Barryvox®

A Fascinating History

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Version: 1.5

Started: July 27, 2017

Modified: August 12, 2017

File: Barryvox History DIN A4.docx

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Modifications

Version	Date	Author	Comment
1.0	27.07.2017	Felix Meier	created
1.1	28.07.2017	Felix Meier	updated
1.2	29.07.2017	Felix Meier	release Allmountain
1.3	10.08.2017	Felix Meier	release Web Site
1.4	12.08.2017	Felix Meier	product naming
1.5	12.08.2017	Felix Meier	patents

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1 History

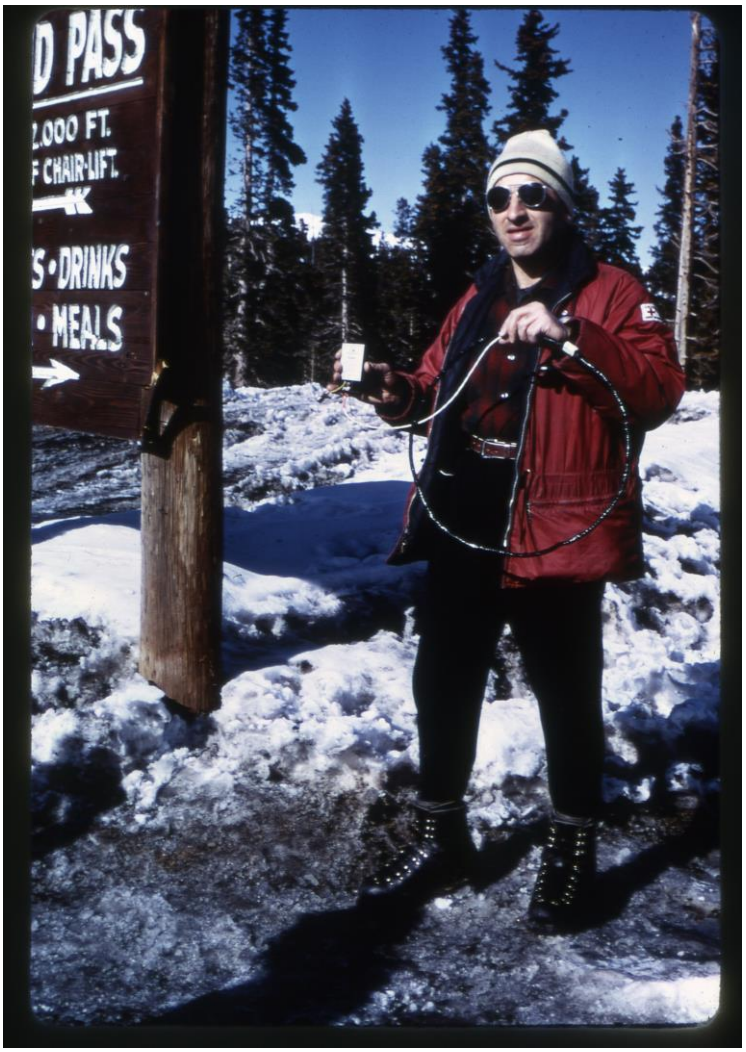
1.1 Skadi, the First Transceiver

John Lawton, an electrical engineer and pilot, was employed by the Cornell Aeronautical Laboratory in Buffalo, NY, USA. In his spare time, he did voluntary work as a ski patroller at a nearby ski area.

Together with a colleague, he invented and patented the first transceiver [3], [10]. It was named the Skadi (nicknamed "Hot Dog") an operated at a frequency of 2.275 kHz.

The word Skadi comes from the old Norse word Skaði, variant Skade. This female is often referred to as the goddess of skis; she traveled on skis, carried a bow, and hunted. She was the daughter of the giant Thiazi, and married Ullr, the god of skis [3].

The first field trials were performed in Colorado and in Utah. The picture shows John Lawton during a test in November 1968 at the Berthoud pass in Colorado [9]. Note the use of an unhandy loop antenna in place of a small ferrite antenna.



Further field trials led con contacts with Ed LaChapelle und Monty Atwater; the then leading US avalanche researchers. The first Skadis were brought to market in 1971.

The first save by means of SKADI and by any avalanche rescue beacon, occurred on Jan. 10, 1972 at 11:00 A.M. At CMH (Canadian Mountain Holidays) the victim was Roy Fisher [3].

In March and April of 1969, the Skadi was tested by the Swiss Federal Institute for Snow and Avalanche Research and compared to other means for locating buried victims [4]. The Skadi performed far better than all other means, and so the Swiss army became interested. But, obviously, the army wanted a device of domestic provenience. So it put out a national call for tender for the development and production of a transceiver that was answered by Zellweger AG from Uster and Autophon AG from Solothurn.

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1.2 VS 68

On December 23, 1970, Autophon AG was awarded a contract based on extensive preliminary work and because its board of directors had better connections to the procurement agency [6]. The tender quoted the following costs (in Swiss Francs) and deadlines [5]:

Development	176'660.00
Tooling	35'000.00
Tentative price (at least 10'000 pcs)	175.00
Completion of development	13 months after order
Pilot production, including field trials and modifications	16 – 18 months
Full production (200 – 2'500 pcs / month)	16 months after approval

The first round of development was completed at the end of 1971.

The army field trials were conducted by the army's Central School for Mountain Combat in Andermatt. They involved 82 devices and were done, among others, with the soldiers of a course for avalanche specialists for mountain units that I participated in.

The Swiss army then ordered 30'000 pcs, and another 6'000 pcs were ordered by the federal agency for youth and sports.

Although the device was named VS 68, it was only put to regular use in 1974.

The VS 68 designation was the name of the project of the Swiss army procurement agency that was started in 1968 for finding a better solution to avalanche rescue [13].

The product name "Barryvox" was coined by Karl Peter, the then head of product advertising at Autophon AG. It makes reference to the famous rescue dog named Barry. Barry was kept by the monks on the Great Saint Bernhard pass and is said to have saved more than 40 lives [12], [13].

The VS 68 was not offered on the free market before 1974. In the following years, about 2'000 to 4'000 items per year were sold on the free market.

1.3 LVS 75

In the years 1973 to 1975, the VS 68 received a modest overhaul, and the color of the case was changed to red in order to minimize the "drift" of army devices to civilian use. The new devices were named LVS 75. On the free market, sales continued with the original yellow VS 68.

1.4 VS 68 II

After production for the army, the modest volume achieved in the free market was a poor fit to the high volume structures of Autophon AG. As a consequence, in the early 80ties development and production were handed over to Girsberger Elektronik AG in Eglisau.

In 1987, the electronics of the VS 68 were adapted to the upcoming Surface Mount Devices (SMD) technology. The circuits remained the same, and the case color was changed from yellow to orange.

In 1987, Autophon AG merged with Hasler AG and Zellweger AG into Ascom AG.

1.5 VS2000 / LVS 95

In 1993, the Swiss army needed to replace their stock of VS 68 / LVS 75. The contract was awarded to Girsberger Elektronik AG. The case underwent a redesign, and the electronics were adapted to the state of the art. For the first time, a full-custom chip in mixed technology (analog/digital) was employed. The chip was made by AMS AG of Austria. The VS 2000 was the first transceiver that provided an automatic revert to send feature to mitigate the effects of secondary avalanches. For army use, the device was named LVS 95.

1.6 Barryvox S2

The Barryvox S2 was developed by Girsberger Elektronik AG in an attempt to promote the dissemination of the devices among off piste skiers. Its success was rather modest. In order to keep the price low, the device contained only a transmitter but no receiver; so immediate rescue by companions was not possible. This led to serious complaints by the user community. The S2 is still in use today in Chilean mining operations.

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1.7 VS 2000 Pro

The VS 2000 Pro was developed in 2005 by Girsberger Elektronik AG and targeted at professional rescuers. Its range was extended relative to the VS 2000. Automatic revert to send was suppressed, since it caused more trouble than benefit to professional rescuers. The analog circuits were implemented with discrete components again, because the full custom chip's circuits produced too much noise. For the control logic a Field Programmable Logic Array (FPGA) was used.

The VS 2000 Pro was the first device to offer an option for the connection of a more powerful external antenna. The option is mostly used for searching avalanches with an antenna that is suspended underneath a helicopter.

The Ascom AG was primarily doing business with large companies and government agencies. In the early 1990ies it came to realize that its marketing structures were a poor fit for a consumer product, and so the marketing was handed over to the Mammut Sports Group AG.

1.8 OPTO 3000

In 1997, Backcountry Access of Boulder, CO started marketing the first digital two antenna transceiver, the Tracker. Mammut and Ascom were forced to catch up. So, in the years 1998/1999 Girsberger Elektronik AG and Ascom AG developed the OPTO 3000 which became the first digital Barryvox, also providing two antennas. The OPTO 3000 used an 8 bit microprocessor. The digital processing of signals was hard to do. In order to squeeze as much computing power as possible from the limited resources, the operating system and most of the digital signal processing had to be coded in assembler.

Production started in 1999 at Ascom AG in Hombrechtikon. In the first two years, two versions were produced that were different only in the color of and printing on the case. Later on, no more devices were marketed via Burton Snowboards. From 1999 to 2006, a total of about 150'000 devices was sold.

1.8.1 Mammut

1.8.2 Burton

1.9 Barryvox Pulse

In 2005, Ascom AG started the development of the Barryvox Pulse with support from Girsberger Elektronik AG. The new device used a 32 bit microprocessor with an ARM core. It provided three antennas in order to achieve an acceptable range even in very unfavorable situations, and for the first time, a graphic display was used. New sensors for the earth's magnetic field and for linear acceleration were used for better user support via the display. A major new feature was the transmission of vital data (pulse, breathing) of buried persons. For the first time, an algorithm for separating the signals from multiple buried transceivers was implemented. The software development effort exploded: whereas the software for the OPTO 3000 was done in a single man year, the Pulse software took about eight man years!

The pulse was the first device to provide a second radio channel (WLINK). The channel is used for vital data transmission, for firmware updates and for purposes of testing.

The Barryvox Pulse was first marketed in the winter 2006/2007.

In 2008, the Barryvox brand and the intellectual property rights were sold by Ascom AG to the Mammut Sports Group AG. In the same year, Ascom AG transferred the development unit that, among other products, took care of the Barryvox, to the CCS Adaxys AG.

Up to today, the Barryvox products are developed and manufactured in Switzerland by CCS Adaxys AG.

1.10 Barryvox Element

The low cost Barryvox Element was derived from the Barryvox Pulse in 2011. The graphic display was replaced by a segmented display; the user interface was reduced to a single key. Rarely used menu options were eliminated. The option for analog mode, which is offered by all other Barryvox devices, is not available on the Element.

1.11 Barryvox S

After several preliminary investigations, the development of the Barryvox S was started in the spring of 2014 by CCS Adaxys AG. The new device uses more sensors (angular acceleration), and the graphic display is larger and offers a higher resolution. The user interface and guidance through the search process and the handling of multiple burials were significantly improved. Also, several invisible functions received special attention: The Barryvox can simultaneously deal with signals from transmitters located at a wide range of distances, e.g. 0.5 meters to 60 meters. The receiver sensitivity is flat over the entire frequency range as set down by the standard (457 kHz ±80 Hz) and even beyond (±160 Hz) below maximum gain. Interference recognition and automatic adaptation have been improved.

Sales of the Barryvox S will start in the winter 2017/2018. The picture shows a prototype.

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2 Frequency

The frequency of 2.275 kHz that was used by the Skadi and later on by other European products exhibited a serious disadvantage:

At this (very low) frequency, it was impossible to build a heterodyne receiver. In receiver mode, the earphone was at the same time a transmitting antenna, and the amplified signal was coupled back into the receiving antenna. This created a closed loop. If the gain of the amplifier was too high, the system began to oscillate on its own frequency. This limited the useful range to 25 to 30 meters. The same effect manifests when the microphone gain is set too high in a public address system.

Therefore, Autophon tried to find another frequency that would allow the implementation of a heterodyne receiver, thus breaking the closed loop and allowing for higher gains. This enabled more than doubling the range. It also permitted to replace the earphone by a speaker, thus eliminating all hassle with the earphone plug and cable.

The first attempts at 40 kHz and at 240 kHz did not yield satisfactory results. Towards the end of the development, the army, the Swiss PTT (aka the Swiss FCC) and Autophon AG agreed on 457 kHz. This frequency is very close to the intermediate frequency of medium wave radio receivers that were very popular at that time. In most countries, no high power transmitters were allowed in this range. The only exception was the Gleichenberg (GBG) transmitter near Graz, Austria, for aerial navigation.

This started some strong fighting among manufacturers, since the devices operating at 2.275 kHz were not compatible with the devices operating at 457 kHz. Two manufacturers started building dual frequency transceivers that were able to handle both frequencies simultaneously. Dual frequency transceivers were more expensive to build and suffered from some restrictions to their performance. This gave rise to strong pressure from consumers and from the International Commission for Alpine Rescue (ICAR) for defining a single standard frequency. In the course of the 1980ties, the conflict was resolved by means of standardization. Today, avalanche transceivers operate at 457 kHz, the European standard frequency, across the entire world.

In the USA, the transition was started after the International Snow Science Workshop (ISSW) of 1987 [7], when the American Ski Patrol began endorsing the future use of 457 kHz.

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3 Standardization

The first transceiver standard (ÖNORM S 4120) was created in Austria about 1982/1983. It defined single frequency transceivers operating at 2.275 kHz and dual frequency transceivers operating at 2.275 kHz and 457 kHz.

In the fall of 1983, the German Institute for Standardization (DIN) started an effort for producing a DIN standard. On June 6, 1984, at a meeting in Salzburg, Austria, where the most prominent supporter of 2.275 kHz was absent, the workgroup decided to recommend 457 kHz for the long term future [8]. This settled the battle. ICAR then also decided to support the 457 kHz.

The first issue of the DIN 32 924 standard, issued in May of 1986, covered dual frequency devices only. But in the introduction, it said "In addition, starting 1989 at the earliest, single frequency devices operating at 457 kHz only shall be standardized in the interest of long term unification. The devices shall be compatible with the dual frequency devices as defined in this standard". Many clauses in the DIN 32 924 were taken over from the Swiss army specifications for the VS 68.

The revised DIN 32 924 issued in April 1989 and valid starting August 1st, 1989, for the first time defined single frequency devices operating at 457 kHz ±0.1 kHz.

In 1991, the DIN 32 924 became the EN 282, which later on muted into the ETS 300 718 and then in 2001 into the current EN 300 718.

Upon request by ICAR, the European Commission decided on February 21, 2001, that the avalanche transceivers fall under Article 3.3(e) of the RTTE directive. This ensures that all devices on the market must meet some minimum requirements as per EN 300 718 in order to guarantee access to rescue operations.

4 Patents

Zellweger AG filed a patent application on July 2, 1970. The patent was granted on October 15, 1972 [11]. Its further fate is not known.

On December 24, 1971, Autophon AG filed its first transceiver patent in Switzerland [14]. The patent was granted on July 31, 1973.

Subsequently, the same patent was filed in

- Austria
- Germany
- France
- Great Britain
- Italy
- USA

Apparently, in the opinion of the national patent examiners, the patent did not collide with the patent of Bock and Lawton [10]. In the US, the patent was published on December 4, 1973.

5 References

[1] Various oral communications by Willy Zurkirch
[2] Various oral communications by Marcel Würgler
[3] Dawson, Lou; Skadi – First Avalanche Rescue Transceiver "Beacon"; August 9, 2013 www.wildsnow.com/10527/skadi-history-avalanche-rescue-beacon-transceiver/
[4] Good, Walter; Bericht über die Prüfung von technischen Hilfsmitteln zur Ortung von in Lawinen verschütteten Personen; Interner Bericht Nr. 496; Swiss Federal Institute for Snow and Avalanche Research Weissfluhjoch-Davos; 28. August 1969; Archive Felix Meier
[5] Vorschlag für die Entwicklung eines Suchgerätes für Lawinenverschüttete; Band I und Band II; Autophon AG, Solothurn; August 20, 1970; Archive Felix Meier
[6] Bericht über die Entwicklung eines Suchgerätes für Lawinenverschüttete; Autophon AG, Solothurn; November 1971; Archive Felix Meier
[7] Meier, Felix; A Standard Frequency for Avalanche Beacons – What's Going on in Europe; Proceedings International Snow Science Workshop, Lake Tahoe, CA; October 22-25 1987; pp. 172-176
[8] Sitzungsprotokoll des Arbeitskreises zur Findung der optimalen Frequenz; Salzburg; June 6, 1984; Archive Felix Meier
[9] Photo courtesy Dale Atkins, Recco USA
[10] Bock, Ditmar H. and Lawton, John G.; Transceiver Apparatus for Generating and Responding to an Alternating Magnetic Field; US Patent 3,551,795; filed April 10, 1968; granted Dec. 29, 1970
[11] Strohschneider, Walter; Vorrichtung zur Ortung; CH Patent Nr. 529 355; filed July 2, 1972, granted October 15, 1972
[12] www.fondation-barry.ch/en/history
[13] Various oral communications by Stephan Affolter
[14] Hans van der Floe, Herbert Kully, Vàclav Štverák, Stephan Affolter; Gerät zur Suche von je ein gleiches Gerät tragenden verschütteten Personen; CH Patent Nr. 539 440; filed Dec. 24,1971; granted 31.7.1973

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