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**Typical applications:**

Geological/ geotechnical surveys up to 70 m depth

Embankment dam safety, voids and core control

Groundwater prospecting in sand, gravel and bedrock

Bedrock profiling, fractures and fault detection

Sand & gravel deposits

Glaciological up to 600 m

Contaminant mapping

Water- and sediment depth of lakes and rivers

Mineral Placer Exploration, Tunneling & Mine Hazards

Archaeological deep tunnel and chamber detection



Odysseus Unbound, Search for Homer's Ithaca — Archaeological Survey, Greece

*High Penetration Low Frequency Antennas*

**SUBECHO™-Antennas**

**Subecho™**-antennas are recognized by hundreds of users worldwide for their outstanding and superior performance compared with any other low frequency GPR-antennas available.

The unique and innovative design of the antennas; the resistively loaded, butterfly shaped folded dipole, gives the following advantages compared with conventional dipole antennas:

- Better penetration and resolution with increased operating bandwidth. (150-173 %).
- Better coupling. Not only ground coupled but also airborne and air coupled surveys can be performed with high efficiency.
- Better signal to noise and F/B-ratio. Limited reflexes from trees and other unwanted objects above ground. Other unshielded antennas will radiate as much up – as downwards.
- The antenna/s can be used both in monostatic mode, one antenna with a plug-in Transceiver or in bistatic mode with a high power Transmitter and Receiver.
- All plug-in electronics used are interchangeable between models and fully compatible with GPR-systems from both GSSI and IDS.



**Model:** SE-40  
**Size:** 200 x 15 x 21 cm  
**Weight:** 5.0 kg



**Model:** SE-70  
**Size:** 139 x 15 x 21 cm  
**Weight:** 3.8 kg



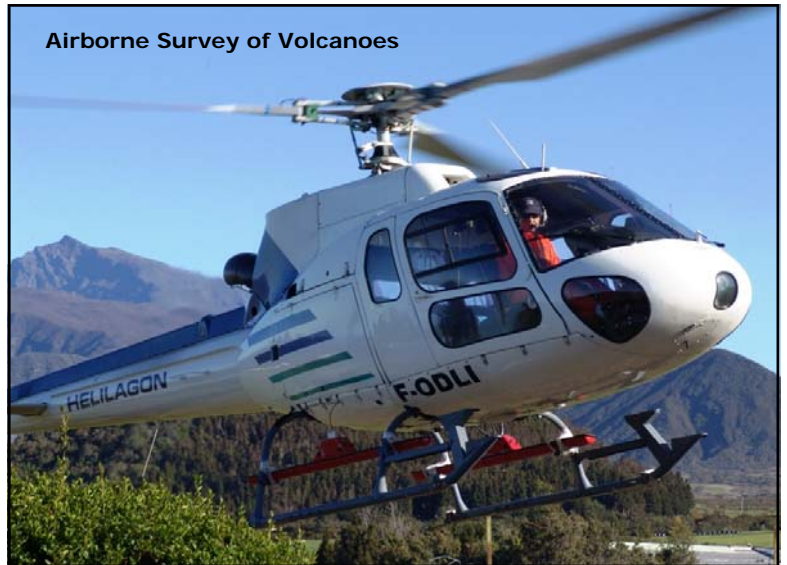
**Model:** SE-150  
**Size:** 92 x 22 x 22 cm  
**Weight:** 3.5 kg



# Very Deep Penetration Applications



Bedrock Profiling



Airborne Survey of Volcanoes

Airborne Survey of active Volcanoes in the Pacific Ocean with bistatic SE-40 Antennas. Early warning system for eruptions based on layer-thickness above magma chamber.



Skinner Saddle Glacier, Antarctica, 2007. 600 m penetration.

Strong bedrock reflections were obtained with the SE-40 antennas to a depth of 600m, the full range 8000ns on SIR-3000 GPR. High resolution isochrone reflections from seasonal firn layers up to approximately 120m depth, 1000 ns.

**REFERENCE:** Watson, M.I., Yelf R.J., et.al., 2008.

**Bedrock Topography and Isochrone Mapping of Five Glaciers in Victoria Land, Antarctica,** 12th International Conference on Ground Penetrating Radar, June 16-19, 2008, Birmingham, UK

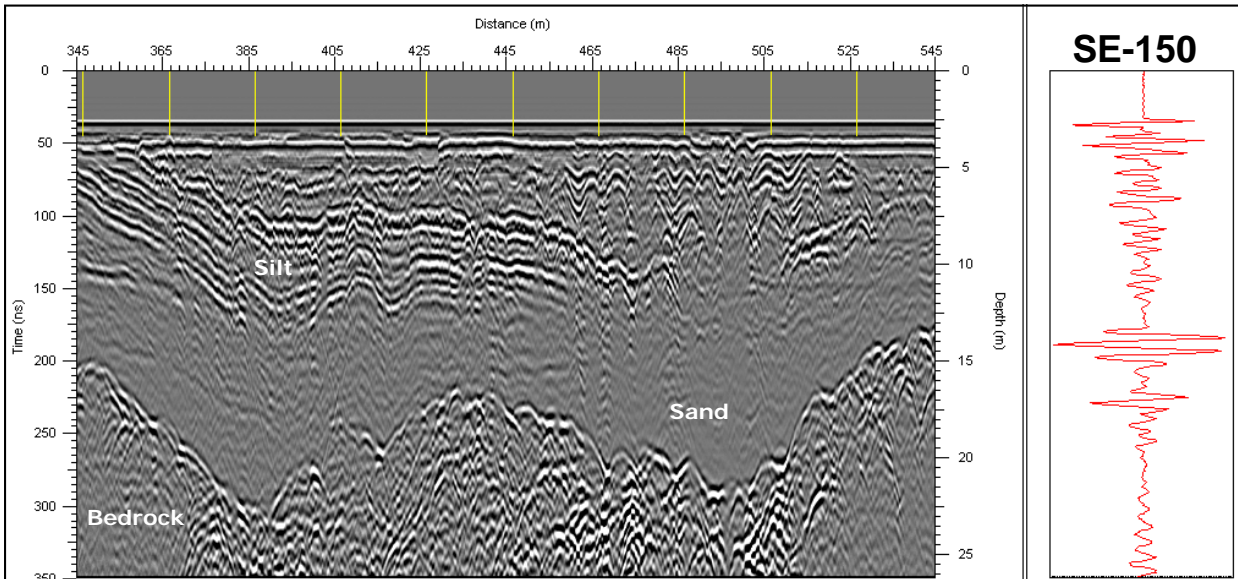


Marble Quality—Macedonia  
53 m penetration with  
monostatic SE-70 MHz

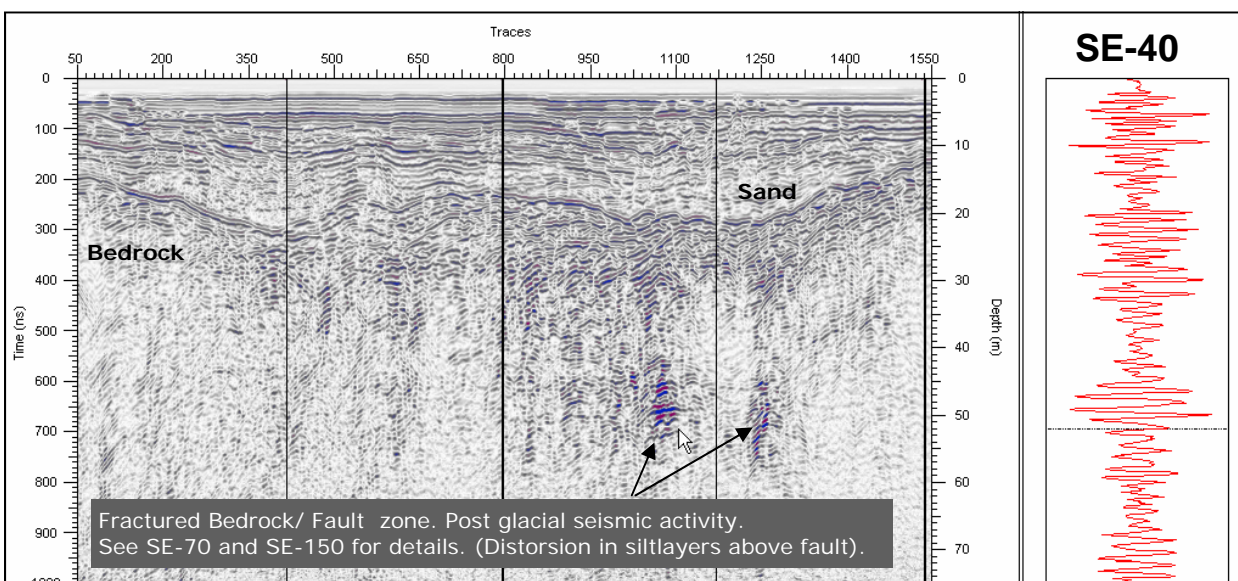
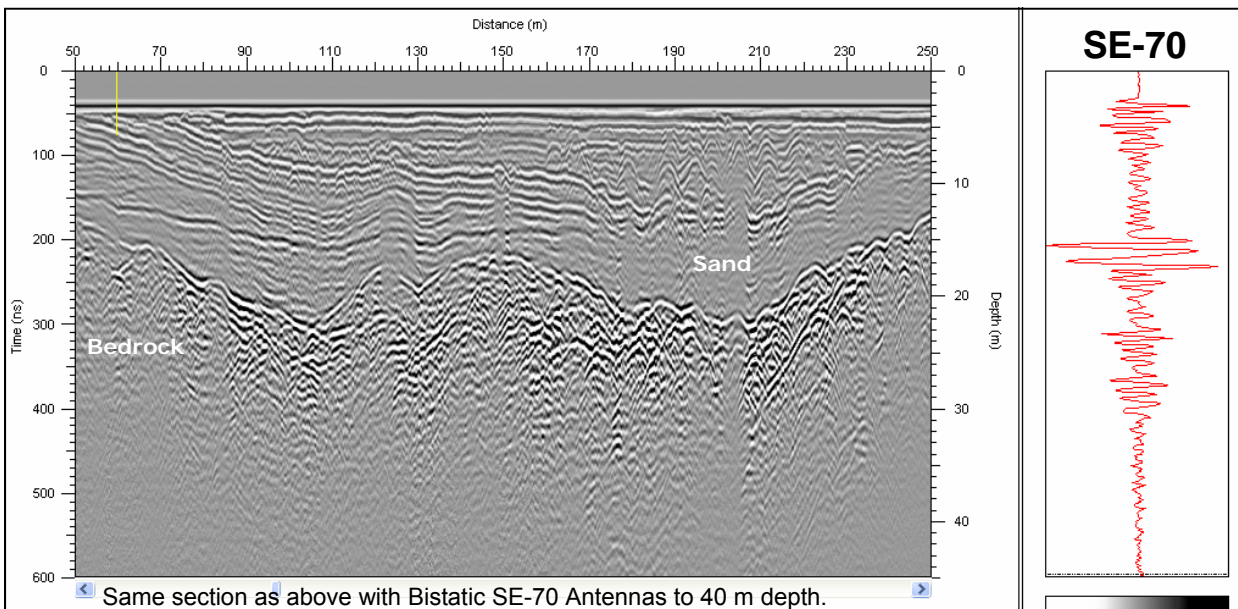


High Speed Sand & Gravel Deposit Survey

# The Subecho™ Antennas Compared.



Bistatic SE-150 Antennas to 25 m depth at our testsite in Boden.



Same section as above with Bistatic SE-40 Antennas to 70 m depth.

# Subecho™ Antenna Specifications.

## Monostatic operation (Transceiver)



Technical Specification	Model SE-40	Model SE-70	Model SE-150
GPR Antenna Type:	Unshielded, resistively loaded, butterfly shaped, folded GPR dipole antennas		
Compatible Plug-In electronics:	<b>Monostatic mode:</b> TR-501 Transceiver (recommended), GSSI 769DA2 <b>Bistatic mode:</b> TR-501 or RX-501 as Receiver and VHPwr Transmitter VHT-501		
Compatible GPR-systems:	<b>All GSSI SIR-systems.</b> (SIR-2/-20/-2000/-3000) <b>IDS</b> , Italy : K2 DAD Control Unit		
Max. PRF-rate: (kHz)	<b>Monostatic mode:</b> 100 kHz with all Transceivers <b>Bistatic mode:</b> 12 kHz. (100 kHz with optional PRFplus-600)		
Operating temperature:	-30°C to 70°C (-22F to 158F)		
Ingress protection:	IP54		
Material:	ABS Plastic, UV resistant up to 10 years		
Peak frequency: (MHz)	55	80	113
BW, Operating Bandwidth: (MHz)	15-105 (90 MHz)	20-140 (120 MHz)	20-280 (260 MHz)
CF, Center Frequency: (MHz)	60	80	150
DC Resistance at terminals:	387 Ohms	270 Ohms	234 Ohms
BW/CF-ratio: (%)	150	150	173
Depth Range, Bistatic	0-70 m	0-45 m	0-35 m
Depth Range, Monostatic	0-40 m	0-30 m	0-25 m
Vertical Resolution @ $\xi_r = 9 (\lambda/4)$	41 cm	31 cm	17 cm
Dimensions: (LxWxH)	200 x 15 x 21 cm	139 x 15 x 21 cm	92 x 22 x 22 cm
Weight: (kg)	5.0	3.8	3,5

## Bistatic operation (V.High Power Transmitter)



# Plug-In Electronics & Adapter Accessories

The SE-antennas uses plug-in electronics, Transmitter and Receivers in bistatic mode and Transceiver in monostatic mode. Compatible Plug-In electronics are available from GSSI and Geoscanners AB, Sweden. The following Plug-In Electronics and Adapter are manufactured by Geoscanners AB. They are all compatible with the Subecho™ low frequency antennas and interchangeable between these antennas. We highly recommend these electronics with a superior performance compared to older GSSI Plug-Ins. (Transceiver Mod 769DA2 and Mod 778 Transmitter). For more information regarding the electronics described below, please contact Radarteam or Geoscanners AB directly.

## Transceiver: Model TR501

The Transceiver TR501 is used with the SE-antenna in monostatic or single mode of operation. It contains both a Transmitter and a Receiver in one electronic plug-in and thus only one antenna is used. The TR501 has a lot of new implementations and performance enhancements compared with its predecessor, the GSSI 769 DA2 Transceiver.  
Output voltage: 240 V  
RF Bandwidth: 962 MHz  
Radarteam recommends the TR501 to be used in our SE-antennas: SE-40, SE-70 and SE-150.



## Very High Power Transmitter: Model VHT501

The Very High Power Transmitter VHT501 is used with the SE-antennas in bistatic or dual antenna mode of operation with TR501 or RX501 as Receiver. The increased output voltage, **5 times** compared with above TR501 allows for much higher penetration but with a lower allowed scanrate than normally used. (Max PRF of 12 kHz compared to nominal 100 kHz).  
Output voltage: 1200 V  
Radarteam recommends the VHT501 to be used in our SE-antennas: SE-40, SE-70 and SE-150.



## Receiver: Model RX501

The Receiver RX501 is used with the SE-antennas in bistatic or dual antenna mode of operation only and with the VHT501 as Transmitter. The increased performance can be noticed by lower noise, increased dynamic range and bandwidth compared with predecessors.  
RF Bandwidth: 962 MHz  
RF Dynamic Range: 56.53 dB  
Radarteam recommends the RX501 to be used in our SE-antennas: SE-40, SE-70 and SE-150.



## PRF Booster: Model PRFPLUS-600

The PRFPLUS-600 is a support or adapter unit allowing full nominal PRF, 100 kHz, on the GSSI SIR-3000 GPR when the Very High Power Transmitter VHT501 is used. (12 kHz without this unit). The PRFPLUS-600 requires additional power-supply and we recommend this unit when high scanspeeds are needed, for instance when performing surveys at highway speed or when many stackings of the raw signal is required.



# Carts & SW-encoders Accessories

Radarteam Carts, the MultiCart and the Towbar Cart, provides the perfect platform for efficient surveys in both mono- and bistatic mode. They are constructed of tough telescopic fibreglass components and includes totally sealed, not sensitive to water- and dirt, integrated SW-encoders for accurate positioning. Highly recommended accessories for both monostatic and bistatic surveys in semi-rugged terrain.



## GPR MultiCart:

The telescopic MultiCart is specially constructed for the air-coupled low frequency SE-antennas in both mono-and bistatic mode but it also fits many other antennas. MultiCart contains very little metal to eliminate interference and the integrated encoder is totally sealed and thus not sensitive to water- and dirt. **GPR MultiCart** can easily be folded after survey and placed in the trunk of your car. Quick Release Pins and Snap-Buttons makes this possible even without tools.

The customer can order the cart customized with holder for either GSSI Inc. SIR-20 or SIR-3000 or for Panasonic TB CF-19 laptop.



## Towbar Cart:

The **Towbar Cart** is a flexible construction allowing both single and dual use of Radarteam antennas, especially the SE-models. The survey trailer is coupled to a standard 50 mm towbar, hitch ball. The unit provides not only a carrying frame for the antennas but also a survey wheel encoder functionality as the MultiCart. The air-coupled mounting of the SE-antennas allows for operation at highway speeds.



## Belt-String Encoder:

The Belt-String Encoder is based on a proven instrument used for exact distance measurements in rough terrain. It features a belt clip for easy carrying and an external mechanical counter reset. This counter allows for reliable calibration without the need for wheels. The housing is moulded from a strong Polycarbonate-plastic. The thread spool lasts for around 2,5 km or 1.55 miles and is easy to replace.



# Frames & Harness Accessories

## SACCI™– Carrying Harness Frame

The SACCI™– Carrying Frame provides fantastic possibilities when it comes to operating the collection systems hands-free in the field. It is developed with great function and ergonomics in mind, and customized with holder for GSSI Inc. SIR-3000 radar system or Panasonic Toughbook CF-19 laptop.

The wide shoulder-pad with body centered suspension makes the operation of the collection system easy and comfortable. The carrying frame is extremely stable and easy to put on. The plate that holds the collection system is adjustable in height to fit all lengths of people.



## Monostatic Carrying Frame: Model SE-handle

The SE-handle provides an excellent way of carrying one Radarteam high penetration antenna, SE-model. One person survey in the most rugged types of terrain. The handle is slightly turned to provide an ergonomic carrying position for the user. Pictured operator with SE-70 antenna, Transceiver Plug-In electronics, SE-handle, SACCI Harness and Belt String Encoder for positioning.



## Bistatic Carrying Frame: Model-3000 and CF-19

The Bistatic Carrying frame provides an excellent way of carrying two of Radarteam's Subecho™ line of antennas. For easy and convenient operation of bistatic antennas it is also customized with holder for SIR-3000 or the Panasonic Toughbook CF-19 when using the IDS GPR system, RIS-K2 DAD.



## Helicopter-kit:

The helicopter-kit is constructed of tough fibreglass pipes for any of Radarteam antennas. Telescopic function makes adaption to any type of helicopter easy in a matter of minutes.

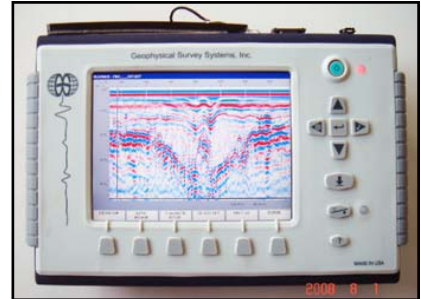


# GPR-systems Compatible with Radarteam Antennas

The following GPR-systems from GSSI and IDS, are fully compatible with all Radarteam antennas. Our complete range of antennas from 15 to 3000 MHz can be utilized successfully. For more information regarding the GPR-systems described below, please contact us, the manufacturer or their local representatives directly.

## Model SIR-3000: Manufactured by GSSI Inc., USA

The SIR-3000 is a portable, digital Subsurface Interface Radar (SIR) System designed for a broad range of environmental, geotechnical, geological and engineering applications. The system is affordable, small and designed for easy single-user operation even in very rugged terrain. (See Accessories). Radarteam recommends this system for most surveys when only one Tx and Rx antenna is needed, (monostatic, fixed offset bistatic or fully bistatic).



## Model SIR-20: Manufactured by GSSI Inc., USA

The GSSI SIR-20 is a multi-channel GPR data acquisition unit coupled with a rugged Panasonic ToughBook PC. 1 or 2 antennas, with Tx and Rx, can be connected. The SIR-20 also includes GSSI's RADAN GPR post processing software with an Interactive 3-D module.

Radarteam recommends this system when more than one Tx and RX antenna is needed. Best performance when mounted in a vehicle or stationary with long cable due to weight. SIR-20 is safely operated at highway speeds.



## Model RIS-K2 DAD: Manufactured by IDS S.p.A, Italy

The RIS-K2 DAD is available both as single and multi-channel GPR data acquisition units together with a rugged Panasonic ToughBook PC. One (DAD-1CH) or 2 antenna (DAD-2CH/MCH), with Tx and Rx, can be connected. With a separate module even 4 antennas, DAD-4CH/MCH.

Radarteam recommends this system when more than one Tx and RX antenna is needed especially for operation in rugged terrain. With specifications similar to the SIR-20 it can also be an alternative when prices are compared.



Technical Specification	SIR-3000	SIR-20	RIS-K2 DAD
Number of antennas (Tx + Rx):	1	1-2	1-2 (4)
PRF, Pulse Repetition Freq. (kHz):	100	500	400
Max. Time Range (ns):	8000	8000	9999
Samples/Scan:	128-8192	128-8192	128-8192
Max. Scanrate (@ 512 samples):	120 scan/s	570	490
Dimensions (cm):	31.5 x 22.0 x 10.5	46.6 x 39.5 x 17.4	22 x 17.x 10 (CU) 27 x 22 x 5 (PC)
Weight (kg):	4.1	12.2	3.4