

Technical information related to the SCS - Syscom Cloud Software

Introduction

In this application note the relevant technical information about the SCS is presented, in particular:

- the management of data storage and SMS;
- the algorithms for the calculation of the different post-processing analyses;
- the sharing features;
- the State-Of-Health notifications.

For any further details please do not hesitate to contact our support department at: **support@syscom-instruments.com**

Data storage

6 GB of data storage are given to each account at the moment of the activation. When more than 8 devices (MR3000 or ROCK) are connected to the SCS, then additional 0.75 GB per device are given.

Additional memory can be rented at the bottom right of the section ADMIN (Figure 1).

SMS

At the moment of the activation, no SMS are present in the account. 100 SMS are added for each ROCK, for each month of activation.

Example: with 4 ROCK activated for 2 consecutive months, the account receives 400 SMS per month, for a total of 800 SMS.

The maximum number of SMS that can be accumulated in an account is given by the sum of:

- 2000, the default maximum number at the moment of the account activation;
- 100 per each device connected in the account (MR3000 or ROCK)

Example: if 4 devices are connected to an account, the maximum allowed number of SMS is 2400.

SMS can be bought in the right part of the section ADMIN (Figure 1).

During a monitoring, the user can set a daily SMS limit per recorder. This option is present in the project creation page and the limit is then valid for all instruments in that project.

The option prevents to send many SMS in case of frequent high vibrations. The e-mails are not concerned by this settings and are sent without any limitation.

SCS

scs.syscom-instruments.com

The screenshot displays two management sections in the ADMIN area. The first section, 'BUY SMS', includes a toggle for 'manage automatically' and a 'Buy SMS' button with the text '+250 SMS = 1 token'. The second section, 'DATA STORAGE', also has a 'manage automatically' toggle. It shows '74.7% / 6 GB remaining free storage' and a 'No bought storage' status. Below this is an 'Extend storage' button with the text '+6 GB for 1 year = 4 tokens'. A 'view detail' button is located to the right of the storage status.

Figure 1. Right part of the ADMIN section of the SCS, including the SMS and data storage management.

The screenshot shows the 'PROJECT OPTIONS' section. Under the 'Report' heading, there is a 'Keep reports during' dropdown menu currently set to '1 month'. Under the 'SMS' heading, there is a 'Daily limit per recorder' input field with the number '2' entered. A help icon (?) is located below the input field.

Figure 2. Section „Project options“ in the project creation page, with setting of the daily SMS limit per recorder.

The algorithms

Differentiation

In the SCS the differentiation is used to transform velocity signals into acceleration signals. The algorithm is based on the following operations:

- Differentiation based on the following formula:

$$a_i = f_s * (v_{i+1} - v_i)$$

where a_i is the acceleration at the instant i , v_i is the velocity and f_s is the sampling frequency;

- No filters are applied on the signal.

Integration

In the SCS the integration is used to transform velocity signals into displacement signals or to transform acceleration signals into velocity signals. The algorithm is based on the following operations:

- Integration based on the Trapezoid rule:

$$d_0 = 0$$

For $i=0:N$

$$d_{i+1} = d_i + \frac{(v_{i+1} + v_i)}{2f_s}$$

End

where d_i is the displacement at the instant i , v_i is the velocity and f_s is the sampling frequency;

- A second order Butterworth high-pass filter at 0.8 Hz is then applied on the integrated signal.

If an acceleration signal is recorded, the integration algorithm is applied twice in order to obtain the displacements.

VSUM

The VSUM (Vector SUM) is calculated from the values of the three orthogonal components at each time instant i .

$$VSUM_i = \sqrt{x_i^2 + y_i^2 + z_i^2}$$

RMS

The RMS is calculated on an event, separately on each orthogonal component, with the following formula:

$$x_{RMS} = \sqrt{\frac{1}{N} \sum_{i=1}^N x_i^2}$$

where N is the number of samples in the signal x .

FFT

The FFT (Fast Fourier Transform) is a mathematical process to obtain the frequency content of a signal. Inside the SCS the FFT is applied directly in case of signal with a duration inferior to $M = 16.384$ s (chosen as a power of two).

In case of a longer duration, the signal is divided in different portions of duration = M , where the FFT is applied. The last portion could be smaller than the value indicated.

A final FFT is then calculated by averaging the partial FFT.

The benefit of this operation is double:

- Reduce the computational time
- In case of signals with more than 16.384 s, obtain a FFT with the same resolution, even at different sampling frequencies.

If the duration is not greater than M , then:

- The whole signal is considered
- The hanning window is applied
- Zeros are added until the signal length is a power of two
- The FFT is calculated
- The amplitudes are normalized

If the duration is greater than M , then:

- The signal is divided in portions with duration = M
- Each portion has a 50% overlap with the previous and the successive one

In each signal portion:

- The hanning window is applied
- Zeros are added until the signal length is M (applicable only for the last portion)
- The FFT is calculated
- All amplitudes of each partial FFT are averaged
- The amplitudes are normalized

ZC frequency

The ZC (Zero Crossing) frequency algorithm estimates the frequency from two consecutive zeros of the signal. A zero is a point with ordinate equal to 0. The algorithm is based on the following operations:

- Consider only the values exceeding a certain threshold, which has been fixed to 0.1 mm/s - 0.004 inch/s - 0.1 mg depending on the measurement unit.
- Identify the sign variations in the signal;
- Consider two consecutive points with different signs and use a linear interpolation between them to find the local zero of the signal;
- Calculate the frequency from two consecutive zeros as follows:

$$f_i = \frac{1}{2(z_{i+1} - z_i)}$$

where f_i is the i -th calculated frequency and z_i is the i -th zero;

- Repeat the operation for all the zeros of the signal.

If there are N zeros in the signal, there will be $N-1$ frequencies.

In the SCS, only the frequencies associated to the 50 highest peaks of the signal are displayed.

One-third octave, MAX

The one-third octave analysis is a procedure that divides the frequency content of a signal in different bands. Then the SCS calculates the maximum vibration values (velocity or accelerations) in the one-third octave bands. The procedure is as follows:

- The one-third octave bands from 1 Hz to 80% of the Nyquist frequency are considered;
- The limit frequencies of each band, named f_1 and f_2 , are calculated from the center frequency f_c as follows:

$$f_1 = \frac{f_c}{2^{1/6}} \quad f_2 = f_c \cdot 2^{1/6}$$

- The signal is then filtered in each band with a Butterworth filter of the fourth order;
- The maximum amplitude value of the filtered signal is considered for each band.

One-third octave, RMS

The procedure is the same as for the „One-third octave, MAX“, with a difference in the last point. Instead of taking the maximum of the filtered signal, the RMS of the filtered signal is considered. The RMS is calculated with the formula shown in the paragraph „RMS“.

FTP service

The FTP service allows to send data coming from the devices to a desired FTP address.

Every minute the SCS checks if new data are available and in that case it sends these data to the desired FTP address.

The status is indicated by 3 colours:

- **GREEN:** FTP active, and data are successfully sent to the desired address
- **YELLOW:** FTP active, but data are not successfully sent to the desired address
- **GREY:** FTP not active

Access levels

The SCS allows to create 2 types of URL links for the remote access to a specific project, to easily share access with other people:

- Read/write access, to have a full access to a specific project;
- View only access, to have a visualization access to a specific project.

The button SAVE „fixes“ the link such that the same link can be shared to different people (Figure 3).

Note: the events hidden by the administrator in the project event table won't be displayed in the „View only“ project event table.

SHARING

View only

Read / Write

● FTP Forward

Publishing URL

Give the following URL to any person you want to give read / write access to this project.

<http://scs.bartec-syscom.com/publish?publishMode=write&publishProject=792&publishKey=d142ee571c7382495f97b aa6beb0b29e65e80a41a74df9025cd810bee936309b3e8dd79c8ee01a40>

[Click here to revoke access](#)
[Save](#)

Figure 3. The creation of the link for a read/write or view-only access.

State-Of-Health (SOH) notifications

The SCS cloud software is able to automatically send different notifications about the State-Of-Health (SOH) of devices:

- **SMS limit reached.** It is sent when the daily limit is reached for a certain unit. The notification concerns both ROCK and MR3000 devices.
- **Connectivity problem.** It is sent when a unit activated in a project does not send data to the SCS for 24 hours consecutively. In other words, if a unit has a certain connectivity problem and cannot anymore send information to the SCS, a notification is sent 24 hours after the first connection problem. The notification concerns both ROCK and MR3000 devices.
- **Low battery for ROCK devices.** A notification is sent as soon as the ROCK battery reaches the 10% of its capacity. This is valid only for ROCK devices.
- **Issues coming from MR3000 devices.** The SCS sends a notification as soon as a MR3000 device detects a problem. The list of issues of the MR3000 devices can be found in the relative user manuals. These notifications are valid only for MR3000 devices.

Conclusions

The document explains the main features and the algorithms used in the SCS cloud software. In case further details are needed, do not hesitate to contact us at: support@syscom-instruments.com