SENSECOM-SK

Communication equipment for detecting the extension of cracks or joints in building structures

Purpose

SENSECOM-SK is a monitoring device with electronic **sensors for detecting the extension of a crack or joint of** a building structure, rock, etc., whose detector detects the extension of **a crack by** 50μ or more. The device may include a **temperature sensor** (thermistor) which is embedded in the building structure in its vicinity. In addition, the device may be equipped with a natural frequency analysis module of the structure to **indicate changes of rigidity**.

The device sends data over the **SIGFOX** or **NB-IoT** wireless IoT network. It is designed to last **more than 5 years** without battery replacement and maintenance, when sending status messages once a day.

The device contains 2 crack detectors, can be optionally equipped with a thermistor or supplemented with a rigidity change indication module (NFQM).

To ensure communication of several devices within a radius of ~20m or in places with poorer signal availability, SENSECOM-WSH, WNH communication units can be used as a common communication gateway or a repeater can be used for each individual device.

Typical use:
Signaling of gap or crack opening in building structures (e.g. prestressed concrete bridges), rock bodies, etc. with possible monitoring of temperature and strength of the structure. The bonding of the electronic detection slides to the structure is the same as for conventional crack monitoring slides.

Description of equipment:

SENSECOM-SK is a type of communication device that works with sensors:

- Crack detectors - 1-2 detectors can be connected
- Temperature measurement of the structure (supplementary)
- Rigidity changes indication (NFQM add-on module)

The crack detector works based on commonly used detection glasses adapted for electronic detection with the ability to detect micro-cracks in glass **from 50μ** (even from one side of the middle part of the glass). The temperature is measured by a thermistor (with an accuracy **of 0.5°C**) which is glued into a drilled hole in the structure. To **indicate changes in rigidity**, an additional module SENSECOM-NFQM is used, which detects and analyses the structure's natural oscillations and their changes.

The electronics of the device is in sleep mode most of the time with minimal power consumption. At regular intervals (standard 1min) it performs measurements of the integrity of the detection slides or reacts to external mechanical stimuli allowing the detection of oscillations. It sends a report via the SIGFOX or NB-IoT IoT network on a regular daily basis or immediately if changes are detected.

Data processing

The data from the device is processed and made available on the **SENSEPARAM.COM portal**, where it can be set up for subsequent sending to the customer database (callbacks), setting up alarm notifications by email or SMS, downloading to a CSV file, etc. Alternatively, sending raw data directly to the customer database (callbacks, REST-API) can be set up in the SIGFOX cloud. Similarly, raw data can be retrieved from the NB-IoT network using UDP packets. Usually within 7 seconds after the start of the transmission (end of measurement/change detection) the data is available in the systems.

The device can be remotely reconfigured, usually once a day when the device requests a downlink. Remote upgrade is only possible when using the NB-IoT network.

Types of messages

Types of messages transmitted from **SENSECOM-SK**:

- **Value message** - periodic status message containing sensor statuses.
- **Alarm message** - a value message generated immediately upon changes in the inputs and manipulation.
- **Keep-Alive message** -system periodic message, sent by the device at 24-hour intervals.
- **Downlink message** - the message that the device receives from the back-end as part of sending the first message, following the Keep-Alive message.
- **Configuration message** - message after reset or after processing a downlink with a configuration change.

Device security

The device includes an accelerometer that indicates tampering/manipulation of the device. In the event of an

intrusion, it sends an alarm message. By default, it sends a 1x/day system Keep-Alive message about battery voltage and CPU temperature. From the transmitted periodic messages, the status of the device and the current state of the inputs can also be continuously identified. The integrity of the message transmission is ensured through the AES-128 algorithm.

Technical parameters

Device model	SK2	SK2T	SN
Main sensors	1-2 crack change/shift sensors connectable via connector SP13/2 (OK/KO states)		
Additional sensors	-	1 temperature sensor (thermistor) accuracy 0.5°C, connectable via SP13/3 connector	
Internal device sensors	▪ Accelerometer (adjustable sensitivity for alarms) ▪ Thermometer (part of the processor) - measures processor temperature [°C] ▪ Voltmeter (part of the processor) - measures battery voltage when transmitting [V]		
Connectable module	Detection of changes in strength (NFQM), natural vibration analysis module		
Network for data transmission	**SIGFOX** (ISM band 868MHz)		**NB-IoT**
Types of uplink messages	▪ Value - initiating and periodic status with values on inputs ▪ Alarm with change of values on inputs, when manipulating the device (accelerometer) ▪ Configuration - after reset or remote reconfiguration ▪ Keep-Alive (24h period)		
Period of sending status messages	**24hr**, adjustable from 10-1440min(24h) in 10min increments		
Access to processed data	**SENSEPARAM** (portal of standardized data and graphs, notification by email or SMS, callback to customer database, remote setup, device and user management) - for device models communicating in SIGFOX and NB-IoT network		
Alternative data access (raw data)	**SIGFOX cloud** (portal, unparsed data, Callback(push), REST-API, CSV Download)		UDP packets over public or private APN
Antenna	Internal built-in antenna		
Power	Lithium battery Li-SOCl$_2$ 3,6V, 7,7Ah, replaceable (non-rechargeable), size C, SAFT LS 26500		Lithium battery Li-SOCl$_2$ 3,6V, 5,8Ah, replaceable (non-rechargeable), size C, SAFT LSH 14
Expected battery life without battery replacement	>5 years at 1 message/day (without add-on module)		
Connecting sensors	Crack change sensor - 75cm long cable with SP13-2/IP68 connector Temperature sensor - 10cm cable with SP13-3/IP68 connector		
Connectivity to a repeater or gateway (for multiple devices simultaneously)	SENSECOM-WSH, WSHD, WNH for SK2, SK2T models		-
Operating conditions	Temperature -20°C to 60°C, relative humidity up to 90%, IP67		
Weight	200g		
Operating temperature	-25° to +65°C		
Housing dimensions	160x80x85 mm, dimensions without grommets/connectors and handles		

Design and housing of the device:
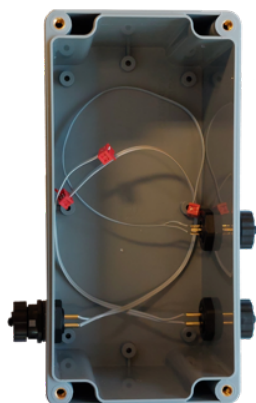
The device is supplied in a plastic housing (ABS material) with handles, IP67 rated and designed to be attached to a flat base
The device has SP13/IP68 type locking connectors on the sides for connecting crack detectors or another connector for connecting a thermistor.
The crack detector has a 75cm long cable with SP13-2 connector, the thermistor has a 10cm long cable with connector.