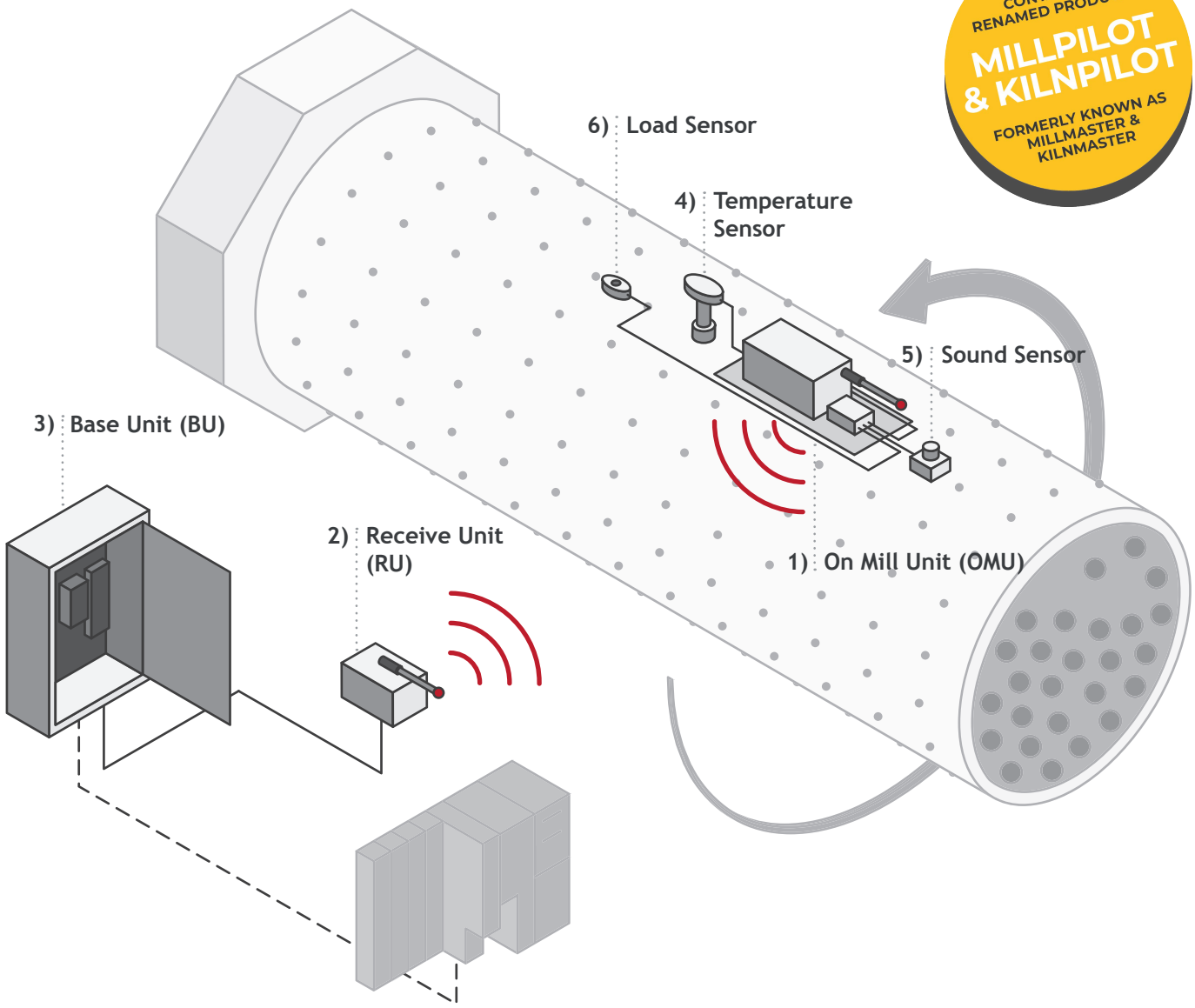
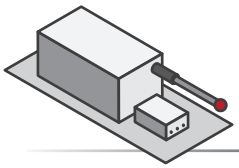
SmartFill—Technical

Fill-level & temperature measurement for ball mills

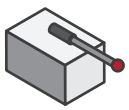
CONTAINING RENAMED PRODUCTS
MILLPILOT & KILNPILOT
FORMERLY KNOWN AS MILLMASTER & KILNMASTER



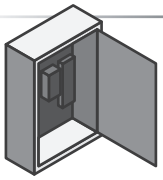
Main components



1) On Mill Unit (OMU)
Data acquisition unit for up to three sensors, radio transmitter and integrated generator.



2) Receive Unit (RU)
Small radio receiver, flexible placement near mill (3..15 m).



3) Base Unit (BU)
The analysis device with control panel.

Three sensor types

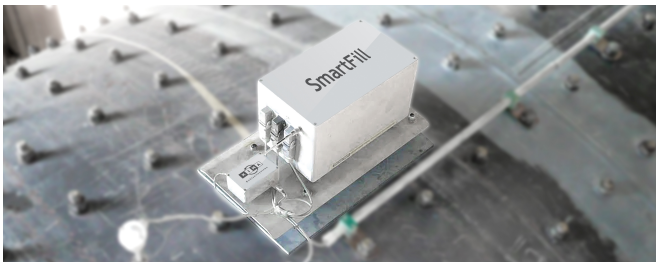
4) Temperature Sensor
Measures the temperature of the material or shell.

5) Sound Sensor
Senses the fill level for the 1st, 2nd and 3rd chamber independently.

6) Load Sensor
Senses the total load of ball mills.

On Mill Unit (OMU)

The **OMU** records, reduces and transmits sensor data by RF link to the Receive Unit. OMU and sensors are mounted directly on the shell, rotating with the mill. The system is **self-powered** by an integrated pendulum driven generator. No battery is needed.



Electrical properties

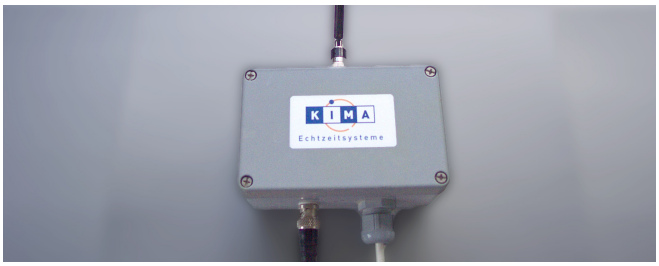
power supply	6 V_{AC} (0.5 W / self-powered)
transmitter	UHF ISM 866 MHz, 2.4 GHz

Mechanical properties

weight	23 kg
height	300 mm
width	400 mm
depths	230 mm
storage temperature	-20..60 °C -4..140 °F
operating temperature	0..70 °C 32..158 °F

Receive Unit (RU)

The **RU** is implemented as separate unit to achieve a high flexibility. Thus it may be mounted at a place with optimal receiving quality. Via coaxial cable the signal is sent to the next component: the Base Unit.



Electrical properties

power supply	24 V_{DC} / 200 mA (powered by BU)
output	≤ 2 V_{pp} / 50 Ohm (RG 58, max. 200 m)

Mechanical properties

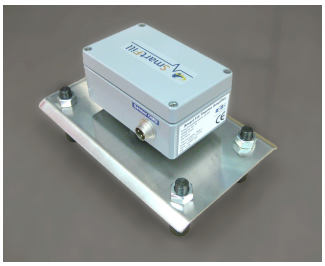
weight	0.6 kg
height	80 mm
width	125 mm
depths	67 mm
storage temperature	-20..60 °C -4..140 °F
operating temperature	0..50 °C 32..122 °F

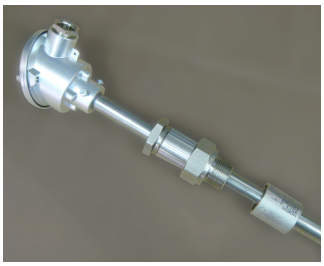
Base Unit (BU)

The **BU** is the control center of the SmartFill system. It performs all mathematical analysis of transmitted data and links to the plant‘s PLC.
The device must be mounted in an air-conditioned room. The industrial PC contained requires a cool and dust free environment.

Temperature Sensor

The Temperature Sensor measures either the material temperature directly in the diaphragm or the shell temperature on the mill surface. It consists of the sensor (right picture) and the amplifier (left picture). Both items are mounted directly on the mill shell and thus rotate with the mill. The **special low power amplifier** is powered by the OMU.





Electrical properties

power supply	110 V_{AC} / 60 Hz 230 V_{AC} / 50 Hz (160 W)
signal	≤ 2 V_{pp} / 50 Ohm
analogue output (x3)	24 V_{DC} / 4..20 mA
digital output (x4)	24 V_{DC} / max. 100 mA
power supply output	24 V_{DC} / ≤ 500 mA (for RU)

Electrical properties

power supply	5 V_{DC} / 20 mA (powered by OMU)
thermocouple	j-type

Mechanical properties

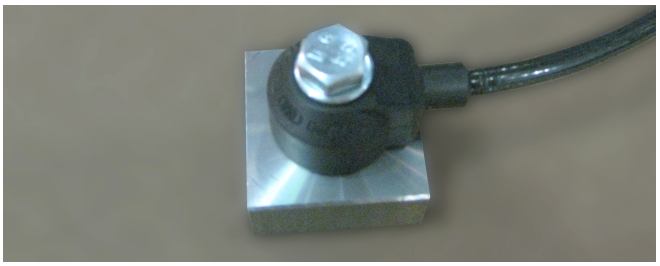
weight	18 kg
height	600 mm
width	400 mm
depths	220 mm
storage temperature	-20..60 °C -4..140 °F
operating temperature	0..40 °C 32..104 °F

Mechanical properties

	amplifier	**sensor**
weight	1.3 kg	1.2 kg
height	130 mm	500 mm
width	220 mm	570 mm
depths	140 mm	15 mm
storage temperature	-20..60 °C -4..140 °F	-20..60 °C -4..140 °F
operating temperature	0..70 °C 32..158 °F	0..150 °C 32..302 °F

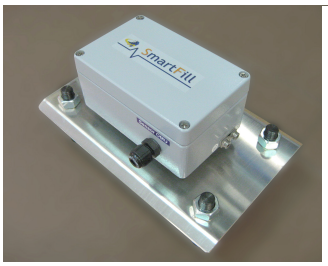
Sound Sensor

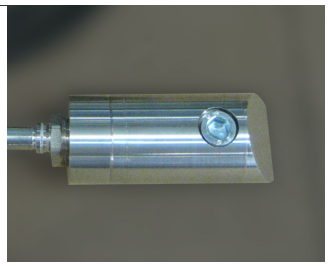
The Sound Sensor senses the structure-borne sound for 1st, 2nd and 3rd chamber independently. For each chamber a sensor is mounted directly on the mill shell and thus rotates with the mill. There is no amplifier. This sensor type is intended for dry grinding processes (e.g. cement, minerals, etc.). It ensures a very high precision in fill level. Mounting plate is glued on the shell.



Load Sensor

The Load Sensor measures the total load of the mill. It consists of the sensor (right picture) and the amplifier (left picture). Both items are mounted directly on the mill shell and thus rotate with the mill. The amplifier is powered by the OMU. This sensor type is predestinated for one chamber mills and grinding of material with widely varying moisture.





Electrical properties

power supply	none

Electrical properties

power supply	5 V_{DC} / 20 mA (powered by OMU)

Mechanical properties

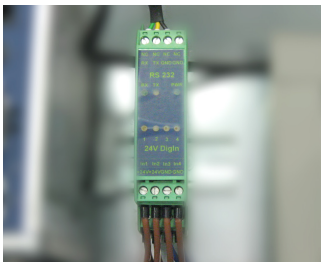
weight	0.3 kg
height	40 mm
width	40 mm
depths	40 mm
storage temperature	-20..60 °C -4..140 °F
operating temperature	0..120 °C 32..248 °F

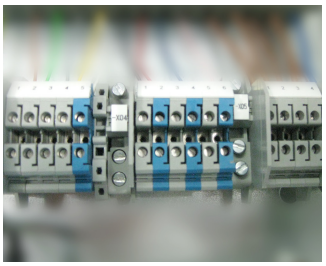
Mechanical properties

	amplifier	**sensor**
weight	1.3 kg	0.2 kg
height	130 mm	26 mm
width	220 mm	60 mm
depths	140 mm	26 mm
storage temperature	-20..60 °C -4..140 °F	-20..60 °C -4..140 °F
operating temperature	0..70 °C 32..158 °F	-30..120 °C -22..248 °F

Type Selection Module (optional extension)

The Type Selection Module is placed inside the BU and switches between different calibrations for different material types. Active type is coded by four digital signals, which are set by the plant‘s PLC.
This module is needed, when the different types are strongly varying in their material composition. A subsequent installation on site is possible.





Electrical properties

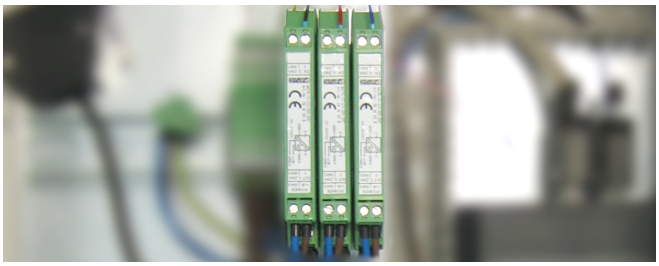
power supply	24 V_{DC} (powered by BU)
digital input (x4)	24 V_{DC} (up to 16 different types)

Mechanical properties

weight	0.13 kg
height	110 mm
width	20 mm
depths	100 mm
storage temperature	-20..60 °C -4..140 °F
operating temperature	0..40 °C 32..104 °F

Galvanic Isolation (optional extension)

The Galvanic Isolation is placed inside the BU and provides an electrical separation for the final fill level and temperature outputs between the BU and the plant’s PLC.
A subsequent installation on site is possible.



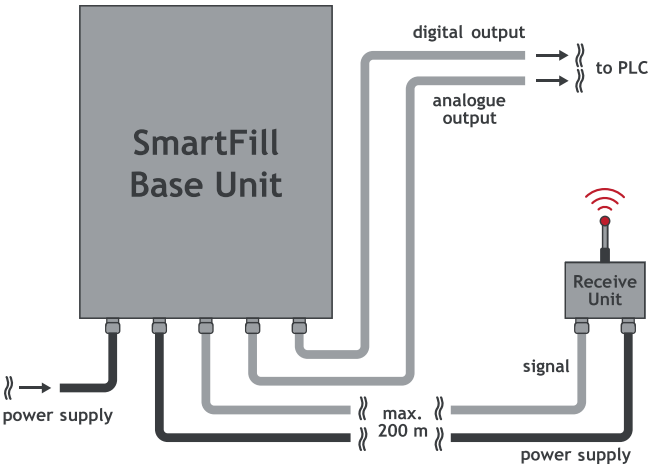
Electrical properties

analogue power supply	24 V_{DC} (powered by BU)
analogue output (x3)	4..20 mA
digital power supply	24 V_{DC} (external power supply)
digital input (x4)	24 V_{DC}
digital output (x4)	24 V_{DC}

Mechanical properties

weight	0.3 kg
height	110 mm
width	36 mm
depths	100 mm
storage temperature	-20..60 °C -4..140 °F
operating temperature	0..40 °C 32..104 °F

Getting it together



Electrical properties

power supply (Base Unit)	110 V_{AC} / 60 Hz 230 V_{AC} / 50 Hz
digtal in- & output	24 V_{DC}
analogue output	4..20 mA (self-powered current loop)
load resistor	≤ 1000 Ohm
power supply (Receive Unit)	24 V_{DC}
signal	≤ 2 V_{pp} / 50 Ohm (RG 58, max. 200 m)

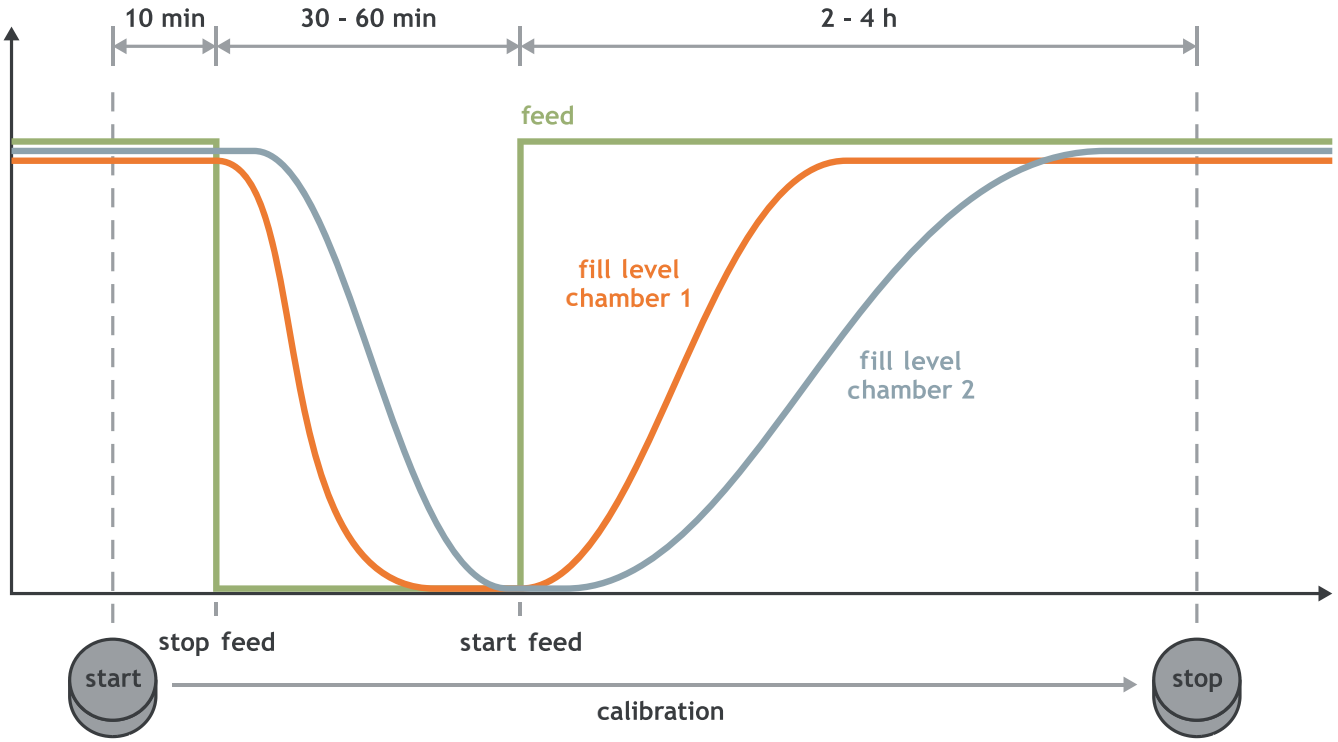
I/O

The analogue outputs are used to signal the calculated fill levels (0..130 % of calibrated range) and the measured temperature (20..170 °C). Therefore, each sensor has got a separate current loop (4..20 mA).
The digital outputs signal the operating status of the Base Unit.

Calibration

After installation a calibration of the sound and load sensors is needed. Therefore, the mill has to be run empty and full.
For maximum convenience, SmartFill offers automatic calibration modes which can be started and stopped by using the Display Unit inside the Base Unit.
The displayed range is 130 % to ensure a signal if the level exceeds 100 % of calibrated range.

Easy calibration (Sound and Load Sensor)



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