# Rainscanner
# Compact Weather Radar

Product Brochure

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# RAINSCANNER - COMPACT WEATHER RADAR



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- **METEOR 50 DX**
  Mobile Compact Weather Radar
- **Weather Radar for Aviation**
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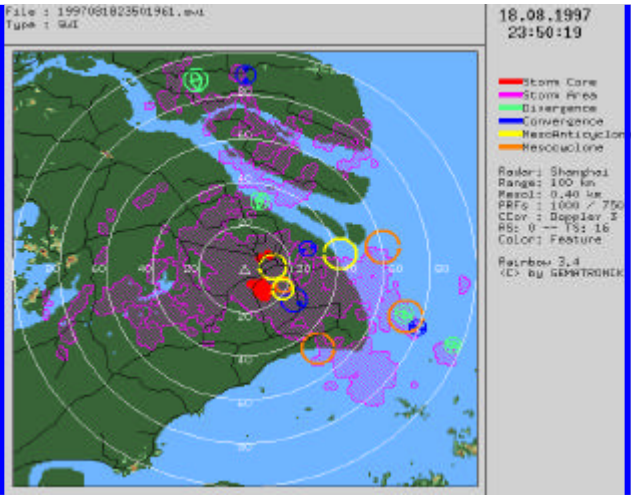

# 1 AMS – GEMATRONIK COMPANY PROFILE

Worldwide, AMS - Gematronik has a leading position in the design, manufacture and installation of weather radar systems. During the last ten years, more than 100 Gematronik Doppler radars have been successfully put into operation in more than 40 different countries.

Today the company focuses on providing customized systems and turn-key solutions that reflect a deep concern for the individual customer. More than 40 years of experience, reliability and a professional approach to challenges have contributed to the company's excellent reputation among experts of the meteorological environment.

**AMS - Gematronik Factory Neuss, Germany**

AMS - Gematronik employs about 100 people, most of them highly qualified engineers and technicians. Weather Radar experts with complete system engineering know-how are available to guarantee that the most cost-effective system architecture is tailored to meet the specific customer's needs.

Now AMS - Gematronik belongs to AMS, an equal shares joint venture between FINMECCANICA of Italy and BAE SYSTEMS of the UK. AMS is a multi-national electronic systems company specializing in the design, manufacture and supply of radar and mission critical command, control and management systems to defence forces and air traffic management authorities throughout the world.

The know-how of AMS - Gematronik in the field of advanced Doppler Weather Radars together with the experience in the fields of meteorological data processing and international system project management gives the customer the guarantee of purchasing a high performance radar system which will work successfully at every site worldwide.

## 1.1 AMS – Gematronik Quality Management

High quality design, production and implementation is needed in order to comply with weather radar system requirements as high system availability necessary for total unattended operation. Our METEOR radars systems excel by minimum maintenance requirements, long lifetime and lowest lifecycle costs.

The AMS – Gematronik Quality Management System ensures high quality standards of products and services. AMS – Gematronik was the first weather radar manufacturer who implemented a quality control system. In the past the company had established and applied a Quality Control System according to AQAP-4 (NATO Quality Control Systems Standards). Since 1996 the AMS – Gematronik Quality Management System was certified and approved according to DIN EN ISO 9001:1994.

**AMS - Gematronik**
**High Quality Manufacturing**
**Made in Germany**

Now our high quality standards are ensured by our enhanced quality management system which has been established and is applied according to DIN EN **ISO 9001:2000**.

AMS - Gematronik's quality control policy is based on the most advanced techniques in this field and is achieved with the aid of modern test and measurement facilities.

The high quality level of the weather radar systems developed and manufactured by AMS - Gematronik is proven by operational METEOR weather radars worldwide.

TÜV MANAGEMENT SERVICE ISO 9001

## 1.2 RAINSCANNER Application & Benefits

The Rainscanner offers a cost efficient and effective solution for short to medium range weather radar application. Simplicity and ease of use are the primary design features, permitting fast installation, radar control and data handling. The entire system is lightweight and portable if mobile operations are required.

The X-Band can be used for a large variety of applications, as for example:

- Gap filler in Radar Networks Tactical Application – Military
- Civil Protection - Municipalities
- Offshore platforms - Oil Industry
- Research
- Hydrological Application
- Airports – Support Air Traffic Management

## 1.3 Key Benefits

- Compact, light weight and portable
- Fixed or mobile installation
- RainView real-time remote radar Control and Data Visualization software

## 2 RAINSCANNER

The RAINSCANNER is designed as an affordable area scanning precipitation indication system. The Rainscanner indicates precipitation areas, and classifies precipitation into levels. Comparing radar with rain gauge data gives improved quantitative rain rate estimations.

The maximum range of operation varies between 50 km and 100 km, depending on environmental and meteorological conditions, e.g. intensity of precipitation. Simplicity and ease of use are the primary design features, permitting fast installation, radar control and data handling.

The antenna and pedestal combination is designed for exposed outdoor operation. Fast antenna scans provide quick updates of atmospheric situations. The modular design offers 2 reflector types, yielding in beam width of 1° to 4° degrees. Depending on the reflector size and the environmental conditions, a suitable radome is available.

The transmitter is capable of approximately 25 kW power output, ideal for operation at ranges between 50 and 100 kilometers.

A typical RAINSCANNER installation is shown in Fig. 1.

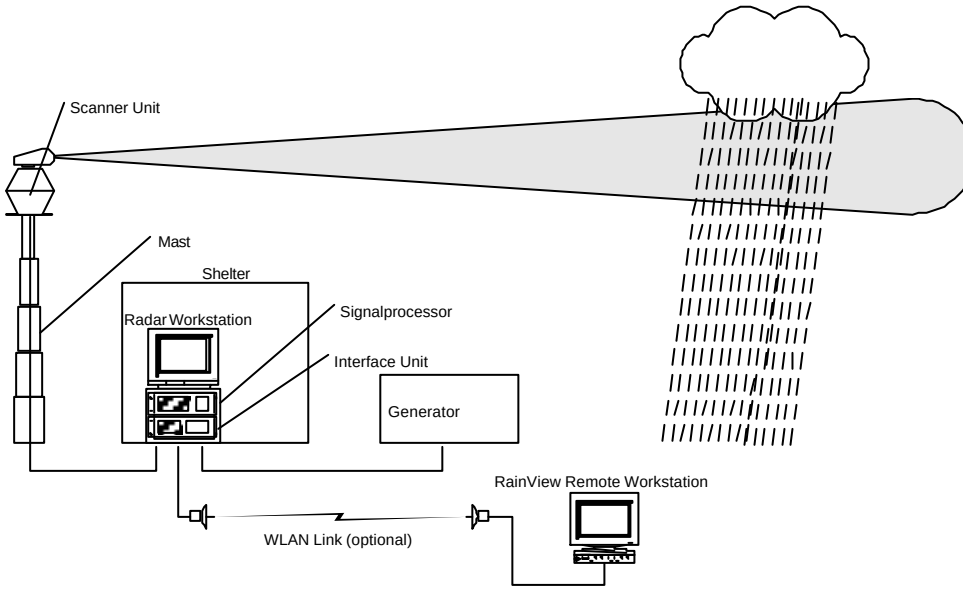


**Fig. 1: RAINSCANNER Installation (example)**

The RAINSCANNER consists of a scanner unit, interface unit and signal processing unit. The scanner unit contains the transmitter, receiver and antenna units, that can be mounted on a fixed installation (building or mast). Antenna Data are feed directly from the scanner unit to the Rainscanner Workstation via an antenna cable (max. length 30 m). The Rainscanner workstation comprises the interface unit and a robust industrial Signal Processing PC.

Data display as well as product and data archiving are provided with the real-time visualization software RainView. This software module is based on our field proven software package Ravis. The real-time radar system and data visualization software Ravis forms an essential components of our full-size METEOR Weather radar series.

Data transfer between the Rainscanner Unit and the remote RainView PC can be provided via ISDN, WLAN, Fibre Optics, etc.

A simplified RAINSCANNER block diagram is shown in Fig. 2.

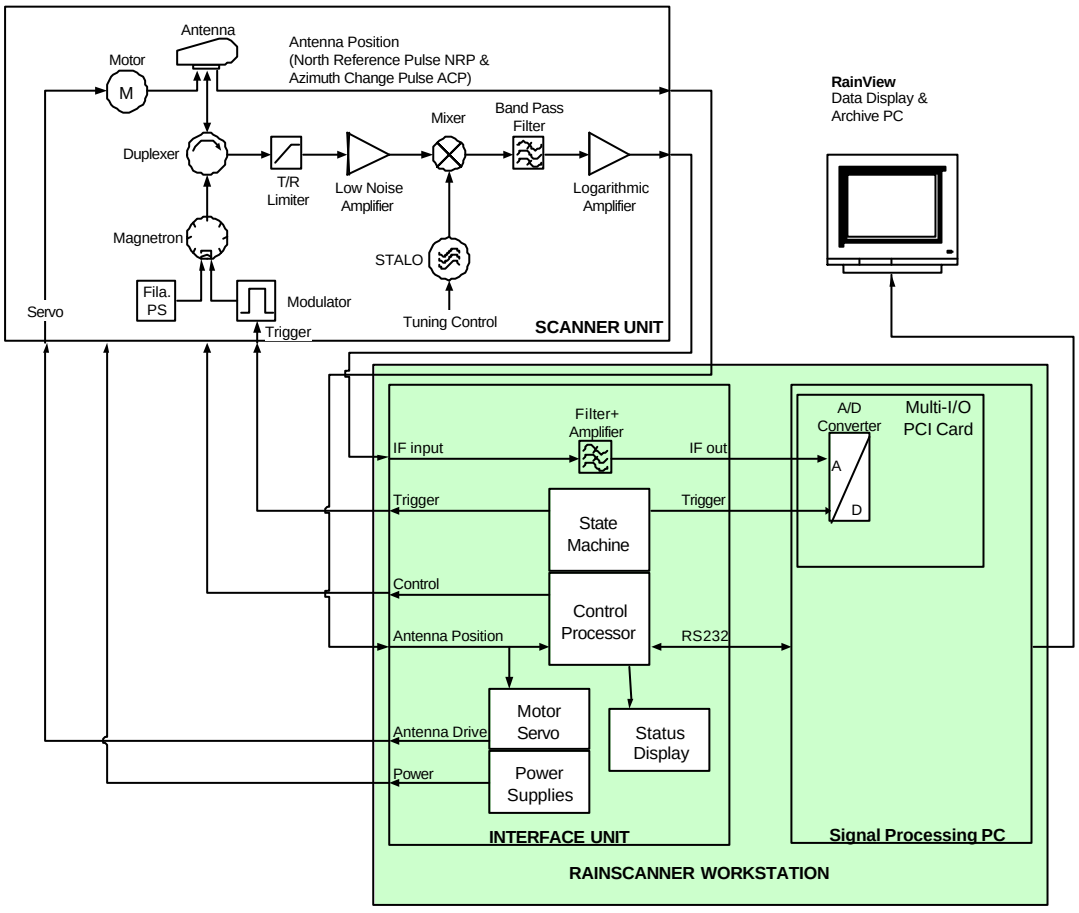


**Fig. 2: Simplified Block Diagram**

## 2.1 The Scanner Unit

The scanner unit is based on a commercial off-the shelf marine radar system. It comprises the antenna, the transmitter and the receiver. The transmitter features a conventional magnetron. The pulse modulator is a hard-switched design which uses high-power MOSFETs as switches. The microwave pulse produced by the magnetron is routed via a junction circulator to the antenna rotary joint.

The receiver consists of a microwave section and an IF section. The microwave section is connected via a T/R limiter to the circulator. The T/R limiter protects the low noise front end (LNFE) from residual transmitter power leaking through the circulator and from the fraction of the transmitter pulse which is reflected by the antenna due to its VSWR.

The LNFE contains the low noise amplifier (LNA), the stable local oscillator (STALO) and an image rejection mixer.

After the received signal is down converted to the intermediate frequency it is processed by the IF section. The main component of this section is a detecting logarithmic video amplifier (DLVA).

The transceiver housing and antenna are designed to withstand hostile and extreme environments. Refer to 3.3 Environmental Conditions for more details.

The antenna housing is optimised for a minimum wind load, which is advantageous for mast installations. Fig. 3 shows the scanner unit with fan beam antenna.

## 2.2 RAINSCANNER Configurations

### 2.2.1 Scanner Unit – Fan Beam Antenna

The antenna is a slotted waveguide design which provides a fan beam shape The antenna position is measured with two signals, the north reference pulse (NRP) and the azimuth change pulse (ACP). During the installation the scanner unit will be adjusted with respect to the north direction, with the help of a compass. After installation, the true north antenna position can be fine tuned with a software routine.


**Fig. 3: Scanner Unit with Fan Beam Antenna**

| **Fixed Installation** | **Mobile Application** |
|---|---|
| Fan Beam Antenna | Fan Beam Antenna |
| Radar Transceiver | Radar Transceiver |
| | Telescope Mast (height up to 15 m) |
| 15 / 30 m Radar Interface Cable | 15 / 30 m Radar Interface Cable |
| Interface Unit | Interface Unit<br>(Housing suitable for outdoor application) |
| Signal Processing PC | Signal Processing Industrial PC<br>(Housing suitable for outdoor application) |
| RainView – Display Software | RainView – Display Software |
| 17 “ TFT Display PC<br>(Win XP, Win 2000, LINUX) | Integrated 17 “ TFT Display PC<br>(Win XP, Win 2000, LINUX) |
| | Outdoor Container |
| | WLAN Interface |

### 2.2.2 Scanner Unit – Parabolic Antenna

Improved resolution in azimuth and elevation can be achieved with our parabolic antenna solution. The narrow pencil beam provides an improved data resolution in azimuth and elevation. A radome is recommended for radar sites with extreme environment conditions or in high altitudes.

**Fig. 4: Scanner Unit with Parabolic Antenna**

| **Fixed Installation** | **Mobile Application** |
|---|---|
| Parabolic Antenna | Parabolic Antenna |
| Radome | Radome |
| Radar Transceiver | Radar Transceiver |
| - | Telescope Mast (height up to 10 m) |
| 15 / 30 m Radar Interface Cable | 15 / 30 m Radar Interface Cable |
| Interface Unit | Interface Unit<br>(Housing suitable for outdoor application) |
| Signal Processing PC | Signal Processing Industrial PC<br>(Housing suitable for outdoor application) |
| RainView – Display Software | RainView – Display Software |
| 17 “ TFT Display PC<br>(Win XP, Win 2000, LINUX) | Integrated 17 “ TFT Display PC<br>(Win XP, Win 2000, LINUX) |
| - | Outdoor Container |
| - | WLAN Interface |

### 2.2.3 Telescopic Mast

A telescopic mast can be supplied if a elevated position for the installation of the radar is not available. In order to reduce the weight for easy transportation the mast is manufactured from carbon fibre composites. A sketch of the installed mast is shown in Fig. 5 Fig. 6 is a picture of a typical installation.

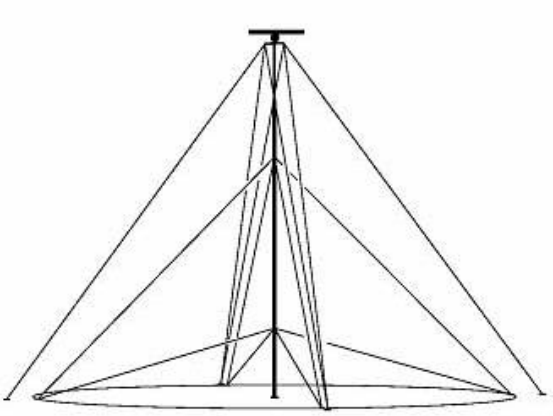

**Fig. 5 Erected Telescopic Mast**

**Fig. 6 Installation Example**

| Telescopic Mast Specification | Unit |
|---|---|
| max extended height | 10 / 15 m |
| Retracted length | 4 m |
| Max operational wind speed | 55 kn |
| Max survival wind speed (gusts) | 75 kn |

## 2.3 Rainscanner Interface Unit

The Rainscanner Interface Unit consists of several subcomponents which are all installed in a standard 19" case. The Rainscanner Interface Unit provides the following tasks:

- Video signal filtering and level adjustments
- Radar Control Processor monitoring the status of the radar subsystems and controlling the operational modes
- Radar Control State Machine which clocks the A/D converter and transmitter trigger
- Antenna control circuit
- LCD status display
- Transmitter power supply
- Several auxiliary power supplies
- Line interface
- Lightning surge arrestors and filters

**Fig. 7: Rainscanner Interface Unit**

## 2.4 Rainscanner Signal Processing PC

The Rainscanner Signal Processing PC is available as a standard PC or an Industrial Computer (recommended 19" cases for rugged & mobile applications). The Signal Processing PC is equipped with a high performance, high speed Analogue-to-Digital Converter card and a digital I/O card. An Analogue-to-Digital card samples the IF signal and transfers the data into the computer memory for data processing. The computer communicates with the Radar Interface Unit via RS232 interface.

An Industrial Computer is a PC in a 19" rack form factor. It has a flat panel display as user display integrated as a drawer together with the keyboard.

The Radar Signal Processor is equipped with a Fast Ethernet interface allowing remote control of the entire system.

## 2.5 RainView - Display Software

For the display of the radar signals the RainView software package will be used. RainView is based on our software package Ravis® which is field proven successfully in our METEOR 500/1500 Doppler Weather Radar systems.

RainView provides local and remote real-time radar control and data visualization. Ravis® has been implemented completely in Java™. The resulting platform independence (UNIX, Windows 9x/NT/2000 etc.) gives the user a maximum degree of flexibility to choose his favourite platform.

The operational display of the Rainscanner is the Plan Position Indicator (PPI). Sample data of RainView with the parabolic reflector are shown in Fig. 8.

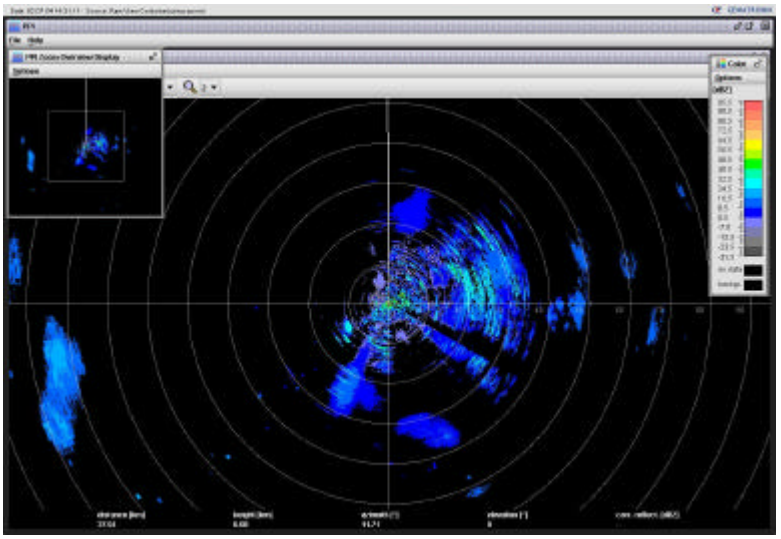

**Fig. 8: RainView PPI Display, 2nd July 2004.**

### 2.5.1 The Concept of RainView

RainView uses the AMS-Gematronik open language convention RCL (Radar Control Language) for interactions in a (multi)sensor intranet. The controlled data sources can be radar, wind profilers or any kind of meteorological data acquisition station.

The use of RCL and TCP/IP allows a licensed number of simultaneously Ravis® connections. As a result it is possible to visualize the desired data source from every point within the intranet, local and remote sites. Using commercially available remote access

servers it is even possible to run your data source visualization via dial-up connections from everywhere in the world.

The RainView BITE (Built-in test equipment) is scalable according to the customer information requests. In cooperation with the data source RainView dynamically chooses data compression algorithms representing the best match to the actually delivered data. As a result the bandwidth request for high resolution real time data transfer and presentation is small. Usually 64 kbps are sufficient.

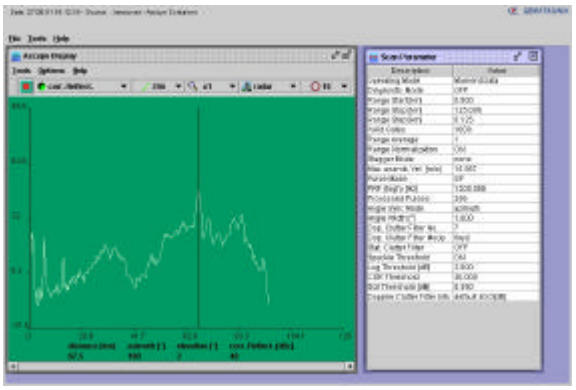

**Fig. 9: Ravis: A-Scope**

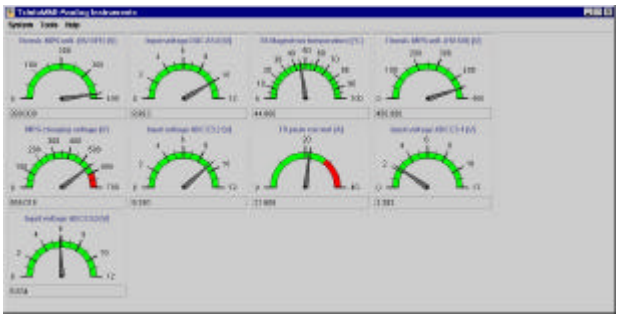

**Fig. 10: Ravis: Analog Meter Display**

**Fig. 11: Ravis: Status Display**

The following list shows some of the key features of RainView

- Implemented as Java™ application
- Supports all common Operating Systems such as: Compaq Unix, HP-UX, Linux, SUN Solaris, Windows™ 9x / NT / 2000, SGI etc.
- Real-time data acquisition control and display of PPI and A-Scope
- PPI Display as jpeg
- Data displays with 6 data colour levels
- Clutter suppression display
- Data zooming
- Geographical overlays
- Printer support
- Built In Test Equipment (BITE) and control
- Support of all necessary calibration functions
- Passive / Active mode for visualization only or additional control
- BITE history user interface
- Free choice of radar location in PPI displays together with raw data zooming

### 2.5.2 RainView – Rain gauge Module

RainView offers an interface to integrate data form additional meteorological sensors. For example, rain gauge data can be integrated in RainView for automatic, real-time rain intensity calibration.

## 2.6 Technical Specifications

### 2.6.1 Antenna

| Technical Characteristics | Fan Beam | Parabolic |
|---|---|---|
| A | 30 dB | 31 dB |
| Azimuth Beam Width | 1 deg | 4 deg |
| Elevation Beam Width | 20 deg | 4 deg |
| Rotation Rate | 24 rpm | 24 rpm |
| Azimuth Accuracy | ± 0.5 deg | ± 0.5 deg |

### 2.6.2 Transmitter

| Technical Characteristics | Value |
|---|---|
| Peak Power | 25 kW |
| Frequency | 9410 +/- 30 MHz(1) |
| Pulse Width | 1.2 µs (180 m resolution) |
| PRF | 1.000 Hz |

Notes: The frequency will be within the specified band, and will change slowly within the specified band when the tube ages. The tube is not tuneable.

### 2.6.3 Receiver

| Technical Characteristics | Value |
|---|---|
| Bandwidth | 3 MHz |
| Sensitivity | -107 dBm |
| Dynamic Range | 70 dB |

### 2.6.4 Rainscanner Signal processing PC

| Technical Item | Description |
|---|---|
| CPU | Intel Pentium 3 GHz |
| Operating System | LINUX |
| Memory (RAM) | 1 GB DDR |
| Graphics | 64 Mbytes Video Card |
| Hard Disk | 80 GByte |
| Interfaces | COM1, COM2, Parallel, 4 x USB2.0, PS2 |
| Network Interface | Fast Ethernet 100Mb/s |
| Radar A/D Converter | 14 bit, 10 MS/s |

## 2.7 System Performance Estimation

The following spreadsheet provides an estimation of the expected sensitivity of the radar. Losses due to precipitation attenuation and due to inhomogeneous beam filling are considered.

### 2.7.1 Scanner Unit – Fan Beam Antenna

| **Radar Sensitivity analysis for a given range, SNR and precipitation over Slant Range** | | | |
|---|---|---|---|
| | | **Rainscanner with 25/8 Fan Beam Antenna** | |
| **Parameters of Meteorological Radar Equation** | | **Figure** | **Figure /dB** |
| Constants | Proportionality | 7,38E+27 1/sm² | 278,68 dB/sm² |
| | Magnitude | 1,00E+03 | 30,00 dB |
| Transmitter | Frequency | 9410 MHz | -79,47 dBMHz |
| | Peak Power | 25 kW | -13,98 dBkW |
| | Pulse Width | 1,2 µs | -0,7 dBµs |
| | Waveguide Loss | 0 dB | 0 dB |
| Antenna | Gain @ Frequency | 30 dB | - 60,00 dB |
| | Az Beam Width | 1 deg | 17,58 dB |
| | El Beam Width | 20 deg | 4,57 dB |
| | Beam Loss Factor (1) | 3 dB | 6 dB |
| | One-way Waveguide Loss | 0 dB | 0 dB |
| | One-Way Radome Loss | 0 dB | 0 dB |
| Receiver | Temp. x Boltzmann Const. | 4,14E-21Ws | -203,83 dBWs |
| | Band Width | 3 MHz | 4,77 dBMHz |
| | Noise Figure | 6 dB | 6 dB |
| | Matched Filter Losses | 0 dB | 0 dB |
| | Waveguide Loss | 0 dB | 0 dB |
| System | SNR | 0 dB | 0 dB |
| | Range | 100 km | 40,00 dBkm |
| | Sensitivity w/o Prec. Attn. | - | 29,53 dBZ |
| Precipitation Attenuation according to Battan | Attenuating Prec. (2) | 10 dBz | - |
| | Precip. Attenuation Kr, a | 2,90E-04 | - |
| | Precip. Attenuation Kr, b | 0,166 | - |
| | one-way spec. Precip. Atten. | 0,0015 dB/km | - |
| | two-way spec. Precip. Atten. | - | 0,31 dB |
| | Single Pulse Sensitivity | - | **29,84 dBZ** |
| Signal Integration | Pulse Repetition Frequency | 600 | - |
| | Azimuth Rotation Rate | -10 | - |
| | Integrated Samples | 10 | - |
| | Incoherent Integration Gain | 5 dB | - 5,00 dB |
| | Post-Integration Sensitivity | | **24,84 dBZ** |

### 2.7.2 Scanner Unit – Parabolic Antenna

| **Radar Sensitivity analysis for a given range, SNR and precipitation over Slant Range** | | | |
|---|---|---|---|
| | | **Rainscanner with 25/60 Parabolic Reflector** | |
| **Parameters of Meteorological Radar Equation** | | **Figure** | **Figure /dB** |
| Constants | Proportionality | 7,38E+27 1/sm² | 278,68 dB/sm² |
| | Magnitude | 1,00E+03 | 30,00 dB |
| Transmitter | Frequency | 9410 MHz | -79,47 dBMHz |
| | Peak Power | 25 kW | -13,98 dBkW |
| | Pulse Width | 1,2 µs | -0,7 dBµs |
| | Waveguide Loss | 0 dB | 0 dB |
| Antenna | Gain @ Frequency | 31 dB | - 62,00 dB |
| | Az Beam Width | 4 deg | 11,35 dB |
| | El Beam Width | 4 deg | 11,35 dB |
| | Beam Loss Factor (1) | 0 dB | 0 dB |
| | One-way Waveguide Loss | 0 dB | 0 dB |
| | One-Way Radome Loss | 0,5 dB | 1 dB |
| Receiver | Temp. x Boltzmann Const. | 4,14E-21Ws | -203,83 dBWs |
| | Band Width | 3 MHz | 4,77 dBMHz |
| | Noise Figure | 6 dB | 6 dB |
| | Matched Filter Losses | 0 dB | 0 dB |
| | Waveguide Loss | 0 dB | 0 dB |
| System | SNR | 0 dB | 0 dB |
| | Range | 100 km | 40,00 dBkm |
| | Sensitivity w/o Prec. Attn. | - | 22,08 dBZ |
| Precipitation Attenuation according to Battan | Attenuating Prec. (2) | 10 dBz | - |
| | Precip. Attenuation Kr, a | 2,90E-04 | - |
| | Precip. Attenuation Kr, b | 0,166 | - |
| | one-way spec. Precip. Atten. | 0,0015 dB/km | - |
| | two-way spec. Precip. Atten. | - | 0,31 dB |
| | Single Pulse Sensitivity | - | **22,38 dBZ** |
| Signal Integration | Pulse Repetition Frequency | 600 | - |
| | Azimuth Rotation Rate | -10 | - |
| | Integrated Samples | 10 | - |
| | Incoherent Integration Gain | 5 dB | - 5,00 dB |
| | Post-Integration Sensitivity | | **17,38 dBZ** |

# 3 LOGISTIC SUPPORT

## 3.1 Support Structure

The Rainscanner can be installed on an existing building. A support structure can be supplied if a elevated position for the installation of the radar is not available.

| | |
|---|---|
| Max operational wind speed | 55 kn |
| Max survival wind speed (gusts) | 75 kn |

### 3.1.1 Lightning Protection

The scanner unit is designed for withstanding a direct impact with moderate peak current. However, because the mast is made from carbon fibre composites it does not provide a large conductivity. Therefore a grounding cable is provided together with the mast. The grounding approach depends on the structure of the ground at the radar site. Depending on the specific conductance of the ground, the guy anchors can be used for grounding or a dedicated grounding strip must be laid.

## 3.2 Power Consumption

| | |
|---|---|
| Rainscanner | 250 VA (via Interface Unit) |
| Radar Signal processing PC | 300 VA |

## 3.3 Environmental Conditions

### 3.3.1 Outdoor

The outdoor conditions apply to the scanner unit and the mast.

| | |
|---|---|
| Temperature | -30 - +50°C |
| Humidity | 95% or less at +40°C |

### 3.3.2 Indoor

Indoor condition apply to the radar workstation.

| | |
|---|---|
| Temperature | -10- +40°C |
| Humidity | 80% or less at +40°C |