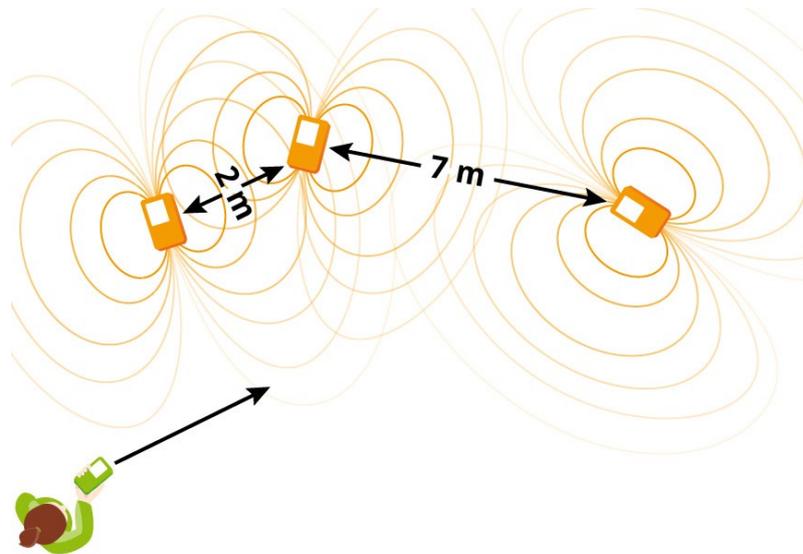
*Fig. 4: MB scenario 1 - two non-overlapping transmitters*

In the **second scenario** - the most likely MB scenario in practice - the signals from two transmitters overlap. One is in coaxial antenna coupling position in the path of the searching person, the second transmitter in y-antenna coupling position 15 meters behind. Here it is noted when the second device is discovered by the searching person and how direct the guidance is (Fig. 5).



*Fig. 5: MB scenario 2 - two overlapping transmitters*

In the **third scenario**, three closely positioned and therefore overlapping transmitters must be detected, found and marked. Two transmitters are within two meters of each other and one is about seven meters away from the others. The devices are hidden and the location is not apparent to searchers (Fig. 6).



*Fig. 6: MB scenario 3 - three overlapping transmitters*

Multiple burial evaluates how reliably other **devices** are **detected** (Fig. 7). On the other hand, whether and in what form the searching transceiver displays information on the number of receiving transmitters, distance and direction to the, after marking, new strongest signal and at what time all transmitters in the receiving space of the device are displayed.



*Fig. 7: Evaluation criterion Detection of a MB*

The second major issue evaluated is the actual **solving** (marking & tracking) of a multi-person burial (Fig. 8). The point is,

- whether the fading out (marking) of found transmitter works quickly and is permanent,
- whether direct tracking to the transmitter is possible, and
- how fast and reliable the device works overall in the situation (impression).



*Fig. 8: Evaluation Criterion Solving/Solution of (Marking & Tracking) a MB*

All in all, solving a complex multiple burial scenario is definitely the most intricate technical challenge for an avalanche transceiver. However, the function should not be overstated, as it is relatively rare for a complex multiple burial to occur at all. If it does happen, it is reassuring to know that your own device can reliably detect and stably mark several transmitters and that you know what to do.

## Group check

Since the group check is by default at the beginning of each tour, it is an important function. It should be easy to activate, be able to clearly distinguish transmitters and reliably display errors. To investigate the function, we go through a group check course with the devices.

- The first task is a correctly performed check of two transmitters at a distance of two meters to test the function when handled correctly.
- The second task is represented by two transmitters at a distance of only one meter. In practice, the required distances (between two and five meters, depending on the manufacturer) are not always observed. Can the transmitters be clearly distinguished or is there a risk of confusion? Can it be clearly identified when one of the two devices is not transmitting? Is there an error message that the transmitters are too close together?
- The third task is a transmitter that broadcasts at 457.1 kHz - i.e., outside the standard frequency. Does the device show an error message? If so, how detailed is this?
- The last task is a transmitter that transmits with a period of 1300 ms at the limit of the standard. Does the device show the deviation or not?

The most important point for the practical test carried out is the clear distinguishability of the transmitters. The greatest danger is that someone forgets to switch on his avalanche transceiver at all. This application error must be easily and clearly identifiable in a group check. Distinguishability is considered to be unambiguous if there is feedback via a display value or an acoustic signal in the close range that exactly the device just checked is also transmitting the signal received.

The device fault tasks determine whether the device detects the fault and makes it visible. Special features of the devices and noteworthy observations are listed in the device descriptions.

## Usability

The tested hard facts of the devices are the basis for a successful search. Fortunately, few of us ever get into the situation of having to search for someone in an emergency. However, how practical, intuitive and convenient is the operation of the device in everyday use? For this purpose, we checked various usability points for each of the tested devices:

- Operability of switches with gloves, switch geometry and handling
- Design & functionality of the support system
- Additional functions
- Battery and update management

We have added the most important conspicuous features or useful functions to the respective device description.

# Device characteristics

Arva <b>Evo 5</b> .....	13
Arva <b>Neo BT Pro</b> .....	15
BCA <b>Tracker 4</b> .....	17
Mammut <b>Barryvox</b> .....	19
Mammut <b>Barryvox S</b> .....	21
Pieps <b>Pro BT</b> / Black Diamond <b>Guide BT</b> .....	23
Pieps <b>Powder BT</b> / Black Diamond <b>Recon BT</b> .....	25
Pieps <b>Micro Race BT</b> .....	27
Black Diamond <b>Recon LT</b> .....	29
Ortovox <b>Diract Voice</b> .....	31

## Rating Scale

				
Very good	Good	Acceptable	Problematic	Deficient

## Arva Evo 5 (Version 1.8.1)

The successor to the Evo 4 is a simple and lightweight avalanche transceiver from the French manufacturer Arva. Even though it is a slight improvement over its predecessor, it still has some not insignificant weaknesses.



### Signal search:

In case of best antenna orientation a stable reception at 46m could be achieved. However, with a range of 28m in y- and only 17.5m in worst antenna orientation, the performance drops rapidly there. With a horizontal (x,y) transmitter, the considerable difference between initial signal reception and stable signal of an average of 17 and 11m, respectively, was also striking. Nevertheless: A clear improvement over the predecessor Evo4 in all antenna orientations. In case of surrounding interfering signals, this is displayed and the recommended search strip width of 50m is reduced to 20m.

### Coarse search:

Horizontal transmitter: ● Vertical transmitter: ●

The Evo 5 still has some room for improvement in the coarse search. With the horizontal transmitter, the device can still be rated as "Acceptable", but with the vertical transmitter, the approach was not without problems even at 10m offset and is therefore to be rated as "Deficient". The approach in the border area was characterized by serpentine lines and signal losses.

### Fine search:

Medium burial depth: ● Deep Burial: ● Search Support: ●

The Evo 5 shows two minima in all scenarios, which are, however, less than half a meter away from the actual minimum, which can therefore be probed in practice; it also reacts relatively sensitively to rotational movements with distance jumps of up to 0.5m in the deep burial scenario, which is why the aim should be to achieve as straight a cross-bracketing as possible without rotating the device around its own axis. The user-friendliness is good. An acoustic and visual aid supports the transition to the fine search mode or in this mode itself. The display values are stable, and the chip's computing speed allows a speedy procedure.

### Multiple burial:

Detection: ● Marking & Tracking: ●

If there were two transmitters further apart, the second one was not detected until the first one was marked! As for marking and tracking further transmitters in case of closely spaced transmitters, the result was once good, once bad. One has the impression that once the device detected a signal during a run, isolating the transmitters also works excellently. If this is not the case, however, the device leaves the person searching rather perplexed. In the evaluation of the MB, recognition is thus to be classified as just about acceptable, and marking and tracking as acceptable.

**Group check function:**

Pleasant: With the group check mode, which can be activated intuitively, the searching device can be brought very close to the one to be checked. If an error occurs, the audio frequency of the device changes briefly. Small distances between two transmitters were not displayed. The deviation in frequency was detected and communicated acoustically and visually.

**Usability:**

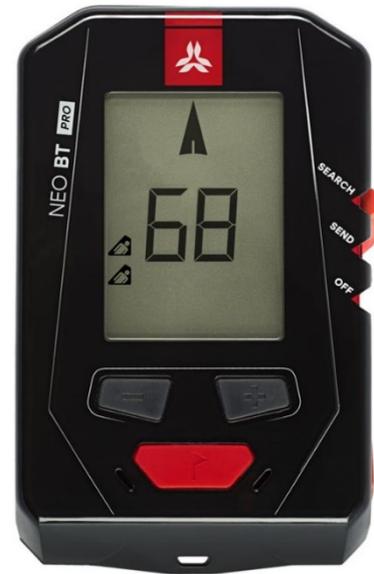
The low weight and handy size of the device are positive. Less pleasing is the toggle switch, which requires quite a bit of force to move, as well as the somewhat small lock button, which is challenging to impossible to use with gloves. In the field, the Evo5 is the only one that comes standard without its own carrying system (optionally available); leaving it out and stowing it in your pants pocket is a good idea in any case thanks to its small dimensions and thanks to the included strap (to be tied around the belly as a belt). When switching off, a warning tone sounds and it must also be confirmed with the marking key. This is a safety hurdle, but in practice, especially in training scenarios, it can happen that the device continues to transmit without being seen (slide switch set to Off). The device does not offer an update function.

## Arva "Neo BT Pro" (Software 1.1)

For its new Pro model Neo BT Pro, ARVA claims a remarkable 80m search strip width. With an analog sound mode as well as other features, the French manufacturer classifies it as a professional device.

### Signal search:

In case of best antenna position, the device actually has the highest range in the field with an average of 62.5m. First, non-stable pulses were received a few meters earlier. The mean values for the y- and z-antenna positions are 39 and 27m, respectively. In case of interfering signals, this is indicated on the screen and the recommended search strip width is reduced to 30m.



**Coarse search:** Horizontal transmitter: ● Vertical transmitter: ●

Due to the high range in good antenna position and solid approach, the Neo Pro BT works very well with a horizontal transmitter. In contrast, the device only proved to be acceptable with a vertical transmitter. There, an approach was only possible without problems at 15m lateral offset and at 20m with minor restrictions. The observed abrupt drop from display value 14 into the fine search is a shortcoming, here it can happen to run over the target (transmitter) when moving quickly.

**Fine search:** Medium burial depth: ● Deep Burial: ● Search support: ●

The device switched to fine search mode at display values 3m (measured distance of 2.6m). Small leaps occurred when rotating the device in the fine search. In case of deep burial and vertical transmitter, the device shows the minimum display value within a rather large radius of 0.9m. Overall, the Neo BT Pro performs very good in fine search at a burial depth of 0.8m and still with good in deep burial. The search support is also good due to quickly displayed and acoustically graded values.

**Multiple burial:** Detection: ● Marking & Tracking: ●

In the multiple burial scenario, the device performed good overall, with marking and tracking very good in the scenario with the three devices close together, and detecting additional devices after the first transmitter was good.

### Group check function:

Turning on the group check function is quite intuitive due to the flashing icon. Group check requires distances between searching and transmitting device of less than one meter. The distance values to the transmitter are quickly displayed, the tone frequency during the group

check changes compared to the conventional pulse tone and thus facilitates the assignment. An error message was displayed for the transmitter outside the standard frequency and also a too small distance between two transmitters to be checked was output. Another positive feature is that the group check can still be activated up to 20 minutes after switching on by pressing a key combination.

### **Usability:**

All of the device's keys are large enough to be operated right away, even with thick fingers or gloves. The existing + and - keys are intended for analog search mode and changing transceivers in MB mode. Turning on the Neo Pro takes the longest of the entire field, while turning it off is pleasantly counted down via a countdown. The case is made of hard plastic throughout, and a rubber coating on the edge is missing. There is a bit much strap material for the sizing of the carrying system. Power is supplied by 3xAAA batteries either alkaline or lithium. The battery status display did not seem very constant during our test and seemed to drop quite quickly. Arva also announced an app that can be used to connect to the Neo Pro BT via Bluetooth to update and configure the device. However, this was not yet available at the time of our test.

## BCA Tracker 4 (Software 6.4)

The new generation of the tracker series remains true to its line. The distinguishing feature is the red LED display, which makes background lighting unnecessary. Strengths are the fast signal processing, but it shows weaknesses in finding perpendicular transmitters.



### Signal search:

The distance when receiving the stable first signal is 42.5/24/9m on average (x/y/z position) for the Tracker4. The device is thus very sensitive to the influence of the antenna orientation. The reduction of the y- and z-position to the x-position is 44% and 79%, respectively. Interesting: while with the transmitter in the vertical position, the Tracker4 received stably only at 9m in the worst antenna orientation, the range increased when the device was turned close to the y-values, indicating a strongly elliptical reception range. From our point of view, it may therefore be advisable to swivel the device during the signal search, as with the older 1- or 2-antenna transceivers.

### Coarse search:

Horizontal transmitter: ● Vertical transmitter: ●

The Tracker4 features a fast display and a distinctive sound. At long range, the coarse search was characterized by short signal losses and distance leaps in both scenarios. In the close-up range, the approach was then without problems in each case. It was possible to find the transmitter with a horizontal transmitter at 25m offset with slight leaps, but with a vertical transmitter only at 15m.

### Fine search:

Medium burial depth: ● Deep Burial: ● Search support: ●

In fine search, the Tracker4 performed very good at medium burial depths and good in the deep burial scenarios. The device displays a single minimum in all scenarios, within a radius of only 25cm from the point directly above the transmitter. Only when turning the device, smaller distance leaps were displayed. The display value is slightly higher than the measured distance, so the device does not switch to the fine search mode at all if it is more than 1.6m above the transmitter - the directional arrow that is still present can then be misleading for the user. Positive are the quickly output display values, which allow a brisk (but not too hasty!) cross-bracketing; the fine acoustic tuning also has a supporting effect.

### Multiple burial:

Detection: ● Marking & Tracking: ●

Since the Tracker's solution for marking a transmitter in a multiple burial scenario is different from that of its competitors, the device quickly reaches its limits in some of the multiple burial scenarios we performed - especially with more than two transmitters.

In both scenarios carried out with two widely distanced transmitters, the device detects the second transmitter quite late; when the first transmitter is faded out, the searching person

must move away from the reception area relatively quickly, otherwise the first transmitter is displayed again after the signal suppression has expired. In the scenario with the three closely spaced transmitters, fading out was well possible in one run and guidance to the other transmitters was possible; in another case, however, fading out did not work reliably and guidance to the other transmitters was not possible. By pressing the Option key for a long time, an overview of the MB situation can be obtained in "Big Picture Mode" by displaying the respective distances to the devices.

### **Group check function:**

The Tracker4 does not have a group check function. Whether switched-on devices of other group members are also transmitting correctly has to be checked in the normal search mode, as in the past and now somewhat unfamiliar - awkward in larger groups or crowds. Devices with faulty transmission parameters were displayed without any abnormalities.

### **Usability:**

The case looks sturdy and is heavily rubberized on the sides. The somewhat protruding switch can easily be moved to the desired position - and stays there. The revision of the icons for Off, Send and Search are now unmistakable compared to the predecessor. On a test specimen, the rotary switch was slightly overtwisted. The device continued to function, but the switch position was no longer consistent. As it may be attached to the strap quickly, the elastic offers plenty of leeway - comfortable when searching, a little too long to just let it hang. With elastic band the device can only be placed in the pocket of the holder upside down. Also attached to this is a small key to open the battery compartment (3xAAA alkaline). Updates can be installed via a USB cable with the computer.

## Mammut Barryvox (Software 3.4)

The Barryvox is the Swiss company's all-round device and has already been on the market since 2018. Updates since then have improved a few small things. The usability is as solid as usual and can be learned intuitively and quickly even by new users.



### Signal search:

In terms of range, the Barryvox is one of the strongest devices, but after an early initial reception of a signal, there is a small blur until a stable signal remains (57/36/26m). In case of strong sources of interference, the recommended search strip width of 70m is reduced to 20m and this is clearly indicated on the display.

### Coarse search:

Horizontal transmitter: ● Vertical transmitter: ●

From the first reception, the person searching is always guided to the transmitter in a targeted manner. The display values decrease only slowly from the first reception, then continuously and in the transition range from the coarse to the fine search (from approx. 15m display value) partly large jumps occur. Users of the Barryvox must be even more attentive at the threshold of the two search phases than they already are, otherwise they run the risk of simply "walking over" the buried person if their walking speed is too high. However, those who know this should not have any problems with the Barryvox when approaching. However, there were differences between vertical and horizontal transmitters in the coarse search. With the former, signal loss occurred on some runs at 25m offset, as well as undetectable 180° errors.

### Fine search:

Medium burial depth: ● Deep Burial: ● Search support: ●

In the fine search, the Barryvox showed strengths in both the deep and less deep burial scenarios. The person searching is well supported acoustically when approaching, the visual assistance when changing from the coarse to the fine search from 3m could be clearer. The display value remains stable during rotation and is therefore also suitable for beginners.

### Multiple burial:

Detection: ● Marking & Tracking: ●

Analogous to the coarse and fine search, larger jumps in the display values for the distance also occurred here. All three transmitters were detected in all runs, although the third transmitter in the complex scenario was not detected until close to the 1st transmitter. However, the signal processing after marking a transmitter, which took quite a long time before it displayed another trackable signal, is annoying. 180° errors were detected and also displayed.

**Group check function:**

The group check can be activated easily. However, the transmitters to be checked must not be too close, otherwise an error tone will sound - somewhat annoying in cramped situations and not always one hundred percent clear. A transmitter is only indicated via an acoustic signal, but not via a distance display. A transmitter outside the standard frequency was not detected.

**Usability:**

The device gives an overall high-quality impression, the key selection works smoothly even with gloves and is always clear. The carrying system is well thought out, but seems a bit clunky. The device fits in there in only one way (display to the belly). It is pleasant that the device can still be switched on (=send) even when it is stowed away. Updates can be applied via a service center (manufacturer or partner businesses) or via another Barryvox device that has already been updated.

## Mammut Barryvox S (Software 3.4)

The professional device from the Swiss manufacturer Mammut comes up with several individual setting options and animated displays in the search phases and is therefore something for (tech-savvy) users. The Barryvox S is one of the three devices in the test where an analog tone can be added as an aid, e.g., in highly interference-prone environments.



### Signal search:

In terms of range, the Barryvox S is one of the strongest devices, but after an early initial reception of a signal, there is a small blur until a stable signal remains (55.5/38.5/28.5m). In case of strong sources of interference, the recommended search strip width of 70m is reduced to 20m and this is clearly indicated on the display.

### Coarse search:

Horizontal transmitter: ● Vertical transmitter: ●

The device performed well in the coarse search with both horizontal and vertical transmitters. From the first reception on, there are no more signal losses, although there are still larger jumps in the distance values. The directional display is slightly better nuanced than the "normal" Barryvox - however, the disturbing jumps during the approach when transitioning from coarse to fine search are even more pronounced (10 → 3m). If the searcher is aware of this fact and reduces the search speed significantly from a display value <15m, the device leads him/her directly and without detours to the transmitter. If a 180° error occurs, the device clearly indicates this and prompts you to turn around.

### Fine search:

Medium burial depth: ● Deep Burial: ● Search support: ●

In the fine search, the Barryvox showed strengths in both the deep and less deep burial scenarios (Very Good). The device has two fine search modes that can be selected in the basic settings of the device. In the so-called guided fine search ('standard'), the device instructs the person searching in the fine search where to move the device to get to the point with the smallest distance to the transmitter. In 'classic' mode, the usual cross appears below a 3m display value as an indication to cross-bracket. Experienced users will prefer the Classic mode; in Standard mode, non-beginners may move the device in exactly the wrong direction. Otherwise, the acoustic gradation is helpful and supports both the decision for the minimum and the correct selection of the cross-bracketing speed - this should nevertheless not be too high.

**Multiple burial:**

Detection: ● Marking &amp; Tracking: ●

Multiple transmitters are detected reliably. Transceivers that are far away from each other are no problem. If the same are close together, the device needs quite a long time until it can distinguish the "new" signal from the previously marked one. 180° errors are not uncommon in such scenarios; however, they are reliably detected and displayed by the Barryvox S. The list of all found transceivers on the right side of the display is also very helpful. The signal currently being tracked is boxed in. Marked transceivers can be selected and deselected using the arrow keys.

**Group check function:**

While the normal group check is active, a Pro-Check can be selected. In this case, if the required distance of 5 m between two transmitters is maintained, both the frequency and the period duration and length are displayed with numerical values. This feature is unique in the entire field of competitors and may be of interest to those responsible for larger groups. In the conventional group check, the device emits a false tone when transmitters are too close - somewhat annoying in cramped situations and not always one hundred percent clear.

**Usability:**

The device gives an overall high-quality impression, the key selection works smoothly even with gloves and is always clear. Various settings can be made directly in the device using the additional side buttons. The display is slightly larger than compared to the Barryvox - useful for the various animated displays in the search phases, which support the user. The carrying system is well thought out, but a bit clunky. The device fits in there in only one way (display to the belly). It is pleasant that it can still be switched to transmit mode even in the bracket. Compared to the Barryvox, the S version can be fitted with leak-proof lithium batteries, which increases the specified runtime to 400h. Updates can be applied via a service center (manufacturer or partner business) or via another Barryvox that has already been updated.

## Pieps Pro BT / Black Diamond Guide BT (Software 2.2)

The devices Pro BT and Guide BT from Pieps/Black Diamond have additional features compared to the Powder/Recon BT, but these are not necessarily necessary components of an avalanche transceiver.



### Signal search:

The Pro/Guide receives a signal at an average of 49/38.5/27m in x/y/z orientation. At first reception of the signal, the device vibrates supportively, the signal remains stable and is no longer lost.

### Coarse search:

Horizontal transmitter: ● Vertical transmitter ●

From the first signal on, there is a traceable signal, even if the directional arrow is somewhat ambiguous at the beginning. From a display value of around 40m, the distance values decrease constantly and the directional arrow guides the searching person very well into the near range. At 25m both scenarios (transmitter vertical/transmitter horizontal) worked without any problems. A 180° error can only be recognized by the increasing direction values and requires an attentive searcher.

### Fine search:

Medium burial depth: ● Deep Burial: ● Search support: ●

The Pro/Guide achieved a very good result at the burial depth of 0.8m. For deeper burials, the display value deviates somewhat from the actual burial depth. The correct minimum extends over quite a large area (plateau). The devices hardly react to rotation, the display values are output quickly and are stable. A deficiency is the late switch to fine search mode below 2m (with a horizontal transmitter and 1.6m depth only directly above the transmitter). Except for the disappearance of the arrows, no additional indication with respect to cross-bracketing appears when entering the near range - not really an advantage for beginners. In the fine search mode itself, the acoustics also no longer changes. Experienced searchers will not have any problems in most fine search scenarios, even despite the trade-offs.

### Multiple burial:

Detection: ● Marking & Tracking: ●

Additional transmitters are displayed stably well before the first one is reached. The approach to the second transmitter in the simpler scenarios was easily possible and straightforward, regardless of the transmitter's orientation. In the complex scenario, all three transmitters were displayed well before the first one was approached, even if the third transmitter was gone for a short time. In one run, a 180° error was not detectable and the tracked transmitter also changed once. Overall, signal detection after the successful (and always stable!) marking takes slightly longer than for the fastest devices in the field of competitors. The scan button (two different modes) can be used to get an overview of the MB situation.

**Group check function:**

A too small distance between two transmitters to be checked is not displayed, which is due to the conception of the group check (small distance possible). A transmitter deviating from the standard frequency was indicated with the error code 'ER'. The marking button has to be held all the time in the conventional group check, which is cumbersome for larger groups. In the Pieps app, the Pro group check mode (pulse period duration) can be switched on and activated by holding down the scan button.

**Usability:**

The Pro/Guide has an analog tone, a tilt meter and is compatible for TX600 transmitters (backup transmitters for dogs or similar outside the standard frequency). Switching between the modes using the slide switch takes some getting used to, but if done correctly, is actually logical. Reminder: First release the lock, then all the way up into transmit mode, release the lock and then (!) down into transmit mode. Worth mentioning is the very high specified battery life of 600h with leak-proof lithium batteries in transmit mode. With the help of the Pieps app, the device can be connected via Bluetooth, settings can be made and software updates can be applied. In addition, the app comes up with an extensive training mode.

## Pieps Powder BT / Black Diamond Recon BT / Recon X (Software 2.2)

The all-round models Powder BT and Recon BT are in no way inferior to the top models of the manufacturers Pieps/Black Diamond in terms of the basic parameters signal, coarse and fine search. If you can do without the scan version, the extended or Pro group check and other smaller features, you will get a solid device for a reduced price.



### Signal search:

The Powder/Recon BT achieved a stable maximum range of 50/38/27m in x/y/z orientation. From the first reception, the device quickly receives a stable signal, which is also not lost.

### Coarse search:

Horizontal transmitter: ● Vertical transmitter ●

From first signal reception no more signal loss, but rapid change of directional arrow between approx. 45° left and 45° right of x-direction. If the searching person does not follow every little twitch, but roughly maintains the main direction, the directional arrow settles after only a few meters and the distance display then constantly decreases. Even an initial wrong turn is promptly followed by the correction of the directional arrow in the right direction. The further approach to the transmitter is straightforward in both scenarios. Despite similar for the first reception, the real, stable first reception occurs about 5-7m earlier and the approach is more direct than with the Micro. A 180° error can only be recognized by the increasing directional values and requires an attentive searcher.

### Fine search:

Medium burial depth: ● Deep Burial: ● Search support: ●

The Powder BT/Recon BT achieved a very good result at the burial depth of 0.8m. For deeper burials, the display value deviates somewhat and a rather large plateau forms within which the correct minimum is displayed, but the scenario can still be rated Good. The devices hardly react to rotation, the display values are output quickly and are stable. A deficiency is the late switch to fine search mode below 2m (with a horizontal transmitter and 1.6m depth only directly above the transmitter). Except for the disappearance of the arrows, no additional indication with respect to cross-bracketing appears when entering the near range. In the fine search mode itself, the acoustics also no longer changes. Experienced searchers will not have significant problems in most fine search scenarios, even despite the trade-offs.

### Multiple burial:

Detection: ● Marking & Tracking: ●

The device reliably detects multiple transmitters regardless of the scenario. Once a transmitter has been marked, it usually remains stably marked. In the case of three closely spaced transmitters, however, the same transmitter was marked twice during one run; the third

remained "unnoticed" in the stress situation because the searcher only noticed afterwards that the same transmitter had been marked twice. On the other hand, the recognition, tracking and marking of all transmitters worked without any problems again during the repeat run.

### **Group check function:**

The device detected a device transmitting outside the standard frequency. In both tests, it is possible to get close to the transmitter, which largely eliminates errors - the reception range is generally limited to one meter in the group check. Not so pleasantly solved, as with all Pieps devices, is the fact that the marker button has to be held down all the time for the group check.

### **Usability:**

Switching between the modes using the slide switch takes some getting used to, but if done correctly, is actually logical. Reminder: First release the lock, then all the way up into transmit mode, release the lock and then (!) down into transmit mode. With the help of the Pieps app, the device can be connected via Bluetooth, settings can be made and software updates can be applied. In addition, the app comes up with an extensive training mode.

## Pieps Micro BT Race (Software 3.2)

Light & Fast and yet solid in performance, the Micro BT Race (formerly Button) scores. Like all Pieps devices, it convinces with a stable signal from the first reception. And: The device reacts the same way in all runs - very pleasant when the user knows how his/her avalanche transceiver reacts in certain situations. The device will no longer be available from the 2022/23 season. Nevertheless, we tested the Micro Race for the sake of completeness.



### Signal search:

The Micro BT Race receives a signal at an average of 50/36/24.5m in x/y/z orientation. At first reception of the signal, the device vibrates supportively, the signal remains stable and is no longer lost.

**Coarse search:** Horizontal transmitter: ● Vertical transmitter: ●

From the first reception of the signal, the device leads to the transmitter reliably and without signal loss. With a vertical transmitter and a large lateral offset (>25m), signal tracking becomes a guessing game - if you decide on the right side, the approach is carried out without problems. A 180° error can only be recognized by the increasing direction values and requires an attentive searcher. In the far range after the first reception, you must not let the slightly jumping directional arrows throw you off and not follow every twitch of the directional arrow immediately, because after a short time the approach is already safe and straight.

**Fine search:** Medium burial depth: ● Deep Burial: ● Search support: ●

In the fine search, the device performed very well in the scenario with medium burial depth (0.8m). In deeper burials, the late switch to the fine search mode below 2m (with a horizontal transmitter and 1.6m depth only directly above the transmitter) is to be criticized. In addition, the discrepancy between the displayed value and real burial depth grows somewhat, as does the plateau of the minimum. Nevertheless, the deep burial can be rated Good, the values remain stable and do not change when turning the device. As with all Pieps devices, the change to the fine search is neither indicated acoustically nor visually. Only the direction arrows disappear. The acoustic gradation also does not change when approaching. Therefore, the device only scores acceptably in supporting the searcher in the fine search.

**Multiple burial:** Detection: ● Marking & Tracking: ●

The Micro Race made a good impression in the MB - a tad better even than the brand's own colleagues. After marking, even in the complex MB situation with three closely spaced transmitters, there was no extended pause until the new signal was clearly processed and could consequently be tracked. In all scenarios, all transceivers were always displayed correctly and stably; marking also worked without problems.

**Group check function:**

Although Pieps specifies a minimum distance in the user manual, you can get very close to the transmitter you want to check. It is somewhat cumbersome that the marking button must be held down the entire time during the avalanche transceiver check (display "CH"). During the check itself, the displayed distance to the transmitter allows a perfect assignment. If there are several devices within 1m, CH and additionally a buried person symbol will appear. The faulty transmission frequency has been detected.

**Usability:**

The carrying system is spartanly small and the waist strap takes some getting used to, but it's not uncomfortable. In the carrying system, the power-on rotary knob is secured against unintentional switching off of the device. Without a lock, the switch seems a bit too smooth-running. The device feels good in the hand despite its small dimensions. The case's hard plastic is not rubberized on the side, but only ribbed for a better grip. Unfortunately, the speaker is positioned unfavorably and you can easily cover it with a normal hand position and hardly hear a "beep" when searching. With the help of the Pieps app, the device can be connected via Bluetooth, settings can be made and software updates can be applied. In addition, the app comes up with an extensive training mode.

## Black Diamond Recon LT (Software 1.2)

The Recon LT, newly released just last winter, is distributed exclusively by Black Diamond. Its shape is reminiscent of the Micro series by Pieps - but turned upside down. A completely different casing concept and most search parameters can convince for the most part in the test.



### Signal search:

A stably trackable signal was present in x, y, and z antenna orientations at 43, 33, and 23.5m, respectively. Thus, the values were all slightly lower than the Pieps Micro series devices.

### Coarse search:

Horizontal transmitter: ● Vertical transmitter ●

With a horizontal transmitter, a signal can be received and stably tracked even at 30m lateral offset (Very good). Initially, the display values do not drop constantly, but after about 10m, both the distance display and the directional arrow are stable. With a vertical transmitter, the coarse search can still be rated as being good. The 25m lateral offset was the limit of what was feasible for the Recon LT, short signal loss occurred on half of the runs. In the test scenario, the directional arrow jumped between right and left a bit more frequently after signal reception than in the related devices and thus made approaching in the far range a bit more difficult. A 180°-degree error can only be recognized by the increasing direction values and requires an attentive searcher.

### Fine search:

Medium burial depth: ● Deep Burial: ● Search support: ●

In the fine search, the device performed very well in the scenario with average burial depth (0.8m). For deeper burials, the late switch to fine search mode below 2m (with a horizontal transmitter and 1.6m depth only directly above the transmitter) is to be criticized. Moreover, the discrepancy between the displayed value and the real burial depth grows as does the plateau of the distance minimum. Nevertheless, the deep burial can be rated Good, the values remain stable and do not change when turning the device. As with all Pieps devices, the change to the fine search is neither indicated acoustically nor visually. Only the directional arrows disappear. The acoustic gradation also does not change when approaching.

### Multiple burial:

Detection: ● Marking & Tracking: ●

Both the detection and the tracking of several transmitters, even if they are close to each other, is problem-free. In the complex scenario, the "small" devices by Pieps and Black Diamond tended to perform even slightly better/faster than the larger models.

**Group check function:**

Pleasant: It is possible to get very close to the transmitters to be checked. For this reason, and thanks to the distance display, accurate assignment of the transmitter is possible even in cramped situations or when group members are standing close together. A detected transmitter is displayed with the same audio frequency as in the fine search. Less pleasant: The somewhat small marking button has to be held down constantly, which is relatively tedious with gloves and/or large fingers. A transmitter outside the standard frequency was reliably displayed, but not two transmitters that were too close to each other.

**Usability:**

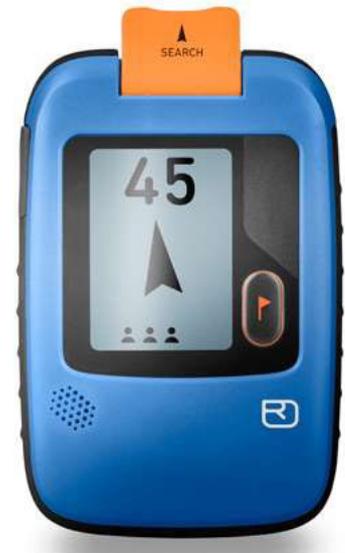
The Recon LT is very light and feels good in the hand. The distinctive rotary knob is secured against unintentional switching by a large slide switch with lock. However, the intended changeover requires some force to push the lock aside. The carrying system is spartan, but sufficient. However, it no longer offers any mechanical protection against shocks. The length of the elastic band is just sufficient to guide the device close to the snow surface in fine search. With the help of the Pieps app, the device can be connected via Bluetooth, settings can be made and software updates can be applied. In addition, the app comes up with an extensive training mode.

## Ortovox Diract Voice (Test software 2.0)

The new Diract in the language version "Diract Voice" from Ortovox after the extensive test showed known weaknesses of predecessors, but also new strengths, especially in the fine search and ease of use. Two software versions were tested by us. Due to minor, but not insignificant improvements, owners of devices with software 1.1 should definitely update them to the latest software as soon as it is available.

### Signal search:

The x and y positions are 32m and 22m respectively. In the worst possible antenna orientation, the range is half as high being 16 meters. From the first reception, the signal is always stable and no longer makes any irritating jumps, both with regard to the directional arrow and the distance display. In the case of nearby sources of interference, this is made visually clear and the recommended search strip width is reduced to 20m.



### Coarse search:

Horizontal transmitter: ● Vertical transmitter: ●

While the coarse search can be rated as "good" with the horizontal transmitter, the low range in unfavorable antenna orientation has a negative effect on the coarse search (15m lateral offset was the absolute maximum in one run with the vertical transmitter) and must thus be rated as "problematic". However, if the device receives a signal, the directional arrow is fine-tuned, the approach to the transmitter is very good and the user is reliably guided through the voice control in case of a 180° error.

### Fine search:

Medium burial depth: ● Deep Burial: ● Search support: ●

The Diract performed very well in both fine search scenarios. Visual and acoustic support are excellent, the displayed minimum corresponds well to the real burial depth even in the deep burial scenario, which should allow a quick completion of the fine search. And: Voice control support is very helpful during two particularly critical phases related to fine search - the airport approach at the beginning ("Go down to the snow surface") and the unnoticed overriding of a previous distance minimum ("You had already been closer").

### Multiple burial:

Detection: ● Marking & Tracking: ●

The detection of multiple transmitters works better and worse depending on the scenario. Additional transmitters are sometimes only displayed in the immediate vicinity of the first transmitter or only after it has been marked, which can have a negative effect on search management. In addition, further transmitters are not displayed in the fine search, which is suboptimal in the stressful situation to maintain an overview; signals are nevertheless not lost, but are displayed "in order". Thus, the Ortovox scores acceptably regarding detection. The voice navigation, on the other hand, was very pleasant, especially in this situation, as it quickly

drew attention to any 180° errors. Overall, this results in a good rating when marking and tracking.

### **Group check function:**

The Diract Voice was the only device to detect a longer period duration of a transceiver to be checked. However, no error was issued in the test scenario with a deviating frequency - the device then needs considerably longer for signal processing, though. If two transmitters are too close to each other, the device detects this only immediately before and then shows an icon with several people in the display. The visual and acoustic support during the group check is very good. The visual prompt "Group Check" after switching on the device may possibly persuade one or the other person to sensibly perform the group check after all.

### **Usability:**

The Diract is relatively wide, but still lies well in the hand thanks to its shape and the rubber coating on the side. The switch geometry takes some getting used to but is designed in such a way that unintentional switching off of the device during the tour is almost impossible and can be operated well with gloves. The carrying system is quite light and equipped with Recco reflector. Carabiner connection and elastic band are well solved. The low frequency of the transmission display is not quite ideal - since the switch position does not indicate whether the device is on or off, it is easy to forget to turn it off. By using a Li-battery with USB-C port for the first time, charging is quick and easy. The voice output offers newcomers, but also experienced users, interesting additional support in stressful situations - and since the manufacturer can expand it via the software, it also offers potential for further development. The device can be updated via an associated app. A connection to the device can be established via Bluetooth, configurations can be carried out, and the knowledge content provided can be accessed.

Avalanche Transceiver Test 2022 DAV Safety Research		Arva		Bca	Mammut		Pieps / Black Diamond			Ortovox	
<b>DEVICE DATA</b>		Evo 5 	Neo BT Pro 	Tracker 4 	Barryvox 	Barryvox S 	Pro BT/ Guide BT 	Powder BT/ BD Recon BT/Recon X 	Micro BT Race/Sensor 	Recon LT 	Diract Voice / Diract 
<i>Except switch-on times all information according to the manufacturers and without guarantee</i>											
Target group		Allround	Professional	Allround	Allround	Professional	Professional	Allround	Allround	Allround	Allround
Latest software version (2022)		1.8.1	1.1	6.4	3.4	3.4	2.2	2.2	3.2	1.2	1.1 / 2.1 January 23
<b>TECHNICAL</b>	Number of antennas	3	3	3	3	3	3	3	3	3	3
	Display illumination (only at switch on and search mode)	Yes	Yes	Yes (LED)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Batteries required	AA x1	AAA x3	AAA x3	AAA x3	AAA x3	AAA x3	AAA x3	AA x1	AA x1	Li-Io Battery***
	Battery life in transmitting mode	220h	350h/450*h	250h	300h	300/400*h	400/600*h	200/300*h	200/350*h	200/350*h	300h
	Groupcheck-function	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Parameters checked	Frequency and transmitting power		-	Frequency, transmitting power	Pro Test: shows frequency, pulse period values	Extended: frequency, pulse, period**	Simple: Frequency	Extended: frequency, pulse, period**		
<b>AUTO-REVERT SEARCH TO SEND</b>		Yes	Yes	Yes**	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Without moving after	8min	Off/2/4(default)/8min**	1 min	4 min	4 min (default), einstellbar	60/90/120 s**	60/90/120 s**	60/90/120 s**	60/90/120 s**	2 min
	Can be deactivated	No	Yes	Yes	No	Yes	deactivated **	deactivated **	No	Yes**	Yes
<b>SEARCH</b>	Recommended search strip width	50m	80m/ Analog 90m	50m	70m	70m/ Analog 100m	60m	60m	50m	50m	50m
	Analog sound available	No	Yes	No	No	Yes	Yes	No	No	No	No
	Marking function	Yes	Yes	No marking → signal suppression 1min	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Markierung einzeln aufhebbar	No	No	No	No	Yes*	Yes	Yes	No	No	No
<b>FUNCTION</b>	Switch-on time to transmit	8 sec	24 sec	7 sec	4,5 sec	6 sec	7 sec	7 sec	7,5 sec	9,5 sec	16,5 sec
	Switch time to search	immediate	2 sec	4 sec	3 sec	2-6 sec	4,5 sec	5 sec	5 sec	4 sec	3 sec
	Additional functions / features	U-Turn Alarm		Big Picture Mode Signal Suppression	U-Turn Alarm W-Link		Auto Antenna Switch iProbe Support			Voice navigation** Smart Antenna U-Turn Alarm Standby function Recco in case	
			Standby function MB-list			Pro-Search MB-list Rescue Send Vitaldata	Scan button Inclinometer TX-600 support				
	Able to update software	No	Yes**	Yes***	Yes***	Yes***	Yes**			Yes	
	Mobile app with Bluetooth connection available	No	Yes	No	No	No	Yes			Yes	
	Service/Maintenance	1 year for professional use 3 years for private use	2 years for professional use 3 years for private use	5 years, after 3 years service and update	3 years or 3000 hours of use. Check next service: switching off press „Info“	3 years or 3000 hours of use. Check next service: switching off press „Maintenance“	1. service 3 years after date of purchase 2. service 5 years after date of purchase After that service required annually			first service after 5 years, then every 2 years	
	Warranty	2 + 3*** years		5 years	2 + 3 years ****		2 + 3 years***		2 + 1 years***	2 + 3 years***	2 + 3**** years
	Weight	165g	214g	215g	210g	210g	230g	220g	150g	160g	210g
	Price	€ 265.-	€ 330,-	€ 340.-	€ 300,-	€ 400.-	€ 400.-	€ 300.-	€ 320/340.- (Race/Sensor)	€ 320.-	€ 390**/330.-

<b>Additional information</b>	*with lithium batteries				
	**Arva App settings *** with registration at Arva	**to be activated options button must be pressed each time when switching on ***connectable to computer via cable	*** Device-to-device Update or Mammut Service Point **** with registration at barryvox.com	** Pieps Mobile Application settings *** with registration at Pieps Service Portal or Pieps-App	** Direct Voice *** rechargeable with USB-C cable ****with registration

### Short explanation of the various additional technologies of the manufacturers

#### **ARVA**

##### Standby Mode

Standby-Mode: user does not have to turn device off while shovelling.

#### **BCA**

##### Signal Suppression

Suppresses the strongest signal and shows second strongest. Returns to standard search after 1 minute.

##### Big Picture Mode

Overview: shows distances and direction of all transmitting transceivers in range.

#### **MAMMUT**

##### W-Link-communication

W-Link is an additional communication channel to send and receive vital data. Frequency regulations in some countries do not allow → W-Link can be switched off.

##### Pro Search: Alternate-Search mode/Range+

Alternate Search mode which shows distance and direction to the strongest signal and has an analogue search sound. Range+ the search strip width is raised to 100m, signal search with analogue sound but without display.

##### Rescue Send

In Rescue Send the transmitting signal is temporarily suppressed, to not disturb the search of other burials. Without movement it returns to transmitting after 4min.

##### Vital-Data

Motion sensor detects small movements and transmits the chance of survival to other W-Link devices (Triage). Barryvox S records the time of burial.

#### **PIEPS / BLACK DIAMOND**

##### Auto-Antenna-Switch

If the antenna is interfered by an external source (mobile phone) in search mode, the device switches the antenna.

##### iProbe-Support

Avalanche transceivers with iProbe-Support will be automatically deactivated when being probed by the Pieps iProbe → the receiving transceiver will automatically be shown the next strongest signal.

iProbe: probe, which makes sounds when close to the transmitting transceivers.

##### Backup-Mode

Transmitting mode is temporarily deactivated to not disturb other searchers.

##### Vibra:

Vibration motor build into Pro/Guide BT and Micros. Vibrates at first signal detection and when switching on into transmitting.

##### TX-600

Der TX600-Mode enables to receive the signal of the PIEPS TX600 (mini-transmitter for dogs/equipment which transmits at 456 kHz).

##### Scan-Button

The regular SCAN gives an overview of all buried transceivers in predefined ranges. This mode is standard. The detailed SCAN shows direction and distance to each buried transceiver and allows selection of the transceiver. Can be activated in Pieps App.

##### Inclinometer:

By pressing the Scan-button of Pro BT/Guide BT in transmitting mode the inclination of the slope can be displayed.

#### **ORTOVOX**

##### Voice-Navigation

In all search phase various voice commands support the user.

##### Smart-Antenna

Analyses the orientation of the device in the avalanche and in case of vertical orientation (worst case) switches to the horizontal antenna for better range.

##### RECCO Reflektor

Integrated RECCO reflector is an additional backup, can only be found by professional Recco search devices (organized rescue services).

##### Standby-Mode

Mode which suppresses the transmitting signal for not disturbing other searcher without having to turn the device off. Switches back to transmitting when no motion is detected.