

# SBS Range Rain Gauge

## User Manual



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# 1. General Information

## About this Manual

This manual is intended as a general guide for installing, wiring and using the SBS range of rain gauges. There are three models of SBS gauge, but the guidelines for each are the same so the generic term of reference used is 'SBS'. The information contained in this manual may not cover all aspects of SBS applications. Please refer to associated equipment manuals or consult papers and technical notes on the EML website ([www.emltd.net](http://www.emltd.net)).

## Version Information

*Table 1 - Document Revisions*

<b>EML Document Number:</b>	<b>Description:</b>
UM-P-780-400	Version 1.0 - First Release, dated 16 <sup>th</sup> June 2002
	Version 2.0 - Second Release, dated 25 <sup>th</sup> July 2017
	Version 2.1 - Third Release, dated 13 <sup>th</sup> March 2019
	Version 3.0 - Fourth Release, dated 22 <sup>nd</sup> June 2023
	Version 4.0 - Fifth Release, dated 15 <sup>th</sup> February 2024
	Version 5.0 - Sixth Release, dated 16 <sup>th</sup> February 2024

## Related Manuals

*Table 2 - Related Manuals*

<b>EML Document Number:</b>	<b>Description:</b>

## 2. Introduction

The SBS is EML's recommended solution for Hydrological or meteorological professionals such as National Met. Services, weather stations and flood warning systems. There are 3 funnel sizes available which are recommended based on the environment in which they are installed. The SBS314 is ideal for heavy rainfall regions, the SBS500 is favoured in a mixed climate such as Europe and the SBS1000 is particularly good in low, light rain areas. Aside from the funnel diameter all gauges are identical, providing a robust and versatile instrument which is ideal for applications where data precision and accuracy are of critical importance.

The SBS is available in White or Green. The internal tipping bucket mechanism has been designed to maximise water flow and therefore to assure maximum performance repeatability.

Traditional cylinder-shaped rain gauges are inaccurate due to the effect of wind blowing over the orifice. The physical presence of the gauge causes air to accelerate, carrying rainfall away from the collecting vessel. The effect of this can be up to a 20% reduction in rainfall catch. The unique aerodynamic shape of the EML range of scientific standard rain gauges reduces this effect, ensuring a high level of confidence in the accuracy of our measurements.

## 3. Site and Installation Requirements

### Choosing a site

A rain gauge site is often a compromise between exposure requirements and operational constraints. The ideal site is level ground with a uniform scattering of objects in the surrounding area thus reducing overall wind speeds. However, these objects should not be too large to cause eddying or high gusts to occur near to the gauge, or so close to prevent rain from entering the gauge. The gauge should ideally be no closer than at least twice the height of the obstruction. Although the SBS rain gauge is designed to operate in higher wind speeds, care must still be taken to avoid over-exposing the gauge where possible. Large expanses of open flat land should be avoided where possible. If the application is very specific, such as monitoring a building site, then the siting of the rain gauge is largely prescribed by use. Those users who wish to enquire more fully into rain gauge exposure are referred to the EML website for more technical information and papers ([www.emltd.net](http://www.emltd.net)).

**NOTES:** No two rain gauge designs are ever likely to produce identical results, and even two identical rain gauges can give slightly different catches even when sited close to each other.

If the gauge is to be operated in the area of livestock then a fence will almost always be required to prevent damage from and to the animals.

**WARNING! Remove packing piece!** The tipping-bucket mechanism is immobilised before shipping to prevent damage in transit. To release the mechanism for use, remove the funnel assembly from its base by loosening the three screws and then lifting the funnel. Remove the piece of foam from under the bucket mechanism. This foam may be saved and used whenever the rain gauge is transported.

## Levelling the rain gauge

The SBS can be mounted directly on to any flat surface, and securely fastened as desired. The gauge must be levelled for correct operation, and it is important to ensure that the rim of the rain gauge is levelled precisely, using a spirit level; failure to do this will result in a systematic error. Levelling is one of the simplest means of improving accuracy of rainfall measurements. Although a small circular spirit level is provided in the base of the rain gauge, this is provided only as a quick check system, always level the rim of the funnel precisely and check regularly. The gauge is levelled by slackening the locking nuts on the adjustable feet, adjust feet for level and tighten locking nuts (Figure 1). Pegs can be fitted if necessary through the holes provided next to the adjusters.

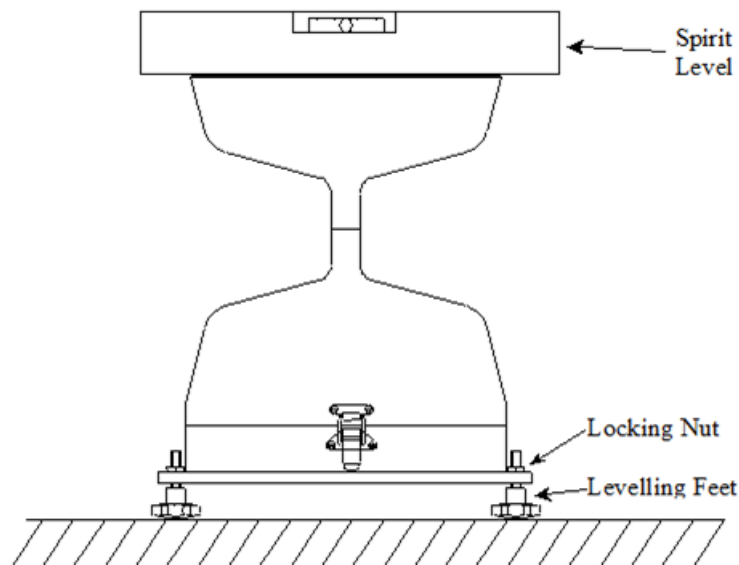


Figure 1 - Levelling the Gauge

## Alternative mounting options

It is not always possible to mount a rain gauge on the ground surface. Examples of applications which make use of rain gauges mounted above the ground include; urban monitoring, areas prone to ground-flooding and areas prone to snowfall. It should be noted that regardless of which option is used to mount the gauge, it must be firmly fixed and not susceptible to vibration. Vibration may lead to 'false-tipping' of the bucket mechanism and thus contribute to erroneous or inaccurate measurements. There are options which can be used to mount the SBS above the ground.

The SBS can be purchased with a rain gauge pedestal and guy kit or a rain gauge pedestal only. An example of this configuration is shown in Figure 2.



Figure 2 - SBS500 fitted to a pedestal as part of the EML system

## 4. Wiring Guidelines

This section gives information on the wiring of SBS rain gauge.

For most applications, the rain gauge may be connected directly to a pulse counting input (contact closure) on a data logger, but some care is needed if long cables are used. In a long cable significant capacitance can exist between the conductors, which discharges across the reed switch as it closes. As well as shortening the life of the switch, a voltage transient may be induced in any other wires which run close to the rain gauge cable each time the rain gauges tips. To help this situation, 100Ω resistors are pre-fitted to each of the reed switches (Figure 3), these will help protect the switches from arcing and help prevent transients.

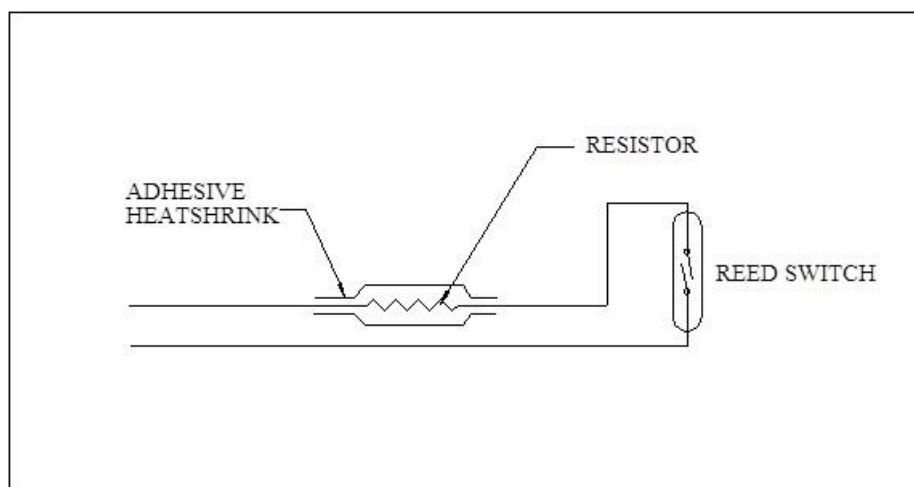


Figure 3 - Reed switch and resistor



## Field replaceable reed switches

SBS gauges are fitted with / have option for dual reed switches. This means that 2 data outputs can be logged using the same tipping bucket mechanism. Dual switches can be an important feature providing built-in redundancy which is often critical for professional users such as National Meteorological Services. Another feature of the reed switches is that they are replaceable in the field. They can simply be ‘clicked’ out of position (0.2mm version), or unscrewed (0.1mm version) and replaced by a new reed switch. This process takes less than one minute and allows for easy servicing of the gauge in the field. Using dual reed switches assures that the gauge remains operational after 1 has failed, allowing for maintenance to be carried out by field engineers. Reed switches can also be replaced periodically as part of preventative maintenance.

## Wiring for Data Loggers

For 0.2mm version there are two black terminal blocks within the gauge casting. Each reed switch is connected to one of these by two wires. To connect an internal data logger or counter, two wires have to be connected to the black terminal block and taken to the contact closure input of your chosen logger. If two loggers are to be used or if one logger is recording two measurements, then the process should be repeated using the other black terminal block.

For 0.1mm version, connection from datalogger should be made to Terminal Block sealed into the Reed Switch Frame.

The type of measurement is contact closure (switch), therefore it does not matter which way round the wires from the logger or counter are connected.

## 5. Operation

### Operation of the gauge

Rainfall is measured by the well-proven tipping bucket method. Precipitation is collected by the funnel and flows through a stainless-steel gauze filter, trapping and removing any leaves, dirt, etc. Figure 4. Water then drips from the nozzle into one of the two halves of the tipping bucket.



*Figure 4 - Filter and filter cap (left) / Nozzle delivering water into tipping bucket (right)*

The internal tipping bucket assembly rotates around precision rolling pivot bearings. The balance arm tips when the first bucket is full, emptying this rain water and positioning the second bucket under the funnel. The tipping process repeats indefinitely as long as the rain continues to fall, with each tip corresponding to a calibrated fixed quantity of rainfall. At each tip of the bucket the moving arm forces the magnet past the reed switch causing contact to be made for a few milliseconds. As each bucket side is used in turn, the outgoing water is drained away via outlets and discarded Figure 5.

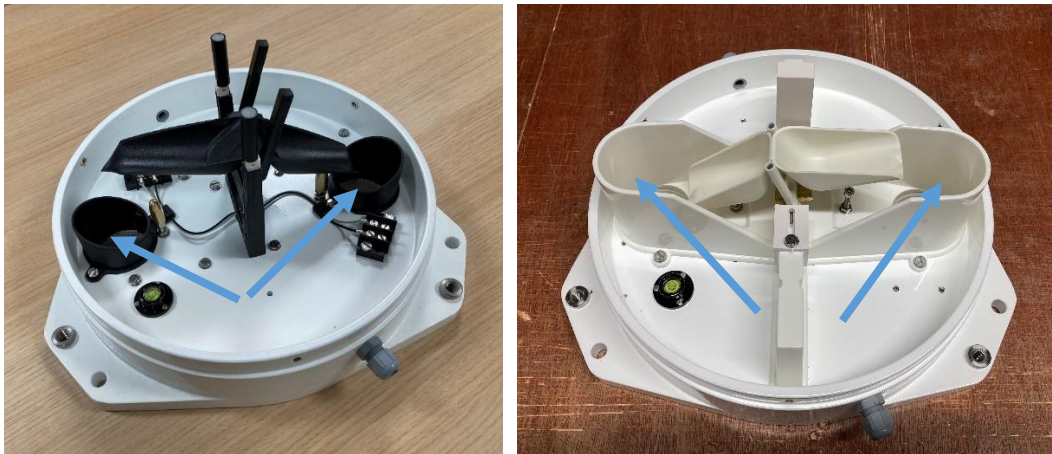


Figure 5 - Internal photograph highlighting water drains

The exact calibration of each tip is pre-set by adjustable stops. Do not alter these stops unless as part of a calibration exercise. A levelling bubble is provided as an aid to levelling of the rain gauge. Connections to the reed switches are made via the connector terminals.

## 6. Maintenance and Calibration

### Basic Maintenance

To ensure reliable and accurate measurements it is recommended that the following checks are carried out at each visit to the rain gauge (if the gauge is still connected to a data logger and the logger is operating, care must be taken to avoid tipping the bucket when carrying out these checks).

1. Inspect the funnel and filter for any damage or blockage. At certain times of the year, particularly autumn, leaves may accumulate in the funnel, dirt and dust can also block the filter preventing or reducing the flow rate to the buckets beneath. The leaves can easily be removed from the funnel and the filter cleaned by removing the end cap from the filter tube, remove the stainless-steel filter gauze carefully, clean and re-fit the filter and cap.
2. Check that the gauge is still level. Small movements may occur over time.
3. Remove and clean any dirt from the tipping bucket, being careful not to tip the bucket should the rain gauge still be logging.
4. During any occasion when the rain gauge is disconnected from the logger, it is good practice to check the balance arm of the tipping bucket for stiffness. The easiest way to do this in the field is to try and balance the bucket in its centre position, it should be very difficult if not impossible to achieve this, if the bucket balances easily then examine the bucket closely for any dirt or wear on the pivot pin and bucket tubes.
5. As mentioned in section 4, the SBS gauges are equipped with removable reed switches. Figure 6 shows a removable reed switch for 0.2mm version (left), the empty housing socket (centre) and the process of connecting the reed switch (right). The other reed switch can be seen directly opposite the empty socket in the middle picture. The two arms in between the reed switches are the magnets which pass the reed switches when the bucket tips, causing a

contact closure. To remove a reed switch, insert a small flat screwdriver into the catch on the white connector. The reed switch has been constructed with an IP67 waterproof connector and is completely potted to produce a robust replaceable accessory. (Note: IP67 means Dust Tight (6) and Immersion up to 1m (7)).

To replace Reed Switch on 0.1mm version simply unscrew the Reed Switch and replace with new switch – care should be taken to position the Reed correctly in order to ensure pulse is received when the bucket (with magnet) passes the Reed.



Figure 6 - SBS replaceable reed switch (0.2mm version) (left) / Empty socket to house one of the reed switches (centre) / reed switch being inserted into the empty socket.

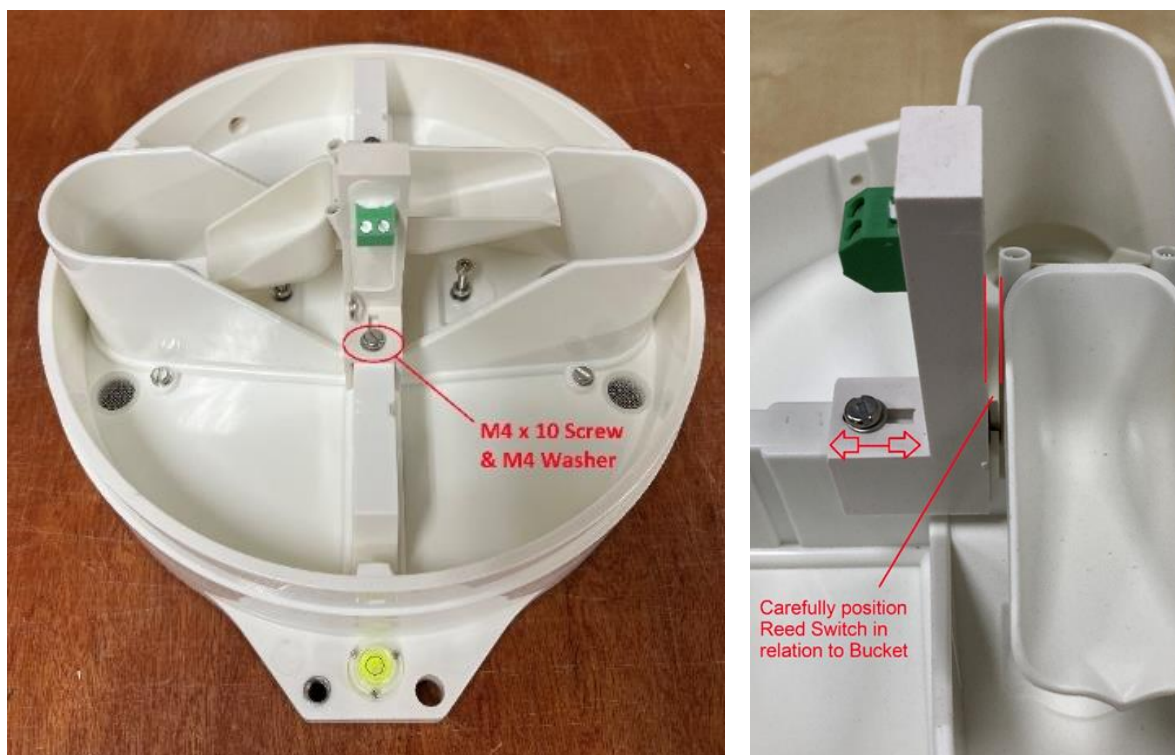


Figure 7 – SBS Replaceable Reed Switch 0.1mm version

**PLEASE NOTE:** A spares kit is available with filter, cap, and screws. Contact EML sales ([sales@emltd.net](mailto:sales@emltd.net)) for more information.

## Calibration

The sensitivity of the rain gauge is accurately calibrated during the manufacturing to a nominal 0.2mm/tip using a purpose-built calibration rig supplying an adjustable constant head of water allowing accurate calibration of the rain gauge. Each rain gauge is supplied with its own calibration figure to three decimal places. All gauges are calibrated to a tolerance of 2% of the 0.2mm tip value.

A re-calibration and overhaul service is also offered to customers; EML recommends re-calibration every 12 to 24 months depending on applications.

For information on how we calibrate the rain gauges see British Standards document BS 7843-1:2012 and the CIMO Guide to Meteorological Instruments and Methods of Observation (Chapter 6). These documents describe the processes of bucket balancing, static calibration at a fixed intensity, and dynamic calibration using variable intensities

## 7. Specifications

### Gauge Specifications

Table 3 - Gauge Specifications

Technical Specifications	
Resolution	0.1/0.2/0.5mm 0.005/0.01/0.02inch
WMO Compliant	Yes
Output	Contact Closure (Reed Switch)
Typical Accuracy	99% up to 120mm/hr
Rainfall Intensity	SBS314 (0-1750 mm/hr), SBS500 (0-1200mm/hr), SBS1000 (0-600mm/hr), With mathematical correction over 120mm/hr - contact EML
Operating Temperature	0°C - 70°C
Funnel Diameter	SBS314 (20cm), SBS500 (25.2cm), SB1000 (35.7cm)
Funnel Area	SBS314 (314cm <sup>2</sup> ), SBS500 (500cm <sup>2</sup> ), SBS1000 (1000cm <sup>2</sup> )
Height	SBS314 (43.5-46.5cm), SBS500 (46.0-49.0cm), SBS1000 (53.0-56.0cm)
Weight	SBS314 (5.5Kg), SBS500 (6Kg), SBS1000 (7.5Kg)
Colour	White (or Green on request)

### Cable Specifications (if fitted)

The standard cable used in all extended versions (on request) of the rain gauge is a single twisted pair of 7/0.25mm (22awg) tinned copper conductors, insulated with polyethylene, wrapped in an aluminised tape with a 7/0.25mm tinned drain wire and a PVC outer sheath.

*Table 4 - Cable Specifications (if fitted)*

Technical Specifications	
Temperature Range	-30°C to +70°C
Overall diameter	4.6 mm
Char. impedance	85 Ω
Capacitance/metre	154 pF
Equivalents	<b>Alpha</b> 2401 <b>Belden</b> 8761 <b>UL style</b> 2092

## Appendix A – SBS products, accessories and spares

Table 5 – SBS500 products

Ordering Information	
Order Code	Product
P-780-4050	SBS314 (0.1 mm)
P-780-405	SBS314 (0.2 mm)
P-780-4049	SBS314 (0.5 mm)
P-780-4081	SBS314 (0.01 inch)
P-780-4001	SBS500 (0.1 mm)
P-780-400	SBS500 (0.2 mm)
P-780-404	SBS500 (0.01 inch)
P-780-410	SBS1000 (0.1mm)
Other options available	
Contact EML for details	

Ordering Information - Accessories	
Order Code	Product
P-780-491	SBS spares kit Including Nozzle

Table 6 - Accessories for the SBS

Product code	Description
M-610-114	Rain gauge Tri Pedestal

*Table 7 - Spare parts for the SBS gauges*

<b>Product code</b>	<b>Description</b>
P-780-415	SBS Bucket Assembly
P-780-425	SBS Reed Switches
P-780-430	SBS Casting Assembly
P-780-450	SBS500 Funnel Assembly
P-780-451	SBS1000 Funnel Assembly
P-780-453	SBS314 Funnel Assembly
P-780-490	Spares Kit (includes funnel screws, filter material and filter cap)