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LAB - THERM

LT - W

E

Operating Instructions

Symbols and their meaning



Warning: Please read carefully this safety instruction !



Warning: There is a serious risk of injury !



Warning: Avoid contact with live components !



Warning: Hot surface, don't touch !



Disconnect mains supply first !



Please read this note !



This information is helpful !



Question and answer ! What is to do, when ...

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U. Setting up

type SM1700 : without cooling

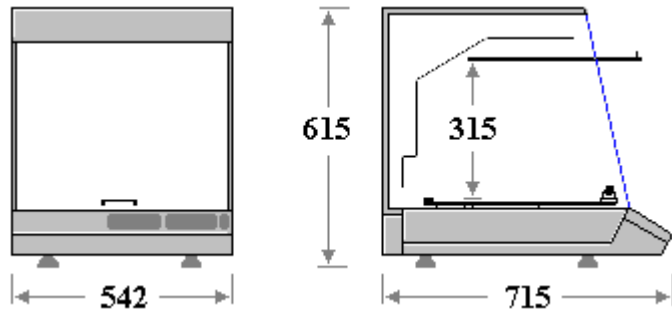
Temperature

... minimum : ambient + 5°C

... maximum : 80°C

Weight : 82 kg

Consumption : 600 W max.



type SM1701 : with cooling

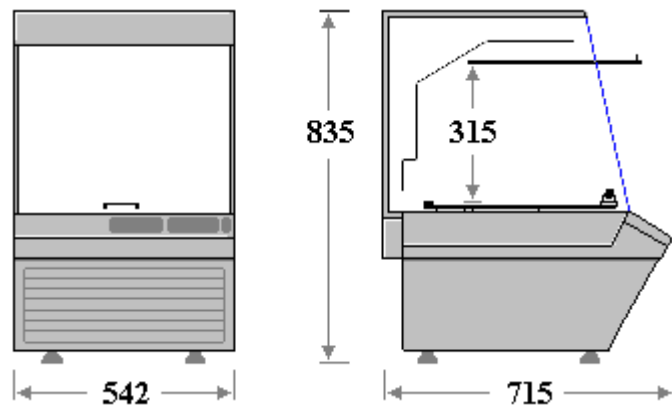
Temperature

... minimum : 5°C

... maximum : 80°C

Weight : 112 kg

Consumption : 850 W max.



Power supply SM1021 : 220 - 240 V / 50-60 Hz

Power supply SM1022 : 190 - 210 V / 50-60 Hz

Ambient temperature : 0°C up to 35°C



If the machine is equipped with cooling system, the condensated water must be diverted (water outlet at the rear side of the machine). You may use a bowl to collect and evaporate this water.



If the shaker is situated on a slippery surface, loaded with an extremely heavy load or operating at a high shaking amplitude and frequency, the machine has the tendency to move. To prevent this the shaker can either be bolted to the table, fit in a frame, or the four feet of the shaker should be partly lowered into special holes drilled into the bench.



Due to the variable tray loading it is not always possible to completely balance the forces due to the moving masses. The resultant unbalance produces an additional dynamic floor loading. Therefore the machine should not be set up close to any vibration sensitive equipment.

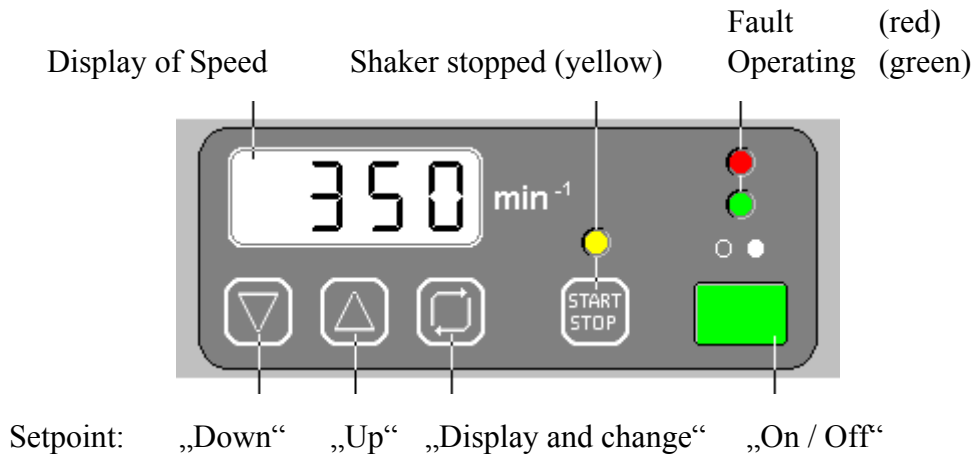


Before making the electrical connections to the machine it is advisable to compare the information on the rating label with the data of your mains supply. The installation category „I“ requires a **protective earth** connection in the mains supply.

S. Shaker Unit

The tray carrier is driven magnetically by two d.c. linear motors. Quartz precise speed regulation is achieved by microprocessor control. Speed is kept constant irrespective of load.

S.1 Controls




Speed setting:

The LCD display always shows the actual speed. To change the speed setting it is necessary to simultaneously press the keys **„display and change“** and **„down“** or **„up“**. This effectively prevents unintentional changes in speed setting. It is, of course, possible to change the speed setting while the shaker is stopped.





Active brake :

The heavy inertia of the moving masses in a shaking machine results in a long slowing-down period after the shaker has been switched off. Where the tray load has to be changed quickly simply press the **„Start/Stop“** key. This applies an active brake to the drive; pressing **„Start/Stop“** once more will then drive the shaker back up to its set speed.





 When in doubt about the speed setting, the drive should be stopped. The speed setting can then be adjusted at leisure.

S.2 Timer setting

With the timer option switched on, the shakers running time can be limited to: **1...500 min**

-  This time can be selected when the machine is stopped by using the **up/down** arrow keys. When pushing the **start/stop** key again, the shaker will run for the preselected time (in minutes) - then active braking takes place.
-  The timer countdown can be interrupted prematurely by pushing the **start/stop** key; when starting again, the full displayed time is valid.
-  The timer function can be turned off by selecting a time of **0'**. Normal start/stop operation is then possible again.
-  Generally the machines are delivered with the timer option switched „off“. To activate the timer, the slide switch pos. 4 on the EMR 44 printed circuit board must be switched „on“. See section „S.4 Selection of operating parameters“.

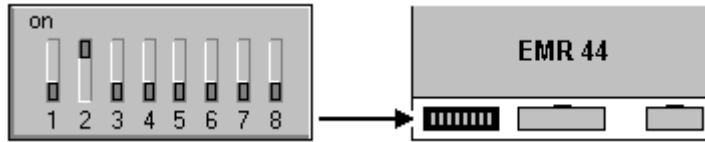
S.3 Safety instructions for the shaking unit

-  The machine should be completely stopped before the tray and contents are handled. Otherwise there is a serious risk of injury (jamming fingers or broken glass) !
-  Please take care that after changing trays, the handle of the tray locking device is as far as possible to the right and make sure that there are no loose parts on the tray before running the machine.
-  The trays must only be loaded with the conical flask sizes for which clips are provided. Before shaking round bottom flasks check which flask size can be held securely in the clips. The tension spring on the clips must never be removed.
-  Please notice that the sizes of Erlenmeyer flasks can differ depending on the make. When ordering trays and clamps please indicate the manufacturer of the flasks you are using.

S.4 Selection of operating parameters



For changing the operating parameters the control module must be pulled out. Disconnect the mains supply first in order to avoid contact with live components.



Pos. 8..4 of the slide switch on the circuit board „EMR 44“ defines the **options**:

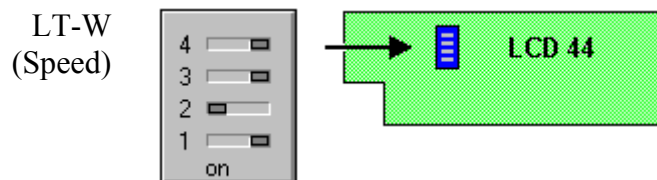
pos	option			see:
8	the internal parameters and limits are ...	proprietary	standard *	
7	the external output „performance“ is ...	disabled	enabled *	I.2
6	stop the shaker when the door is open ...	yes *	no	S.1
5	the active brake operates ...	fast *	slow	S.1
4	the timer is ...	enabled	disabled *	S.2
	factory setting *	„on“	„off“	

The **maximum permissible speed** (rpm) is determined by the shaking diameter or stroke and is set by pos. 3..1 of the slide switch on the circuit board „EMR 44“:

	?	100	200	300	400	500	600	max.
3								
2								
1								
	on	on	on	on	on	on	on	on
orbital motion →				50	25	12.5		mm, diameter
linear motion →		50	25	12.5				mm, stroke



The slide switch settings on the display board „LCD 44“ determines the type of machine. This has to be checked whenever the circuit board has been changed:

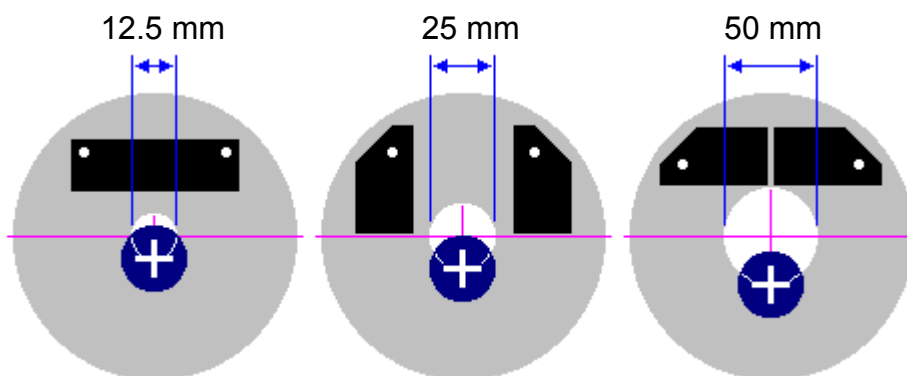


S.5 Changing the shaking diameter



Changing the shaking diameter involves opening the unit. This operation should only be carried out by qualified personnel. Pull out the mains supply plug in order to avoid contact with live components.

The shaking diameter can be changed by altering the eccentric position of the bearing according to the diagram below. Please make sure, that the counterweights are always mounted opposite to the eccentric bearing. With the shaking diameter set to 12.5 mm, both counterweights must be replaced by a single rectangular weight. Do not forget to change the speed limit on the speed controller as explained in the section S.4.



S.6 Technical data

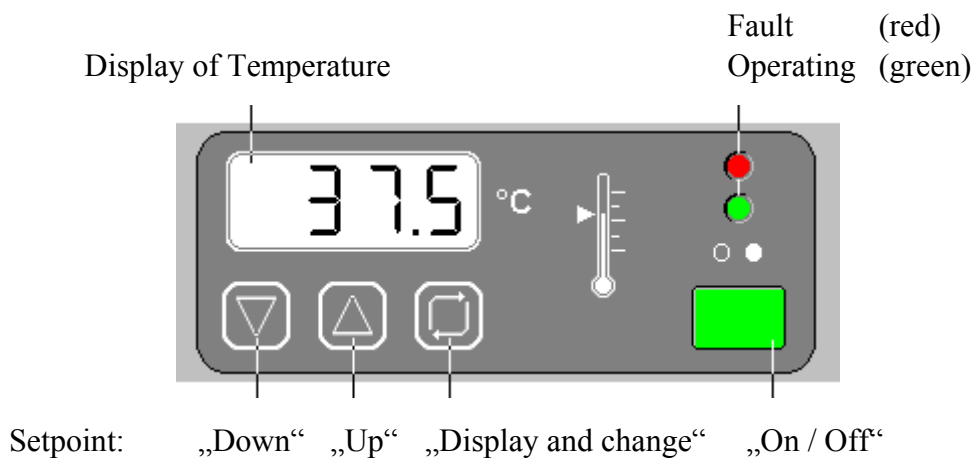
Orbital shaker type	:	SM 1001	SM 1002	SM 1003
Orbit diameter	:	12.5	25	50
Shaking speed (rpm)	:	20...500	20...400	20...300
Linear shaker type	:	SM 1011	SM 1012	SM 1013
Stroke (mm)	:	12.5	25	50
Shaking speed (stroke / min)	:	20...400	20...300	20...200
Loading	:	1 tray size „E“		
Speed accuracy	:	± 0.1 rpm		
Speed indication	:	± 1.0 rpm, digital		

T. Temperature Control

The temperature control of the Lab-Therm operates on the principle of direct air heating and cooling. The air is drawn in at the rear bottom and passed by the powerful fan into the circulation duct at the back wall. There the air flows first past the evaporator of the refrigerator and then past the enclosed electrical finned heater and returns at the top into the chamber.

Electronic, fully digital PID control incorporating a microprocessor ensures exact matching of the heater power and accurately maintains the desired temperature.

T.1 Controls



Temperature setting:

The LCD display always shows the actual temperature. To change the temperature setting it is necessary to simultaneously press the keys „**display and change**“ and „**down**“ or „**up**“ . This effectively prevents unintentional changes in temperature setting.

Note: To ensure ready identification the setpoint is displayed with a flashing decimal point.

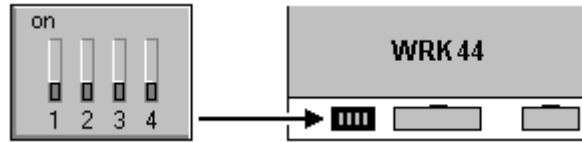
Cooling system (SM1701 only):

The cooling machine is controlled intelligently and optimized for minimum energy consumption depending on ambient temperature and set value. After opening the door, the previous cooling state is maintained for a certain time. If temperature decreases even without refrigeration, the cooling machine remains switched off. Minimum on- and off times are observed to protect the compressor.



T.2 Selection of operating parameters



For changing the operating parameters the control module must be pulled out. Disconnect the mains supply first in order to avoid contact with live components.

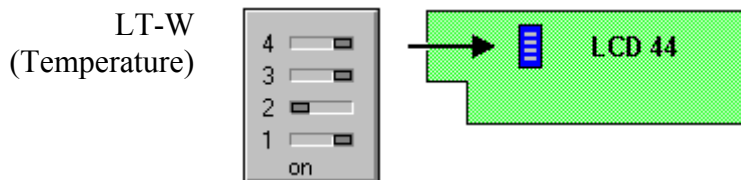


The slide switch on the circuit board „WRK 44“ defines the following **options**:

pos	option			see:
4	the internal parameters and limits are ...	proprietary	standard *	
3	the external output „performance“ is ...	disabled	enabled *	I.2
2	„performance“ delayed after opening the door	no	yes *	I.2
1	N/A.	-	-	
	factory setting *	„on“	„off“	



The slide switch settings on the display board „LCD 44“ determines the type of machine. This has to be checked whenever the circuit board has been changed:



T.3 Technical data

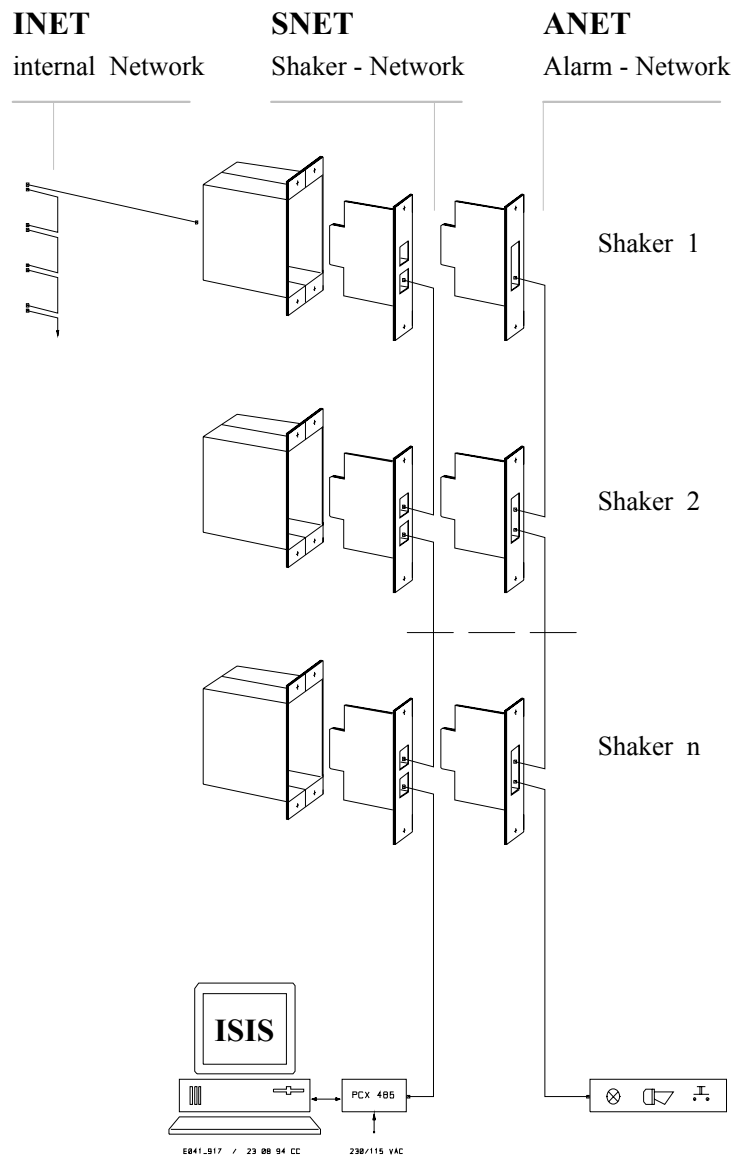
Temperature minimum	: 5 °C above ambient	← SM1700
... with cooling system	: 20 °C below ambient, min. +5 °C	← SM1701
Temperature maximum	: 80 °C	
Temperature accuracy	: ± 0.30 °C, absolute (at place of sensor)	
Temperature accuracy	: ± 0.02 °C, relative (at place of sensor)	
Temperature indication	: ± 0.1 °C, digital	
Temperature control	: PID, digital	
Temperature probe	: RTD (Pt-100, class „A“ DIN IEC 751)	
Linearisation	: Table, digital	
Heater rating	: 500 W	
Air circulation	: 160 m ³ /h	

I. Interface - System

I.1 Concept of the Interface - System

Working with the machines under the rules of e.g. ISO-9000 or GLP requests a continuous supervision and monitoring of all influencing parameters such as temperature, humidity and shaker speed. Setpoint control via a common personal-computer makes the process independent from the machine operator, e.g. for setpoint changes during the night or on the weekend.

For this purpose, all machines are equipped with a cardcage for two plug-in boards on the rear. You can chose between different interfaces. In addition, several machines can be simply connected together to form a network:



SNET: external network

All data of the controllers (actual value, setpoint and status) are passed to a personal computer PC by means of the external data path.

INET: internal network

The internal network connects all individual controllers of one machine. One of the controllers is defined as a „master“ and connects the INET with the outside world trough **one** port.

Switching off the „master“, interrupts the connection with the other controllers.

LT-W: Temperature = Master

ANET: external network for connection of alarm circuits

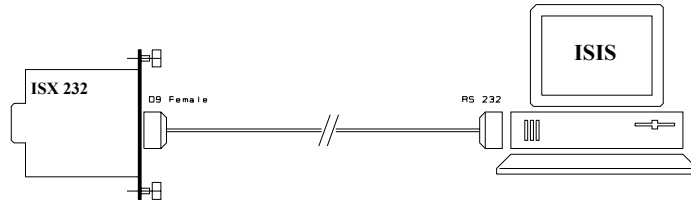
The ANET provides relay-contacts for the direct monitoring of deviations from the setpoint (performance) and for the indication of failures.

I.2 Plug-in Interfaces

All interfaces are galvanically separated from the machine electronics. Electrical noise, a floating voltage or a short circuit have no influence on the operation of the machine.

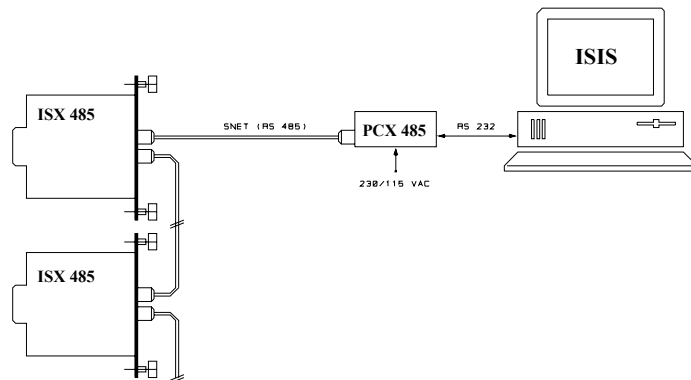
ISX 232: machine - PC

This interface connects a single machine to a personal computer.



ISX 485: machine - SNET

This interface connects up to eight different machines to SNET.



PCX 485: SNET - PC

This interface connects the SNET to a standard personal computer.

DAC 44: analog output

for an external recorder.

Output voltage for ...

temperature:

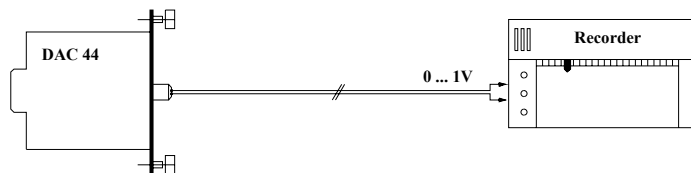
$$U_a = 10\text{mV} \cdot T \quad (100^\circ\text{C} = 1\text{V})$$

humidity:

$$U_a = 10\text{mV} \cdot F \quad (100\% = 1\text{V})$$

shaker speed:

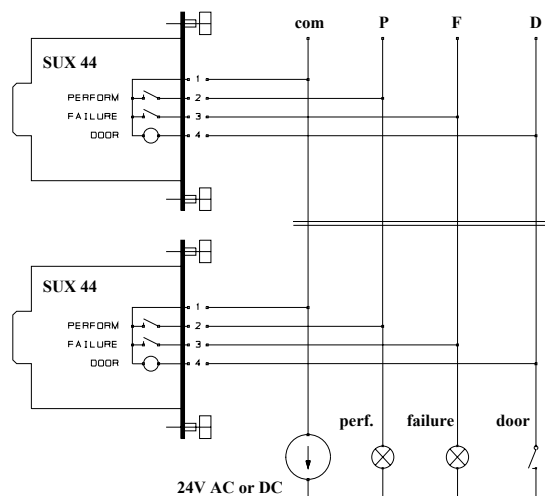
$$U_a = 2\text{mV} \cdot n \quad (500 \text{ rpm} = 1\text{V})$$



SUX 44: Alarm - Interface

This interface provides relay-contacts for the direct monitoring of deviations from the setpoint (performance) and for the indication of failures. Alarm circuits can be directly connected.

An open contact at input 4 shuts down the shakers. This can be used for e.g. door-switch on a walk in environmental room.



I.3 Setup of „ISIS“ = Information System for intelligent Shakers

System requirements:

This comfortable software is running under the graphical operating system „Microsoft-Windows“ 3.x / 95 / 98 / NT, on any standard personal computer.

Installation of the Hardware:

For a single machine: only one plug-in board ISX 232 is needed.

For several machines: each machine needs a plug-in board ISX 485. Connect these boards together (SNET). The sequence of this wiring has no influence. The module PCX 485 interfaces the SNET with a single personal computer.

Installation of the Software:

1. Insert the ISIS diskette in drive "A"
2. Select the command "Run" in the menu „Start“
3. Enter **a:\setup** and push the "OK" button
4. Follow the instructions on the screen

System Settings:

After the installation, the ISIS software must be customized for your application with the „Setup / System: Settings“ program.

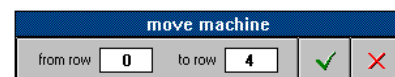


1. **Serial port on your PC:** To what serial port are the machines attached ? To run the program without the machines, you have to select the entry „---“ for this field. The machine-functions are then simulated. Please do not forget to change this when the machines are later connected.
2. **Language for help:** The ISIS program always uses English. However, both English and German are available for the integral help text.

Assign the individual machine (row) number:

If you work with several machines attached to the same PC, you must assign each machine an individual number. This number is permanently stored in the machine. Only one machine can be installed at any one time. The other units should be switched off ! Also note that each number may be used only once. Procedure:

1. Switch „on“ desired machine.
2. Scan the network: „Setup / Network: **Scan**“
3. Assign a number: „Setup / Network: **Move**“
4. Switch „off“ this machine.
5. Continue with step 1
6. Conclude the setup with all machines switched „on“ and a final „Network: **Scan**“.



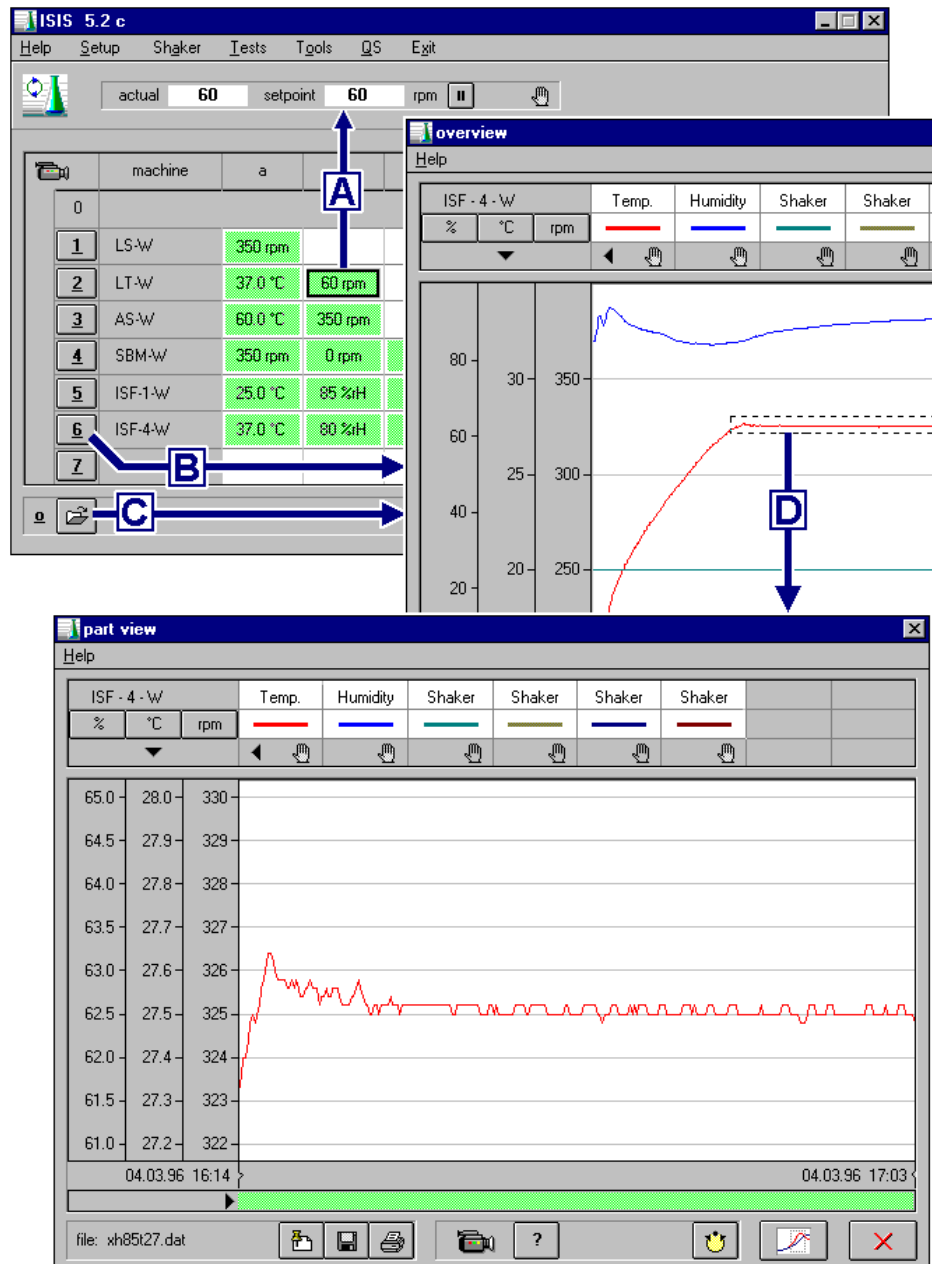
I.4 Operation of „ISIS“

an overview:

main picture →

graph, overview →

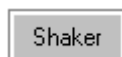
graph, part view →



- A: Click on a field to show and manipulate the settings.
- B: Select a machine and all actual data will be graphically represented. or ...
- C: Select a data file from the archive (e.g. from the hard disk of your PC).
- D: Draw a window around the part of interest and magnify this section.

Background colors of the fields:

- white: unit switched off
- green: unit working properly
- yellow: door open or shaker stopped
- blue: water refill (humidity)
- red: unit failure



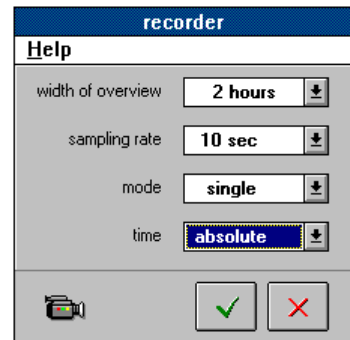
Data Acquisition:



When a new file is opened, the **sampling rate**, i.e. the time interval between two measured values, is defined. The maximum recording time (width of overview) is stipulated by the sampling rate. After elapse of this time, the data acquisition is in the „single“-mode automatically ended. In the „continuous“-mode the oldest measured values will be overwritten, i.e. the width of overview remains constant.



After a new file has been opened, the data acquisition is still switched „off“. It must be explicitly switched „on“.



ISIS - Files:



The file names are generated automatically: the name starts with the letter „I“ followed by the date. But to simplify the retrieving, the file can be stored under a name of your choice.



It is advisable to enter comments related to the data acquisition in this field. This text will be stored together with the curves and printed on the report.

Graphical Representation:



Click on the field with the line to change the color. Click on the field below to present the Y-grid lines and the status of the module selected.



The status field shows the time history of all events (e.g. open door, stop).



The Y-coordinates of the graphics representation can be changed at any time, independent for each measured quantity and has absolutely no influence whatsoever on the recording of the measured values.

Controller Program:



On demand: the setpoint of the controllers are no longer entered manually, but are defined in a program. For detailed information, see the help file.

Printing a Report:



Once the graphical representation has been defined, printing of the report is child's play and is essentially limited to adding a comment.



End the ISIS program properly by the „Exit“ command and not by switching off the computer. Otherwise, the program can not write the last measured values and parameters to the hard disk.

C. Calibration

With the general introduction of the ISO 9000 quality management system, calibration of all quality relevant measured values (measured quantities) is of increased importance.

Calibration in the measuring field means to determine the deviation of measured quantities. Calibration does not mean to interfere with or to adjust the system but to simply find out the difference between system readout and a standard reference value.

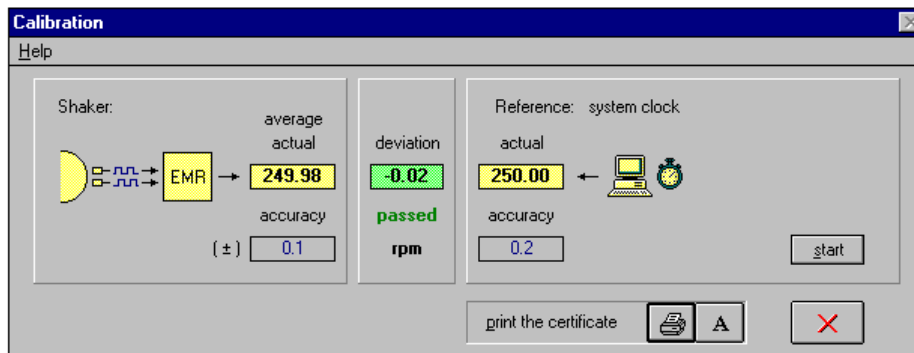
C.1 Calibration of Speed

Conditions:

Shaker serial interface and personal computer with „ISIS“-Software installed.

Calibration method:

Independent speed data is computed from a speed sensor pulse count during a time interval given by the PC. This value is then compared with the speed indicated by the speed controller. From this, the deviation is calculated. The complete procedure takes 2 minutes and goes on automatically. A calibration report will be printed on request.



Reasons:

The shaker tray is directly connected to the shaker drive, thus the shaking speed is identical with the drive speed.

The phase shifted sensing of the rotor magnetic poles by 2 sensors is an integrated part of the drive. Faulty signals immediately switch off the motor. This ensures that a simple pulse count during an external time reference exactly corresponds with the real shaking frequency.

This principle does not apply with competitors shakers using transmission by drive belt or friction wheel



A faulty condition is assumed with calibration results outside the given tolerance. The „EMR 44“ controller has to be replaced.

C.2 Calibration of Temperature

Please note the difference:



Calibration of the temperature controller: temperature being measured at the controller sensor location. This is the only temperature kept at a constant level and displayed by the controller. The meaning of this calibration is to discover a faulty sensor or controller.



Calibration of incubation chamber temperature: temperature being measured for instance in the shacked materials. This calibration additionally considers the temperature dispersion (gradient) caused by heat loss through the insulation, outside air leaking in, heat radiation from illumination.

This temperature dispersion is a constructive feature and can not be influenced.

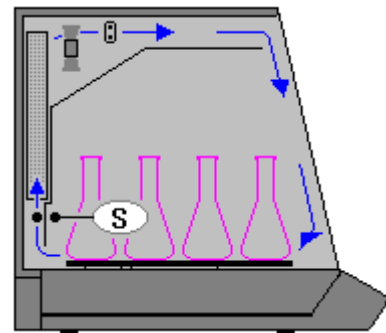
C.2.1 Calibration of the temperature controller

Conditions:

1. Shaker serial interface and personal computer with „ISIS“-Software installed.
2. Certified temperature measuring system including sensor, e.g. „TCAL 44“ (Kühner AG)

Calibration method:

1. Position the calibrator sensor „S“ right beside the temperature controller sensor.
2. Close the machine, switch on, enter the set value and wait for the temperature to be stabilized.
3. Enter all measured temperatures to the „ISIS“ calibration table. Evaluation goes on automatically; a calibration report can then be printed.



Tolerances:

sensor	(Pt-100 class „A“ DIN IEC 751):	$\leq 0.15 + 0.002 \cdot t \text{ °C}$
controller	(including calibration accuracy):	$\leq 0.07 \text{ °C}$



A faulty condition is assumed with calibration results outside the given tolerance. The „WRK 44“ controller or the Pt-100 sensor have to be replaced. Adjustment of the controller can only be done at the factory.

C.2.2 Calibration of the incubation chamber temperature

Conditions:

Calibrated multi channel temperature measuring system including at least 4 sensors.

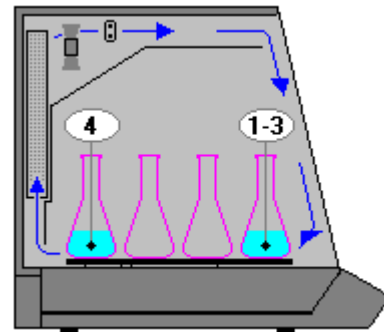
Test conditions:

Ambient temperature : 20 - 25 °C

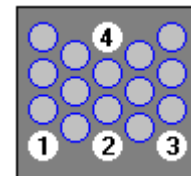
Accuracy : ± 0.05 °C

Calibration method:

Simultaneously measure temperature inside Erlenmeyer flasks of 250 ml at 4 locations on the tray. For calibration purpose first the average of all 4 measured values is calculated. Relative deviation of the single values to the average value has to be within the following guaranteed limits:



Setpoint	Deviation
5.0 °C	± 0.6 K
15.0 °C	± 0.5 K
27.5 °C	± 0.5 K
37.0 °C	± 0.4 K
45.0 °C	± 0.7 K
60.0 °C	± 1.2 K
80.0 °C	± 1.8 K



Typically deviations are lower. Before shipping we carefully check the temperature distribution. An individual calibration certificate is supplied.



If the calibration result lies outside the indicated limits, please verify the following points:

- Isothermal state reached ? (for at least 1 hour ?)
- Outside air leaking into the machine ? (Ventilation closed ?)
- Direct heat radiation ? (Sunlight ? Illumination ?)
- Fan working ? (Air blowing out from the top ?)

D. Diagnosis

D.1 Shaker unit: self-monitoring system

An extensive self-monitoring system switches off the drive when a fault occurs. The red fault lamp lights up and the type of fault is indicated on the display as follows:

display	cause of errors	countermeasure
F 0	drive obstructed or disconnected	check, if drive blocked, ⇒ call service
F 1	speed sensor 1 faulty	⇒ call service
F 2	speed sensor 2 faulty	⇒ call service
F 3	program, error in check sum	⇒ call service
F 4	memory, read / write - test failed	⇒ call service
F 5	watchdog time-out	⇒ call service
F 6	program-code, undefined instruction	⇒ call service
F 7	short circuit on the outputs	⇒ call service
F 8	speed limit has been exceeded	check settings of pos-3,2,1 on EMR 44
F 9	speed limit, invalid settings	check settings of pos-3,2,1 on EMR 44
F 10	type of machine, invalid settings	check settings on LCD 44
F 11	program doesn't match the hardware	⇒ call service
F 13	program, internal error	⇒ call service
F 14	proprietary param. are not defined	set opt-8 = off or enter new parameters
F 15	proprietary param. <> machine	set opt-8 = off or enter new parameters



If a safety shut-down is caused by a temporary fault or if the fault clears itself, the fault logic can be reset by simply switching the main supply switch off and then on again. If the failure doesn't clear itself and appears again, please contact our service.

D.2 Temperature control: self-monitoring system

An extensive self-monitoring system switches off the air circulation, heating and refrigeration when a fault occurs. The red fault lamp lights up and the type of fault is indicated on the display as follows:

display	cause of errors	countermeasure
F 0	temperature safety cutoff	check, if fan is operating, ⇒ call service
F 1	cooling system overheated	check, if fan is operating, ⇒ call service
F 2	safety-input 3 = open	⇒ call service
F 3	program, error in check sum	⇒ call service
F 4	memory, read / write - test failed	⇒ call service
F 5	watchdog time-out	⇒ call service
F 6	program-code, undefined instruction	⇒ call service
F 7	short circuit on the outputs	⇒ call service
F 8	temperature too high	open circuit at probe ? ⇒ call service
F 9	temperature too low	short circuit at probe ? ⇒ call service
F 10	type of machine, invalid settings	check settings on LCD 44
F 11	program doesn't match the hardware	⇒ call service
F 12	T/H-switch in wrong position	check on WRK 44: T/H = T
F 13	program, internal error	⇒ call service
F 14	proprietary param. are not defined	set opt-4 = off or enter new parameters
F 15	proprietary param. <> machine	set opt-4 = off or enter new parameters



If a safety shut-down is caused by a temporary fault or if the fault clears itself, the fault logic can be reset by simply switching the main supply switch off and then on again. If the failure doesn't clear itself and appears again, please contact our service.

A. Appendix

A.1 Maintenance

Shaker:



Due to the electronically commuted linear motors and self lubricating ball bearings the shaker units are virtually maintenance free.

Cooling system:



Experience has shown that the heat exchanger of the refrigerator has to be cleaned after about 2500 hours operation to remove any dust collected.



Servicing the heat exchanger involves opening the unit. This operation should only be carried out by qualified personnel. Pull out the mains supply plug in order to avoid contact with live components in the open unit.

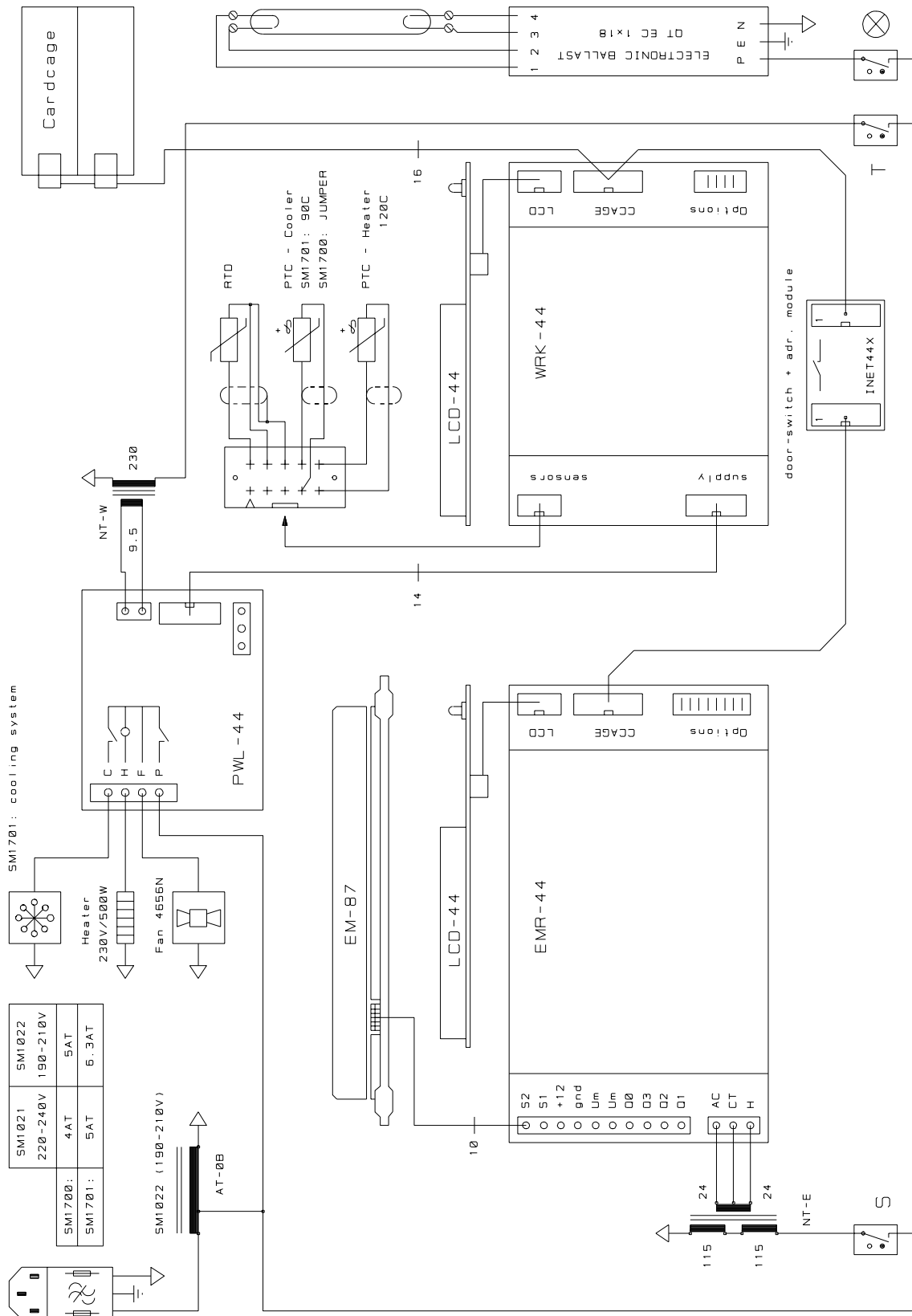
A.2 Accessories

order no	type	description
		E-trays (420 x 420 mm):
SM32 0025 - 2000	E25 - E2000	with fixed clamps for Erlenmeyer flasks of 25 - 2000
SM3002	EU	Universal tray for mixed loading with ...
SM31 0025 - 2000	U	... clamps for Erlenmeyer flasks of 25 - 2000 ml
SM31 7016 - 7034	RGH	... holder for test tubes with a diameter of 16 - 34 mm
SM3502	E-MT	E-tray for 12 microtiter plates
SM3602	EG	E-tray with rubber mat
SM3702	EK	E-tray with sticky mat
		Interface - System:
SM854070	SUX 44	Interface: alarm network
SM854090	ISX 232	Interface: machine - PC
SM854100	ISX 485	Interface: machine - SNET
SM854110	PCX 485	Interface: PC - SNET
SM854120	DAC 44	Interface: analog output
SM854200	ISIS	Software for Shakers

A.3 Spare Parts

order no	description	type	for
SM850100	Complete drive	EM-87	
SM850200	Main bearing	assembly	
SM850500	Bearing	6006 ZZ	
SM850800	Excenter bearing	assembly	orbital
SM850900	Excenter bearing	assembly	linear
SM851100	Parallelogram	assembly	orbital
SM851200	Parallelogram	assembly	linear
SM851320	Shaking table		orbital
SM851340	Complete tray clamp		
SM851370	Silicon rubber (2 pcs)		
SM852100	Electro magnet		
SM852110	Speed sensors	EM87H	
SM852140	Fan	4656N	
SM852150	Semiconductor Relais	H240D10	
SM852160	RTD sensor		
SM852180	Finned Heater	AR25/500W	
SM854000	Board: Drive	EMR-44	
SM854010	Board: Temp., Humidity	WRK-44	
SM854020	Board: Pushb., display	LCD-44	
SM854030	Board: Power interface	PWL-44	LT, AS
SM854040	Board: Power interface	PWI-44	ISF-1,4
SM854050	Board: Wiring	INET-44B	ISF-1,4
SM854053	Board: Door switch	INET-44X	
SM854058	Board: Supervision	SUP-44	
SM854060	Board: Voltage monitor	OVP-44	
SM854300	Fluorescent tube	L15W/20	LT
SM854301	Fluorescent tube	L30W/11	ISF-1
SM854302	Fluorescent tube	L18W/33	ISF-4
SM854310	Electronic Ballast	QT 1x18	LT
SM854311	Electronic Ballast	QT 1x24	ISF-1
SM854312	Electronic Ballast	HF416-3	ISF-4
SM854320	Float Switch		
SM854322	Doorswitch		ISF-1,4
SM854330	Cooling system	VKD2106	LT
SM854331	Cooling system	VKD2111	ISF-1,4
SM854340	Circuit Breaker	10 A	ISF-1,4
SM854341	Circuit Breaker	16 A	ISF-1,4
SM854350	Control module	Main	ISF-1,4
SM854351	Control module	Temperature	ISF-1,4
SM854352	Control module	Humidity	ISF-1,4
SM854353	Control module	Drive	

A.4 Diagram



E040_010



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