

Vaisala Radiosonde RS92 Release Test results



*The New Shape of
Upper-Air Weather Observation*



Continuous Evolution of Vaisala Radiosondes

1931
RS11



.....
1983
RS80



1999
RS90



2003 - 2004

Vaisala Radiosonde RS92-SGP

- Code correlating ccGPS wind
- World's highest level of PTU performance



Vaisala Radiosonde RS92 Family

All major RS80 and RS90 radiosonde models will have an equivalent replacement model in the RS92 family

RS92 family, 400 MHz transmitter

<i>Model</i>	<i>Wind</i>	<i>Transmitter</i>	<i>Standard</i>
RS92-SGP	ccGPS	Digital 70 mW, ETSI EN 302 054-1	
RS92-AGP	ccGPS	Digital 20 mW, ETSI EN 302 054-1	
RS92-BGP	ccGPS	Digital 20 mW, ETSI EN 300 220-1	
RS92-KL	Loran-C	Analog 200 mW, ITU-R SA1165	
RS92-K	PTU only	Analog 200 mW, ITU-R SA1165	



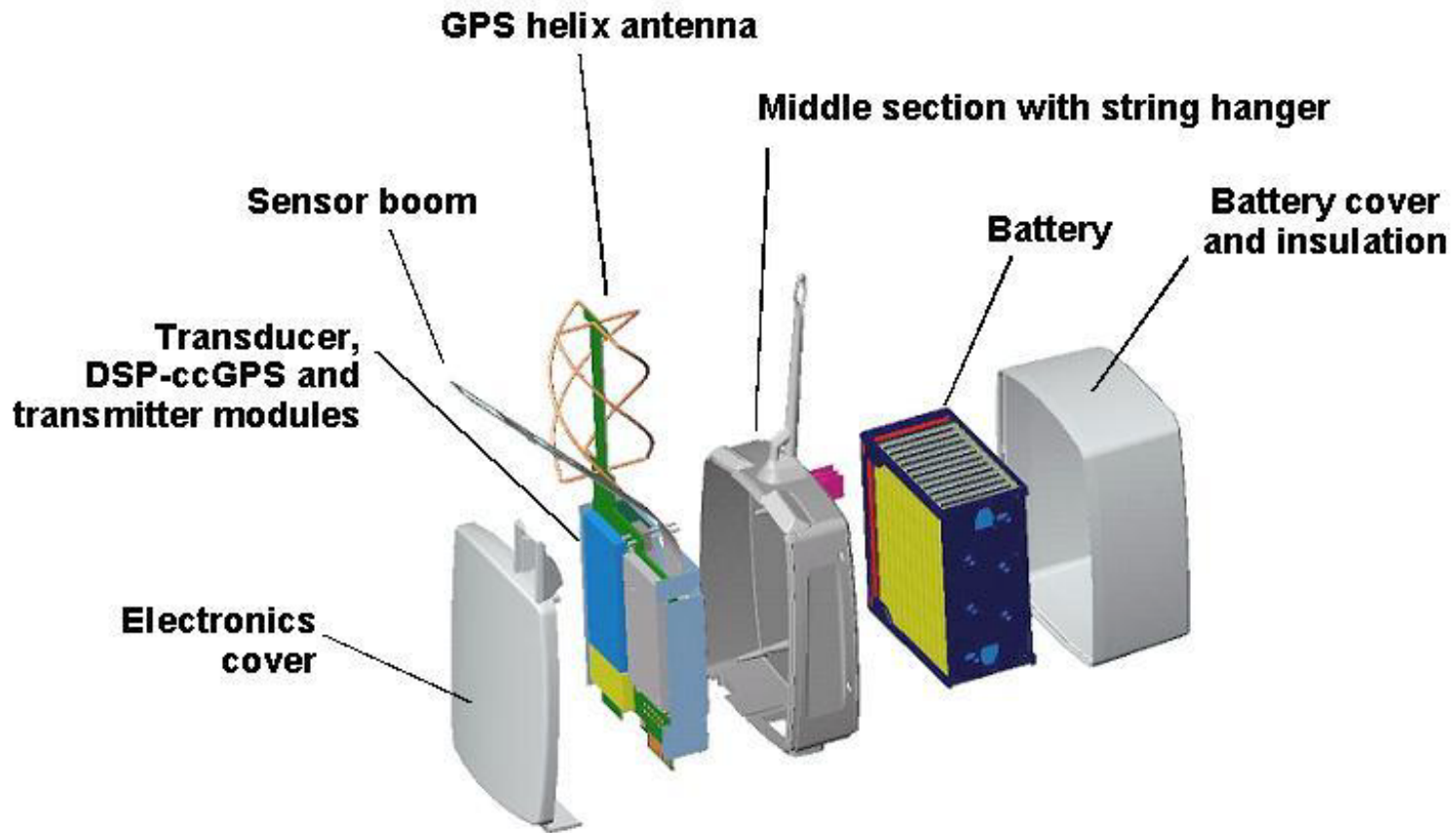
RS92 family, 1680 MHz transmitter

Under development

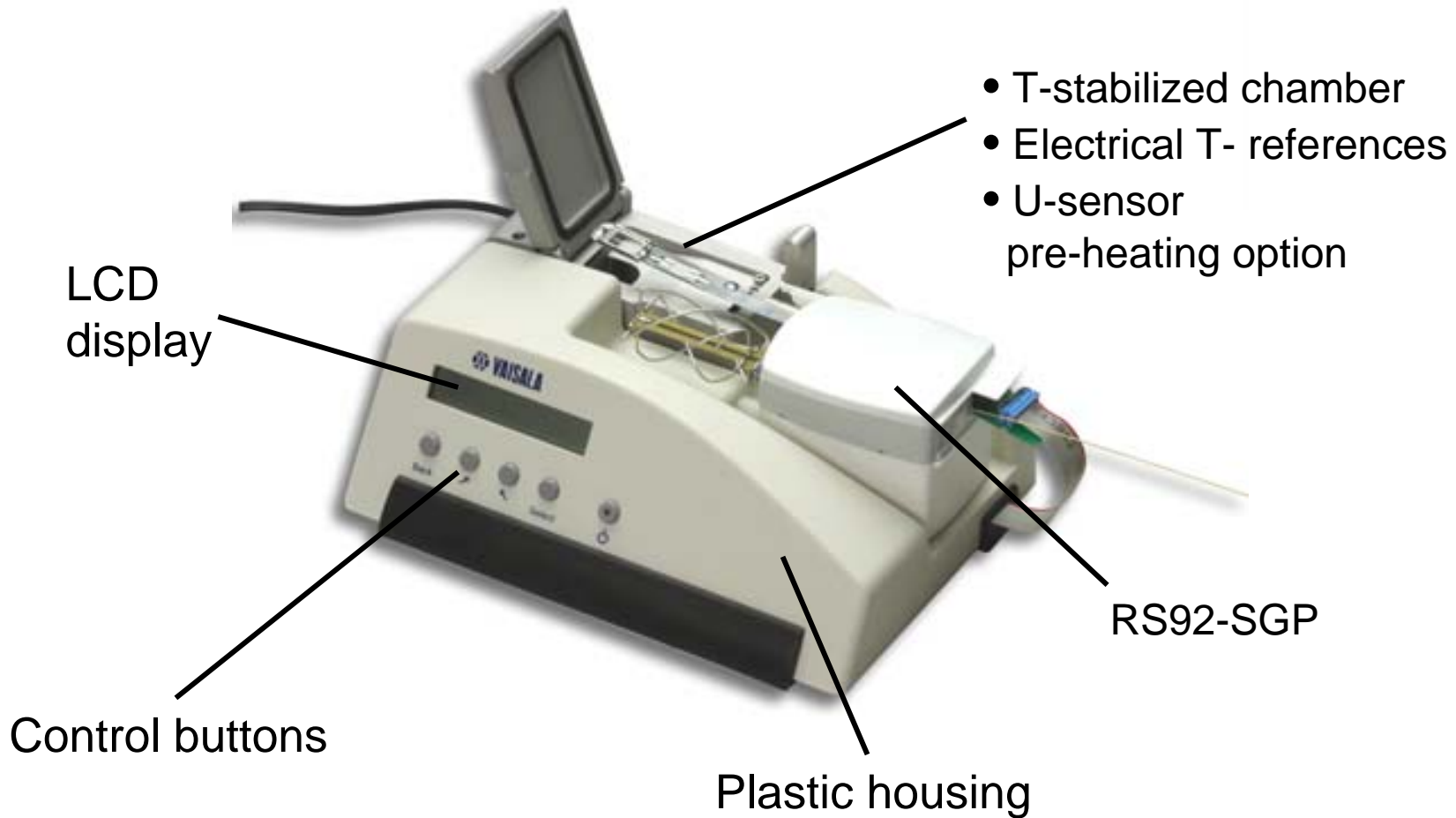
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New Modular Design



New Vaisala Ground Check Set GC25



RS92 Field Testing in 2002 and 2003

Most important RS92 field tests were performed in various locations and conditions in co-operation with selected customers:

<i>Main test locations</i>	<i>Radiosonde type(s)</i>
Europe (6 countries)	RS92-SGP, -AGP, -BGP, -KL
South America (2 countries)	RS92-SGP
Asia (2 countries)	RS92-SGP, -AGP

Field testing focus areas

- Radiosonde reliability: Continuous data availability for all measurements
- External RF interference (e.g. radar) : GPS tolerance, radiosonde recovery
- Measurement accuracy in real sounding environments: Solar radiation, extreme high and low temperatures, cloud top detection
- Continuity of time series: Comparison with RS80 and RS90 radiosondes

In addition, extensive laboratory tests were done to verify PTU and GPS measurement accuracy

Code Correlating GPS Advantages

Code correlating GPS (ccGPS) offers significant advantages over codeless GPS

Significantly higher signal-to-noise ratio = better sensitivity

- Data availability is continuous regardless of environmental sounding conditions

Better immunity to different kinds of external interference

- Radar or other sources of RF interference

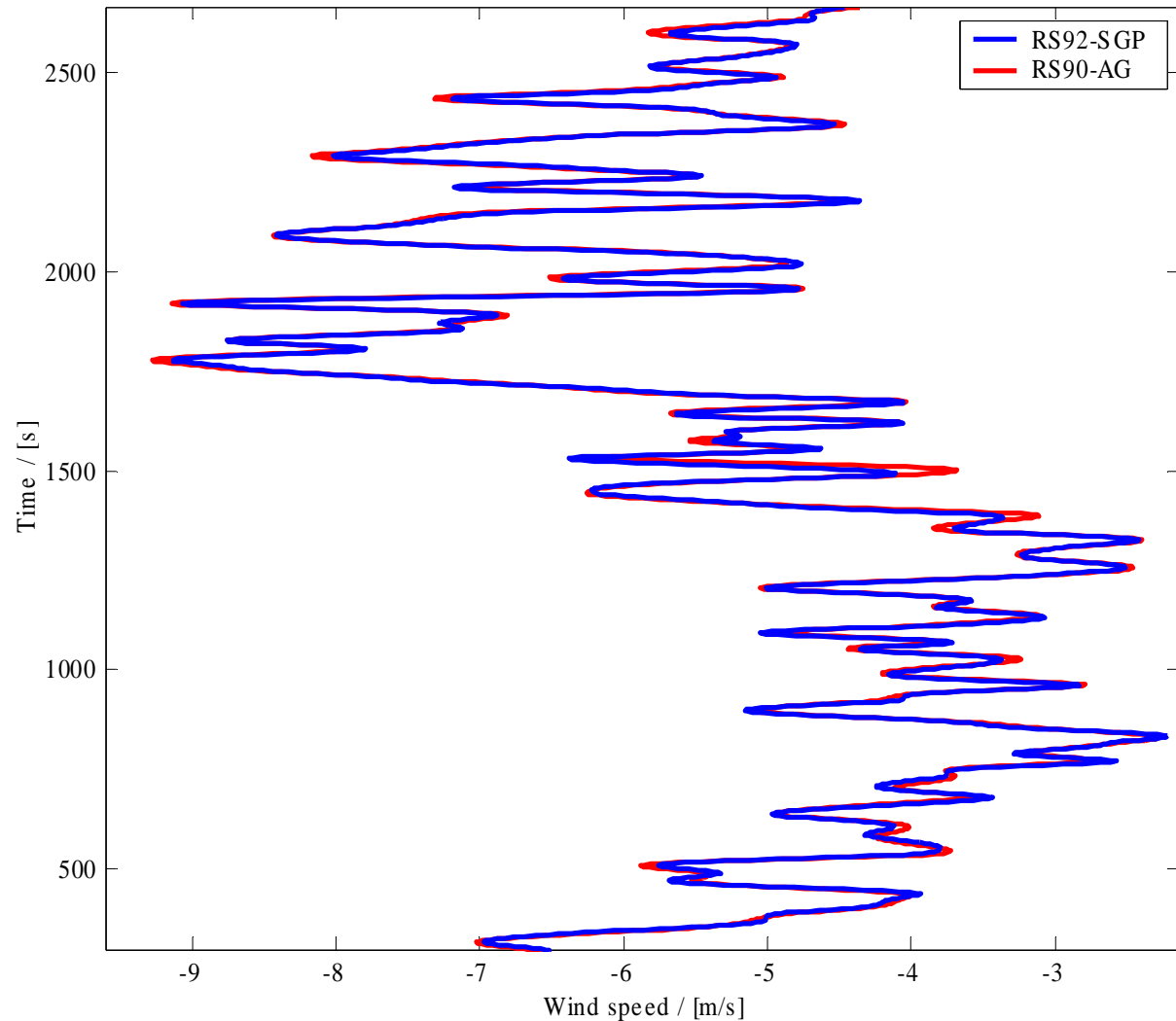
RS92 code correlating GPS navigation performance

- Positioning accuracy, horizontal: 10 m
- Positioning accuracy, vertical: 20 m
- Velocity measurement accuracy: 0.2 m/s

RS92 code correlating GPS Accuracy

**Comparison of
wind speed**

**RS92-SGP vs.
RS90-AG**



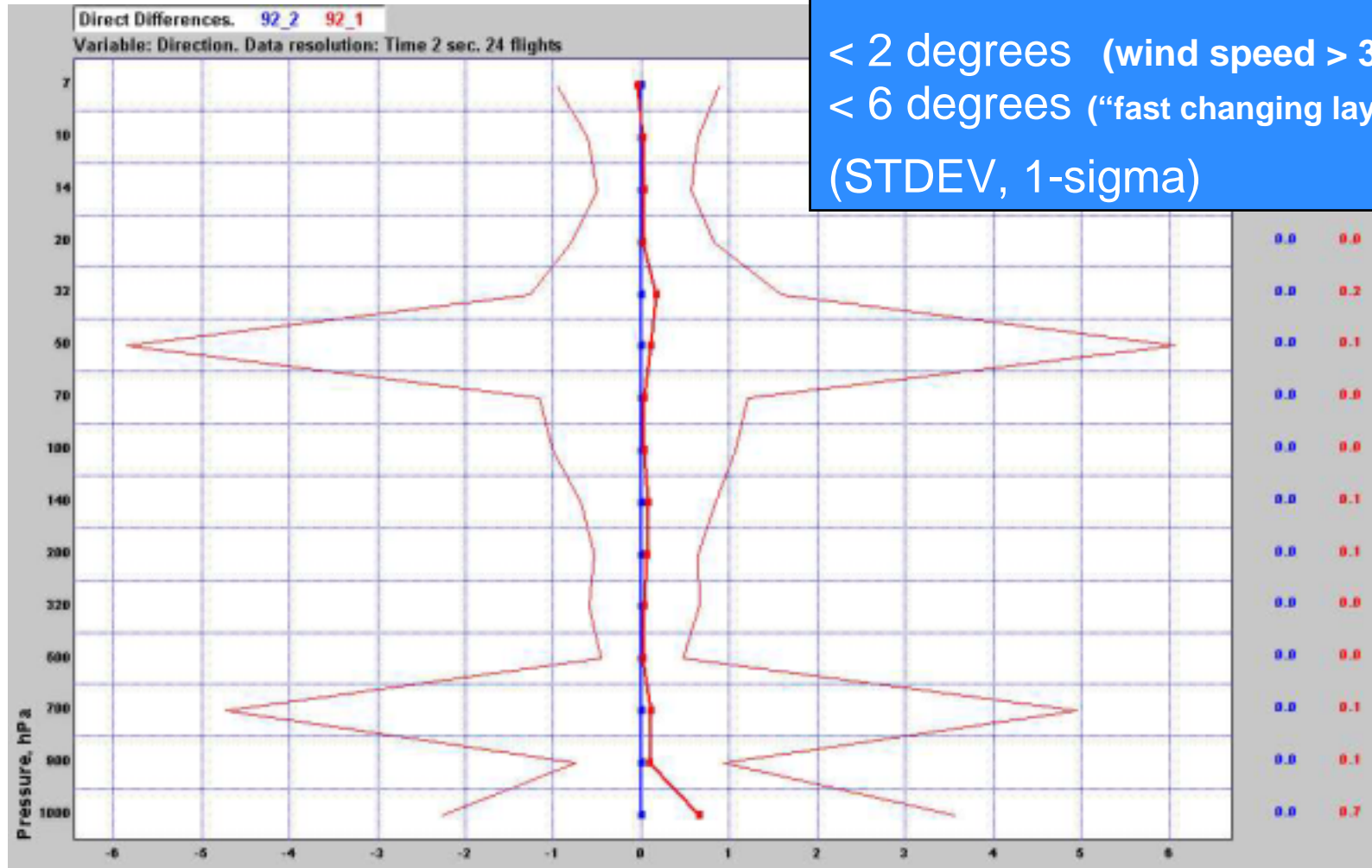
RS92 Release Soundings: Wind Direction

Reproducibility in sounding

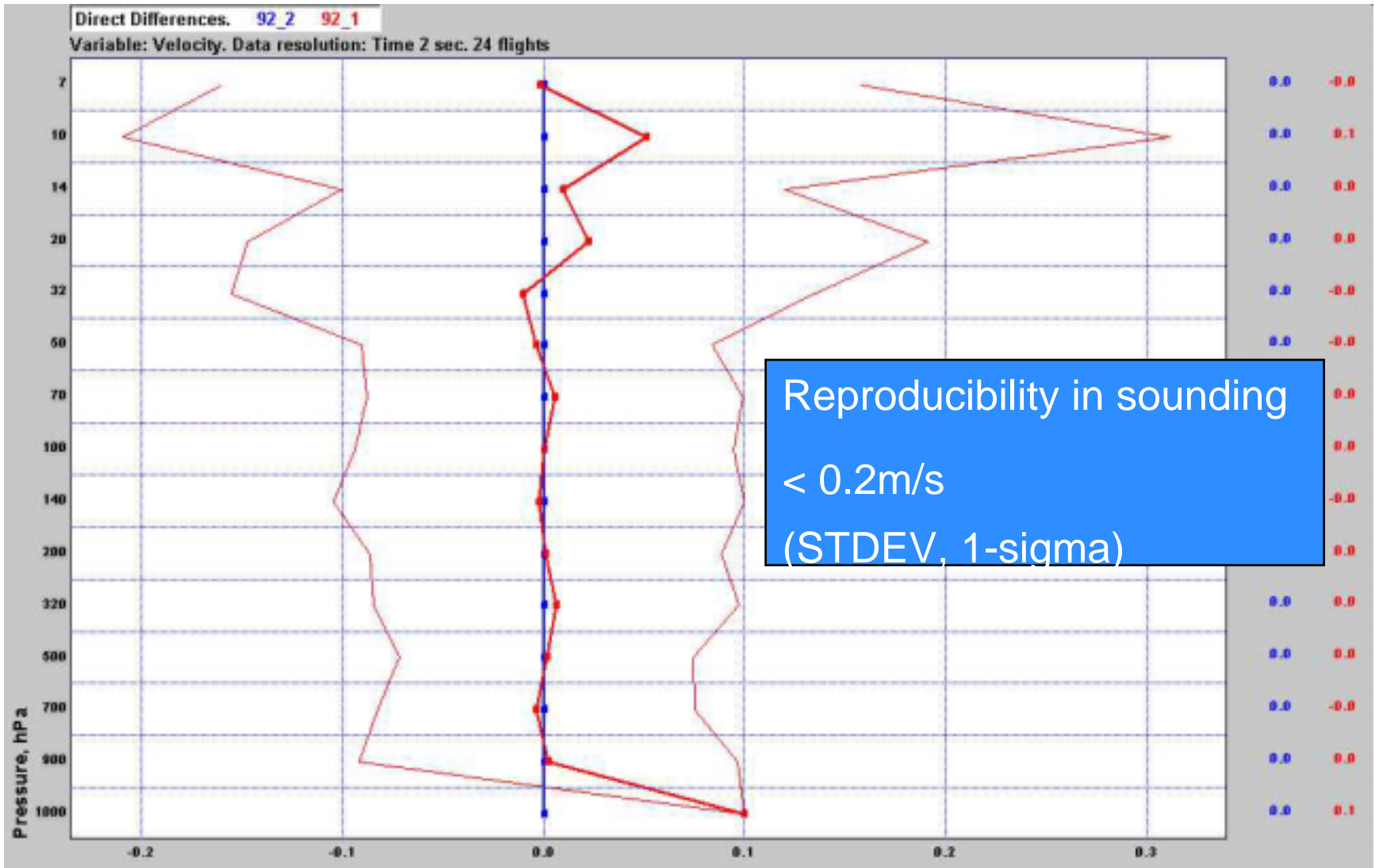
< 2 degrees (wind speed > 3m/s)

< 6 degrees ("fast changing layers")

(STDEV, 1-sigma)



RS92 Release Soundings: Wind Speed



Operation With RF Interference

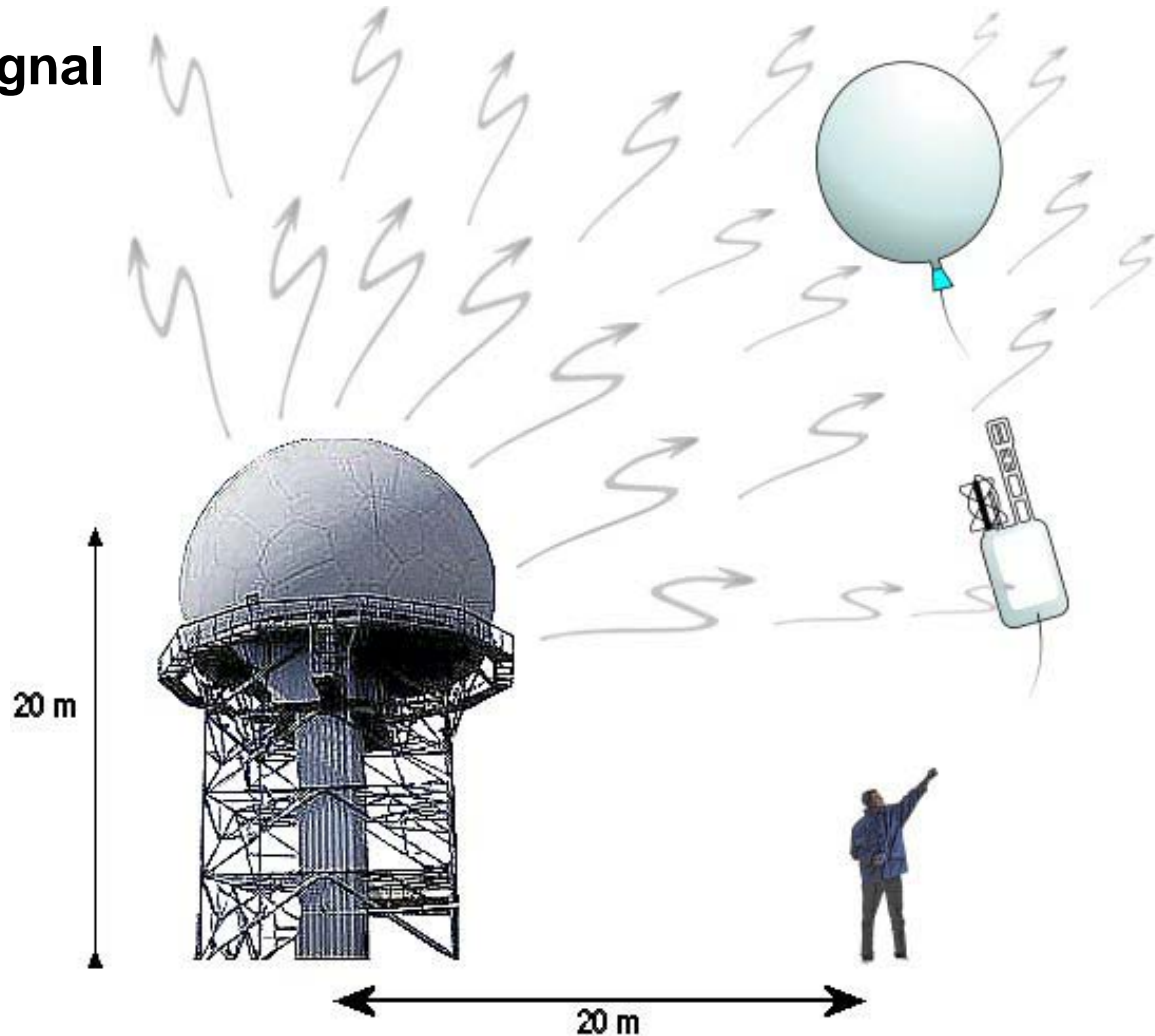
Implementation of GPS signal filtering and amplifying

“Watchdog” resets if malfunction occurs

Electrical resetting circuitry

Tested with radar interference

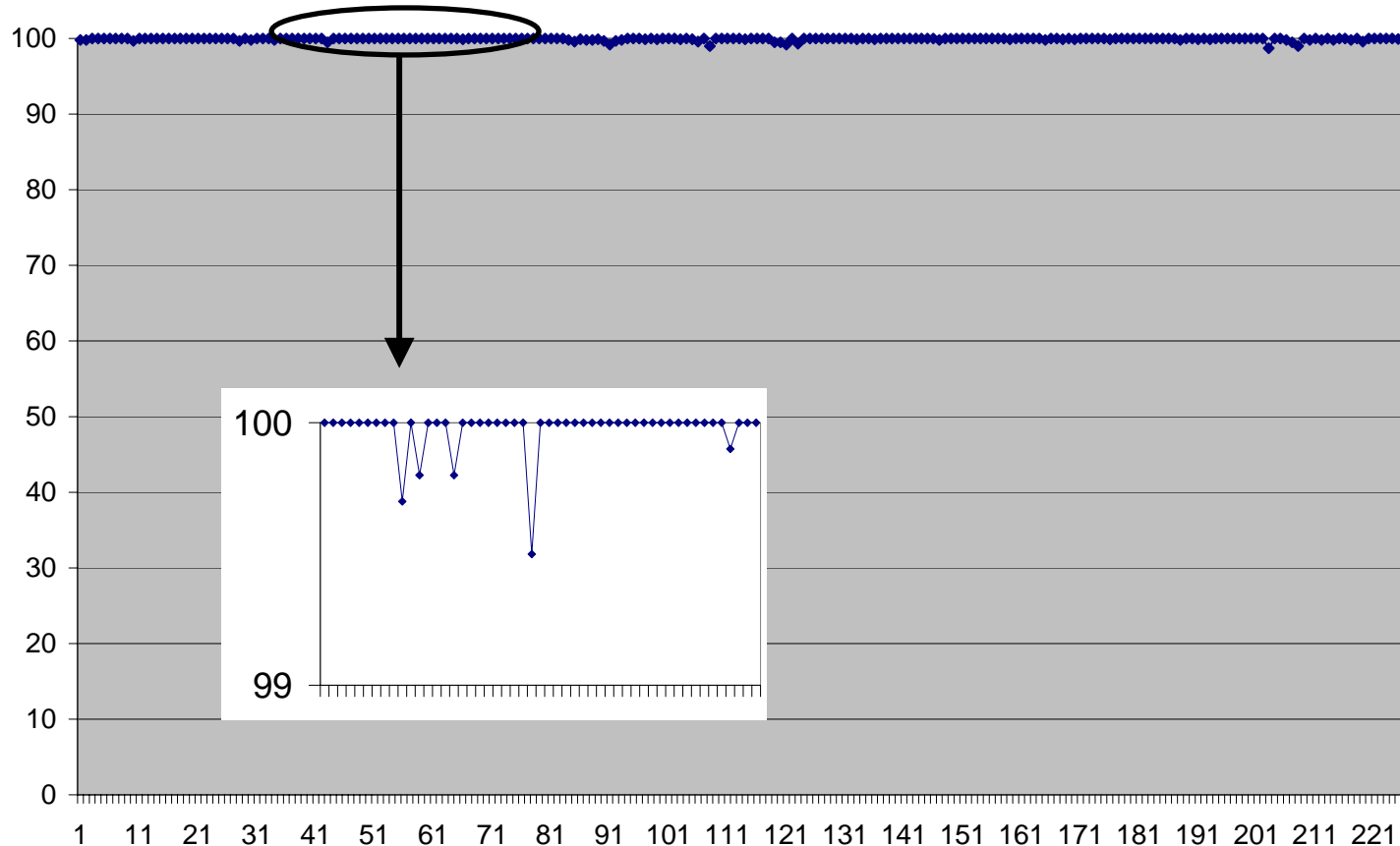
1MW Pulse power, 3 GHz



Code Correlating GPS Data Availability

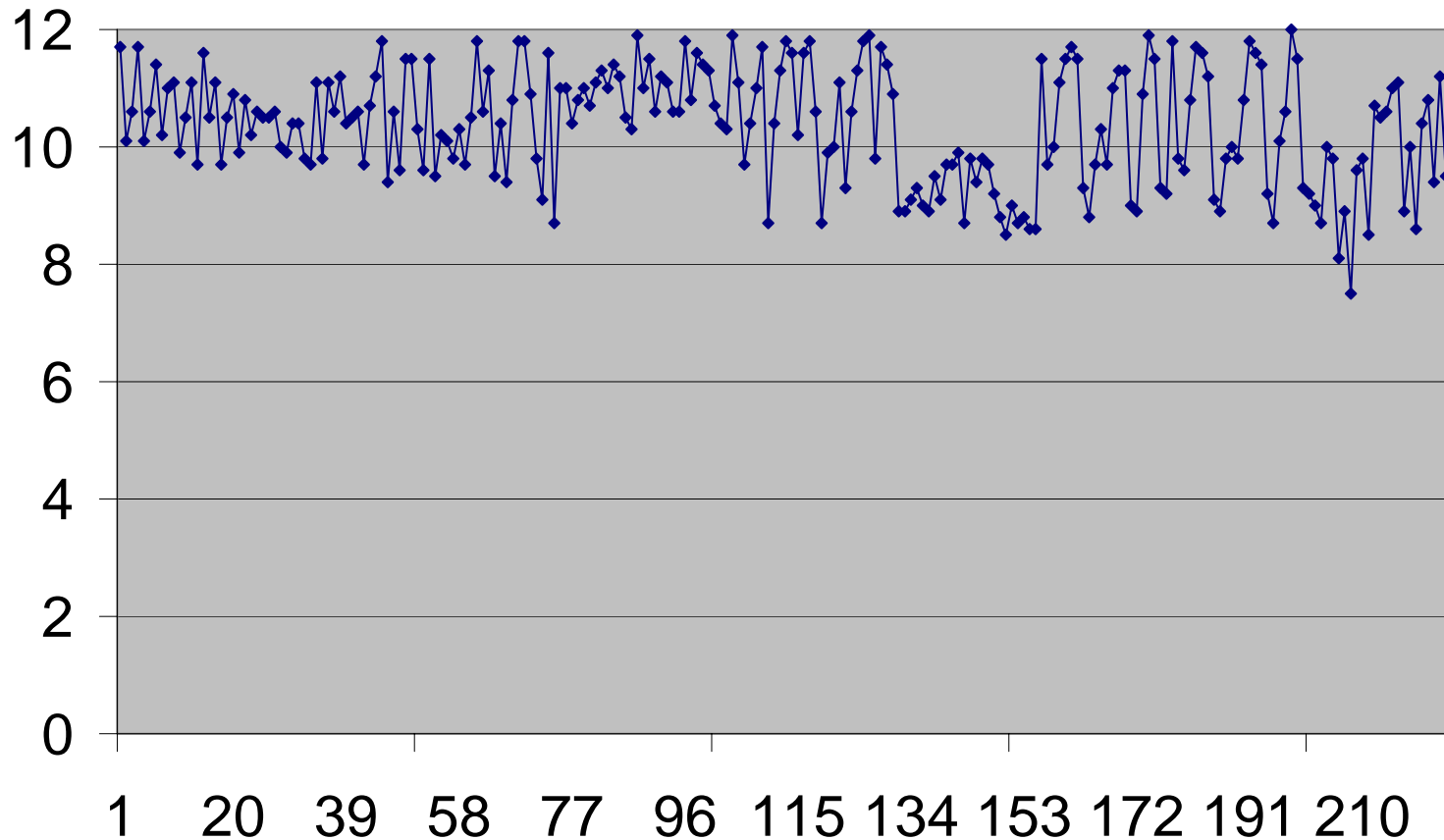
Objective: Continuous GPS wind and position data availability using code-correlating GPS technology optimized for sounding applications

Result: Average of >99.9 % raw GPS wind and position calculation success rate with production models in 227 test soundings since August 2003



Results: GPS-Based Wind and Position

Average number of tracked satellites: 10.4 in 227 soundings.
4 satellites are required for proper findfinding



Proven PTU Sensor Performance

Vaisala F-THERMOCAP®: temperature sensor

- Excellent accuracy, fast response time and minimized solar radiation error

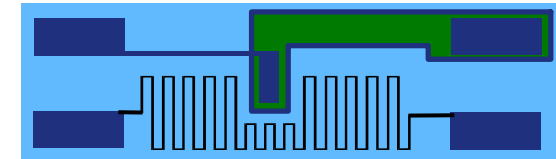
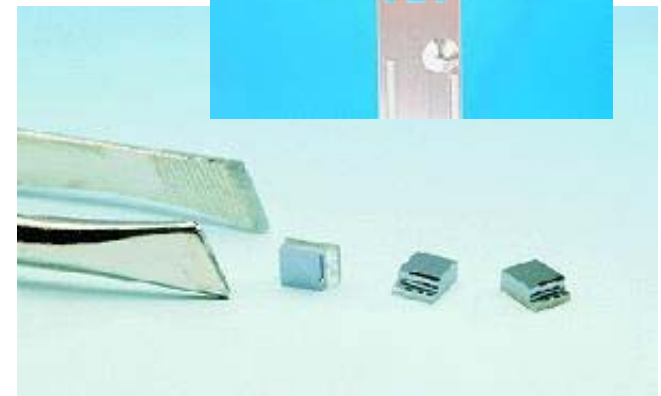
Vaisala BAROCAP®: shock-resistant silicon pressure sensor

- Immune to fast temperature changes

Heated Vaisala HUMICAP®: fast, defrosting humidity sensor

- Short response time, reduces condensation and icing
- Reconditioning at ground check to remove contaminants from the sensor and recover original sensor calibration

CAL-4 factory calibration is traceable to international standards



F- THERMOCAP[®] Temperature Sensor

The most important design factors in radiosonde temperature sensor construction:

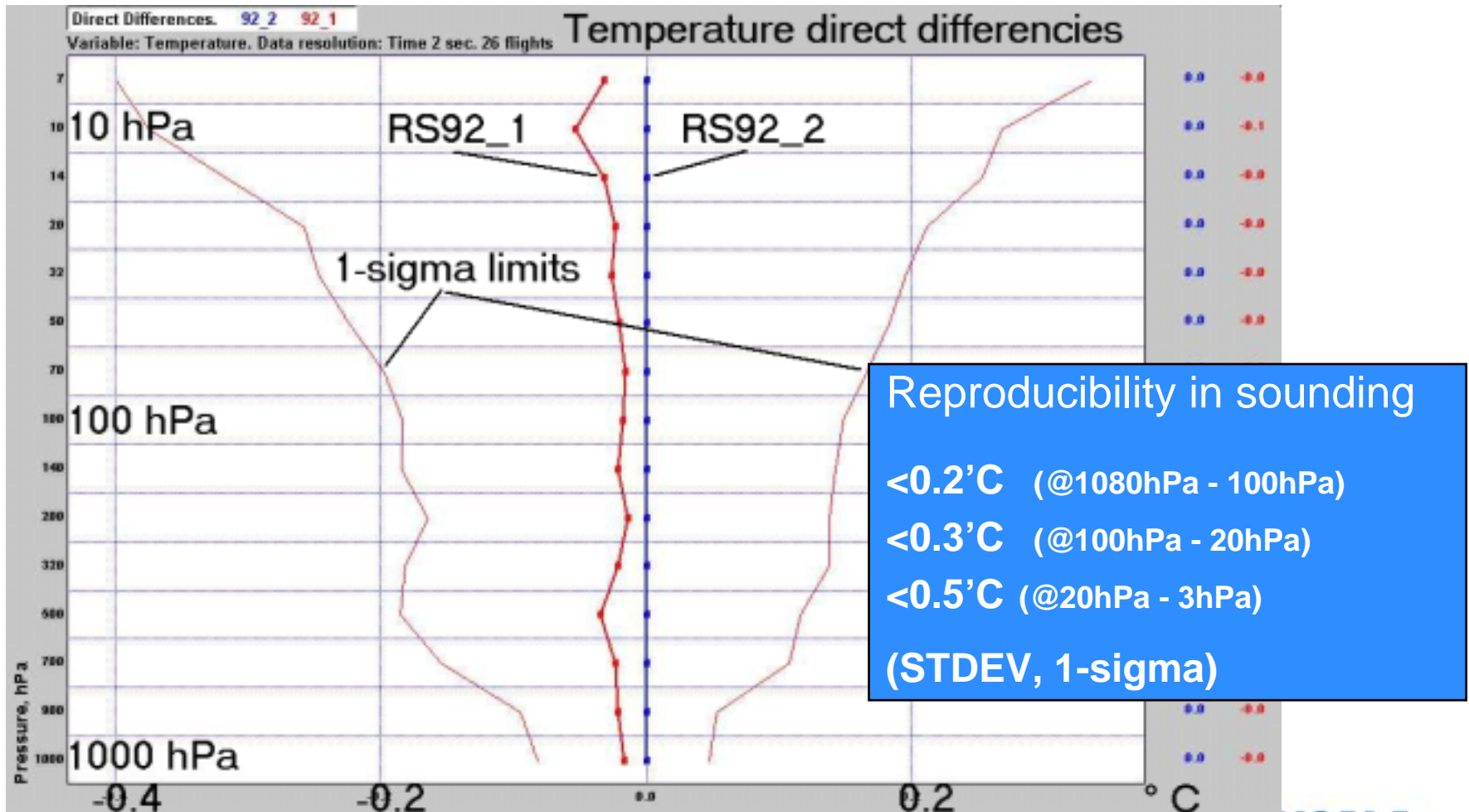
- **Minimize the response time (lag)**
- **Minimize the effects of solar and infrared radiation**



RS92 Release Soundings: Temperature

Location: Jokioinen observatory, Finland

Time: May 2003



RS92 Heated HUMICAP® Humidity Sensor

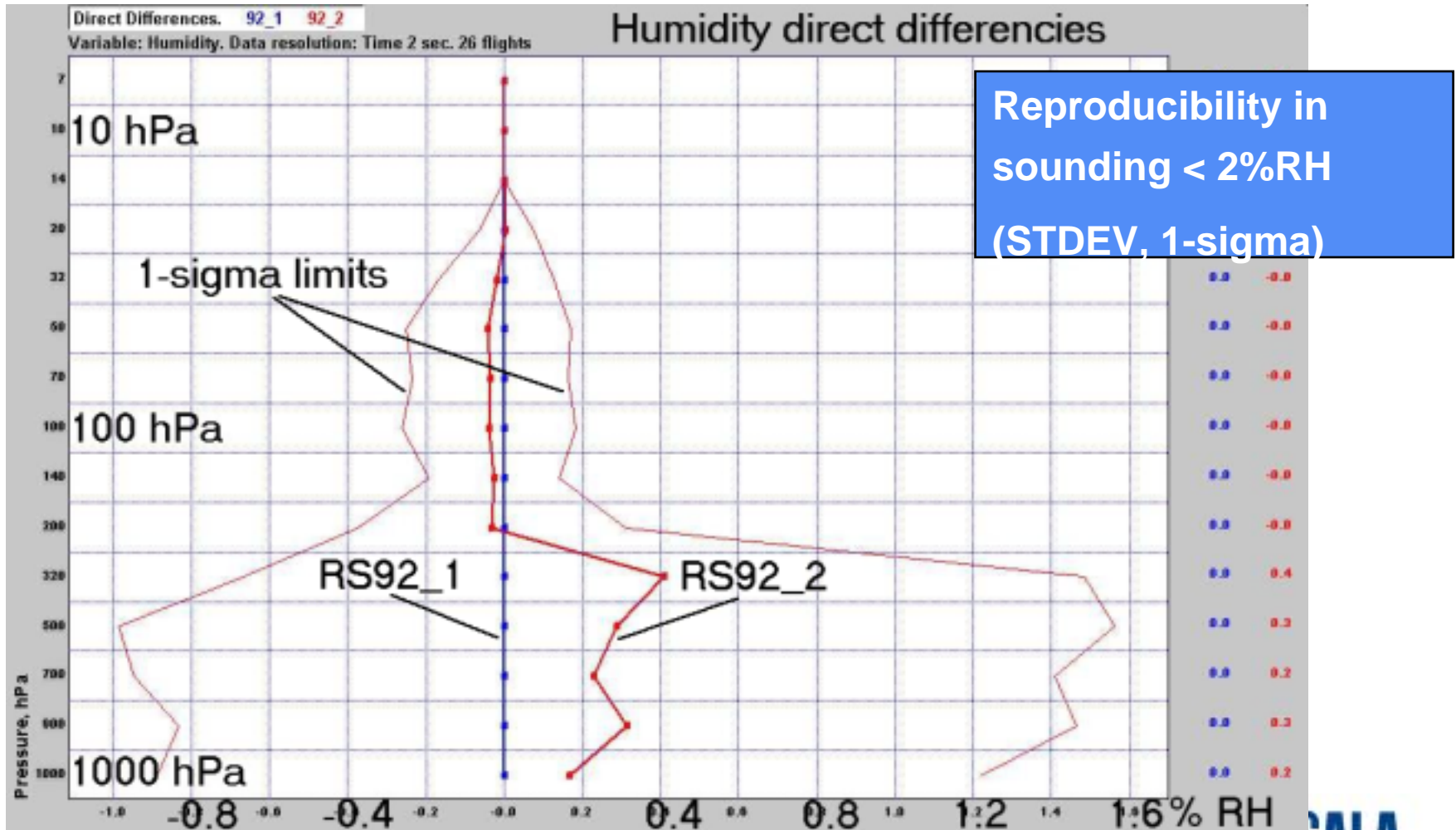
The new RS92 radiosonde family introduces a higher level of humidity measurement performance. The humidity sensor used in RS92 radiosondes is based on the humidity measurement technology originally introduced with the Vaisala Radiosonde RS90.

- The calibration accuracy of the HUMICAP® humidity sensor and its time response capability have been proven in operational use with the RS90 radiosonde. Special attention has now been paid to such factors as sensor stability, calibration accuracy after storage, and the elimination of the possible condensation of water vapor during sounding. As a result, some significant improvements have been made.

RS92 Release Soundings: Humidity

Location: Jokioinen observatory, Finland

Time: May 2003



Silicon BAROCAP[®] Pressure Sensor

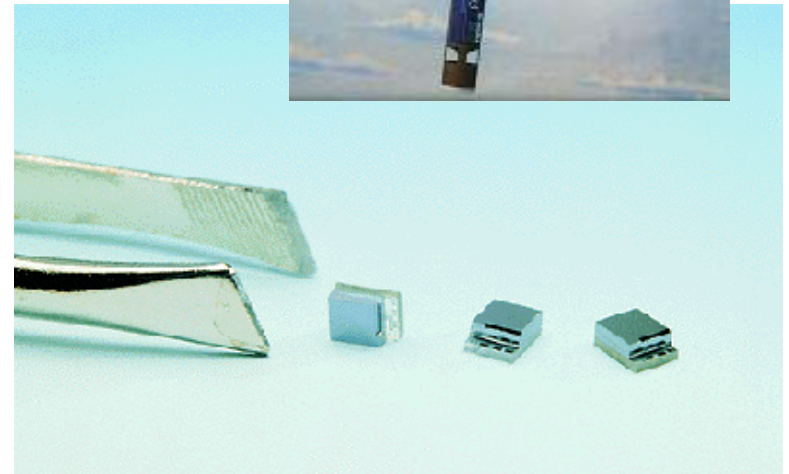
Endures transportation shocks

- Silicon BAROCAP[®] is shock-resistant, minimizing the risk of damage during shipping

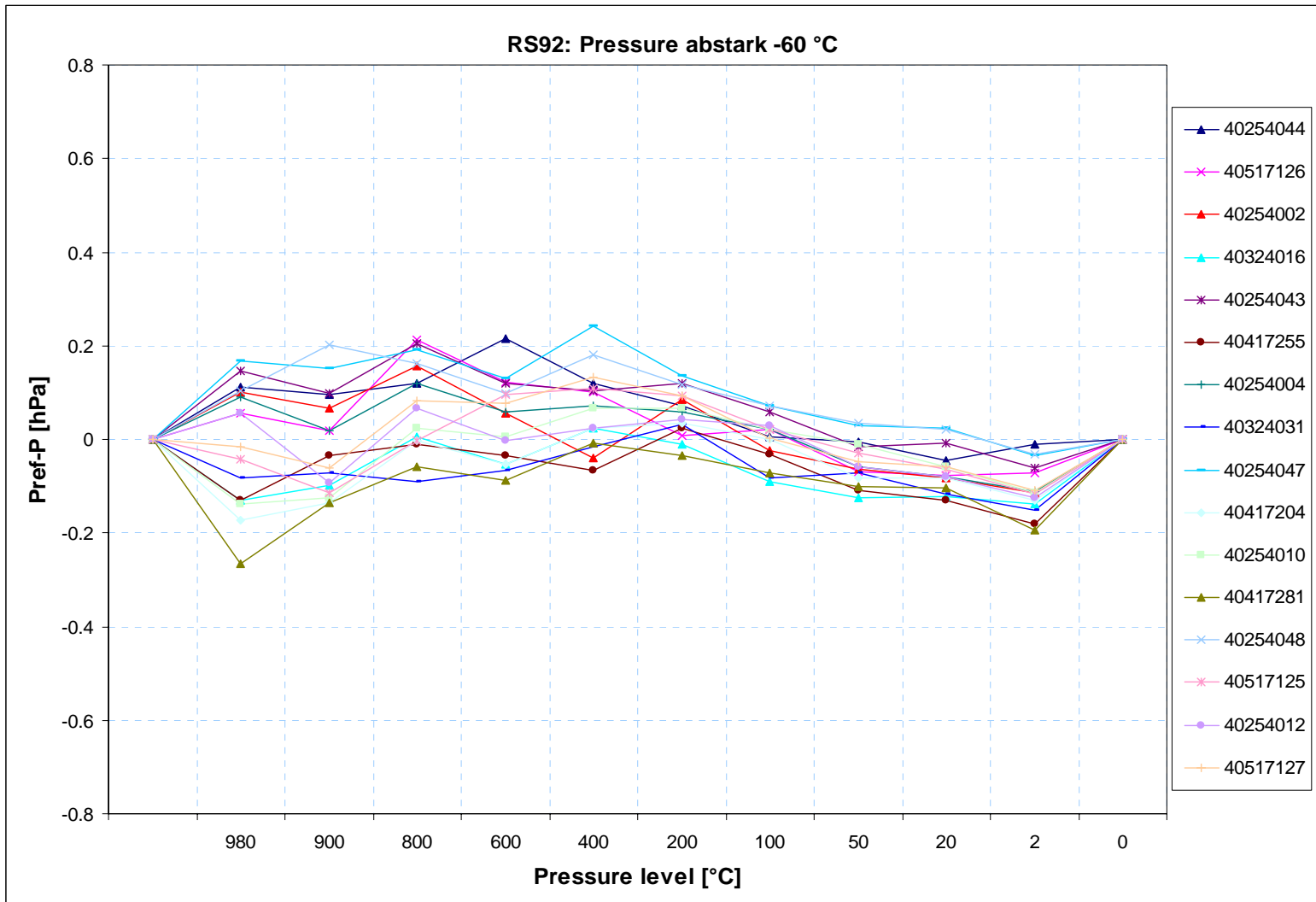
Fast temperature response

- Eliminates measurement errors even when ambient temperature changes rapidly

RS92 radiosonde sensors have also been used successfully in dropsondes for hurricane measurement



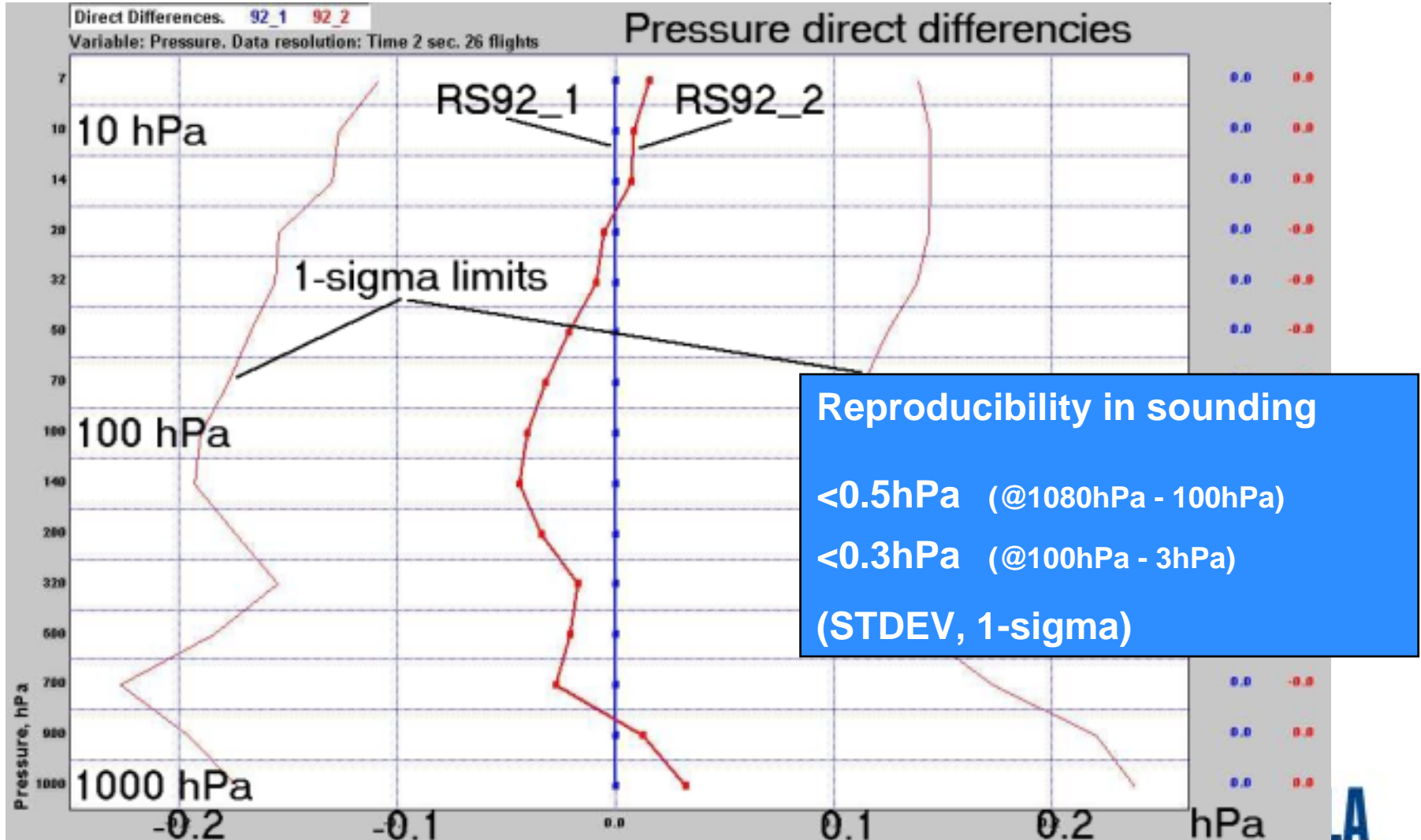
RS92 Pressure sensor, accuracy test in chamber, -60 °C



RS92 Release Soundings: Pressure

Location: Jokioinen observatory, Finland

Time: May 2003



RS92 Radiosondes with special sensors

Various types of special sensor interfaces will be available:

- **OIA11 interface for analog RS92-KL sonde (currently available)**
- **New interfaces for digital RS92 sondes for ozone, radioactivity, etc.**

Reliable Digital Data Transmission

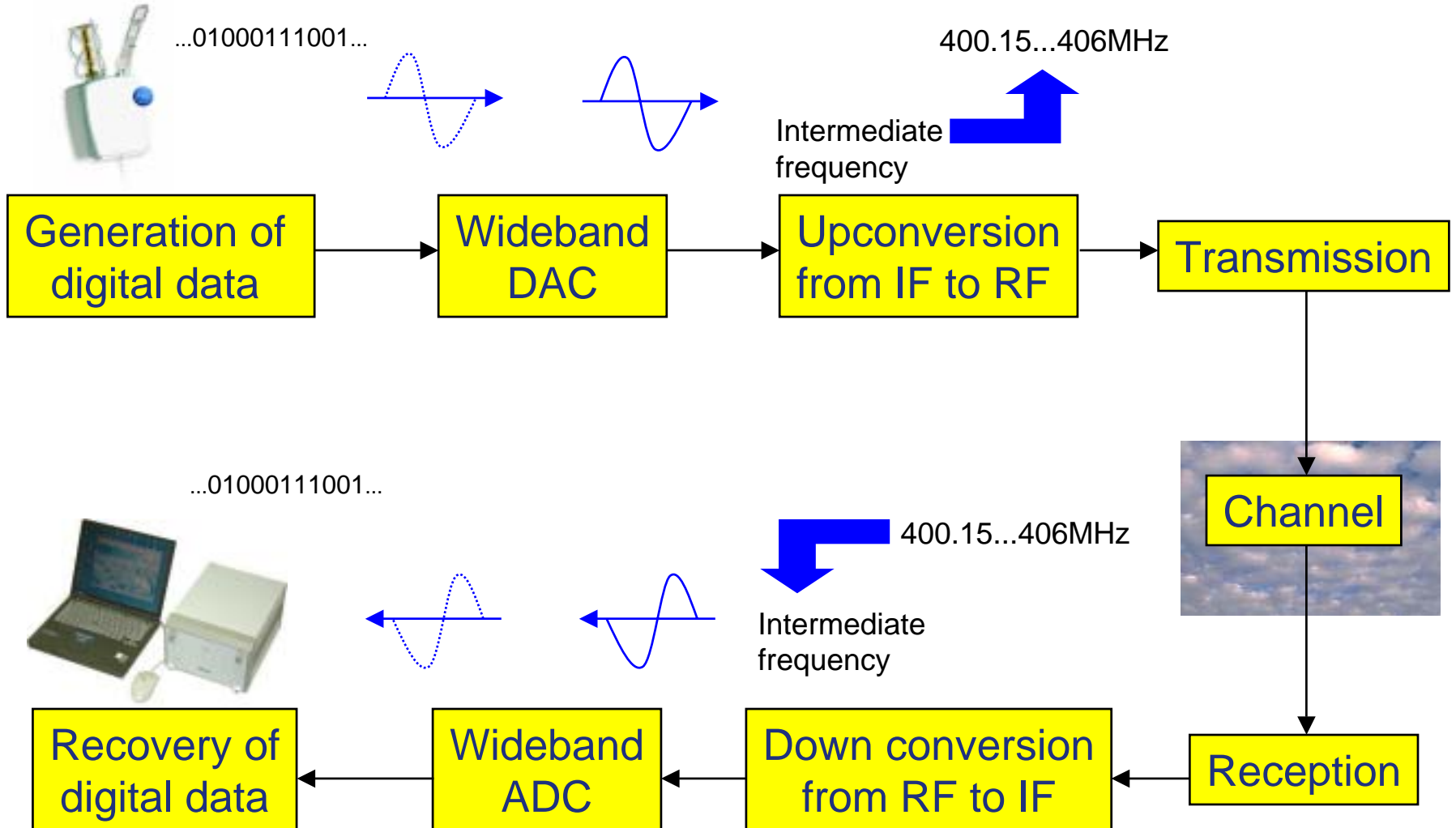
Most transmitter functions are performed in the ASIC circuit

- Transmission is stable with temperature-compensated crystal oscillator and on-chip synthesizer
- The processor controls the transmission frequency

The digital RS92 is compatible with the ETSI standard for radiosondes (ETSI EN 302 054-1)

- Radiosonde output power has been reduced while telemetry range performance and data availability remain excellent, typically over 99%

Digital Telemetry Link



New Software Defined Radio for DigiCORAlll

New DCIII's are delivered with the new software defined radio introducing:

- **Digital receiver**

- The received signal is sampled
- After sampling digital signal processing is applied
 - **Software configurable digital filters**
 - **Modern digital modulation techniques**
 - **Efficient error detection and correction methods**

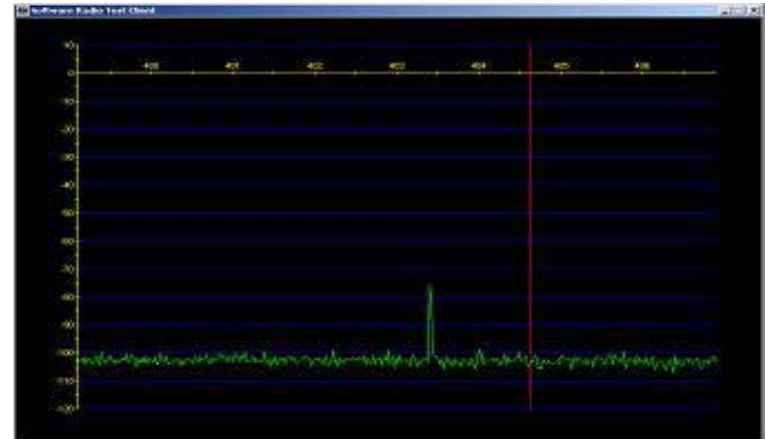
- **Multi-channel receiver opportunity**

- The current software supports 1 radiosonde and 2 diagnostics channels

- **Software configurable operation!**

DigiCORAll sounding package

- Vaisala Radiosonde RS92-AGP
- New deliveries of Vaisala DigiCORA® Sounding Systems
- Vaisala Sounding Processing Subsystem SPS311



First User Experiences

- **First operational adopter of RS92 GPS radiosondes was the Deutscher Wetterdienst, German Weather Service**
 - ccGPS wind data availability is excellent
 - RS92 is also used with Vaisala AUTOSONDE
 - The entire German upper air network including military installation is being upgraded to RS92
- **UK-Met Office acceptance tests for RS92 operational use in May2004.**
- **In 2004 approximately 25% of Vaisala radiosonde production will be based on the RS92 radiosonde family**
- **The perception of RS92 amongst radiosonde users has been very positive and the transition from RS80 and RS90 radiosondes to the RS92 is expected to be rapid**

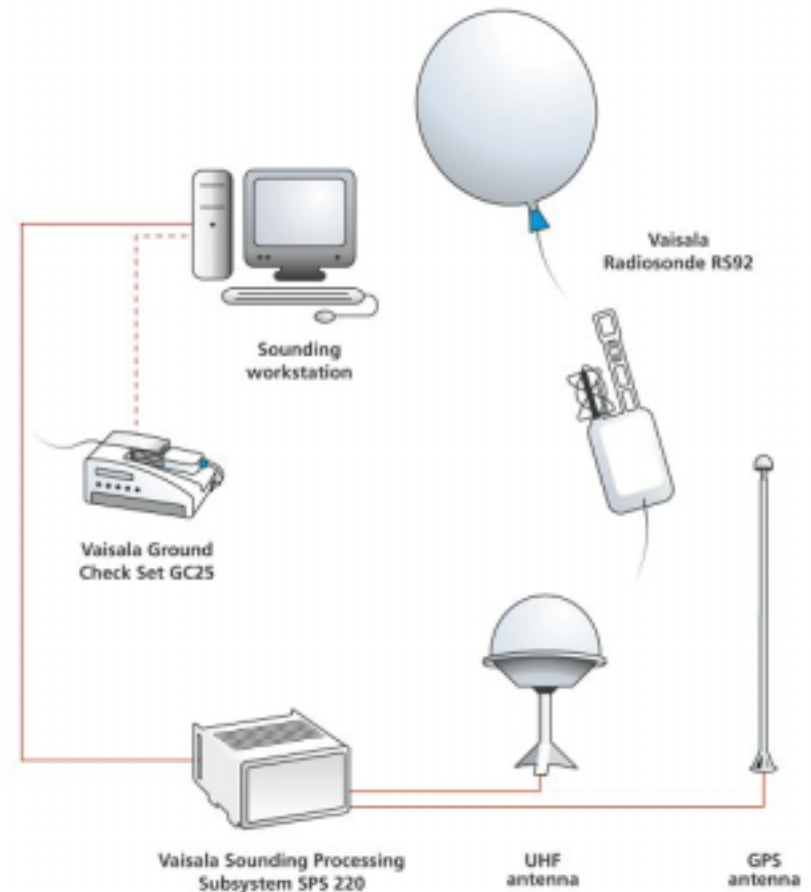
Upgrading The Sounding System

DigiCORA III users

- Software upgrade
- New ground check device

DigiCORA I, II generations and MARWIN

- Receiver processor upgrade
- Software upgrade
- New ground check device



Thank You!



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