

Product Information

# Acoustic Wind Profilers

Advanced High Performance Sodars  
for Wind and Turbulence

**SFAS**  
**MFAS**  
**XFAS**

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## 1 INTRODUCTION

Sodars of the Scintec FAS Series are advanced instruments for the remote measurement of wind and turbulence in the lower atmosphere. They allow continuous vertical soundings without the installation of masts or the work-intensive use of tethered balloons. Areas of applications include meteorological research and monitoring, wind energy siting, diffusion analysis at industrial plants, wind shear detection at airports and optical propagation through turbulence.



**Antarctic research with Scintec MFAS Sodar**  
[Photo courtesy of British Antarctic Survey]

Sodars vertically emit sound pulses and derive the output information from the frequency and amplitude of the atmospheric echoes. Besides wind speed and direction, a multiple of information is provided about the characteristics and structure of boundary layer turbulence.



**Power plant emission monitoring**  
[Photo courtesy of Iberinco C.T., Aceca]



**Wind energy: one of many applications for Scintec FAS Series Sodars**

The three models of the Scintec FAS Series SFAS, MFAS and XFAS have spatial resolutions between 5 m and 20 m. Depending on the model, maximum measurement ranges between several hundred meters and more than a kilometer can be achieved.

The Scintec FAS Series has features you do not find with any other acoustic profiler, such as the highly efficient Flat Array Antenna, the patented<sup>1</sup> multi-frequency and multi-angle operation with digital processing, advanced software capabilities allowing operation in noisy environments like airports, an html interface for remote control or the possibility to perform an automatic site and settings analysis. The result is a significant increase in data accuracy, measurement range, data availability and comfort of operation.

The Scintec FAS Series combines the most innovative technology with the highest quality standards to satisfy your needs in acoustic profiling.

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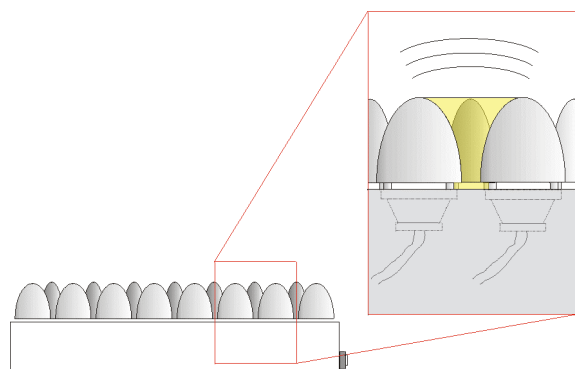
<sup>1</sup> ) Patent DE 19805328

## 2 ADVANTAGES

This section describes a selection of particular advantages of Scintec FAS Series Sodars.

### 2.1 Flat Array Antenna

Scintec's proprietary antenna design represents a remarkable step in acoustic profiler innovation. User benefits include higher efficiency, longer measurement ranges and improved performance characteristics in rain.



### 2.2 Active Tapering

Through application of an active tapering technique on individual amplifiers, Scintec FAS Series Sodars generate significantly less acoustic noise without extensive mechanical shielding.

### 2.3 Multi-Frequency Operation

Scintec FAS Series Sodars operate with up to 80 different frequencies in a single measurement cycle. Different frequencies are received and evaluated simultaneously. The result is a considerable increase of the signal-to-noise ratio, which leads to longer measurement ranges, shorter possible averaging times and an improved vertical resolution.

### 2.4 Multi-Beam Operation

Scintec FAS Series Sodars have the capability to send and receive beams at 9 different angles. Like the multi-frequency operation, the simul-

taneous reception at opposite angles results in a significant increase of the signal-to-noise ratio with all the connected benefits.

### 2.5 Height-Dependent Vertical Resolution

Scintec FAS Series Sodars can emit pulses of different frequencies and lengths within a single emission sequence. The result is a height-dependent vertical resolution allowing a high spatial resolution close to the ground without sacrificing maximum measurement range.

### 2.6 Unmatched Software Capabilities

Scintec's new APRun profiler software for Windows<sup>(R)</sup> offers unmatched convenience of use and system control capabilities. After just a few clicks you start to measure. With built-in intelligence, the system will automatically detect and suppress noise sources from air planes, wind vanes or ground clutter, analyze measured data and generate reports, recommend improvements in the parameter settings. The software offers a full range of display possibilities and remote access options. For other details, please see Section 5 in this document.

### 2.7 Fully Automatic Self Test

One simple keystroke and Scintec FAS Series Sodars perform a comprehensive self test. This includes an individual test of all transducers and related electronics without any manual interaction required. This ease of testing will ensure convenient maintenance and full lifetime performance.

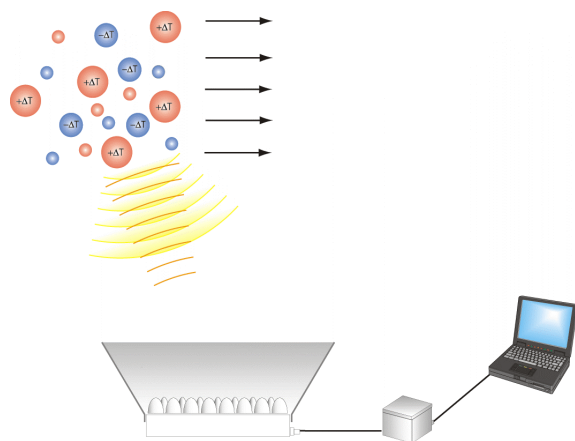
### 2.8 RASS Extensions Available

All models of the Scintec FAS Series can be expanded with the Scintec RAE1 RASS Extension allowing accurate measurement of the atmospheric temperature profile. For details, see the separate Product Information on the Scintec RAE1 RASS Extension.

### 3 TECHNIQUE AND USE

#### 3.1 Operation Principle

A sodar antenna emits short acoustic pulses into the atmosphere. The acoustic waves are back-scattered at temperature inhomogeneities in the air. The antenna receives the backscattered signals and the subsequent electronics and digital processing evaluates the amplitudes and frequencies. The duration between emission and reception provides the height information about the area to be evaluated.



Since the temperature inhomogeneities move with the wind, a Doppler frequency shift is observed revealing the wind speed relative to the beams axes. If this Doppler shift is measured at different beam directions, the three-dimensional wind profile is obtained. The amplitude of the backscattered signals supplies information about the strength of the thermal turbulence.

#### 3.2 Output Quantities

Scintec FAS Series Sodars provide a full set of output quantities and quality control parameters at each selected measurement level.

The following table gives a summary of the output:

##### Output Quantities of SFAS, MFAS and XFAS

Wind speed
Wind direction
Wind components U, V, W (East, North, vertical)
Standard deviation of wind speed
Standard deviation of wind direction
Standard deviation of wind components U, V, W
Wind shear
Confidence classes for U, V, W
Error codes for U, V, W
Backscatter actual
Backscatter averaged
Temperature structure parameter $C_T^2$
Temperature structure parameter $C_T^2$ averaged
Stability parameter $z/L$
Eddy diffusivity
Temperature lapse rate
Inversion layer identifier

#### 3.3 Applications

For the remote measurement of wind speed, wind direction and turbulence in the lower atmosphere, Scintec FAS Series Sodars are used for a variety of different applications. The most important of them are listed in the following table:

Application	SFAS	MFAS	XFAS
Turbulence research	■	■	■
Climate research		■	■
Wind energy	■	■	
Pollution monitoring		■	■
Weather forecast		■	■
Airport wind detection		■	■
Optical propagation	■	■	■
Agrometeorology	■	■	
Weather networks	■	■	■
Urban meteorology	■	■	
Forest meteorology	■	■	

## 4 MODELS

The Scintec FAS Series consists of three models, which differ in antenna size, operation frequency, vertical measurement range and spatial resolution. Each model consists of the Acoustic Antenna and the Signal Processing Unit (outdoor capable) to be connected to the Terminal PC of the user.

### 4.1 The SFAS

The SFAS has made a sodar more compact than ever. With its high operation frequencies it provides a vertical resolution down to 5 m. In spite of its small size, the SFAS has an impressive measurement range of up to 500 m not achieved by many larger sodars before.

Because of its compactness, high measurement resolution and the wide band of easily shieldable operation frequencies, the SFAS is the ideal instrument for applications at wind energy sites, in urban environments or as part of mobile or permanent research equipment.



**Scintec SFAS Acoustic Antenna**

### 4.2 The MFAS

For many applications, the MFAS represents the ideal balance of performance characteristics and size. Operation frequencies in the 2 kHz band allow for a spatial resolution of 10 m and measurement ranges of up to 1000 m can be achieved.



**Scintec MFAS Acoustic Antenna**

Because of these characteristics, the MFAS is used for almost all sodar applications. It is still portable by a single person and has a low power consumption facilitating the operation at remote locations.

### 4.3 The XFAS

The XFAS is a powerful instrument optimized for long measurement ranges. It is the only instrument which can cover even vertically extended atmospheric boundary layers. With operation frequencies around 1 kHz, it can provide a spatial resolution of 20 m.

Besides environmental research, it is particularly used for permanent monitoring applications on airports, power plants and other industrial sites.



**Scintec XFAS Acoustic Antenna**



#### 4.4 Special Versions

Please contact Scintec for military and other special versions.



**Scintec SFAS Military Version**

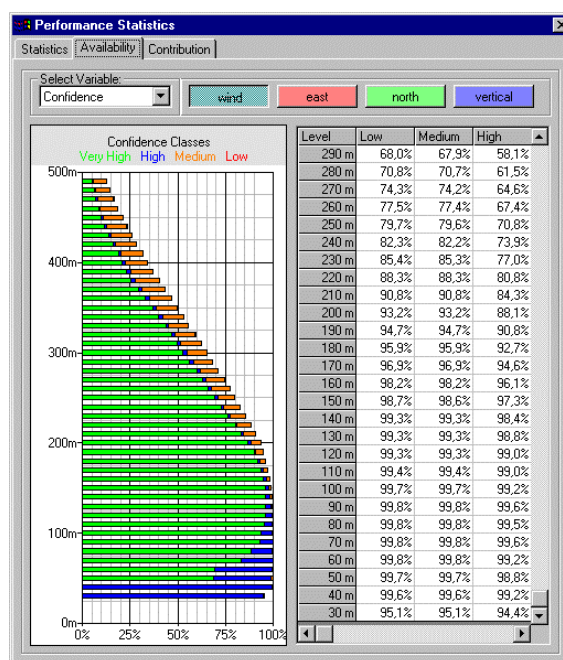
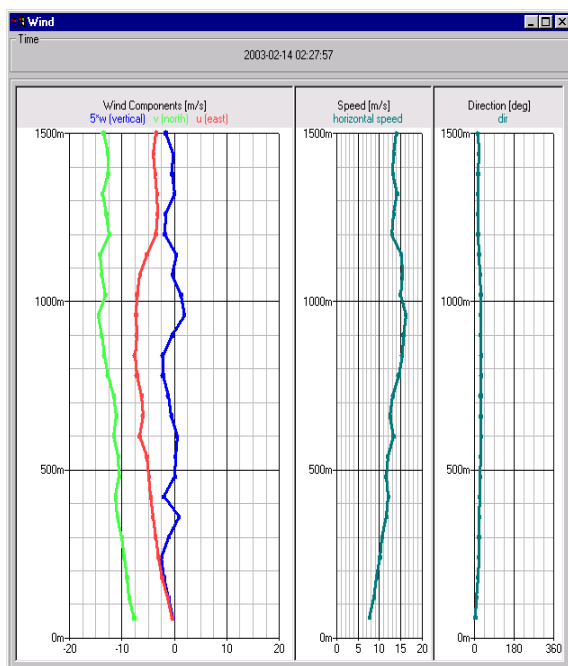
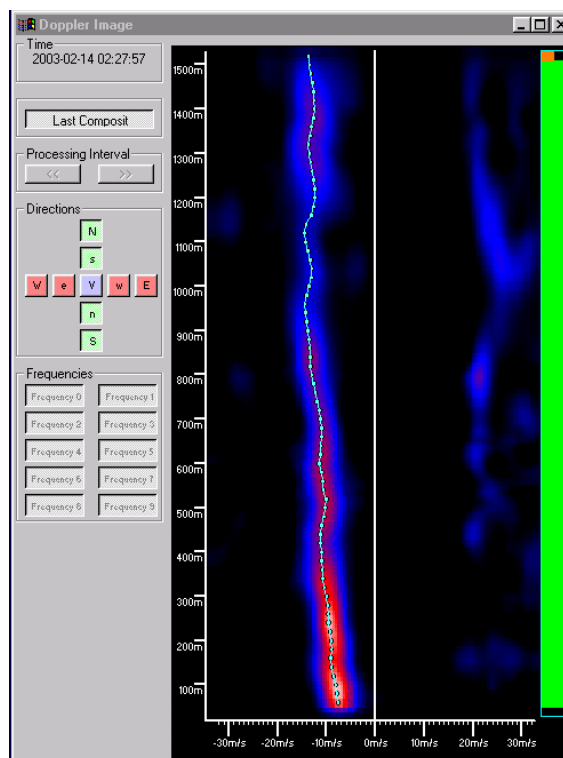
## 5 SOFTWARE

Scintec APRun is a unique software for processing and displaying wind and temperature profiler data. It has the capability of simultaneously evaluating signal returns at different beam angles, emission frequencies and operation modes. The increased amount of information gathered with this technique significantly improves data availability (range, resolution) and quality (accuracy, immunity to noise).

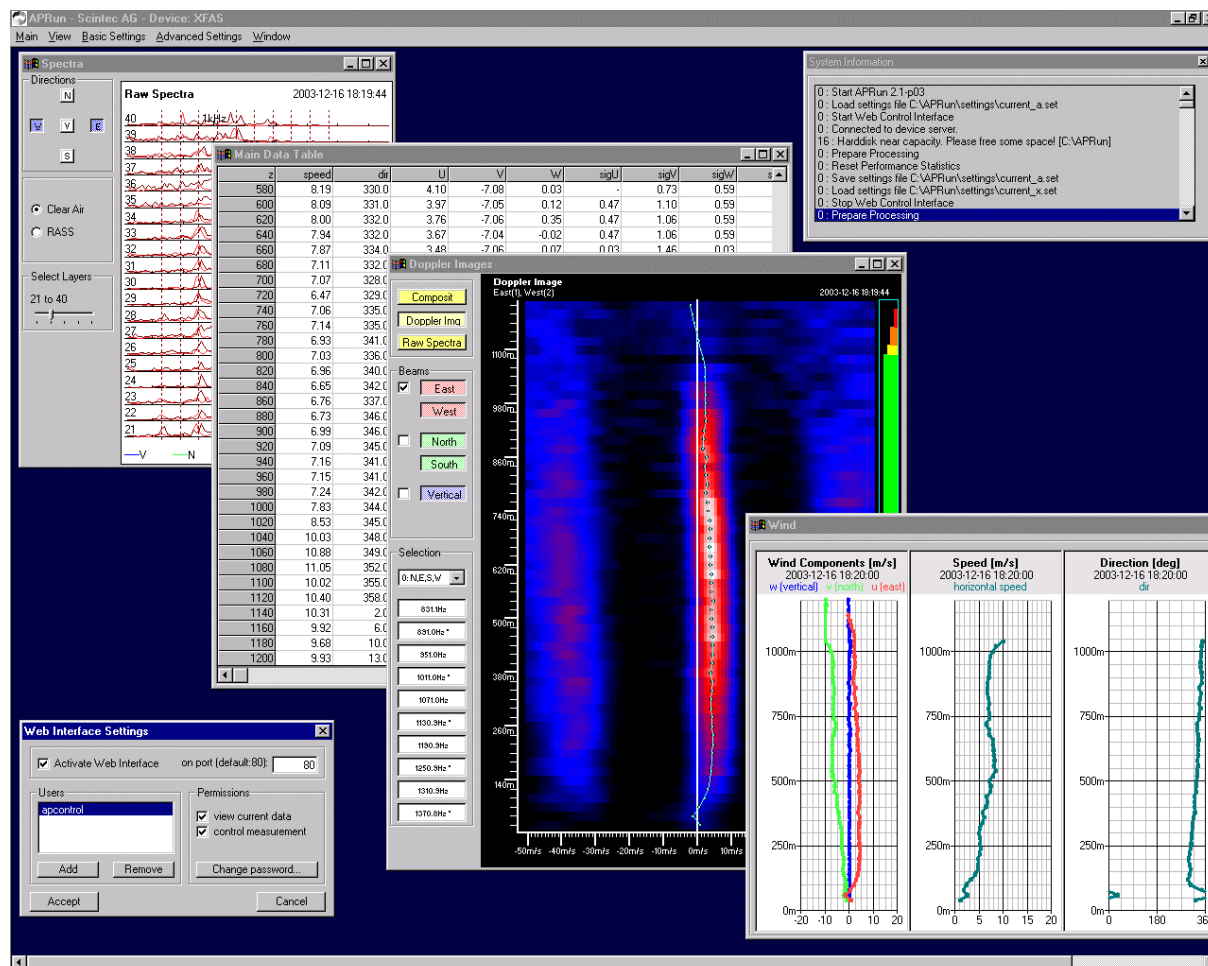
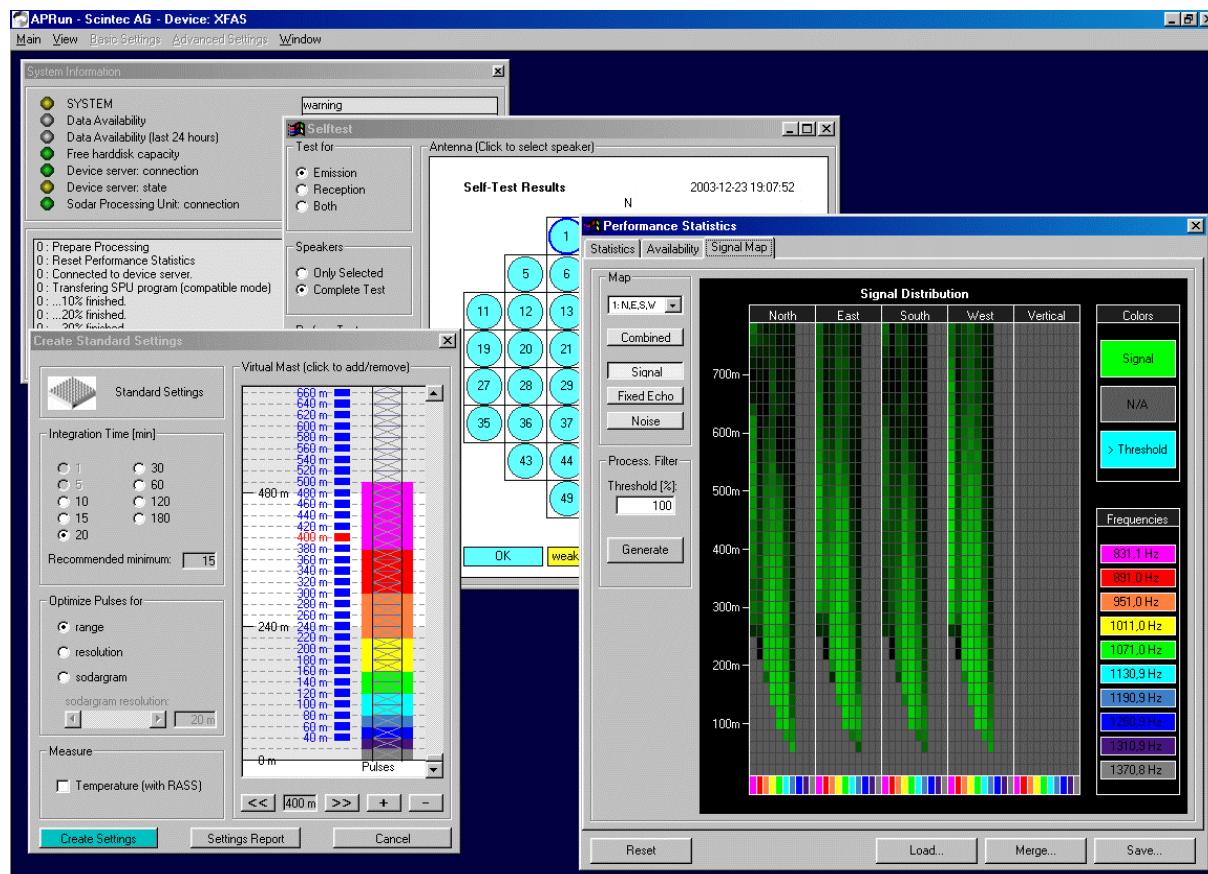
Features of APRun include:

- Easy set-up
- Full parameter access
- Advanced Doppler signal processing
- Multi-beam capability
- Multi-frequency capability
- Multi-mode capability
- Consensus algorithms
- Noise interference suppression
- Ground clutter (fixed echo) suppression
- Full set of output quantities (see Section 3.2)
- Flexible configuration of output
- Raw data output option
- Data quality management
- Raw spectra representation
- Doppler image representation
- Vertical profile representation
- Multi-level time series representation
- Wind vane / arrow representation

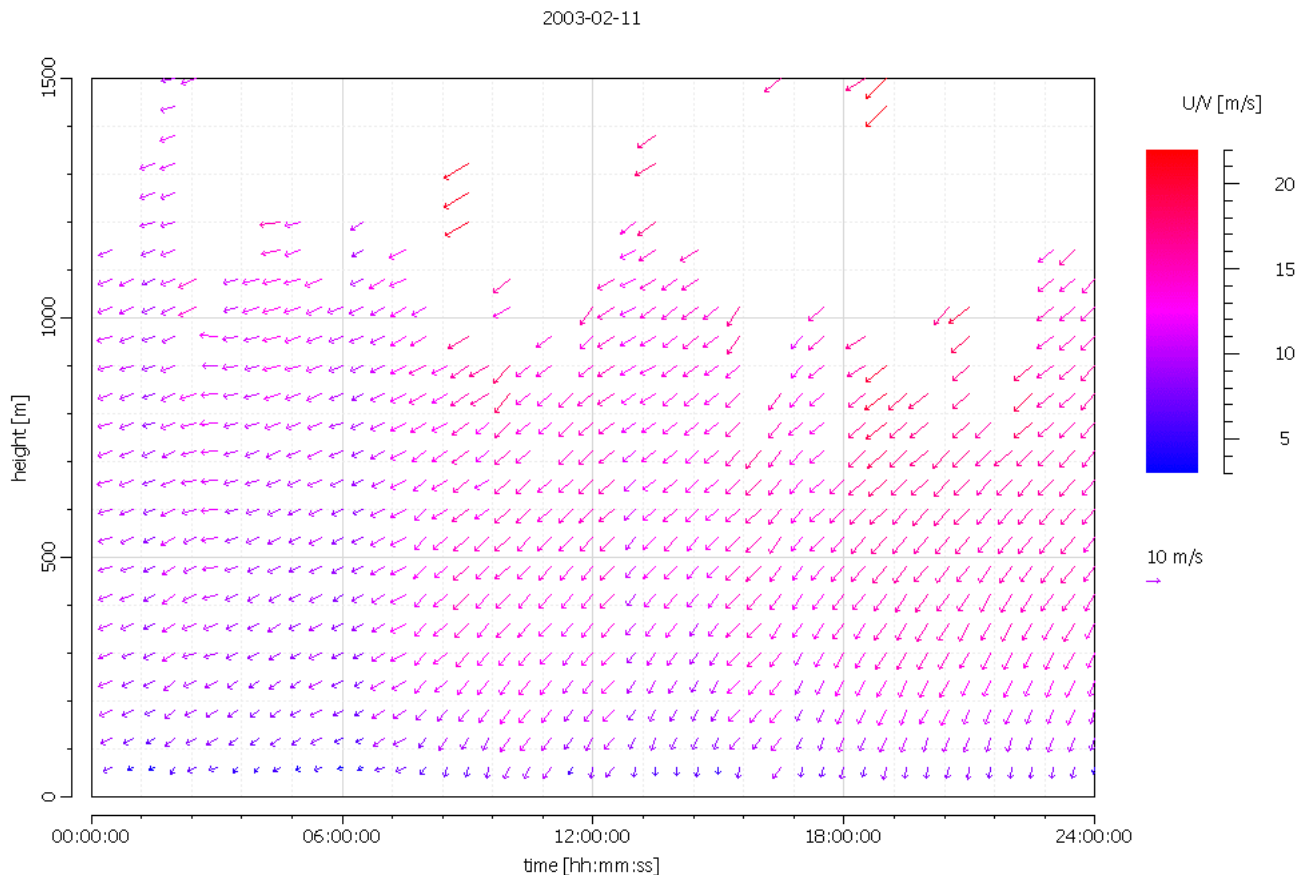
- Sodargram (backscatter plot)
- Data reprocessing capability
- Generation of data statistics
- Frequency / beam performance analysis
- Web html interface
- System status monitor (SNMP)
- Automatic restart after power failure
- Fully automatic self test



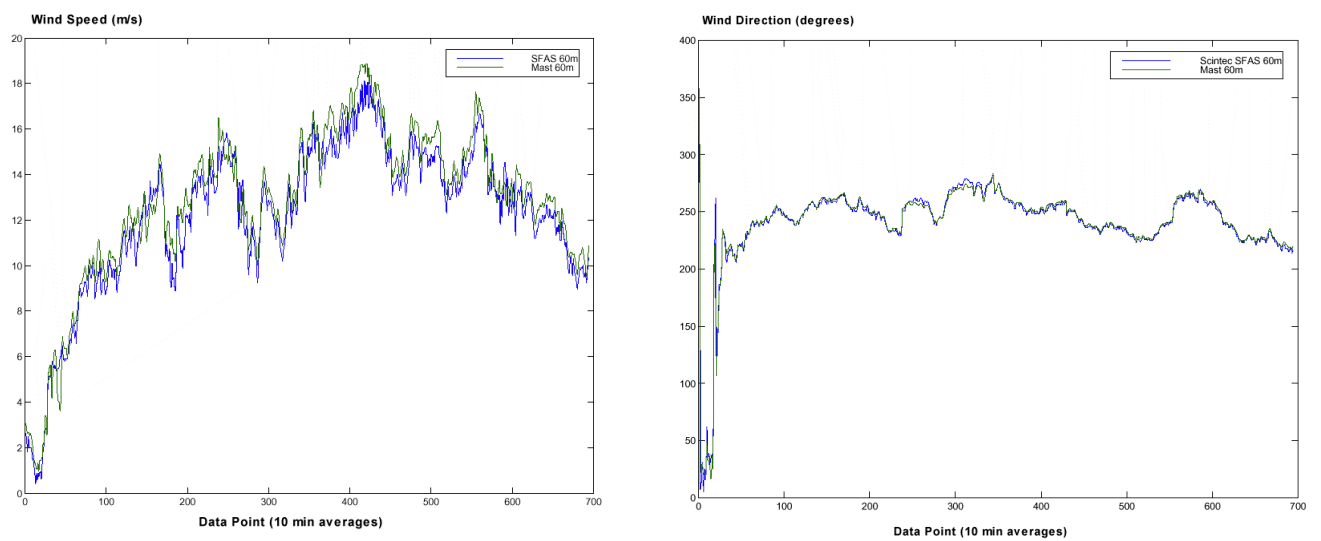




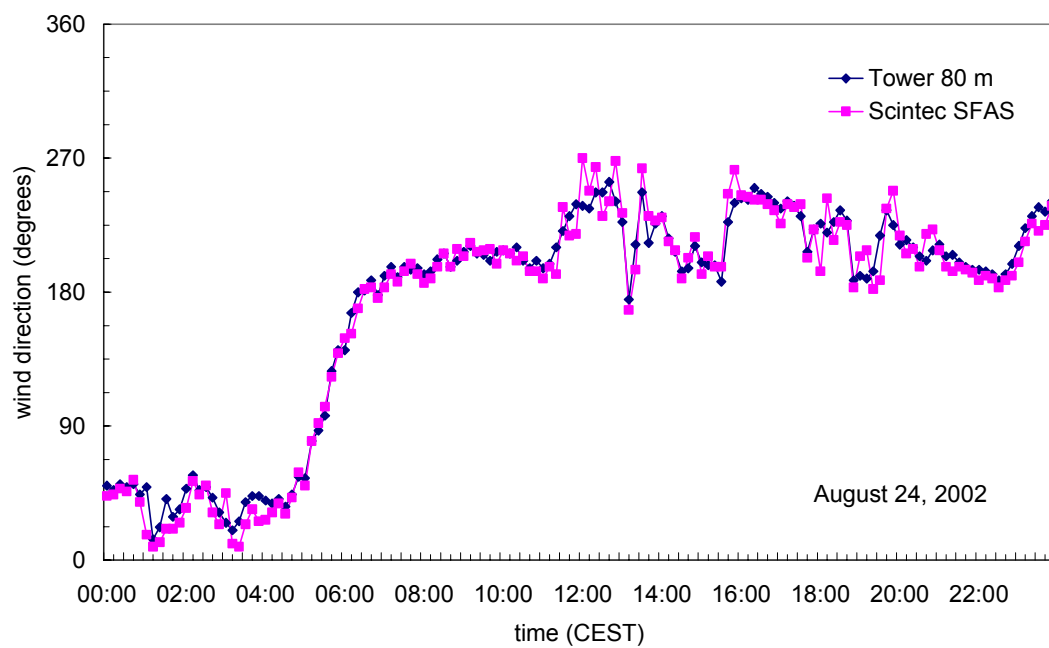
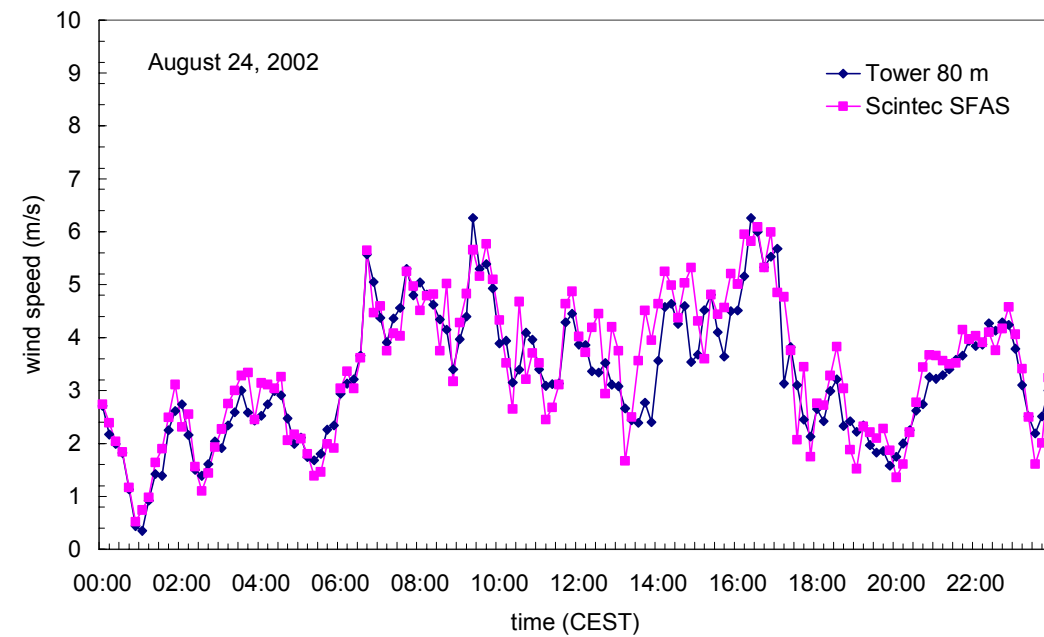
## 6 EXAMPLE DATA



**Scintec XFAS: Measurements in noisy airport environment (Data courtesy of Athens International Airport)**



**Scintec SFAS: Comparison with tower data in wind energy application (Data courtesy of Windtest GmbH)**



**Scintec SFAS: Comparison with tower at Research Center Karlsruhe (Data courtesy of FZK GmbH)**

## 7 OPTIONS AND EXTENSIONS

The Scintec FAS Series hardware can be individually configured to suit the user's particular need. Note that each instrument comes with the complete software package and no extra software option has to be purchased.

### 7.1 Standard Acoustic Enclosure

For most measurement environments, it is recommended to operate the system with an Acoustic Enclosure. This minimizes disturbances of the measurements caused by environmental noise and reflections of the pulse at obstacles on the ground (ground clutter). At the same time the enclosure reduces the sound intensity audible in the surrounding of the instrument.

The Standard Acoustic Enclosure is recommended for measurement environments with few noise sources and sound scattering obstacles in the vicinity and when space for transportation and installation is limited.



### 7.2 Large Acoustic Enclosure

Whenever the performance of SFAS or MFAS Sodars has highest priority or measurements are prone to be disturbed by buildings, trees, roads or industrial noise sources in the vicinity, the use of a Large Acoustic Enclosure for this sodar type should be considered. The Large Acoustic Enclosure consists of 16 elements forming an octagon. It can be disassembled for storage when not in use.



### 7.3 AC Power Supplies

While DC battery operation is possible with all Scintec FAS Series Sodars, the AC line will be the source of power in most cases. For each model, Power Supplies for 100 to 120 V (60 Hz) and 220 to 240 V (50 Hz) are available.

### 7.4 Antenna Heating

A built-in Antenna Heating is available for all models to melt snow and ice allowing operation in winter climates. The Antenna Heating comes with a separate Power Supply.

### 7.5 Remote Operation

The Signal Processing Unit of the Scintec FAS Series Sodars has a data connection to the PC used for control and data storage. Optionally the following types of connections are available:

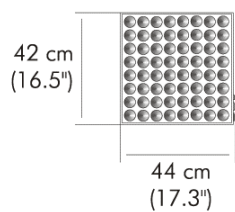
- RS232 serial line (standard)
- RS485 serial line
- Ethernet connection
- Radio transmission link

### 7.6 RASS Extension

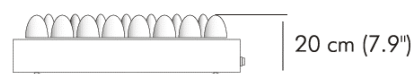
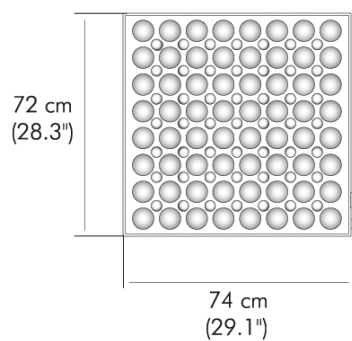
The RASS Extension RAE1 is available for accurate measurements of the vertical temperature profile. See separate Product Information for details.

## 8 DIMENSIONS

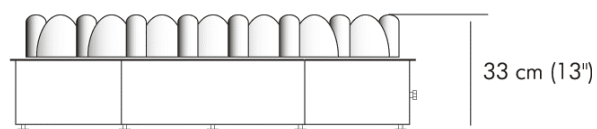
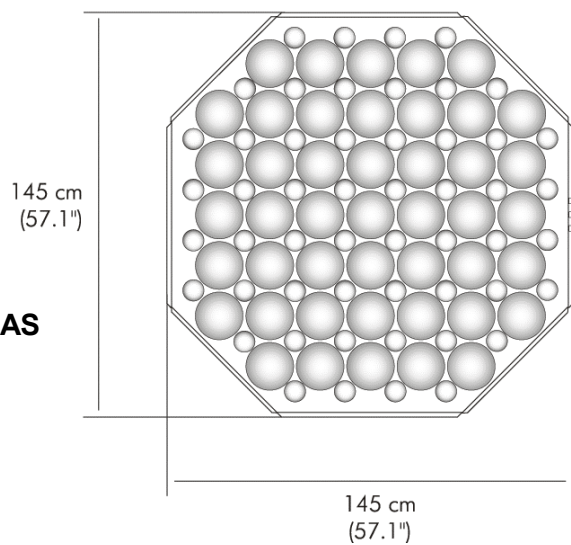
### SFAS



### MFAS



### XFAS





## 9 SPECIFICATIONS

Description	SFAS	MFAS	XFAS	Remarks
No. of elements	64	64	52	individually driven
Frequency range	2525 - 4850 Hz	1650 - 2750 Hz	825 - 1375 Hz	all frequencies user selectable
Electric (acoustic) output power	20 W (2.5 W)	50 W (7.5 W)	500 W (35 W)	maximum, value user selectable
Multi-frequency operation	yes, up to 80 frequencies			mode user selectable
Multi-beam operation	yes, up to 9 beams			beams user selectable
Beam angles	0°, ± 19°, ±24°	0°, ± 22°, ± 29°	0°, ± 22°, ± 29°	independent of frequency
No. of range gates	100	100	256	maximum, user selectable
Vertical resolution	5 m	10 m	20 m	finest selectable
Minimum range	20 m	30 m	40 m	depending on settings and atmosphere
Maximum range	500 m	1000 m	> 2000 m	
Averaging time	1 min - 60 min	1 min - 60 min	1 min - 180 min	for SFAS down to 2 s for research applications
Accuracy of horizontal wind speed	0.1 to 0.3 m/s			depending on mode
Accuracy of vertical wind speed	0.03 to 0.1 m/s			
Accuracy of wind direction	2 to 3°			at wind speeds > 2 m/s
Measurement range horizontal	0 to 50 m/s			depending on mode
Measurement range vertical	-10 to 10 m/s			
Operation temperature range	-35 to +50°C (-95 to 122°F)			Antenna, Processing Unit, Power Supply
Power requirement DC operation	± 12 V, 4 A peak, 1 to 2 A average	± 12 V, 8 A peak, 2 to 4 A average	± 18 V, 20 A peak, 2 to 8 A average	depending on mode
Power requirement AC line operation	100 to 240 VAC 200 W	100 to 240 VAC 400 W	100 to 240 VAC 1500 W	without antenna heating, specify voltage with order
Size	44 x 42 x 16 cm	74 x 72 x 20 cm	145 x 145 x 33 cm	Antenna without Enclosure
Weight	11.5 kg	32 kg	144 kg	



## 10 SERVICES

We are committed to supplying solutions for demanding atmospheric measurement tasks and understand the importance of service and support after the sale. Through our experienced professionals, we'll help ensure that you receive support to keep your system operational and at peak performance throughout its useful life.

To ensure optimum product performance please review our list of additional services.

### 10.1 Repair Services

#### 10.1.1 Hotline

If you need any assistance, we will help you by email, phone or fax at all times.

#### 10.1.2 Factory Warranty

Your instrument comes with a full-service factory warranty. If your instrument requires repair while under warranty, we will cover labor, replacement parts, and return shipment from the factory.

#### 10.1.3 On-Site Warranty

If you are unable to return your instrument to the factory for repairs, we have professionals who can visit your site to provide repair service. As in our Factory Warranty Service, we cover all qualifying on-site labor and parts. A travel fee will apply for on-site warranty repair.

#### 10.1.4 Factory Repair

If your instrument is out of warranty and you need to return it to the factory for repairs, please contact us to arrange for the return. We offer flat rate repair for a number of instrument models. If a flat rate does not apply, we will provide a quotation for the repair after inspection.

#### 10.1.5 On-Site Repair

If required, we can provide repair service in the field. We will provide cost estimates for applicable travel charges in advance.

### 10.2 Consulting, Installation and Test Services

#### 10.2.1 Site Survey

During the planning phase, we offer to perform a survey of the dedicated measurement location. The site will be analyzed with respect to the measurement technology and possible environmental interactions. Finally, a proposal for an optimum configuration and installation will be made.

#### 10.2.2 Factory Acceptance Test

All our instruments are carefully tested throughout the manufacturing process and prior to shipment. As a special service, the Factory Acceptance Test (FAT) can be performed and documented witnessed by the customer.

#### 10.2.3 Installation Service

If required, our technical specialists perform all basic installation work of hardware and software at the dedicated measurement site. The Installation Service is completed with the issuance of an Installation Test Protocol.

#### 10.2.4 On-Site Training

On-Site Training is given by qualified scientific personnel and includes an introduction to the theory of operation, a description of the instrument and detailed instructions for optimum use with emphasis on software features and their applications in the particular environment. On-Site Training is given in the English language and will be given upon completion of the Installation Service.

#### 10.2.5 Site Acceptance Test

On customer's request, the Site Acceptance Test (SAT) documents the process of the system verification after completed Installation Service and On-Site Training and is presented for customer review.

#### 10.2.6 Factory Training

At all times, we organize training events for groups of users at our own facilities. Please contact us for details.

## **NOTES**