

MONI LOG[®]

USER MANUAL

for

MONI LOG[®]

ShockDisplay curve / ShockDisplay curve plus



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User Manual for MONI LOG[®] ShockDisplay curve / ShockDisplay curve plus

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ShockDisplay curve applications

The **ShockDisplay curve (SDC)** is the successor model of the data loggers SDY1 and SDY2 that have been well-established since 1994. With its accompanying acceleration sensors it measures, evaluates and records mechanical **shocks in any direction** over a long period. Every shock event is always recorded with its time of occurrence, shock maximum, shock duration and curve and stored in the file system of the instrument.

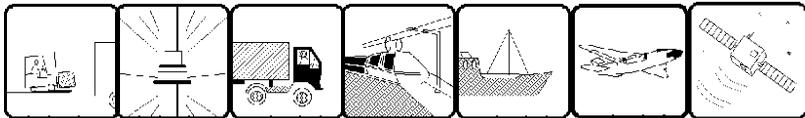
Additionally, the instrument is able to carry out inclination measurements for slow events (e.g. rolling of a ship, tipping over of the consignment) and to store the GPS coordinates of an event in the SDCplus version or in combination with the *MONILOG Tracking Module/data link*.

By means of an external sensor, the ShockDisplay curve plus model can additionally capture temperature, relative humidity and absolute air pressure as synchronous measurement data. This makes it possible to monitor transports under inert gas or temperature- and humidity-sensitive processes

The ShockDisplay curve is designed for application in stores, at transshipment sites and for the various transports on rail and road, on water and in the air. The evaluation of the stored data gives information about shunting or loading shocks as well as the time of occurrence of a possible damage and the GPS position.

The optional recording of temperature, humidity and pressure provides you with a comprehensive measurement data basis for the evaluation of events and processes affecting monitored goods and facilities.

So the instrument is essential for determining the causes of transport damage. The ShockDisplay curve does not only serve to find out in retrospect which shock events the freight was subject to. It can also be used to determine the necessary "soft" handling by conducting a test transport of dummies.



With its **compact construction and independent power supply**, the instrument can easily be attached to or inside goods to be transported or transport facilities. The use of a metal casing with through-holes for mounting makes the instrument quite insensitive to environmental effects. Its compact dimensions allow for low-vibration mounting.

Power can be supplied by 2 commercial cells of size C (R14) or size D (R20). The casing is therefore available in two sizes. Permitted batteries are primary cells of the alkaline or lithium type or rechargeable NiCd or metal hydride batteries. Its low power consumption combined with a suitable battery makes the ShockDisplay curve an ideal instrument for long-term applications. When used with 2 standard alkaline R20 batteries, the instrument reaches an operating time of approx. 6 months.

ShockDisplay curve applications

Tampering of the instrument is prevented by **password protection** and by an internal memory back-up, checksums and logging of all procedures.

The **operating parameters are set** directly at the instrument by using the keys and the integrated LCD or at the PC.

The measurement data can optionally be evaluated at the instrument or at a PC via the existing USB interface and using the **SYCUR** program. In addition to the tabular overview of all shock events with time, shock maximum, shock duration and direction as well as X,Y,Z components of the shock maximum, diagrams for an overall view of the transport process and every single curve are available for you to print out or save for further processing. The possibility of data output in various formats allows further user-specific evaluation such as vibration analyses.



Shocks (a-events) are recorded when they exceed a threshold value of acceleration that can be set. Internal acceleration sensors in the three dimensional axes determine the absolute magnitude of the shock vector, irrespective of its spatial location. As the values are pre-processed, the 100 greatest shock events are always available in the memory.



In addition to the piezoelectric acceleration sensor, it is possible to use a built-in micromechanical sensor (MEMS) to determine acceleration with a very long impulse duration up to the static state. This permits the derivation of inclination in relation to the body edges of the instrument. The data are recorded in the instrument over a long period. They are evaluated on the PC using the appropriate software SYCUR from version 4.40 or later. Instruments with this option determine the initial position immediately after programming and every time they are switched on. The criteria for recording curves are always the changes of static acceleration values / inclination in relation to the initial position while the measurements are always stored as absolute values. It is therefore possible to program the instrument in a horizontal position (Z-axis 90°), to switch it off, to mount it vertically (Z-axis 0°) and to switch it on again without any tipping over of the freight being recorded. The process (see page 10) is especially designed to monitor ship transports with maximum battery life.

Safety instructions



Caution: Before changing the batteries, switch off the instrument as described on page 11.



With the exception of its power supplies, the ShockDisplay curve does not contain any caustic or environmentally harmful substances. Before placing the instrument out of service, remove the batteries and dispose of them in an environmentally friendly way. The same applies to the permanently installed back-up battery.

Used batteries should be instantly removed from the instrument.



Only our service technician has the permission to open the inner cover because this calls for a recalibration of the instrument and causes the warranty to expire.

Notes on the use of lithium batteries

Please note that the use of the ShockDisplay with lithium batteries in transport systems is classified as dangerous good. The relevant provisions must be observed (Dangerous Good class 9).

If needed, the lithium battery packs will be supplied together with the relevant information.

Changing the batteries

Before changing the batteries, switch off the instrument in the menu. Then remove the cover screws securing the cover on the right with a cross-tip screwdriver. After unscrewing the battery holder (cross recessed head H size 2), you can remove the used batteries.

Insert the new batteries, making sure their polarity is correct. Tighten the battery holder with a tightening torque of 75 Ncm. When refitting the cover, make sure the seal has the correct orientation (lips pointing into the casing). Check that the sealing faces are clean. The maximum tightening torque is 30 Ncm.

Getting to know the instrument

The ShockDisplay curve stores the 100 greatest acceleration events, each with the 3D curve over 1024 ms. One event corresponds to exactly one curve. Furthermore, it counts minor events. The recording threshold for each of the 3 axes as well as the minimum shock duration can be set by the user. An LC display shows the number of registered shocks, the battery life and other information. The saved measured values will remain intact for years independent of the state of the primary power supply.

64 dynamic inclination curves as well as further 16,000 time-synchronous inclination events can be recorded additionally.

The ShockDisplay curve plus model allows the connection of an external combined sensor for the time-synchronous measurement of temperature, relative humidity and absolute pressure.

If the ShockDisplay curve is used together with the MONILOG *Tracking Module/data link*, both time-synchronous events and the GPS coordinates of each event can be recorded. If a ShockDisplay curve plus is used, only an external GPS antenna needs to be connected.

The full functionality of the instrument is available by menu control, using the 4 keys and the LC display on the top panel of the instrument. The stored data are displayed with the main parameters, i.e. date, time, maximum shock amplitude, shock duration, shock intensity and 2 symbols for the direction of each event.

Another menu window displays the number of cyclic measurement data (measurement of inclination, temperature, humidity, pressure or GPS position) as well as the related measurement data with date and time.

You can enter a password to prevent unauthorized switching on and off as well as changes to the measuring parameters.

The USB interfaces provided allow the configuration of measurement parameters from a PC and the transfer of stored data to a PC for evaluation. The software SYCUR supplied with the instrument enables you to represent data as a results table or to represent curves graphically. These can also be output on a printer. As the values can be output in a file format, they can be processed further with database management systems or spreadsheets. SYCUR is an intuitive program with integrated help function that runs under Windows operating systems.

For clear reproducibility of the device status each activity relevant for the recording of measurement is registered starting from firmware V3.10. An acquisition period marks the measuring-ready condition of the device by the associated measuring parameters and time data.

The RS-232 interface is used to connect the *Tracking Module/data link* as well as the PC if there is a need to use the password unlocking software. The connection of the *Tracking Module/data link* facilitates tracking and tracing in logistics. Equipped with a state-of-the-art GPS receiver and the quad band GSM technology (GSM unit in preparation), it is the ideal complement for the ShockDisplay curve.

The *Tracking Module/data link* is connected with the data loggers via the serial RS-232 interface and a special data protocol. The data logger can poll and store the position coordinates or send the measurement data of the event via the GSM/UMTS radio network. (GSM unit in preparation)

Transferring programs and measured values

You use a PC and the SYCUR evaluation program to set the measurement program (acceleration threshold values, setting the clock etc.) as well as to process and represent the measured values collected by the instrument.



First switch on your ShockDisplay curve and connect it to the PC with the USB connection.. Please consult your hardware manual for the location and designation of your PC ports. If the data transfer between your PC and the ShockDisplay curve does not work, please look for possible causes in the "*Troubleshooting*" section. The instrument display indicates any connection established.

As an alternative to the software, the instrument can be configured using the 4 instrument keys (see page 11).



Please note that the ShockDisplay curve can also collect new measurement data while a data transfer is running. These are first kept in the intermediate memory of the instrument and processed after the data transfer has been completed.

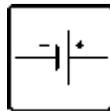
Data can only be exchanged between the ShockDisplay curve and the PC with charged batteries!

Disconnect the USB cable immediately after the transfer of a new measurement program so that the actual time is accepted by the instrument and power consumption is minimized.

Power supply

The power supply to the ShockDisplay curve is ensured by two different commercial internal power sources in addition to the external batteries.

Depending on the uptime, you can select between models for R14 or R20 batteries. Moreover, different types of battery can be used:



- **Alkaline primary cells**

Preferably use these batteries because these offer an optimal price/performance ratio and can be disposed of in an environmentally friendly way.

Alkaline batteries can be used within a temperature range from -25°C to +70°C and can be stored up to four years. In the R20 design, the device reaches an operating time of approx. 6000 h.

- **Rechargeable batteries**

Rechargeable NiCd or NiMH cells can be used, but must be recharged before use in an external battery charger. These cells can be used in the temperature range of -20°C to +65°C. The mean uptime is approx. 1500 h with R14, with self-discharge being an essential disadvantage when the batteries are used over several weeks.

Please note the fact that the battery pack discharges itself when the instrument is not operated for a prolonged period. To exploit its full capacity, we recommend charging the battery pack immediately before use.

Please dispose of discharged batteries in an environmentally friendly way.

- **Lithium batteries**

In applications with extended temperature range of -40°C to +85°C it is also possible to use lithium batteries, reaching an uptime of 2500 h with R14 models.

When using lithium batteries, please observe the relevant safety instructions. The ShockDisplay curve with lithium batteries is to be declared as a dangerous good.



In addition to the power source in the battery compartment, the ShockDisplay contains another battery which is permanently installed in the electronics section and cannot be switched off. It supplies the internal clock with the calendar and data memory for at least 6 years. This preserves recorded measured values, the measuring parameters and the internal clock even when the batteries are discharged or have been removed. This battery must be replaced every 6 years during the device service at the producer's premises.

Attaching the instrument to the freight



Depending on the type of information you want to collect, you can attach the instrument to the goods to be transported, inside the package or to the means of transport. To avoid unintentional shock absorption and thus the measurement of insufficient acceleration values, you should attach the ShockDisplay curve as close as possible to the goods or package.

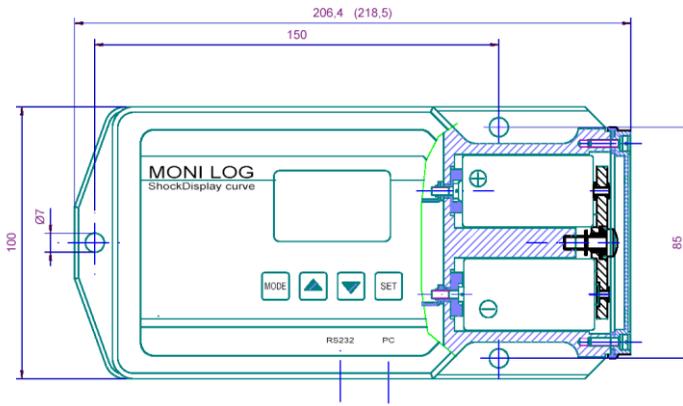
The instrument is IP 65 protected. Therefore, please attach the instrument vertically to the freight with the connections facing downward if the freight is uncovered.

Shock absorbing padding or instable bodywork falsifies the measurement results!

The available mounting accessories give you the following possibilities of fastening the instrument:

• Direct mounting of the instrument (recommended method)

If the freight or its package is suited for direct mounting, fasten the ShockDisplay curve directly with 3 wood screws, machine screws or M5/M6 cheese-head screws with spring washer or similar fasteners. This method ensures optimum load transmission to the internal sensor.



• Attachment by means of tightening or tie-down straps

Cut two appropriate pieces of tightening straps, bend the two straps at one end and fasten one end of each strap to a turnbuckle, one per strap. Then guide the other ends of the tightening straps over the freight (or parts of it) and over the ShockDisplay curve and insert each end beneath the clamping tongue of the turnbuckle. Now tension the tightening straps by moving the tensioning levers to and fro until the ShockDisplay is firmly attached to the freight. Two ratchet tie-down straps of 2m length are available as an alternative.

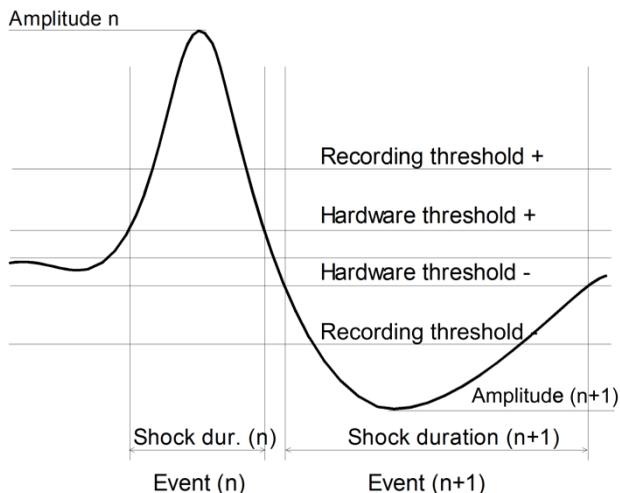
Measuring shock events

The measuring principle

Every acceleration event that exceeds the set recording threshold and the minimum shock duration on at least one of the active measuring channels (X, Y, Z) is evaluated. If the measured value does not reach the recording threshold set in the menu on any of the channels, the measured value is rejected and only the activation of the instrument is recorded (release counter). If the **recording threshold** is exceeded on at least one measuring channel, the amount of the space vector is compared with the values that are recorded in the memory and the complete curve replaces the curve of the smallest value if the memory is already filled up with 100 values. In addition to date and time, the greatest amplitude with amount and direction for the individual measuring channels as well as shock duration and shock intensity are stored. The **shock duration (t)** is the period of time during which the permanently set hardware threshold (approx. 3% of the measuring range) is exceeded on at least one channel. Furthermore, an event is considered as finished if the greatest signal amplitude reached at least 10% of the measuring range and the measured value of the channel with the greatest amplitude falls below 3% of the measuring range again or changes its direction. For being recorded as a measured value, the minimum shock duration that has been set must be reached.

The **shock intensity** is the value integrated over the time of an event, corresponding to the speed difference in m/s.

Every shock event is always recorded with its **curve** at a sampling rate of 2 kHz and the duration of 1024 ms. If, at the end of a curve, the hardware threshold is still exceeded by at least one measuring channel, this releases the evaluation of a new event. An event always corresponds to exactly one curve. When a stored value is overwritten, the release counter is also incremented.



Measuring inclination events

The inclination measurement is carried out by means of a separate three-dimensional acceleration sensor (NX/NY/NZ). The measurement process is designed to detect the position (static components, represented in the synchronizing level table/graphics) and to record long-lasting slow processes like e.g. rolling movements of a ship (dynamic components, represented as inclination curve).

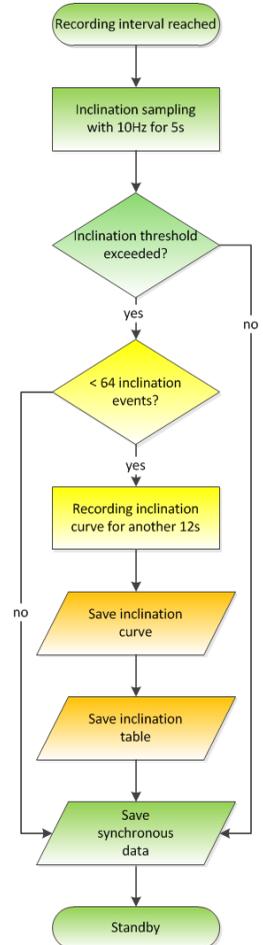
The measurement always starts at fixed times with the recording and valuation interval (also ABI, see p. 23 ff) settled in the measuring program. It is independent of the event-controlled acceleration measurement.

It is checked after 2.5s and 5s if the recording thresholds for the inclination have been exceeded that are configured in the measuring program. If the thresholds are still exceeded after 5s, the entire curve of another 12s is recorded with a scan rate of 10Hz.

The first 64 inclination events with the entire course of the curve of 17s are saved (21.25s in case of instruments until 07/2013).

The characteristics (time stamp and inclination values) of all saved inclination curves are listed in the table for inclination events (see p. 21ff).

Irrespective of whether an inclination curve has been recorded and saved, if necessary, the static share of the inclination will always be recorded as average of the respective period (2.5s, 5s or 17s) in the synchronizing level table.



Measuring temperature, humidity and absolute air pressure

Recording temperature, humidity and air pressure requires a ShockDisplay curve plus in combination with a temperature probe and humidistat. There are probes available with additional pressure sensors and ones without.

If a ShockDisplay curve plus model is used, temperature, humidity and pressure can be measured in the preset Recording and Evaluation Interval (REI) (see Measuring inclination events). This functionality requires that the recording function has been activated. Activation is possible both at the ShockDisplay curve plus and in the measurement program menu of the SYCUR evaluation program.

The captured temperature, humidity and pressure data are displayed in the table of synchronous measurement data in addition to the inclination data.

Instrument control functions

The ShockDisplay curve offers menu-guided operation with 4 keys and an illuminated LC display. Please note the operating structogram on one of the last pages. When the keys are held depressed, the automatic repeat function starts after approx. 1 second. The keys have the following functions:

	Change menu
	Scroll up
	Scroll down
	Confirmation of input or move cursor

Note: In the display functions the instrument automatically reverts to the basic state (display of measured value counter) 1 minute after the last key has been pressed. This has no effect on the acquisition of measured values.

Switching on / Switching off

Switch on the instrument with the *MODE* key. In its state of delivery the instrument shows the firmware version, the instrument number and the current battery voltage for any seconds and is then immediately ready for operation. When switched on, instruments with inclination sensor determine their initial position and must not be moved during this period.

If you have secured the ShockDisplay curve against unauthorized switching on or off by entering a 2-digit ON/FF code, you will be prompted for entering this code. If a wrong code is entered, the instrument will switch off automatically one minute after the last keystroke.

To switch off, continue to press the *MODE* key until the display shows “switch off”. At this point you can switch the instrument off with the *SET* key when the **ON/OFF code** is not activated. When the ON/OFF code is activated, you need to enter the right code for switching off and confirm with *MODE*.

Instrument control functions

For devices with the designation “U” (e.g. R20U) there is the possibility to switch them on and off using a remote ON/OFF function via USB. For this purpose, the USB cable is connected with the device. After a short time (at full device memory, this can take several minutes) the device logs on to the PC. Now, the switching operation can be carried out using the software SYCUR (from version 4.80 onwards) via the menu “ShockDisplay curve / On/Off via USB”. If the device is protected by an **ON/OFF code**, this code must be entered into the field provided in SYCUR.

The switching operation is not carried out by the device until the USB cable is disconnected.

Setting the measuring parameters

To get to the menu level for setting the measuring parameters, press the *SET* key in the basic menu. When **password** protection has been activated, you need to overwrite the asterisks on the display by the right password. This protects instrument settings against being tampered with by unauthorized persons. In the state of delivery, this password is not activated and the “password” input menu is automatically skipped and the first parameters are immediately displayed. The active line shows an underline cursor. Using the arrow keys, you can scroll this line up or down to display other parameters. The active parameter can be changed either with the *SET* key or in a separate input field that is displayed (e.g. password change, mailbox, time etc.).

In the line **password mode** you arrive the menu for modification of the password protection by the *SET* key. Therein the password mode becomes fixed in the first input line by the *SET* key again:

off - The data are unprotected

prog - The programming of the device is protected by a password.
However unprotected reading of the data is possible.

all - Programming and reading of the data are protected.

To arrive the input of the password in the second line you have to use the right arrow key and confirmation by the *SET* key. The number at the cursor symbol can be changed by the arrow keys, the next character is reached by the *SET* key. The password can consist of up to 8 numerals. After conclusion of the password input the *MODE* key is to be pressed.

Now the assumption of the settings have to be confirmed in the third line by the *SET* key. After leaving the menu by the *MODE* key the settings are valid.

Caution: **If you forget the password or the on/off code, only the manufacturer can help !!! There is no way of reading it out.**

In the “**ON/OFF code**” menu, you can use the *SET* key and the scroll keys to activate a 2-digit “ON/OFF code”. If activated, the code must then be entered when both switching on and switching off the ShockDisplay curve.

The menu item **Start stop time** allows a delayed activation of data recording. The start and stop time can be settled and activated in the subordinate menu here. If the programmed start time has been reached in the switched on device, the recording of the shock and synchronizing data will begin. Events occurring previously will not be considered. The display will be deactivated in the period before reaching the start time and will be activated for a few seconds only when the key is pressed. If the stop time is reached, the device switches off automatically. When switched back on, all functions are active again.

Instrument control functions

Acceleration measurement parameters leads you the parameter settings for dynamic acceleration measurement:

Both the **minimum shock duration** and the recording threshold are criteria for recording shock events. Only those values are stored which have an impulse duration greater than the value that has been set (see page 9).

The **recording threshold** of the three measuring channels can be set within 5-90% of the measuring range by pressing the scroll keys.

The setting of the limit values for the alarm display (**alarm threshold**) takes place in the same way as the setting of the recording threshold separately for each of the directions. The alarm threshold does not have influence on the recording of values. It serves only the advance information of the user for possible damage of the goods. If the alarm display is not desired, set the alarm limit value to 100% (Display: "off").

When a *Tracking Module/data link* is connected or a ShockDisplay curve plus device is used, you can activate the determination of **GPS**-coordinates which are assigned to a shock event. The receiver to be used for GPS locating can be set in the option "GPS source". If "external" is selected, the *Tracking Module/data link* is used for locating.

Synchronous parameters can be defined as to whether and how GPS coordinates, measurement data from inclination sensor or temperature, humidity and pressure data are to be recorded.

The measuring channels activated in the submenu are then sampled at the defined time intervals.

Using the menu line "**Interval**", you can set the recording interval for the synchronous measurement (inclination measurement and GPS position). The interval can be set from 1 min upwards in increments of minutes. It should be noted that frequent measurements are to the detriment of battery uptime both in the ShockDisplay curve and in the *Tracking Module/data link*.

The recording threshold for dynamic inclination measurements is set using the menu line "**Inclination threshold**". It can be set separately for each spatial axis in 0.1 g increments between 0.1 and 6 g.

Pressing the *SET* key when "**Delete memory**" is underlined twice erases the data memory including the release counter and the current system time of the ShockDisplay curve is recorded as the start time.

The **battery type** is selected once for the correct indication of the instrument's battery reserve to be expected.

Press the *SET* key to confirm "**New battery**" when underlined. This resets the hour counter and should be done every time when a new battery is installed.

Instrument control functions

The **mailbox** line shows only the first characters. With the *SET* key, you get to the input field where you can enter up to 21 characters (numbers, letters and /.-). This notepad function has no effect on data acquisition, but appears in the header of a table when the data is evaluated with the PC software. You can, for instance, use the mailbox for an inhouse ID code of your ShockDisplay curve.

The next line enables you to select the **display language**. At the moment you can select between English, German and French.

In the **“Date / Time”** menu, you can set the system clock of the ShockDisplay. When you have pressed the *SET* key, the cursor appears at the day position, and you can change the date with the scroll keys. The other items can be changed likewise. When you exit the menu, the set time is sent to the clock.

Leave the setting menu by pressing the *MODE* key. The changes are noted in the table of recording times.

Evaluating data at the instrument

In the **basic state** the display indicates the number of the shocks recorded (curves), the release counter, the possible excess of an alarm threshold and the remaining battery reserve in hours.

Pressing the *MODE* key displays the main parameters of all shocks recorded. By pressing the scroll keys, the two bottom lines list all **100 shock events** with the shock amplitude (amount of vector) in g, the shock duration in ms, the integrated shock intensity in m/s, date and time as well as 2 symbols for indicating the direction of the shock in chronological order.

S1 - Display of the main direction of shock

Symbols S1	Condition of the component values
→	$ a_x \geq a_y $ and $ a_x \geq a_z $ and $a_x > 0$
←	$ a_x \geq a_y $ and $ a_x \geq a_z $ and $a_x < 0$
↑	$ a_y \geq a_x $ and $ a_y \geq a_z $ and $a_y > 0$
↓	$ a_y \geq a_x $ and $ a_y \geq a_z $ and $a_y < 0$
↖	$ a_z \geq a_x $ and $ a_z \geq a_y $ and $a_z > 0$
↘	$ a_z \geq a_x $ and $ a_z \geq a_y $ and $a_z < 0$

Instrument control functions

S2 - Direction relative to the object (edges of case)

Symbols S2	Shock in direction of	Component ratios
┌	Corner	$\left \frac{a_{N1}}{a_{\max}} \right > 0.58$ and $\left \frac{a_{N2}}{a_{\max}} \right > 0.58$
	Edge	$\left \frac{a_{N1}}{a_{\max}} \right > 0.58$ and $\left \frac{a_{N2}}{a_{\max}} \right \leq 0.58$
□	Surface	$\left \frac{a_{N1}}{a_{\max}} \right \leq 0.58$ and $\left \frac{a_{N2}}{a_{\max}} \right \leq 0.58$

a_{\max} Acceleration value of the direction component with the highest absolute value

a_{N1} Acceleration value of the component with the second highest absolute value

a_{N2} Acceleration value of the component with the lowest absolute value

Press the *MODE* key to get to the next menu. The first recorded synchronous data record is displayed if **Synchronous data** are available. The 3 bottom lines display the temperature, humidity, pressure and inclination data as activated, depending on the model used.

Valid position data are displayed using "GPS". The scroll keys can be used to display all data records successively, each with time.

Pressing the *MODE* key once again takes you to the next menu. There you can **switch off** the ShockDisplay curve by pressing the SET key. When the ON/OFF code is activated, you need to enter it.

The last menu is the **status display**, indicating the instrument number, firmware version, current battery voltage as well as date and time of the last memory erasure and the current system time of the instrument. The parameters cannot be changed here.

As an alternative to entries with the keypad and display at the instrument, you can make the same settings at the PC.

Installing the software

Before you start installing the program, please check that your PC meets the hardware requirements:

Minimum hardware configuration

- Pentium II PC or laptop with 300 MHz
- 64 MB RAM
- VGA and 640 x 480 monitor
- One free USB interface
- Mouse
- 6 MB free storage capacity on the destination drive
- WINDOWS XP operating system



Recommended configuration

- Pentium IV PC or laptop with 800 MHz
- 128 MB RAM
- Super VGA and 1024 x 768 monitor, 256 colours
- One free USB interface
- Mouse
- 20 MB free storage capacity on the destination drive
- WINDOWS 7, 8, 10

To **install** the SYCUR program, please proceed as follows:

- Start WINDOWS.
- Put your installation CD-ROM in the drive.
- Select "Run" in the Program Manager
- Enter "D:\SETUP.EXE" on the command line (depending on your selected drive).
You will be guided through the installation.

After successful installation start the SYCUR program via the program bar or the icon on the desktop.

Should any errors occur during the installation, you should check if the drive has sufficient storage capacity. Another cause of improper execution of the installation procedure can be the missing authorization to access the directory.

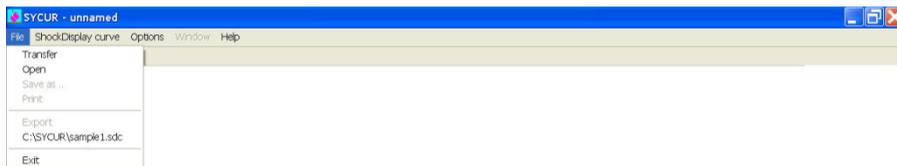
Google Earth is required for the evaluation of recorded GPS data (via ShockDisplay curve plus or Monilog Data link). An installation file for this can be found on the installation CD. An internet connection is required for displaying the data.

Working with the SYCUR program

Basically, the well-known WINDOWS routines also apply to SYCUR. In addition to menu operation, a number of windows can also be opened by clicking on an icon on the icon bar.

After having started the program, you need to go to the File menu to Open a stored file or read data from an instrument. A requirement for data transfer is the cable connection USB and the one-time selection that is to be made in Options/Basic settings. Using the data that you can then access, you can open further windows for data evaluation or programming the instrument.

Open file or transfer data



- Transfer** Reads data from the ShockDisplay curve. For this purpose you must have switched on the instrument, charged the battery, made USB connection and selected the port. If the instrument is password-protected, you are prompted to enter the valid password.
- Open** Calls a data file with the extension **SDC** from the diskette or hard disk. Password-protected files require password input.
- Save as** Saves the records entered by *Open* or data transfer with the displayed filename and the extension **SDC** to the diskette or hard disk. The function activates a dialogue which allows the input of a filename. If a valid filename exists, the data are stored with this filename.
- Print** First opens the preview. The active window (table/diagram) can be printed. In addition, a complete status report is available.
- Export** Data of a currently open window can be stored in different formats for external processing. Formats offered are **Text**, **Excel**, **Bitmap** or **JPEG**.
- Exit** Exits the SYCUR program.

Working with the SYCUR program

Evaluating the measurement log

After a log file has been called by “Open” or transferred from the instrument by “Data transfer”, the **table of the acceleration values** shows an overview of the status data and the recorded shock events:

Status data

Device number	20147399_D010D	Releasecount	629
Mailbox	Mailbox	Measuring range	1.0 g
		Registration threshold X/Y/Z	10 % 1.0 % 1.0 %
		Min. shock duration	3 ms
Starttime	09/04/15 15:21:41	Acquisition periods	5
Recording start	09/04/15 15:22:30	Synchronous measured values	289
Recording stop	09/04/15 15:23:30	Inclination events	0
Transmitted	09/07/15 16:01:36	Recording interval	15 min
Password protection	no password		
Battery reserve	5421 h 95 %		
Battery voltage	2.679 V		

Measured values

Count	Date [mm/dd/yy]	Time [hh:mm:ss]	Vector [g]	I-shock [ms]	Strength [m/s]	Direction	Surface	max [g]								GPS			
								24 Hz	48 Hz	816 Hz	1632 Hz	3264 Hz	64128 Hz	128256 Hz	256512 Hz		X [g]	Y [g]	Z [g]
1	09/04/15	15:22:40	10.80	4.5	0.336	+Z	surface									1.541	3.781	10.00	
2	09/04/15	15:22:44	10.05	95.0	0.491	+Z	surface									0.935	0.550	10.00	
3	09/04/15	15:22:45	10.23	7.5	0.272	+Z	surface									0.851	2.055	10.00	
4	09/04/15	15:22:46	10.01	4.0	0.170	+Z	surface									0.184	0.473	10.00	
5	09/04/15	15:22:56	4.611	97.0	2.748	-Z	surface									0.414	1.642	4.307	
6	09/04/15	15:22:57	3.001	3.0	0.044	+Z	surface									0.046	0.129	2.998	
7	09/07/15	14:59:55	10.02	540.0	50.37	-Z	surface									0.245	0.557	10.00	
8	09/07/15	14:59:56	10.00	675.5	33.93	-Z	surface									0.260	0.221	10.00	
9	09/07/15	14:59:57	4.117	1024.	36.27	+Z	surface									0.092	0.229	4.117	
10	09/07/15	14:59:58	2.618	1024.	16.83	+Z	surface									0.076	0.160	2.617	

Warning threshold exceeded 1g 10ms 0.2m/s
 Alarm threshold exceeded 2g 25ms 0.5m/s

This display is the starting point for the **evaluation** of the measurement data. It shows the current instrument parameters, the measurement parameters, the frequency components and a selection of all shock events. The number of response corresponds to the release counter, described on page 9 (number of the non-relevant shocks). The vertical scroll bar and the left mouse button are used to display more shock events. By right-clicking on an event, you can display its curve or a line diagram of the whole mission.

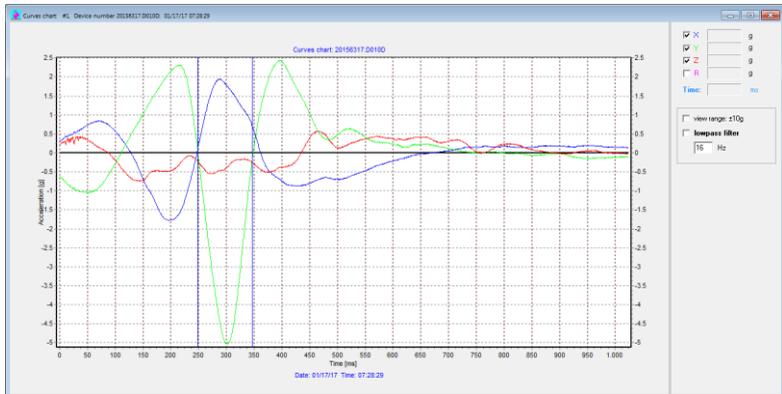
A **shock event** is shown with date and time of the event, the amount of the maximal spatial vector with its shock duration and intensity, the directional components as well as the X,Y,Z axis components. This corresponds to the representation on the instrument display (without directional components, page 13/14). Evaluation can be made easier by colour-highlighting all events that exceed a warning or alarm threshold defined in the basic settings.

The computation of the **frequency analysis** can be started if necessary with one button each either only for the marked line or for all impact events. It is displayed divided into octave steps in accordance with EN13011. After execution of a frequency computation the frequency components are represented in landscape format when printing the table.

Working with the SYCUR program

Position coordinates determined with a connected *Tracking Module/data link* or by the internal GPS receiver of the SDC plus are symbolized with an “i” in the “GPS” column and temporarily shown at the mouse cursor position. By clicking a button, it is possible either to display only the marked line or all shock events in a map in Google Earth ® via an Internet connection.

Curve of a shock event:



This window is opened if you double-click on an event in the *Table* window. The directional components X, Y and Z as well as the calculated space vector can be activated or deactivated at the top right of the screen. On the right central position of the image are further display options. It is possible here to have the indicated field of the measurement range of the device displayed and to filter the signal sequence digitally.

The beginning and end of the event evaluated in the shock table are marked with two vertical lines.

The icons on the icon bar have the following functions:

 Setting of graphics options which can be used to set important diagram parameters such as the colours of curves, grid and cursor.

 Panning of a section.

 Activation of the zoom mode. Then you can zoom in on a diagram section by dragging the frame while holding the left mouse button. Zooming can be repeated. Clicking on the  symbol takes you back to the previous scale or clicking on the  takes you back to the original scale.

If the diagram is not in the pan or zoom mode, pressing the left button displays a line cursor. The right part of the screen displays the curve values that are stored in the area of the line cursor.

Working with the SYCUR program

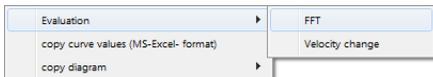


Export of curve data in the selectable formats Text or Excel. The values are separated by commas. Alternatively, they can also be stored as a graphics file in the formats BMP or JPG. To import the data into Microsoft Excel, please note the instructions of the "Excel Text Import Wizard".

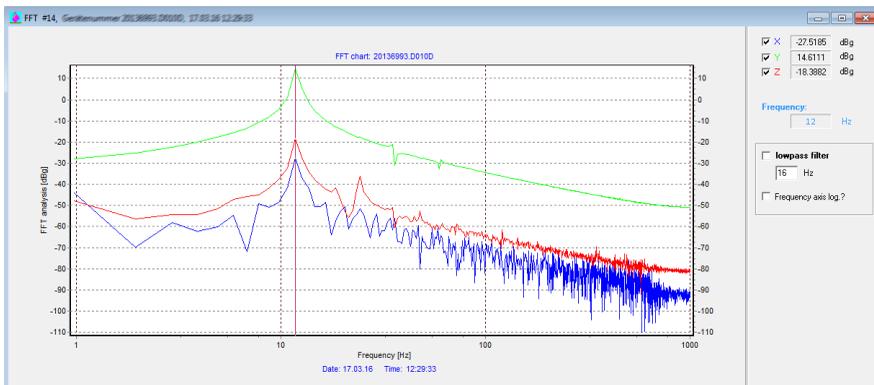


Print / Preview

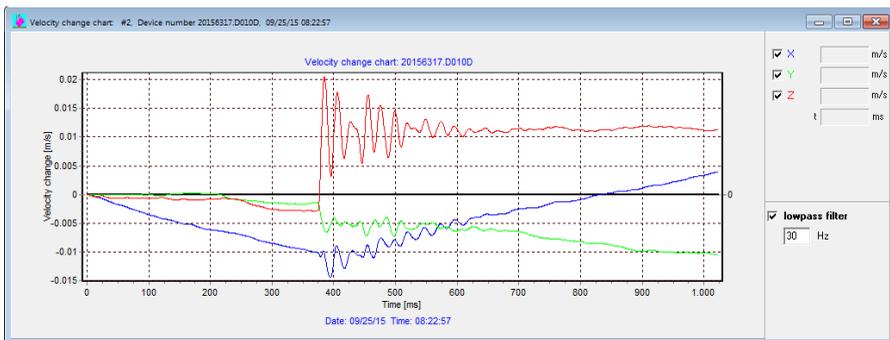
By right clicking on the curve of an acceleration event, an FFT-Frequency Analysis and also a curve of the speed change can be displayed.



In the diagram of **FFT-Frequency Analysis**, the linear or logarithmic frequency axis as well as a digital signal filtering at the right side of the legend can be selected.



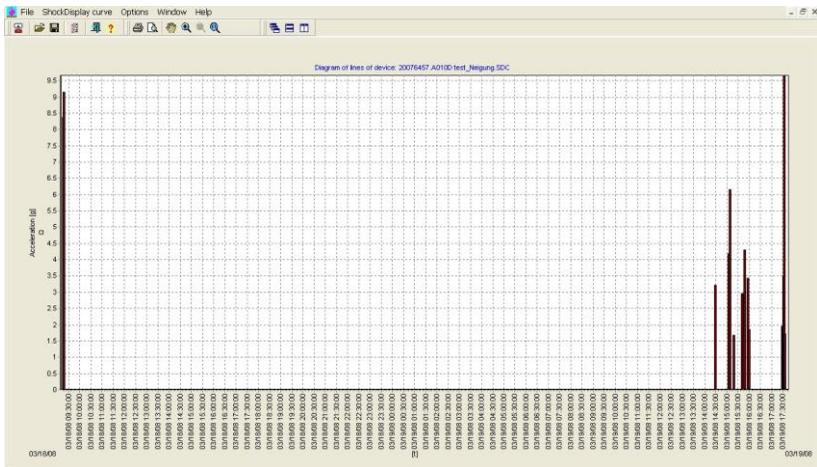
Velocity change chart to the course of a shock curve



By clicking with the right button on the curve of a shock event, the display of the change of speed can be activated.

Working with the SYCUR program

Line diagram of all shock events



You can open the line diagram at any time from the “*ShockDisplay curve/ Line diagram*” menu. All events are represented as a vertical line on the time axis over a period between the erasure of the data memory and the reading of the data.

The length of the line corresponds to the vector amplitude. Clicking on a line opens the related curve or zooms in on the part of the diagram if several lines are superposed.

Pan and zoom functions and printer output are available in the same way as in the curve diagram. The graphics file can be output from the “*File / Export*” menu or by clicking the right mouse button.

Evaluating the acquisition periods

For clear reproducibility of the device status each activity relevant for the recording of measurement is registered starting from firmware V3.10. An acquisition period marks the measuringready condition of the device by the associated measuring parameters and time data.

If one of the following parameters is changed a new period begins:

- manual switching the device on or off with menu handling
- automatic switching off the device because of unloaded battery or error conditions
- change of the parameters registration threshold or minimum shock duration
- change of date or time
- change of battery

The acquisition periods are erased together with the data memory. The display of the acquisition periods is possible by means of the PC software SYCUR in the menu “*ShockDisplay curve / acquisition periods*”. In a table one active period per line is indicated in each case. The last period has no end because it's still active.

Working with the SYCUR program

Table of acquisition periods

Status data

Device number: 20135915.D010D Acquisition periods: 7
 Mailbox: Battery reserve: 5601 h 94 %
 Battery voltage: 2,868 V

Starttime: 06/10/13 09:34:50
 Transmitted: 06/13/13 11:59:53

Count	Start Date / Time	End Date / Time	Status	Threshold imp [%]			Min. t [min]	Inclination registration threshold [g]			Status2					
				X	Y	Z		X	Y	Z	A	2	H	T	I	G
1	06/10/13 09:34:50	06/10/13 09:34:53	Switch off by menu	10	10	10	3	0.1	0.1	0.1	x	x	x	x	x	
2	06/10/13 11:57:17	06/10/13 11:58:05	Change of parameter	10	10	10	3	0.1	0.1	0.1	x	x	x	x	x	
3	06/10/13 11:58:05	06/10/13 11:59:12	Change of parameter	10	10	10	4	0.1	0.1	0.1	x	x	x	x	x	
4	06/10/13 11:59:12	06/10/13 16:55:38	Switch off by menu	20	20	20	4	0.1	0.1	0.1	x	x	x	x	x	
5	06/12/13 05:02:59	06/12/13 13:11:16	Switch off by menu	20	20	20	4	0.1	0.1	0.1	x	x	x	x	x	
6	06/13/13 06:59:14	06/13/13 07:12:08	Switch off by menu	20	20	20	4	0.1	0.1	0.1	x	x	x	x	x	
7	06/13/13 11:59:52		Activated	20	20	20	4	0.1	0.1	0.1	x	x	x	x	x	

Evaluating of synchronous and inclination measurements

The recorded GPS coordinates, the static mean values of the inclination sensor and temperature, humidity and pressure data can be displayed via the menu ShockDisplay curve / Synchronous data. The various types of measurement data are only displayed if marked for data transfer in Options / Basic settings / Data transfer.

Table of synchronous measured values

Status data

Device number: 20135915.D010D Synchronous measured values: 609
 Mailbox: Recording interval: 60 s
 Available channels: Inclination
 GPS

Starttime: 06/10/13 09:34:50 GPS map: Selected event
 Transmitted: 06/13/13 11:59:53 All events
 Battery reserve: 5601 h 94 %
 Battery voltage: 2,868 V Graphic Presentation: Inclination Climate

Count	Date / Time [mm.dd.yy hh:mm:ss]	Inclination X		Inclination Y		Inclination Z		Temperature [°C]	Humidity [%H]	dew point [°C]	air pressure [mbar]	GPS
		[g]	[deg]	[g]	[deg]	[g]	[deg]					
181	06/10/13 14:58:17	-0,02	-1	0,03	2	1,03	88	25,0	35,2	8,5	962,0	1
182	06/10/13 14:59:17	-0,04	-2	-0,08	-4	1,02	85	25,5	35,6	9,2	967,0	1
183	06/10/13 15:00:17	-0,04	-2	0,13	7	1,01	83	25,4	35,5	9,0	964,0	1
184	06/10/13 15:01:17	-0,01	0	0,05	3	1,01	87	24,8	35,8	8,6	969,0	1
185	06/10/13 15:02:17	-0,05	-3	0,06	3	1,00	85	25,3	35,9	9,1	969,0	1
186	06/10/13 15:03:17	-0,02	-1	0,02	1	1,02	88	25,4	36,2	9,3	969,0	1
187	06/10/13 15:04:17	-0,01	0	0,03	2	1,02	88	25,0	36,2	9,0	973,0	1
188	06/10/13 15:05:17	-0,05	-3	0,02	1	1,02	87	25,3	36,4	9,3	982,0	1
189	06/10/13 15:06:17	-0,01	0	-0,03	-1	1,04	88	25,8	36,0	9,6	981,0	1

Warning threshold exceeded 0.2g Minimum -2deg X -20°C 36%H 1mbar
 Alarm threshold exceeded 0.5g Maximum 2deg X 60°C 10%H 2000mbar

Working with the SYCUR program

The dynamic data of the inclination sensor that exceed the set time threshold of the synchronous interval are represented via the menu *ShockDisplay curve / Inclination data*. (See page 10 for measuring principle)

Tabelle der Neigungswertwerte

Statusdaten

Gerätenummer: 20136193.CO10D
 Mailbox:
 Neigungsereignisse: 64
 Bewertungsintervall: 60 s
 Messbereich: 6 g
 Registerschwelle X/Y/Z: 0.1 g 0.1 g 0.1 g
 GPS Kartendarstellung:

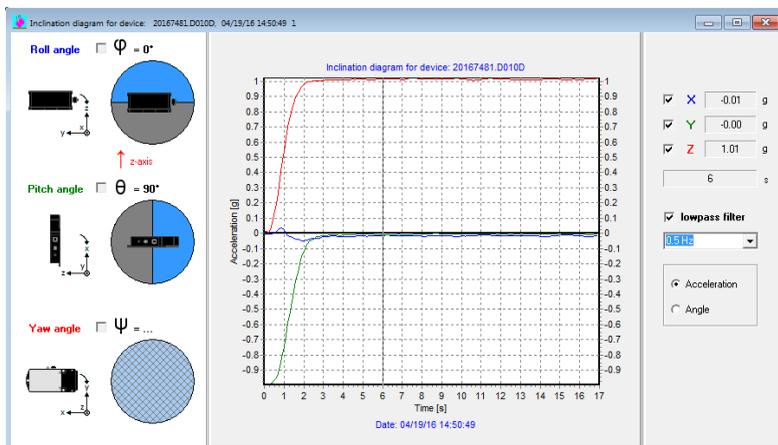
Startzeit: 02.07.13 15:29:13
 Ausgelesen: 08.07.13 12:57:01
 Batteriereserve: 1027 h 92 %
 Batteriespannung: 2,726 V

Neigungswertwerte

lfd.Nr.	Datum / Zeit (t.mm.jj hh:mm:ss)	Neigung X [g]	Neigung Y [g]	Neigung Z [g]	GPS
51	26.06.13 06:45:32	0,27	0,33	0,34	1
52	26.06.13 06:46:32	0,41	0,58	0,54	1
53	26.06.13 06:47:32	0,47	0,43	0,29	1
54	26.06.13 06:48:32	0,16	0,26	0,27	1
55	26.06.13 06:49:32	0,03	0,20	0,27	1
56	26.06.13 07:00:32	0,08	0,30	0,23	1

Every line hides a full curve with a length of 17 seconds to be opened by double-clicking the relevant line.

The illustration of the **inclination diagram** can be switched between acceleration values and equivalent angle specifications. The spatial angles on the cursor position are illustrated on the left side with the device and an artificial horizon. The rotation angle at the axis of the acceleration of gravity cannot always be calculated based on the measurement procedures (here in the picture of yaw angle). Inclination events actually often overlap with the acceleration events. Therefore, the display of the angle curve is only useful with activated low-pass filter.



Working with the SYCUR program

The names of the angle are based on the ENU-Reference System (“Right-Hand-Rule“, see https://en.wikipedia.org/wiki/Aircraft_principal_axes).

Calculation of the angle:

- Rotation to x-Axis: Roll Angle $\Phi = \arctan(y/z)$
- Rotation to y-Axis: Pitch Angle $\Theta = \arctan(z/x)$
- Rotation to z-Axis: Yaw Angle $\Psi = \arctan(x/y)$

Evaluating the GPS coordinates

The graphical display of the recorded GPS coordinates requires the installation of the free version of Google Earth (see installation CD) and Internet access. It is possible to call up the representation of measurement data from the measurement log window by clicking on the buttons or via the local menu by right-clicking or via the main menu ShockDisplay curve / GPS evaluation. The GPS column shows whether any position data are available.

Printing a status report

A concise two-page report with all relevant measurement data is generated and can be printed. This report includes device status data, the essential acquisition periods, the table of the greatest shock and inclination events, a line diagram as well as the curves of the greatest shock and inclination events. The period for report generation can previously be restricted in the query window.   The arrow keys can be used to change between pages 1 and 2 of the report.

Programming of the instrument

The ShockDisplay curve must be programmed for its use according to each application. You can open the necessary measurement program window from the “ShockDisplay curve/ Measurement program” menu with the default values from an opened data file *.SDC or with data read from the instrument. Using the **Open** button, you can load a stored measurement program file *.CFG.

The program **parameters** can be set in the same way directly at the instrument (page 10). The parameters can be transferred to the ShockDisplay curve by using the **Send** button.

Working with the SYCUR program

Measurement program - unnamed

Measurement program -

Erase memory

New battery

Time from PC

Recording start:

Recording stop:

Reg. threshold X/Y/Z [% of measure range]

Alarm threshold X/Y/Z [% of measure range]

Min. shock duration [ms]

Recording/evaluation interval [min]

runtime ca. 2666 h

GPS

Measuring Channels (cyclic)

Inclination measurement

Recording threshold inclination X/Y/Z [g]

Mailbox

Menu language of device

Alkaline battery

09/11/15 13:37:09

09/04/15 15:22:30

09/04/15 15:23:30

10 10 10

70 70 70

3 (166.7 Hz)

15

internal cyclic event-driven

Temp. Humidity Pressure

0.2 0.2 0.2

transport XYZ

German

Password settings

The past password settings of device are valid

New password settings are valid or the password settings of the opened measuring program file are valid.

Protection mode

New password

Repeat new password

program only

***** (1 to 8 numbers)

On/Off code settings

The past on/off code settings are valid

New on/off code settings are valid or the on/off code setting of the opened measuring program file are valid.

New On/Off code

Repeat new On/Off code

** (1 to 2 numbers)

**

Send Open Save Sensors Print Close

Working with the SYCUR program

- Erase memory** Before a mission is started, the data memory should always be erased by ticking the box. The time specified is stored as start time.
- New battery** Resets the hour counter and activates the battery type selection. This indication should be displayed after a new battery has been installed, being the basis for the display of *Battery reserve*.
- Time from PC** By default, the current time of the PC will be transferred to the device. But you can remove the marking to keep the time of the device or to enter another time in this line. All subsequently recorded measuring values refer to this *system time*.
- Recording start** It is possible to enter here at which time the recording of the shock and synchronizing data should begin. Before the device reaches the recording start, the display is deactivated.
- Recording stop** In order to switch the device automatically off, the corresponding time can be entered here.
- Recording threshold** It is possible to set a recording threshold for each channel within 5-90% of the measuring range. If at least one threshold is exceeded in positive or negative direction and the minimal shock duration is also reached, the shock event is recorded.
- Alarm threshold** It is possible to set a limit for display of threshold excesses for each channel. If the alarm display is not desired, set the alarm limit value to 100%.
- Min. shock duration** A minimum shock duration can be specified to suppress high-frequency values and should be set as a function of the sensitivity of the freight. As a rule of thumb: the bigger the freight, the greater the duration that harms it.
- Recording/ evaluation interval REI [min]** The REI is the time-interval for taking synchronous measurement data. Depending on the model and activation, GPS coordinates, inclination, temperature, humidity and pressure data are taken. This entry is ignored if measuring channels have not been activated.
- (Runtime)** The displayed runtime is used as basis for the operation with the above set type of battery and depends on ABI and the activated measuring channels (also see diagram page 33).
- GPS / measuring channels** Ticking a box activates the measuring channel if the instrument is prepared for this function. GPS recording can optionally be activated at regular intervals (cyclic) or by a shock event (event-related). With ShockDisplay curve **plus** devices it is possible to select the internal GPS receiver as GPS source by ticking "internal".

Working with the SYCUR program

Inclination registration threshold [g] After every inclination measurement at the cyclic interval time, the data from the inclination sensor are compared with these threshold values. If these are exceeded on at least one spatial axis, an inclination curve will be recorded.

Mailbox Input field for up to 128 characters of text or split up into 4 separate input fields. The setting can be changed in Options / Basic settings

Menu language of device Language selection for operating the instrument, is not identical with the language selection of SYCUR.

Activating password protection

You can protect the ShockDisplay curve from unauthorized access or inadvertent changes of a measurement program in *Password settings* of the measurement program window. The measurement data files (*.SDC) from a password-protected instrument are then also protected by this password. Password protection does not affect the functionality of the ShockDisplay curve. The following entries are possible:

- **Activating or changing the password protection**

A ShockDisplay curve is to be protected by a password. It does not matter whether or not the instrument is already password-protected. First select "*New password settings...*" and the *Password mode*. You can either protect only the measurement program from tampering or prevent reading of data, too. The input field *New password* accepts a freely selectable combination of up to 8 numerals. The input is not displayed on the screen, only the position of the character entered is marked by *. The password must be repeated for reasons of security.

- **Preservation of current password settings**

This is the default setting when the measurement program window is opened. The input fields for *Password mode* and *Password* are inactive.

- **Removing password protection**

Select "*New password settings*" and the *Password mode* "No password".

Activating the ON/OFF code

In the *ON/OFF code area of the measurement program window* you can protect the ShockDisplay curve from unauthorized or inadvertent switching on or off. Two numerals can be entered and need to be repeated at the instrument for switching off after the program transfer and for switching on the ShockDisplay curve.

Working with the SYCUR program

Send

By clicking on this field, you start the transfer of the parameters displayed in the program window to the ShockDisplay curve connected. If the instrument is password-protected, you will be prompted to enter the password that is still valid in the instrument. This may differ from the new password entered in the input screen. A correct program transfer is acknowledged with the notice "Program transferred". If individual parameters are not accepted by the instrument, an error message will be displayed (see appendix). The data memory is erased within approx. 15 s.

Note:

Disconnect the USB cable immediately after the transfer because the clock will be activated only afterwards. Otherwise there will be a time delay.

Save

The settings of the current measurement program window can be saved as a measurement program file. Clicking on this field opens the window described in the paragraph headed "File - Save as". The file is saved as *.CFG after you have entered a filename and selected a path.

Open

is used to load program files. This feature makes it easy to program instruments repeatedly with the same measurement programs.

Print

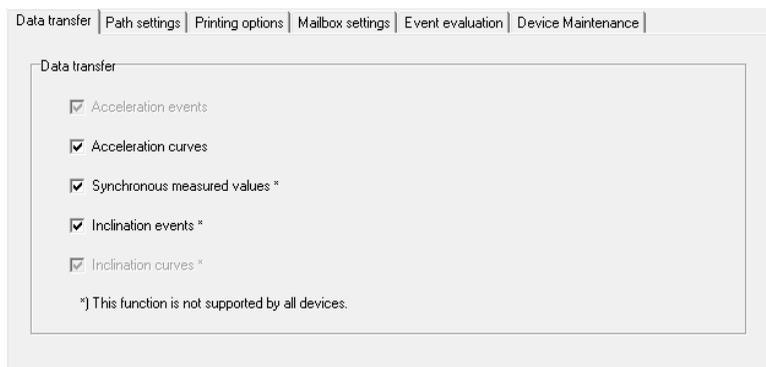
opens the preview of the print layout for the set program parameters.

Close

closes the measurement program window.

Basic settings

The "Options / **Basic settings**" menu enables you to customize the evaluation program to your applications. The settings made are saved and used automatically when the program is restarted.

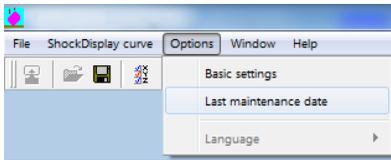


Working with the SYCUR program

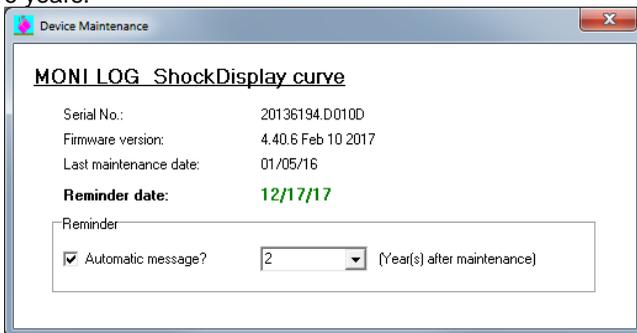
- Data transfer** The data transfer between ShockDisplay curve and PC take place about a USB connection. There is still the possibility of leaving particular data on the instrument if they are not needed. For this purpose, deactivate the corresponding box. This speeds up the transfer and shortens the stored file accordingly.
- Path settings** Specification of the working directory and the directory of GoogleEarth.EXE. The paths need to be set manually.
- Printer options** is used to select and install a printer
- Mailbox settings** is used to change between the classic mailbox field and a layout with structured input fields.
- Event evaluation** is used to activate freely selectable warning and alarm thresholds for easier data evaluation. Values exceeding thresholds are then shown in bold characters and highlighted in yellow or red.
- Device Maintenance** A reminder for factory calibration can be activated in the period of 1 to 3 years. On the expiry of the period, a notification window then opens during the data transfer from the device or while opening a file. The maintenance period can be changed anytime in SYCUR. The date of the last maintenance is not modified in the device.

Working with the SYCUR program

Last Maintenance Date



In the devices from Firmware V4.32 (2016), the date of the last check or factory calibration is saved. SYCUR helps in setting a snooze time locally on this PC in the basic settings. The display then depends on whether the time has lapsed and the function is supported by the device. During the maintenance, the manufacturer also checks runtime of the fixed integrated Backup-Battery. This must be changed after 6 years.



Language selection

"*Options / Language*" enables you to change to an alternative menu language without having to reinstall the program. Changing the language is only available if all files are closed.

Window menu

The *Window* menu shows a list of all currently open windows. By clicking on Window, you can change quickly between windows. The usual window arrangement in Windows can be changed by using the icon bar.

Working with the SYCUR program

Help menu

Help topics offers an interactive help system to support you in your work with the program and the instrument ShockDisplay curve.

Password unlocking Using the password unlocking, all instrument passwords of a ShockDisplay connected to the PC via USB can be reset. The instrument manufacturer can create an instrument-specific activation code that has to be entered in the corresponding input mask. A prerequisite is that the instrument is switched on. Instruments which are switched off and have the USB remote function can be switched on via the password unlocking function using the activation code.

Info about ... displays the current program version with date of issue and copyright notice

Technical data

Sensors, parameters, shock measurement	
Measured values	100 shock events with greatest amplitude, 3-dimensional (X / Y / Z), storage of events also as signal curve of 1024 ms duration at a sampling rate of 2 kHz
Measuring range	5, 10 or 20 g as well as special models available
Frequency range	1 ... 512 Hz (3 dB, digital frequency filter, 4th order Bessel)
Measuring accuracy (amplitude)	± (2% of the full-scale value + 5% of the measured value) for half-sine acceleration events from 5 ms to 250 ms duration at 25°C
Recording threshold Minimum shock duration	Preselectable from 5% to 90% of the upper rating for each axis. Overshooting of the threshold on any axis for the minimum shock duration (1 to 100 ms) leads to the recording of an acceleration event (see exact description on page 9)
Evaluation	On the instrument display or with more options in the PC software for WIN XP/7/8/10 delivered with the instrument
Calibration data	Permanently stored in the instrument and only to be changed by manufacturer

Sensor, inclination measurement parameters	
Measured values	-1 g to +1 g corresponding with -90° to +90° inclination
Measuring range	64 acceleration curves ranging from -2 g to +2 g along 3 spatial axes (sampled 10Hz, length 17 seconds)
Frequency range	Dynamic range from 0 up to 1 Hz, resolution 0.003 g
Measuring accuracy	Drift +/- 0.2 mg/°C non-linearity X/Y: +/-0.12 g Z: +/-0.18 g
Measuring interval	Adjustable in intervals of minutes
Duration of recording	Up to 16,000 measuring intervals (dependent on runtime)
Evaluation	On the instrument display or with more options in the PC software for WIN XP/7/8/10 delivered with the instrument
Calibration data	The inclination measurement is factory-calibrated

For the technical data of the *Tracking Module/data link* please refer to the manual of this device (see installation CD).

Technical data

Data acquisition, temperature, humidity and pressure parameters

Temperature	Measuring range -40 to +85°C, resolution 0.1K, accuracy ± 1K
Humidity	0.2 to 100% RH, resolution 0.1 % RH, accuracy ±3 % RH (20-80 %RH), ±5 %RH (0-100 %RH)
Pressure	260... 1260 mbar, resolution 1 mbar, accuracy ± 1 mbar (T=25°C), ±2 mbar (0°C to + 80°C)
Calibration	The combined sensor is factory-calibrated.

Power sources and uptime at 20°C (without GPS/GSM, without inclination)

Model R14 (C)	<ul style="list-style-type: none"> • 2 rechargeable NiCd batteries of type C 1000 h • 2 rechargeable NiMH batteries 1500 h • 2 alkaline batteries 2500 h • 2 lithium batteries 2500 h
Model R20 (D)	<ul style="list-style-type: none"> • 2 rechargeable NiCd batteries of type D 1500 h • 2 rechargeable NiMH batteries 2200 h • 2 alkaline batteries 6000 h • 2 lithium batteries 6000 h
External power supply	Optionally possible with external 2 to 10 V batteries
Preservation of data	6 years min. (independent of battery state) The Backup-Battery must be changed after 6 years.

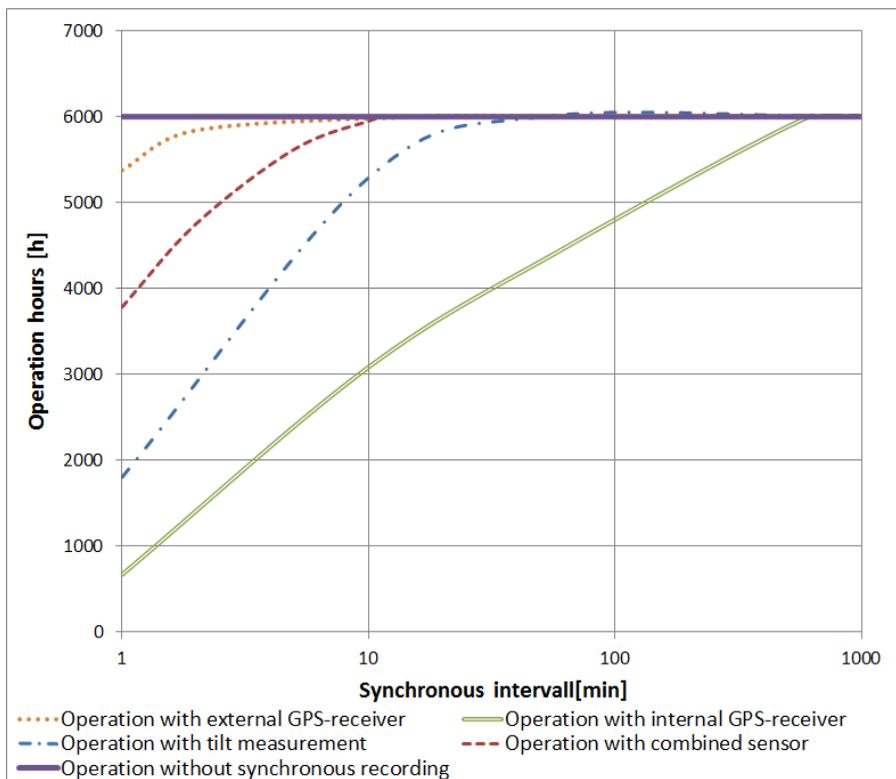
Casing, operating conditions, connections

Casing	Aluminium, painted, IP65 protection
Weight	Model R14: 0.9 kg with batteries, 206 x 100 x 40 mm ³
Dimensions	Model R20: 1.1 kg with batteries, 218 x 100 x 44 mm ³
Operating and storage conditions	-20 ... +65°C with rechargeable batteries -40 ... +85°C with lithium batteries (dangerous goods !) -20 ... +70°C with alkaline batteries (internal or external) max. 98% rel. humidity, non-condensing. In case of extended requirements, please ask the manufacturer for special models.
Display and control elements	Illuminated LC display and four keys, The display shows date, time, vector, integrated shock intensity, shock duration, minimum, maximum, number of values. Multilingual and password-protected menu guidance.
Connections	USB 1.1 for connection with a PC for configuration and evaluation, RS-232 for connect of <i>the tracking module/data link</i>

Technical data

Software parameters	
Instrument number	Permanently stored in the instrument, no change by user possible. It appears on switching on, during evaluation at the PC and during data printing.
ON/OFF code	The instrument can be protected against unauthorized switching on or off by a 2-digit numerical code.
Password protection	Access to data can be protected by an 8-digit numerical code.

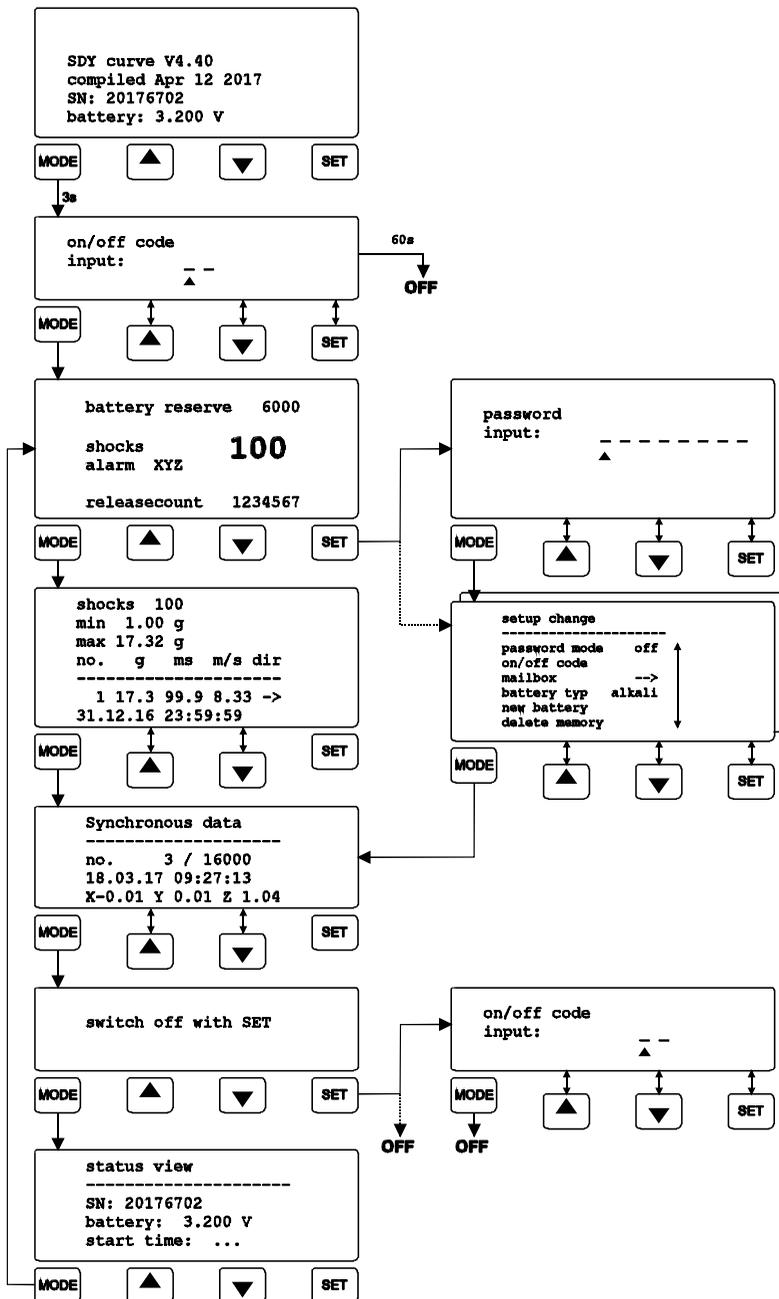
The uptime of instruments with time-synchronous measurements depends on battery time, interval settings, option settings and the additional devices used (e.g. MONILOG *Tracking Module/data link* as external GPS receiver). The diagram shown applies to R20 devices with lithium or alkaline batteries.



Troubleshooting

Error when installing the software	<ul style="list-style-type: none">• Check remaining storage capacity of the destination drive.• Check access rights to the destination drive.
Error during data transfer	<ul style="list-style-type: none">• Instrument is not switched on.• Instrument is inactive. Change the battery.• Try data transfer on a different computer; interface is possibly defective.• If possible, try another data cable of the same type.
Instrument is not recognized via USB	<ul style="list-style-type: none">• Find out in Windows Explorer if ShockDisplay curve has logged on as drive under the name sdycurve. If your PC did not assign a drive letter you can do it by "Administrative Tools/Computer Management/Disk Management".• Check if there are network drives with the same drive letter. This can be resolved by disconnecting the network from the PC, or by manually assigning another drive letter for the device.• Optionally, use a memory stick to check the functionality of the USB driver.
A new measuring program is not accepted by the instrument via USB	<ul style="list-style-type: none">• Terminate a USB connection under WIN XP/7/8/10 with the Icon " remove or eject hardware components " in the task bar to preclude loss of data
wrong time in the instrument	<ul style="list-style-type: none">• During transmission of measuring program the time of the PC will transfer to the instrument and must be correctly adjusted therefore• After transmission of measuring program via USB you have to terminate the USB connection as described above, so that the time can be taken over immediately.

Setting functions of the instrument from V3.30



After-sales service

- Accessories and spare parts can be ordered from:

SMT ELEKTRONIK GmbH
An der Priessnitzau 22
D - 01328 Dresden

Phone: (+49) 351 / 26613 0

Fax: (+49) 351 / 26613 10

e-mail: info@smt-elektronik.de



- In case of any malfunctions of the ShockDisplay curve, please state the serial no. You can find it on type label or on the logs when evaluating your measurement data.

SERIAL No.:



- Address, phone and fax number of our after-sales service:



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Warranty Certificate

ShockDisplay curve ShockDisplay curve plus

Instrument no.:

Against submission of this warranty certificate we grant a 12-month warranty from the date of delivery for the above instrument.

In case of deficiencies we first have the right of rectification, either rectification of the deficiency or subsequent delivery. Should the rectification fail, and only then, we will take back the instrument and reimburse the purchase price. Any further warranty claims shall be excluded.

This warranty covers all faults that impair the proper functioning of the instrument due to technical defects of individual components or assemblies.

Batteries and rechargeable batteries as expendables are not covered by this warranty.

This warranty will only be granted if the instrument has been used properly for its intended purpose.

Any attempts of the warrantee or third persons to repair the instruments or to intervene in any other way exclude warranty claims.

Any mechanical damage which is the result of undue stress also excludes warranty claims.

We will immediately notify the warrantee of any repair work excluded from warranty coverage.

If the instrument is sent in together with the warranty certificate, this will be considered as a repair order for the elimination of all damage.

The warrantee can exclude partial services.

Dresden,

SMT ELEKTRONIK GmbH
An der Priessnitzauze 22
D - 01328 Dresden
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