

Digital vs. Analog Technology in the Avalanche Rescue Field

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This paper will discuss both analogue and digital technologies as to their application to avalanche transceivers. Ortovox's philosophy concerning simplicity vs. technology also will be discussed.

Key Words: Digital, analogue, pulse rate, norm standard, compatibility.

Main Requirements for Avalanche Beacons

1. Receiver Sensitivity

Paragraph 3.3.3 of DIN EN 282:

"In the best coupling position, i.e. when the antenna rod is parallel to the lines of the magnetic field, the following field strengths shall produce a signal plus noise to noise ratio ($\{S + N\}/N$) of 6 dB, measured flat over a bandwidth of 20 kHz at the terminals of the electro-acoustic transducer:

type 1f=	457 kHz	80 nA/m
type 2f=	2,275 kHz	10 nA/m
f=	457 kHz	200 nA/m..."

Basically, this means that with electro-acoustic transceivers you should hear a clear piep signal in a distance of about 50 meters. The available transceivers on the market have an average range of 60 to 80 meters, depending upon an individual's hearing ability.

New techniques in the future, however they work, should show a signal within a range of 50 meters. If not, they don't properly fulfill (din) norm requirements.

2. Searching Distance

The definition of searching distance is equal to the shortest range of a transceiver.

*With conventional (analog) acoustical transceivers, the searching distance is 40% of the maximum range -

$$80\text{m} \times 40\% = 32\text{m}$$

*For the 20 year old Ortovox F2 Beacon:

$$50\text{m} \times 40\% = 20\text{m}$$

Therefore, there is great variability between searching distances of the various acoustic transceivers on the market.

*Statistics show that inexperienced searchers have at most a yield of 98%.

3. Switching from Transmit to Receive Mode

Paragraph 3.10 of DIN EN 282:

"The avalanche beacons shall permit reliable and fast switch-over from transmit to receive mode, without any danger of unintentionally turning off the device.

The transit mode shall include a safety feature against involuntary turn-off. In the receive mode, there shall be a means to modify the received signal manually."

Preface: Safety has its own limits and nobody is perfect!

However, the transmitter of a beacon should never be unintentionally switched over to "receive" or "off".

This standard is well justified: Can you imagine if you were caught by an avalanche and suddenly your receiver no longer transmits because it is inadvertently switched to "receive" by the impact of the avalanche and you are unable to switch it back? You can hear the rescue team searching above but unable to locate you due to the design fault. Even if after 5 minutes, your transceiver switches back automatically to the transmit mode, precious time has been lost in the search process. If the rescue team passed over your position without receiving a signal, they will never find you gain. In Austria, the guide exams require locating two victims within 5 minutes.

Moreover, from a practical standpoint, the automatic switch-back to the transmit mode is unacceptable for the following reason: After 5 minutes of a group search, one of the team's beacons unintentionally switches back to the transmit mode. This action disturbs the search and even makes it impossible!

4. Compatibility

General definition: Independent from the used technique, all brands have to mutually receive in the same quality (pulse rates).

Extended definition of full compatibility means:

- a. mutual receiving with the required minimum range of 50m in accordance with DIN standard.
- b. ability to locate several burials at the same time:

*It must be certain that all victims have the same chance. A receiver which prefers a special transmitter mode must be dismissed.

*Multiple burials may be searched at the same time, one after the other, without having to switching off the beacon of the first victim found. It is well known that you sometimes need more than half an hour to recover a body. You don't have time to wait before continuing the search for the next victim.

The pulse rates of the beacons must be compatible!
The following table shows pulse rates per minute:

Tracker - DTS	75
Pieps - Opti Finder	65
Arva - 8000	52
SOS - F1nd	50
Ortovox - Focus	50

5. Analog/Digital Techniques

What's the practical use of a digital transceiver for the user?

The distance is shown in meters.

What does the user really need?

- a. audio information on direction
- b. information on whether you are closer or farther away from the target
- c. confirmation that you have reached your target - the signal no longer increases.

Summary:

The most important information the searcher needs is analogical.

It is helpful when you get additional information after your pinpoint search such as how deep the victim is buried. But it is not essential because a physical search with a probe pole will give you an exact depth.

Digital transceivers which search without analog information are not much of a technological advancement! They take the simplicity out of the search.

6. Search Time

The search time is composed of the following:

- a. **Search Preparation.** It can take as long as five minutes to insure that everybody in the search crew is switched over to the receive mode.
- b. **Coarse Search.** The length of the coarse search depends upon the minimum range of the transceiver. A distance of 30m takes about 3 times as long as a 10m search distance.
- c. **Fine Search.** The more experienced you are, the faster the fine search! This time can also be reduced by digitally transceived information.

7. Handling

A transceiver must be foolproof as well as most effective in its search technique. For example, a large number of fatal accidents have occurred because people have failed to switch on their beacons. Or, they didn't realize that their beacons weren't functioning.

The **M-1** offers many important features:

- forced on/off switch
- analog battery control
- switch-over to receive mode
- quick emergency switch-back to transmit mode
- menu-controlled searching makes it foolproof
- visual searching supported by a worldwide known acoustical principle
- coarse search indicator
- search arrow
- volume control indicator
- pinpoint search indicator

Everything that you need is provided with a clear display reading!