Description

of

Radiosonde System

DS99

with

Receiving device

DSE 99

and

accessory

BBL Elektronik GmbH
Systeme für die Meteorologie

Odertal 8
D-37431 Bad Lauterberg

Tel: (49) 0-5524-5809
Fax:(49) 0-5524-2987
EMail: Info@BBL-Elektronik.de

1 Radiosonde

1.1 Abstract

The Radiosonde DS99 is the continued design of the DS96.

As a standard there is one temperature sensor and a humidity sensor fitted. The converters are on the PCB of the controller unit. Their calibration data are stored non-volatile on the controller unit.
The user can easy extend the use of the DS99 with additional sensors.
The transmitter is solder - connected with the controller unit.
Plugs make all connections of additional converters, sensors and battery pack.

Difference to the DS96 is the use of a polymer sensor for sensing of humidity. This makes sensing of humidity able even on ambient temperature of approx. –20°C.

Via the „set-up - plug“ all necessary information of calibration and other sensor data are sent from the DS99 to the receiver system during initializing the system.

Additional sensors for pressure, ozone and position (GPS) are available.

There are plugs to connect 2 additional sensors with signal output of voltage of 0..5VDC. A plug to connect the Brewer Mast ozone sonde too is fitted.

By use of the „setup – plug“ all calibration data of the sonde and the number of additional sensors are transmitted by wire to the receiving unit. During set up, the desired radio frequency of the transmitter and receiver become switched to the same frequency. Frequency can become typed in manually or selected from stored standards of the PC by software ADS99.

To save battery power during set up, the Radio weather sonde DS99 is powered by the receiving device.

The design of the Radiosonde DS99 supports the all over the world called recycling. This may reduce the cost of Radiosonde launching of approx. 60 .. 70% versus use of only new Radiosondes (depending on the landing area).

Discharged batteries can be disposed off into local battery collection. All the parts of the DS99 are not harmful to the environment.

Using of light weight components makes it possible to keep the launching weight of a DS99GPS below 300gr (including unwinder with 40m balloon cord and batteries).

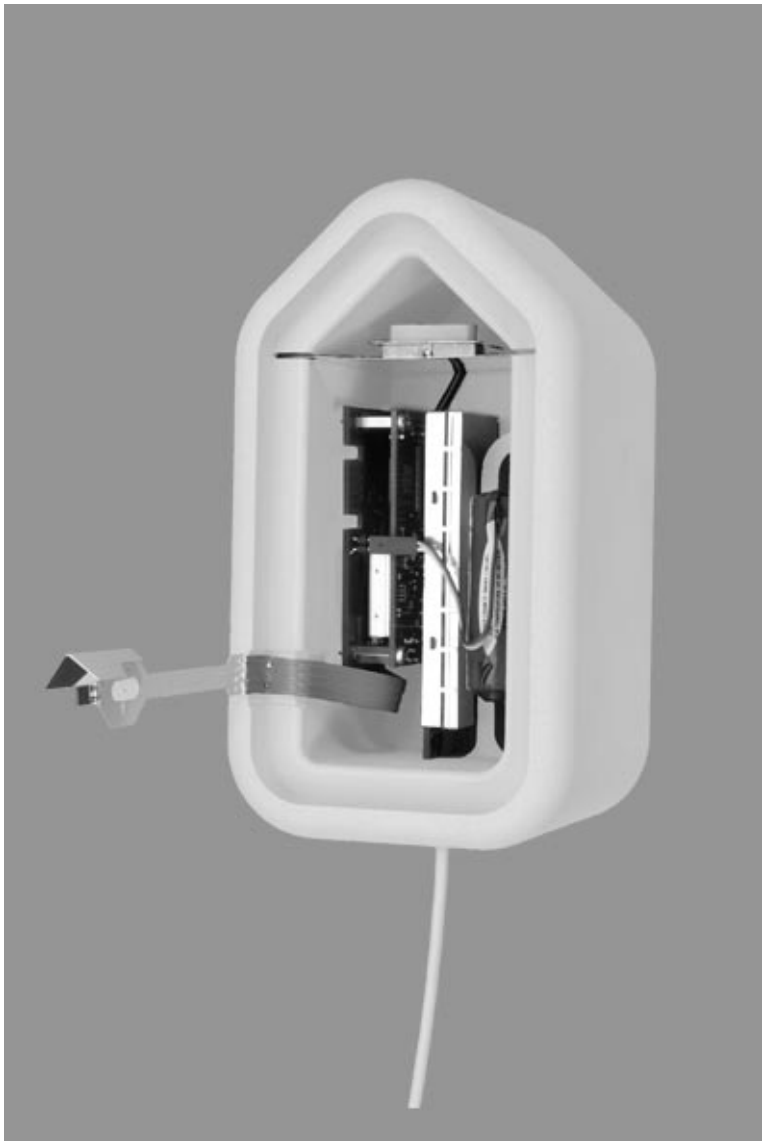
The unwinder DSA99 is new designed by BBL.
It is used to have the Radiosonde close to the Balloon for launching under windy conditions. During first minutes of the launching the unwinding of the balloon cord from the spool is obstructed.

The assembled balloon cord has a breaking load of approx. 150N.
On regard of the WMO there are 40m of balloon cord on the spool of the unwinder.

Radio weather sonde DS99 can be delivered in version:

- DS99 — Standard version, one sensor for temperature and humidity. 3 spare channels
- DS99GPS — same as standard version but extended with GPS – module for measuring of position and wind data
- DS99GPSD — same as before but extended with additional pressure sensor. Option pressure sensor is not deliverable without GPS

1.1.1 Picture shows opened radio sonde (without option pressure)



1.2 Battery

The DS99 is powered by standard lithium sulfur dioxide batteries with size AA. Voltage is 3V with 1.5Ah. These batteries makes it able to run the DS99 with temperature range of -20°C .. +70°C inside the housing.
On ambient temperature of –50° ..+ 70°C this batteries can be stored for approx. 10 years with minimum loss of power of 2% per year.

Three of this batteries are factory assembled to a battery pack. They are fitted with polarized wire connector. One of the battery packs can run the DS99 for approx. 2.5h.
To save battery power, it is best not to run the DS99 by battery power except short before launching .
There is no need to power the DS99 by battery during preparing for launch because with connected set up plug the DS99 is powered by the receiving system.

Before using the batteries for ascent it is useful to bring the battery temperature above 0°C (best is room temperature).

Discharged batteries can be disposed off into local battery collection.

1.2.1 Picture of Battery pack

1.3 Housing

All of the electronic components of the DS99 are assembled inside housing made of Styrofoam. This Styrofoam is not harmful to the environment and foamed with water steam. Because of the good thermal isolation of such housings, power consumption of the electronic works as a heater inside the housing and gives the inside temperature not to remain under –20°C.

To reduce the risk of hurting people with landing a DS99 and dropping the housing to them, all the edges of the housing have a radius of minimum 10mm. Only the sensor carrier leaves the outlines of the housing. This carrier uses easy to bend wire for connection and will not hurt persons.

The housing consists of 3 parts:

1. the all carrying case
2. the cover for closing the case
3. the on top fixed connecting rope

The top of the housing is designed as a roof to give rain run down and snow not to store on top.
Under this roof there is the GPS antenna fitted.

The operator has close the cover short before launching. For opening the cover there are two handles made of tape.
Do not open the cover often. This may hurt the exact shape of the cover. And that will result in water and air enter into the housing during ascent and take affect to the electronics.

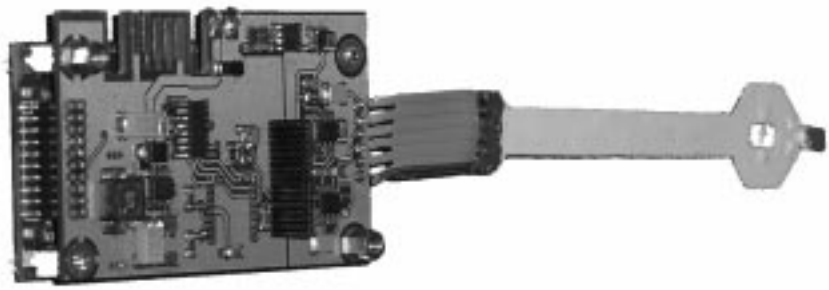
For measuring the sensor carrier is to be fitted into its measuring position as shown in the picture above. For transportation it is positioned inside of the housing.
The paper made roof saves the sensors from becoming wetted by raindrops.

1.4 Electronics

All the electronic components are assembled on two printed circuit boards. One is the transmitter board. The other one is the main board with the microcontroller and the converters.
If the DS99 is fitted with GPS, there is another printed circuit board, carrying the GPS engine and controller for calculating of position and wind data. The receiver is a 12 channel engine. The module is designed by Conexant (former Rockwell, USA)

Compliance with existing European rules for EMV is shown by CE – signet.

1.4.1 View to Electronics, without transmitter



1.4.2 Transmitter

The transmitter is a synthesizer with followed power amplifier and filter circuit. Antenna is made of high flexible wire.
The transmitter is designed in compliance of BAPT 222 ZV 128 and EN 300 220-1V1.2.

From high stable crystal frequency the synthesizer controlled oscillator generates the transmitter frequency. This frequency can be switched in steps of 20kHz from 402,1MHz to 405,99MHz by the microcontroller of the DS99. This steps are fixed in the BAPT 222 ZV 128, but can become factory adjusted to national rules as an option.

During set up the microcontroller of the DS99 receives the transmitted data of desired frequency and than programs the synthesizer. The last used frequency is stored non volatile for additional use in EEPROM.
After each new connection of power to the DS99 this frequency is retrieved from EEPROM and used until there is a change made by the set up.

Transmitting power is adjusted to approx. 100mW with battery voltage of 7V DC .

The antenna is designed to keep the effect to the transmitter during handling as less as possible.

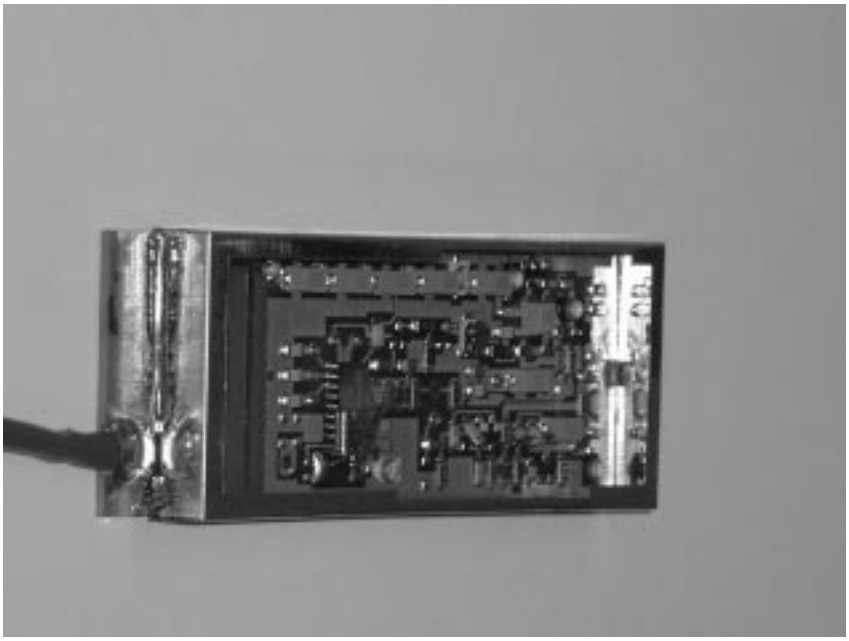
Testing of touch sensitivity is point of acceptance during manufacturing

The used flexible antenna and their positioning under the bottom of the housing of the DS99 prevents of using the gap of the antennas diagram when looking with receivers antenna to the Radiosonde on extreme low wind ascents.

The flexible antenna too reduces danger to hurt people by dropping DS99 after ascent.

The resulting shape of the antenna after unpacking from storage needs no change.

1.4.2.1 View into opened transmitter housing



1.4.3 Electronics (microcontroller board)

Controlling of electronics is done by a microcontroller and its software.

The supply voltage of the microcontroller is 3.3VDC and its clock frequency 4MHz.

Measured temperature results into resistance and humidity in capacity. Both are converted in separate electronic components. High stable and temperature compensated timer elements are used for the conversion into frequency.

This frequencies become multi period counted by the microcontroller. Gate time of the counter depends on the drift of the crystal of the microcontroller. This total drift over the ambient temperature range of +70°C .. –20°C results in temperature and humidity error of maximum 50ppm.

Conversion of pressure sensor is done by 16bit A/D converter.
Temperature of the pressure element too is measured by resistance of its temperature sensor.

If an ozone sonde is added, this sonde has its own converter. Data of ozone sensing are converted by 12bit A/D and transferred to the microcontroller board of the DS99 via separate connector. The microcontroller detects the connected ozone sonde and includes their data into the total data set if found.

All the measured results of converting and counting are set to data set of raw data with additional information.
The microcontroller generates the DPSK modulation and subcarrier using the data set of raw data and transfer's it to the transmitter.

1.4.3.1 Definition of „raw - data"**:**

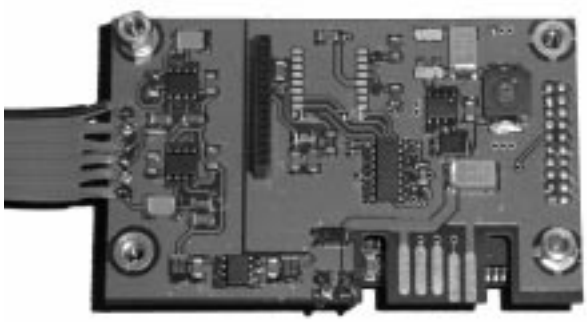
They are the received data of converter for: temperature, humidity, as an option the pressure and from GPS telegram isolated data of wind and position as well as the converted data of additional channels. There is no pre calculation for i.e. cleaning of spikes.
These data are transmitted to the receiver and transferred to the calculating software ADS99. Without knowledge of calibration data and their position inside a data stream of raw data it is impossible to generate (compute) physical correct units of measured data.

1.4.3.2 Data transmitting, first reduction of errors

Raw data are transmitted as continuous data sets to the Receiver. Transmitting is done in blocks, each consisting of different parts of P,T,U, 4xGPS, spare channel. This is done by subcarrier modulated as 2400 Baud DPSK (differential phase shift keying). Block transmission rate is >1/s.

Error reduction is done by block parity on each block. By this one transmission error can become corrected by the receiving software. If there are more than this error, the block is marked as non usable or deleted.

1.4.3.3 View to Microcontroller board



1.5 Sensors

Sensors for temperature and humidity are assembled on a sensor carrier . Its connection to the microcontroller board is done by solid but easy to bend wire. This makes it able to turn the sensor carrier into best position for launching.

For transportation the sensor is stored inside the housing of the DS99. For measuring it easily only has to be turned out of the housing into its launch position.

Sensors are blocked against RF from the transmitter. Additional ground areas prevent touch sensitive change of capacity during handling and their influence in humidity data.

1.5.1 View to Sensor - device

(shown without rainprotecting roof)

1.5.2 Temperature

Measuring temperature is done by thermistor with smallest dimensions. To protect the thermistor against water it is coated with special varnish.
Testing of leaks is point of acceptance during manufacturing

The color (white) reduces the influence of sun radiation. Additional correction of sun radiation can be done by the software ADS99 as per CIMO or with use of tables with standard correction.

Dependence of resistance versus temperature is measured as described before by the microcontroller.
The difference of the measured temperature to the real temperature is calculated as calibrating data during manufacturing. This calibrating data are calculated in comparison of measured temperature and temperature of calibrating units. The calibrating units have exactly temperatures of +40°C; +20°C; 0°C; -20°C; -60°C and –80°C.
Calibrating data are stored on chip of the microcontroller of the DS99.

During set up of the DS99 the calibration data are transferred to the software ADS99. ADS99 than calculates, using a polynomial of 5^{th} order, the physical units of measured temperature. This data become stored on the hard disc in the PC. The calibration data are stored in a log file. All the data are connected with other data of the ascent.

1.5.3 Relative humidity

The sensor is designed as a capacitor. This is consisting of a glass carrier plated with a contact and polymer layer as dielectrics and another porous contact above. Trough this porous contact water steam can soak into the dielectrics. This results in change of capacity of the capacitor.

The capacitor is used in a timer element. The humidity depending frequency is counted and becomes part of the data set of raw data in the DS99.
The software ADS99 from the PC of the ground station now calculates the physical unit of the measured humidity. To do this it uses calibration data and the relation between ambient temperature and capacity.

The high linearity of the sensor allows calibration with only two reference points of humidity. This are 33%rH and 86%rH. The dependence of capacity and humidity is described as a polynomial of 4^{th} order.
Influence of ambient temperature to the capacity is standardized and stored in the software ADS99.
Calibration data are stored on chip of the microcontroller of the DS99 and transferred to the ADS99 during set up of the DS99.

Icing of the sensor on ambient temperature below 0°C is calculated by the software ADS99. This is done by watching the dynamics of difference of measured points.

Protection of raindrops is done by using a small roof over the sensor device.

1.5.4 Pressure

As an option the DS99GPS can be fitted with a pressure sensor.
This is a small device with high linearity. There a strain gauge on the diaphragm of its measuring chamber. Change of pressure results in change of voltage. This voltage is converted by 16bit A/D.

To reduce temperature depending error, there is a thermistor on the diaphragm too. The resistance is converted by a 8bit A/D and transferred to the software ADS99. This now can calculate the real pressure, using calibration data and thermal influence.

During factory calibration the calibration data become stored on chip of the microcontroller of the DS99. This calibration data are transferred to the software ADS99 during set up of the DS99.

Difference between measured pressure by the DS99 pressure sensor and the pressure sensor of the ground station or the receiving device results in automatic correction of the sensor of the DS99.

1.5.5 Position, Wind data

Inside the DS99 there is a GPS module made by Conexant. This 12 channel engine is a stand alone GPS receiver. It transfers via NMEA - data - set all of the necessary position and wind data.
In combination with the same module working in the receiving device, height of the sonde, position and wind data can become calculated with high accuracy by the software ADS99.

1.5.5.1 Position

The actual data for position become isolated from the C/A correlated data set of the GPS module by the microcontroller of the DS99.
The module uses software which makes it possible to calculate height of >40,000m and wind speed <200m/s.

The antenna is a passive patch antenna. The antenna is shielded to the transmitters energy by metal sheet.

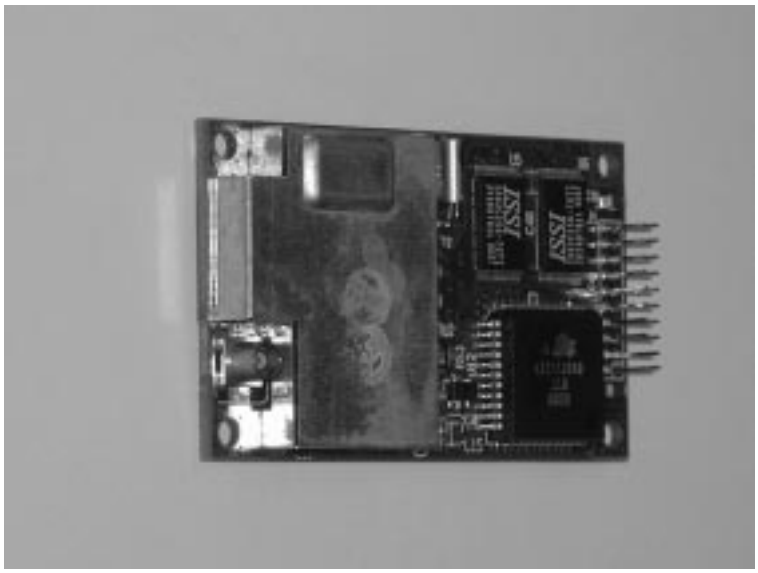
1.5.5.1.1 View to Patch antenna used by GPS

For indoor use of GPS during set up of the DS99 there is a transmitter device obtainable. Using this you have to remember that the so measured position is that one from the GPS antenna outside the building.

1.5.5.2 Wind data

Wind speed and wind direction is calculated by Doppler effect by the GPS module. It only has to become isolated from data set and transferred to software ADS99 via transmitter and receiving device.

1.5.5.3 View to GPS – Module



1.6 Additional data - channels

The microcontroller board of the DS99 is fitted with plugs for connection of maximum 3 additional channels.
This are two serial channels with data word of 16 bit in special format and one additional analog channel for input of 0 .. 5volt DC. This voltage is converted by 16bit A/D.

The additional channels are transferred to the software ADS99 without any pre calculation.

The software ADS 99 can separate the information of this additional channels using the added channel name. The data only can become displayed on the screen of the PC, located inside a special window.

As an option there is a ozone sensor Brewer Mast ECC6A with adapted conversion electronics deliverable. This combination is plug compatible with the plug of the additional channels of the DS99.
Nevertheless the ozone sensor needs its own power supply.

1.7 Data transmitting to receiving device

kind of modulation	FM, DPSK on subcarrier 2,4kHz Modulation of subcarrier by software
FM frequency sweep	3 kHz
mode of transmission	transmitting in blocks
test for correct data transmission	by block parity with error correction
data rate (P, T, U)	≥1/s
data rate additional channels	≥1/s
data rate GPS (Pos, W_D, W_V, height)	1/s

DPSK= Differential Phase Shift Keying

	1.8 Technical data of Radio weather sonde DS99	
1	**dimensions, weight**	LxWxH = 93x95x175 mm³
	weight without batteries	150 gr.
	launching weight with batteries and unwinder (using T,U,P,GPS – Module)	≤ 300 gr.
	quantity of radio sondes in one parcel, total weight	10 pc., with batteries approx. 3,3 kg
	dimensions of parcel	LxWxH= 400x300x180mm³
2	**Storage**	
	time, ambient temperature, humidity	one year, -40°C...+70°C,
3	**power supply**	
	batteries	3 x 3V lithium sulfur dioxide
	type (single battery)	G36 2.1 SAFT
4	**transmitter**	
	frequency (crystal stabilized, programmable)	402,01 – 405,99 MHz, by set up software
	adjustment of frequency, channel spacing	via software ADS99 during set up, steps of 20kHz according to BAPT 222 ZV 128
	transmitter output power	typical 100mW at 7VDC
	drift of frequency during ascent	<5kHz
	bandwidth	<15kHz
	modulation	FM, DPSK on subcarrier
	transmission ratio	≤1s P,T,U
	cyclic measuring ration P,T,U	≤0,5s
	operating time each battery pack (using P,T,U,GPS)	≥2 h
	sensors	
5	**pressure sensor**	
	sensor	aneroid – with strain gauge, temperature compensated
	measuring range	1060 - 1 hPa

	resolution, range	0.1 hPa , 1 .. 1060 hPa
	accuracy, range	≤ 0,5 hPa, 1050 - 5 hPa
6	**temperature**	
	sensor	NTC – Thermistor
	measuring range	-90 .. +50°C
	resolution	0,1K within –95 .. +60°C
	accuracy, range	≤0.2K within -80 .. +40°C
	time constants at 1000 hPa at 10 hPa (on launching speed of 5m/s)	≤ 2s ≤ 20s
7	**relative humidity**	
	kind of sensor	Polymer, capacitive
	resolution	0,1% within 0 .. 105%
	measuring range	0 .. 100% relative humidity
	accuracy (at t_{amb}= -25°C .. +40°C)	±5% within 0 .. 100% relative humidity, below 0°C until ice saturation
	time constants at +20°C at –20°C (with launching speed of 5m/s)	< 5s < 40s
8	**position**	
	sensor	12 channel GPS – receiver with passive patch antenna, adjusted to the same satellites as in the ground station
	kind of measuring	C/A code correlated GPS
	accuracies	
	geogr. width (φ)	≤0,001 degree (≤100m)
	geogr. length (λ)	≤0,001 degree (≤100m)
	height over normal zero	≤10m @ –400 till 40.000m ≤100m @ 40.000 till 50.000m
	resolutions	
	geogr. width (φ)	≤0,001 degree
	geogr. length (λ)	≤0,001 degree
	height over normal zero	≤10m
	measuring range	height ≤50 km speed ≤200m/s
9	**wind data**	
	wind speed	
	accuracy	±1,0m/s 0..150m/s
	resolution	±0,1m/s 0..200m/s
	wind direction	
	accuracy >5m/s accuracy from >3m/s averaging time 30s	±5 degree 0...360 Grad ±10 degree 0... 360 Grad
	resolution	±0,5 degree 0... 360 Grad
	cycle of measuring position data	1/s
	cycle of transferring GPS-data	≤1s

10	**additional channels**	
	channel 1	serial, 16 bit
	input level	CMOS
	channel 2	serial, 16 bit
	input level	CMOS
	channel 3	Analog input 0...5VDC input resistance 100 kΩ
	A/D converter	16 bit
	error of linearity , total	±3LSB
	gain error	±3LSB
	offset error	±8LSB
	cycle of transmitting additional channels	≤1s

1.9 Combination of Radiosonde devices

1.9.1 General

Dimension and handling of radio weather sonde DS99 combination is described in each users guide of the different devices. Useful tips are to find in the “Guide to Meteorological Instruments and Methods of Observation” from the WMO

1.9.2 Balloon

Balloon for meteorological use mostly are made of pure latex. To give it reaching its desired height, the handling needs a lot of care. No rough table is allowed and no peaked units (i.e. finger nails!) have to touch the skin of the balloon.

According to WMO the minimum launching speed is approx. 5m/s. This needs a free lift of 16N.
The desired size of the balloon, resulting in its weight, depends on the height over ground the balloon has to reach. The WMO guides helps to find the size.
As per example:
For ascent with the DS99 up to heights of over 25km you will need a balloon with 800gr and the filling volume will be approx. 3m³
A balloon is filled with helium or hydrogen of the desired volume.

During filling, the skin will become charged by electrostatic voltage. To prevent discharging and by this burning small holes into skin, the balloon filling nozzle has to be grounded.

To bring the latex of the skin into good filling conditions, it is necessary to warm the balloon before filling. Best is to store the balloon one day before filling under warm but dark conditions.

Filling with gas needs some time to give the skin expand even over the total size.

To fill a balloon even under windy conditions, it is useful to use the filling devices K090 for manually filling. For automatic filling the K091 will be available from middle of 2003.

If the launching of the Radiosonde combination has to be done under windy conditions without use of a balloon filling building, the use of the filling and launching devices K191 is necessary. Even under wind conditions one person can prepare and fill the Radiosonde combinations as well as to launch it.

1.9.3 Parachute

Reaching its maximum diameter during ascent, the balloon will burst. This starts descent of the radio sonde combination. If there is no parachute, speed of descending to ground will only become reduced by rubber of the bursted balloon until the combination bumps onto ground. To prevent of hazard, the usable parachute reduces the speed to a maximum of approx. 5 .. 8m/s.
We offer parachutes made of foil which are decomposed under influence of light and air.
The parachute has to be fixed into the combination in such kind that the bursted balloon may not obstruct the parachute to open.

Radio weather sonde DS99 combination with weight up to 2kg will be fitted well by parachute with opened diameter of approx. 1.5m.

1.9.4 Radar target

If the ascent is in areas with air traffic, part of Radio weather sonde DS99 combination has to be a radar target. By this the Radio weather sonde DS99 combination can be localized with radar.

The size of the radar target depends on the distance to become localized. As a standard in Europe there are targets in use with edge length of 60cm.

Targets are made of coated paper and will decompose under the influence of and not harmful to the environment.

1.9.5 Unwinder

During day ascent, the balloon of a Radio weather sonde DS99 combination becomes heated by sun radiation. This exceeds cooling by expansion of the gas inside the balloon. Result is a warm spot ahead of the temperature sensor.
On the other hand, during night ascent cooling of expansion of the gas inside the balloon results in a cold spot ahead of the temperature sensor of the Radio weather sonde DS99.
Temperature of the balloon takes affect on the air, gliding over the balloon during ascent.

To prevent error in measuring air temperature in this vortex, it is necessary to have a long distance between the balloon and the temperature sensor.

According to WMO there is recommended to have a distance of 40m between temperature sensor and balloon to bring this affect to a minimum.

But this is not helpful on launching the Radio weather sonde DS99 combination on windy days. It is much easier to have the Radio weather sonde DS99 fitted to the balloon with a short cord .
To help you having a short cord for launching but a long cord during flight, the unwinder DSA99 has 40m of cord on its spool. The minimum length of the device is 0.4m.

The unwinder is to be connected between Radio weather sonde DS99 and parachute. For easy fitting with the balloon cord there is a loop on top of the unwinder. The cord of the unwinder has to be fitted with the connecting loop of the DS99.

Handling before launching is shown with the picture below.

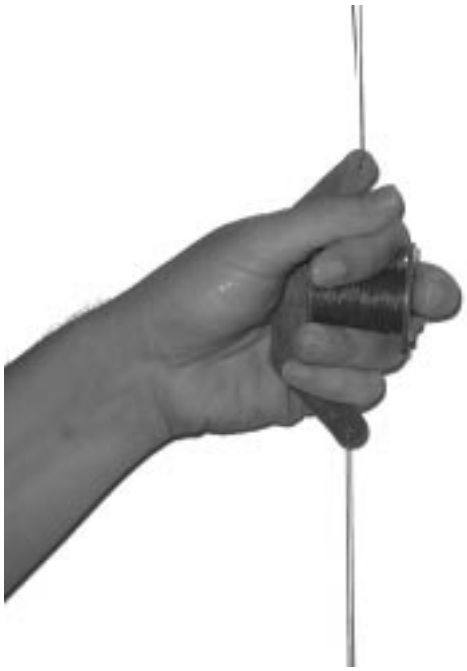
After launching of the balloon, the balloon cord becomes unwinded by the weight of the Radio weather sonde DS99. To reduce acceleration, unwinding is obstructed. This gives the cord unwinding on its total length during first minutes of the ascent.

Remark: Time of unwinding depends on air humidity, temperature and wind speed.

1.9.5.1 Technical data of unwinder DSA99	
dimensions	180x80x70 (length x width x thickness)
weight	approx. 35gr
length on balloon cord on spool	40m
breaking load	<160N
breaking load, reduced by knots	>100N
diameter of balloon cord on spool	1,0 ±0,1mm
color of balloon cord	rot
kind of balloon cord	2 Polyester cords inside PE coating
unwinding time for 40m	ca. 2 .. 5 minutes, depending on temperature, humidity and wind speed

1.9.5.2 View to unwinder DSA99

1.9.5.3 View to handling of unwinder



View of hand blocked unwinder before launching. Radio weather sonde DS99 below the unwinder not shown.

1.9.6 Balloon cord

All the connection between components of the Radio weather sonde DS99 comparison is made by balloon cord.
Breaking load has to be big enough to have save connections, but low enough to break on hazard (i.e.: touching aero plane during flight or cars on the floor).

After descent the balloon cord has to decompose not harmful to the environment.

The BBL balloon cord has a breaking load of 160N. According to WMO the maximum is <230N.

1.10 Storage of Radio weather sonde DS99 and devices

Best use for Radio weather sonde DS99 is before end of 1 year after manufacturing. They must be stored inside their transportation parcel in dark and dry places.
The Styrofoam is not packaging, it is housing for electronics.

Batteries can be stored up to 10 years with a minimum power loss of 2%/year.

Because the material of the parachute, the unwinder and the balloon cord is specially designed to decompose quick under environmental influences. They have to be stored inside their transportation parcel in dry, cool and dark store.
Maximum storage time is approx. 2 years after manufacturing.

2 Receiving device

2.1 General

Inside the housing there are printed circuit boards for decoding the DPSK, converting the transmitted data into ASCII data set and power supply even for set up the Radio weather sonde DS99.
The further devices are the sensor for measuring ground pressure, the receiver for radio sonde signal and the reference receiver for GPS as well as the power splitter for power supply of the amplifier for GPS and radio sonde antenna.
On the rear panel there are all of the plugs to connect the receiving device with PC, AC or DC power and the antennas.
On the front panel there are only the main switch and the plug for connecting the Radio weather sonde DS99 during set up procedure.

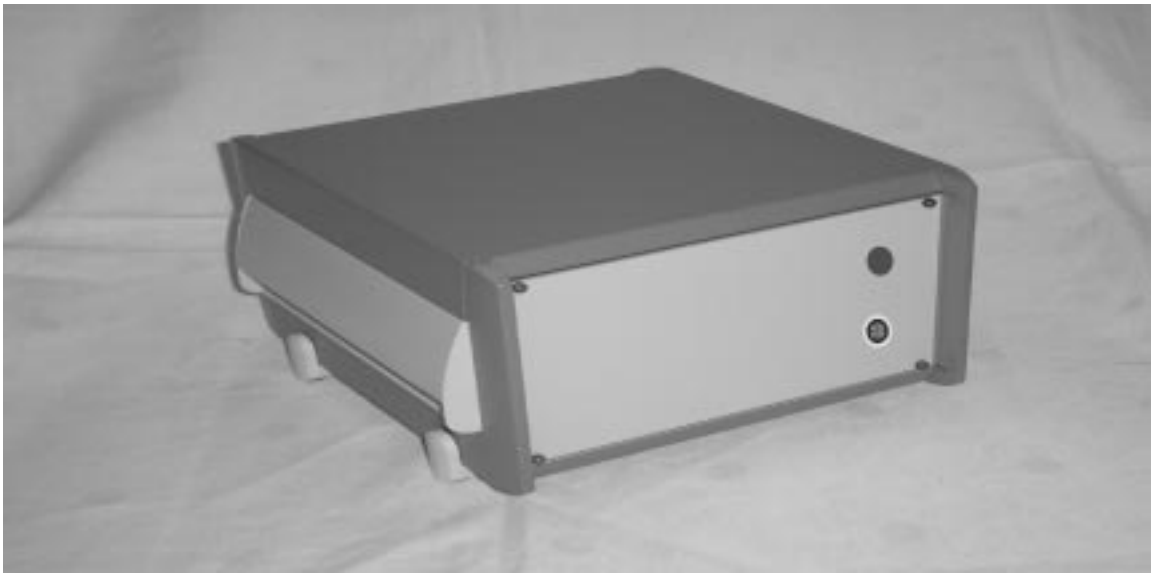
All necessary adjustments are done via software ADS99 with the PC. Because of this remote control, i.e. control of speakers loudness too, the receiving device has not to be placed in direct reach of the operators hand.

2.1.1 Outlines of housing

As a standard the units of the receiving device are assembled inside a 19” case with dimensions of 2 HE in height, 63 TE in width and a depth of 300mm.
Outlines and kind of housing of the receiving device can be adapted to consumers demand.

The receiving device, except the pressure sensor, can be fitted too inside of an standard PC with tower case. It than needs place of 4 long slots.

Standard case 19“, front view without fitted plugs



(new picture to include)

2.1.2 Antenna device

The antenna device consists of a carrier with clamp, the amplifier for radio sonde signal and the antennas for GPS and radio sonde signal.

The carrier is made of a square tube with 40mm edge width out of anodized aluminum. The clamp and their nuts are made of stainless steel.

The amplifier for radio sonde signal is inside a shielded housing.

The active antenna for GPS is designed for marine use.
The antenna for radio sonde use is made of brass coated with glass fiber reinforced plastics.

Grounding of the antenna device can be made via mast or additional with separate wire from earth connector to earth electrode.

While fitting the device to the mast, please ensure that the GPS antenna is not obstructed (shielded) against their satellites by the mast or high buildings.

Antenna cable are connected via plugs type “N” to the antenna and amplifier. Power supply of active GPS antenna and amplifier for Radio weather sonde DS99 signal is made via antenna cable.

We recommend use of cable type RG 213 or better. Maximum length without additional amplifier is approx. 15m with using of RG 213.

View to antenna device, completed with GPS antenna and amplifier


(new picture to include)

2.1.2.1 Additional unit for mobile using of antenna device

For mobile using of the standard antenna device there is a special carrier with 3 magnetic holder available.
Using this, the antenna device has to be grounded by wire.

For use on container or similar mobile buildings there is a separate clamp available. By this the antenna device is clamped to the fixing eye of the container. Separate grounding is necessary.

The additional carrier for mobile use are made of brown anodized aluminum. Grounding is fitted by nut and bolt of stainless steel. Fixing nuts can be made without tools.

2.1.3 Mobile using of receiving device

For mobile use all the units from the receiving device are available for use with a PC.
The parts need spare place of 4 slots in full length inside the PC.

If there is a tower case in use, the pressure sensor can be fitted inside the case. A pipe to connect with outside pressure is recommended.
Otherwise it has to be fitted somewhere outside and connected by cable to the PC.
The power supply is generated from that of the PC. Additional power consumption is approx. 50W with 12VDC.

2.1.4 Request to PC

To do all the calculations the software ADS99 needs a standard PC with following technical data:

2.1.4.1 Technical request to PC	
processor/ clock frequency	Pentium III / >800 MHz
RAM	256 MB
hard disc	two units 10..40GB (RAID 1 controller)
interfaces	3x RS 232; 1x centronics; 2xUSB
power supply (without receiving device)	national or 230V / 300W
housing	i.e. tower
display, resolution for graphics	LC display 17“, 1024x768
mouse	i.e. optical USB mouse
keyboard	i.e. standard USB
ISDN interface (optional)	DSS1 as a PCI board
LAN board (optional)	10/100 PCI Base TX
protocol printer	i.e. laser printer 600 dpi
supply voltage	national standard or 230VAC
interface	centronics
if print of graphics is necessary	A3 color printer is recommended

2.2 Preparing a Radio weather sonde DS99 for launching

(GPS, Setup of Radio sonde)

Before the Radio weather sonde DS99 is ready for launching, set up of the software ADS99 and the radio sonde (initializing) has to be done.
During the set up procedure, the microcontroller of the DS99 does checks of the converters of the electronics. Then it has to receive the transmitting frequency from and transfer calibration data to the receiving device.
The desired frequency is the same for both of transmitter and receiver and is sent by the software ADS99 from the PC to the DS99.
The software ADS99 needs the calibration data for calculation of physical units of all the measured data of the sensors.

The comparison of ground data (ground check) and data of the DS99 has to be made by the software ADS99 during preparation for launching.

Next is switching to same satellites for receiving in the receiver of the DS99 and the GPS receiver in the receiving device. The DS99 has to store the code of the desired satellites in the almanac of the GPS receiver of the DS99.
This reduces the time to start of calculation of correct position before launching to approx 3 minutes. Without adjusting it may last more than ½ an hour.

Set up procedure can be repeated on demand.

Procedure of set up:

After fitted set up plug to the DS99 connector DS99 starts it own set up. Running without error makes the microcontroller waiting for contact to the software ADS99.

On error, nothing happens, even if the ADS99 goes on contact with the DS99. Failure of the DS99 is displayed by ADS99.

The sonde running in error less conditions, waits until the software ADS99 asks for calibration data. From this moment the DS99 will send all the calibration data as a data set of all sensors to the ADS99.

After the ADS99 has stored all of the calibration data, it starts sending the desired and user chosen transmitter frequency as well as the usable code of satellites to the DS99.

Hereafter the ADS99 is waiting for believable data set, measured by the sensors, transmitted by the transmitter.
The software ADS99 now checks all the data and displays them. On running without error, the ADS99 now indicates the ability for launching the Radio weather sonde DS99.
The operator now can do its own checks of plausibility of measured data, checks of spare channels and so on.

It is best, to power the DS99 by the receiving device until launching happens within next some minutes.
With opened set up cable but receiving data set from the DS99, ADS99 will recognize the Radio weather sonde DS99 powered by battery. From this time until launching ADS99 displays the spare of battery power as time to fly with the DS99 on the display. With spare time of less than 1.5 hours, there will occur a hint of changing battery pack before launching.

We recommend warming up the battery pack to room temperature before use in a DS99.

2.3 Data collection

The DS99 transmits the DPSK modulated subcarrier to the receiving device. Inside a triple superhet the subcarrier is received and demodulated. Transferred to the decoder interface of the microcontroller board of the receiving device, DPSK data set become isolated

Now the microcontroller of the decoder unit calculates the block parity and, if necessary, can correct one defect data bit by block parity. If there is more than one error in the data set from the DS99, this data set is cancelled and not further transferred. Collected, changed into ASCII and named to a new data set P, T, U, Pos and spare channel 1-3 this data set are sent as a continuous data stream to the serial interface.
The software ADS99 from the PC (ore other) now can read data set for further calculations.

2.4 Interfaces

The receiving device requires 2 serial interfaces for data exchange and communications with peripheral software or hardware.

	2.5 Technical data of receiving device DSE 99	
1	**ranges of temperature**	
	working temperature	0 ... +50 °C non condensing
	storage	-30 ... +70 °C non condensing
2	**supply voltage**	12V DC or 230 V/50 Hz, approx. 50W
	mobile versions	24VDC lorry supply
3	**receiver unit**	triple superhet, controlled by PC
	sensivity for S/N 1:1	<= 0.5µV
	AFC	frequency adjust within ±5kHz around center frequency
4	**antenna (radio sonde receiver)**	
	type	vertical polarized omni directional antenna, 1.5 dB gain, additional low - noise GaAsFet amplifier, 20dB gain, noise max. approx. 0.9 dB
	dimensions, weight (incl amplifier)	length x max. diameter: ca. 900mm x 200mm, ca. 3.5 kg
	material	antenna: brass with housing made of Fiberglas, fitted on carrier from aluminum; amplifier: housing made of PVC
	connector	type N
	length of cable, type, connector	20m, type RG213/U, connector „N“
	lightning arrester	all of the parts of the metal antenna device are electric connected to the mast or can be grounded by separate ground wire
	wind load	ca. 80 N (at W_V=40m/s)

	assembling	by stainless steel clamps to a mast with diameter of 20 .. 54mm. Depending on the diameter of the mast, cable can be wired inside or outside the mast pipe.
5	**GPS – antenna**	
	gain	ca. 5,5dBic
	working temperature	-40 ... 85°C
	storage temperature	-40 ... 85°C
	supply voltage	3 ... 5,5VDC
	current consumption	20 ... 25mA
6	**audio amplifier (accoustic control)**	ca. 0.5 W loudness adjustable by software ADS99
7	**interfaces to PC with ADS99**	V.24 (RS 232) 19200 Bd, hardware handshake (DTR/RTS)
8	**interface for protocol printer (optional)**	centronics, print out of raw data in formatted lines;

3 Additional devices for use with Radiosonde DS99

3.1 Transmitting GPS for indoor use

To make it able receiving GPS signal inside a building, there is a GPS transmitter available at BBL.
By this the GPS signal is transferred to a small transmitting antenna near the set up plug. So the GPS antenna of the DS99 can receive the signal. Now preparing the DS99 for launching can be done in the working area of the operator.

During set up this small antenna has to be positioned ahead the GPS antenna inside the DS99 housing.
Remark: The now displayed position corresponds with the position of the outside GPS antenna of the ground station!

3.2 Pressure sensor inside of receiving unit DSE99

For measuring ground pressure of the station there is a high precision pressure sensor fitted inside of the receiving device.
There is the need of a pipe with inside diameter of >6mm to outside of the building to prevent errors in measuring ground pressure.

If there is the option “pressure measuring (“D”)” inside the DS99 recognized by the software ADS99 and there is a difference between ground pressure from the DS99GPSD and ground pressure, the pressure from the DS99 becomes corrected.

ADS99 needs data of the pressure sensor for software calculation of air pressure during flight.

3.2.1 Technical data of sensor for ground pressure	
ranges of temperature	
storage	-25°C ... +60°C
working	-25°C ... +60°C
interface	RS 485, half duplex
supply voltage	11 .. 28VDC
pressure supply	G1/8” outside thread
measured data	
non linearity, hysteresis, repeating accuracy	0,01% FS (1,15hPa)
long term stability	<100ppm/Jahr
measuring range	35 hPa .. 1150hPa
accuracy (-25°C ... +60°C)	typical 0,1hPa on behalf of the calibration; max 0,13hPa

3.3 Mobile stations for meteorological service and military use

The Radiosonde DS99 even for mobile use is the same as for every use.

The request to PC differs in withstanding of shock, vibration and range of ambient temperature as well as low power consumption and carry ability.

Information on these will be given with additional sheets on requests.

4 Accessory

4.1 Software ADS99

The software ADS99 is designed for operating with the receiving device DSE99. It is able to prepare the weather messages as recommended by WMO and German army.

Connected via serial interface with the receiving device DSE99. The software ADS99 collects all the data set from the sensors transmitted from the DS99.

Before launching a Radio weather sonde DS99, the set up is done by ADS99. This means that all the settings of receiver and transmitter (frequency) are done as well as transfer of calibration data and specific data of the Radio weather sonde DS99 to the ADS99 for storing and calculation. Time and specific ground data are added by ADS99 to the describing data file and stored on hard disc.

The data set are stored as raw data and pre calculated data as well as their data set of meteorological messages.

The following meteorological messages are part of standard ADS99:

- METCM
- PILOT
- TEMP

There are more messages deliverable on request:

- METB2/3
- BWD
- PPAA
- PPBB
- PPCC
- PPDD
- TTAA
- TTBB
- TTCC
- TTDD

The secondary data set, as they are: number of Radio weather sonde DS99, ground data and more are stored with connection to the number of the Radio weather sonde DS99 and terms of ascent too.

Stored data can be used for “off line” calculations as for teaching and other kind of calculations. Data too can become exported to ASCII file for use with other software i.e. Excel.

Calculated data set can be shown in graphics.
There are two graphics as a standard: t-log p and Stüve diagram. Position and wind data can be shown as separated graphics too. Except wind and position data, graphics can be shown during ascent.

Position data can be shown as a view from top onto a map. The map software is not part of the ADS99.

Special and detailed description of the ADS99 is deliverable on request.

4.2 Filling device for meteorological balloons K090

The balloon filling device K090 is designed to fill meteorological balloon with a desired volume of 1 .. 9,999l of helium or hydrogen.
The K090 is full manually operated as described below:

- push earth electrode into earth
- connect grounding wire with earth electrode
- connect pressure reducer to bottles of filling gas (using tool)
- connect pressure reducer to K090 with pipe of 5m (using tool)

- connect filling pipe (10m) with K090 (using tool)
- connect filling nozzle with filling pipe (using tool)
- fix filling nozzle to K191 or to the box of K090 (using tool)
- switch filling counter to desired volume
- open high pressure valve on the bottle
- start filling by opening filling valve manually
- watch the filling pressure to be within the green range on the pressure meter by manually turning filling valve open or close
- watch tone generator marking the end of filling
- close filling valve manually on tone generated
- if no more balloons have to be filled:
- disconnect pipe from pressure reducer
- connect hand air pump with pipe
- blow with a lot of air all the hydrogen from inside the pipes and the tubing of the K090
- remove all pipes
- store them inside the box of the K090

4.2.1 technical data of K090	
dimensions	length x width x height = 607 x 424 x 520 mm³
weight incl. spare parts	31 kg
working pressure (pressure of storage bottle maximum)	20MPa (200bar)
filling capacity/h	50,000l/h
max filling volume per filling	max. 9,999l
thread to bottle connection (at pressure reducer)	according to DIN477
hydrogen	W21.8 x 1/14" LH
helium	W21.8 x 1/14"
length of pipes (low pressure)	1 x 5m; 1 x 10m
battery supply for tone generator	1.5VDC, size "D"

4.3 Automatic filling device K091

The balloon filling device K091 is follower of the K090. Most of the jobs the operator has to do manually during filling with K090 are done automatically with the K091. This results in more accuracy in filling and lower need of operators time.
Filling speed ca be adjusted between soft and quick. After last filling of a balloon the system can become automatically render inerted by stirring gas. A bottle with 2l compressed (20MPA) stirring gas is stored inside the K091 and fitted to the system.
Connection of pipes are done by plugs or hand driven swivel nuts.

All the pipes and tools are stored in a separate box with same outlines like the K091.

For using K091 the operator only has to do the following:

- push earth electrode into earth
- connect grounding wire with earth electrode
- connect the K091 to the bottles with filling gas by pipe (hand driven swivel nuts),
- connect the filling pipe to the filling device (plugged)
- connect the balloon to the filling nozzle
- open valve of bottle with filling gas
- switch the main switch of the K091 into “ON” position
- chose the desired volume (type in or select from last filling stored in memory of the K091)
- start filling by push button
- after filing is ended: close filling neck of balloon with rope
- if no more filling is desired:
- close valve of filling gas
- start render inerting by opening valve of stirring gas and push button
- switch power off
- remove pipes after stop of inerting and store in the box

4.3.1 technical data of K091	
weight	approx. 50kg
dimensions	LxWxH 610mmx410mmx510mm (transportation, box closed)
ranges of temperature	
storage	-30 ... +75 °C
working	-20 .. +50 °C
IP-group	IP23 hole for rinsing the box in the bottom IP52 for electronics, connectors and sensors
type of filling gas	hydrogen (H2, with adapter helium (He)
filling of balloons, one battery set	20-25 balloons each 3m³ per charging of battery
filling speed l/minute	>150l/minute (<20 minutes for 3m³)
maximum volume per filling	9,999l
minimum volume per filling	50l (10l on reduced filling speed)
error of filled volume	<3%
volume of stirring gas inside the K091, (fixed to the tube – system)	2l with 20MPA (200bar)
stirring gas for render inerting of filling system	nitrogen (N_2)
quantity of render inerting the system with each bottle of 2l stirring gas	>50 each bottle of 2l stirring gas

4.3.2 K091 accessory box	
weight	approx. 25kg
dimensions	LxWxH 610mm x 410mm x 510mm (transportation, box closed)
ranges of temperature	
storage	-30 ... +85 °C
working	-20 ... +50 °C
IP-group	on closed box IP23 hole for rinsing the box in the bottom
content	• high pressure pipe 5m with swivel nut for tightening by hand without tool • filling pipe 10m with plug • filling nozzle with clamp to fix at the storing box • wire for grounding • earth electrode • soft – head hammer • spare gaskets for high pressure pipe • spare filter elements • tools for filter removal • spare rechargeable battery

4.4 Filling and starting device K191

Using the K191 for filling, preparing and launching the Radio weather sonde DS99 combination only needs maximum 2 operators even on windy days.
There is no need of a special balloon filling building for preparing Radio weather sonde DS99 combinations. It is quick assembled and disassembled.
For use in snow there are plates on the legs of the net.
For transportation it is stored in handy case.

Until launching, the balloon is inside of the net within the K191. So it is save even on windy days.
For launching, the operator only has to carry the Radiosonde with one hand and open the net by pulling the start rope with the other hand. The net then opens spring operated to give the balloon launching.
When the balloon cord between balloon and Radio weather sonde DS99 is lightly stretched, the operator has to go some steps in direction under the balloon with stretched cord and than give the Radio weather sonde DS99 launch.
The unwinder DSA99 after this will unwind the balloon cord to safely launch the Radio weather sonde DS99 without touching the floor.

4.4.1 technical data of K191	
(all data below for standard version, other dimension on request)	
dimensions of case	LxWxH= 1.7m x 0,55m x 0,12m
weight with case	approx. 27 kg
diameter fitted for filling	1.9m
height from floor to bow of tube	approx. 0.95m
diameter of net	approx. 1.7m
usable volume of biggest balloon	approx. 2,400l
length of starting rope	30m