Digital clocks
NDC Series
User's Manual

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1. INTRODUCTION

These operating instructions describe the installation and operation of NDC numerical electronic displays with remote control, designed to display the time, date and temperature. The basic parameters of the described displays are contained in Tab. 1.

Tab. 1 Basic parameters of NDC displays

Type of display	Displaying elements	Number of digits / format	Digit height (mm)	Readability range (m)
NDC 57/4	superbright 7-segment LED modules	4 / 88:88	57	23
NDC 57/6		6 / 88:88:88	57	23
NDC 100/4		4 / 88:88	100	40
NDC 100/6		6 / 88:88:88	100	40
NDC 160/4	superbright elliptic LEDs for outdoor use	4 / 88:88	160	70
NDC 160/6		6 / 88:88:88	160	70
NDC 212/4		4 / 88:88	212	100
NDC 212/6		6 / 88:88:88	212	100

All displays have 2 connectors for a 2-wire or 3-wire RS485 communication interface and can be connected into a communication network. If the displays are connected into a communication network (Fig. 1), any of them can be controlled via a handheld infrared controler. Up to 127 devices can be connected to an NDC-net.

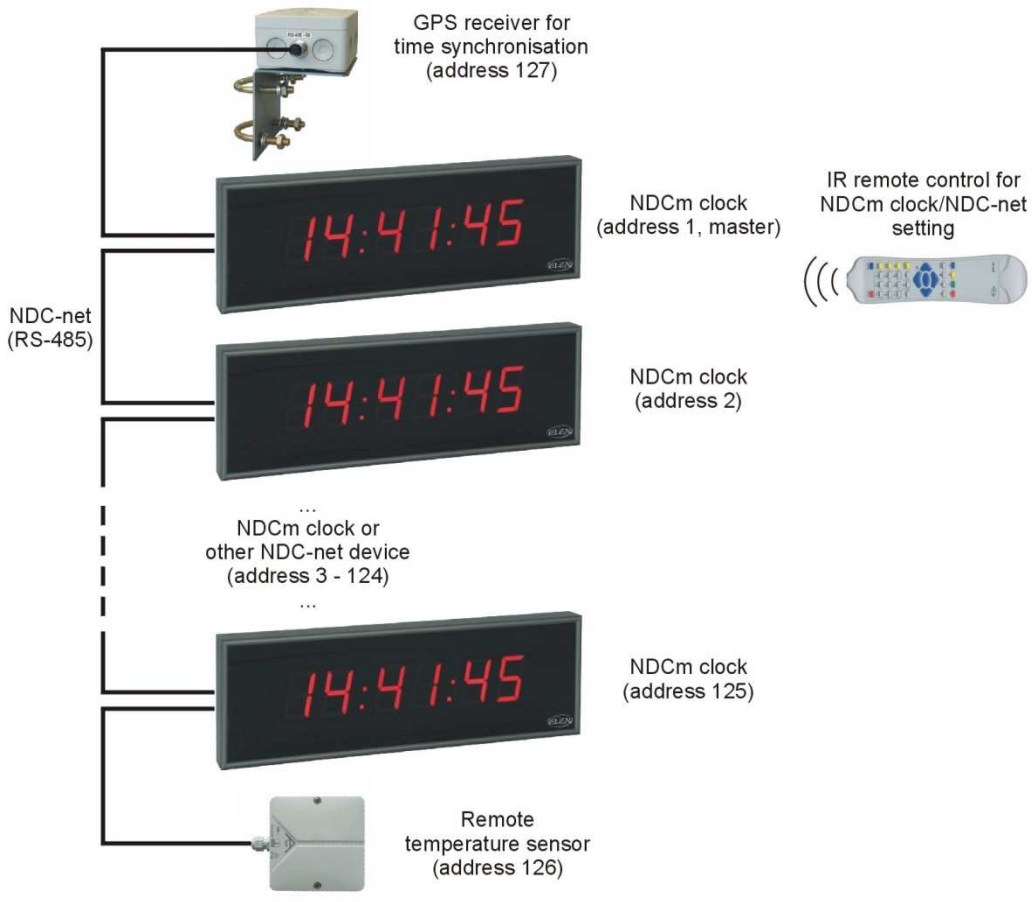


Fig. 1 Connection of NDC displays in a communication network

The easiest way of controlling an NDC type display is shown in fig. 2.

Fig. 2 The easiest way of controlling an NDC display.

2. PROPERTIES

2.1 Display functions

- **Time** (display format)
  - − HH:MM (Hours:Minutes) NDC xxx/4;
  - − HH:MM:SS (Hours:Minutes:Seconds) NDC xxx/6.
- **Date** (display format)
  - − DD:MM (Day:Month) NDC xxx/4;
  - − DD:MM:YY (Day:Month:Year) NDC xxx/6.
- **Temperature*** (display format)
  - − -99° ÷ -10° ÷ -9.9° ÷ 99.9° NDC xxx/4;
  - − -99°C ÷ -10°C ÷ -9.9°C ÷ 99.9°C NDC xxx/6;
  - − A local thermal sensor (i.e. connected directy to the clock) can be located near the NDC or as part of the frame (for extra fee). The precision of the displayed temperature is given by the precision of the sensor.

  ** if a local thermal sensor is connected*
- **Stop watch**
  - − SS:ss –> MM:SS NDC xxx/4
    Seconds:hundreths of seconds with automatic switching to Minutes:Seconds when the seconds are full;
  - − MM:SS:ss –> HH:MM:SS NDC xxx/6
    Minutes:Seconds:hundreths of seconds with selectable automatic switching to Hours:Minutes:Seconds or a 99-minutes mode (MM:SS:ss)
  - − Functions: START, STOP/FREEZE (intermediate time, the measured time runs in the background), RESUME, RESET ;
  - − Automatic restart of the stop watch when the maximum displayable time is reached;
  - − Remote control of the stop watch, external contact (with or without galvanic separation) or with a remote button in the NDC-net.
- **Counter** (counting up/down)
  - − Automatic switching of the display format, range: 1 s to 99 days, 23 hours, 59 minutes, 59 seconds;
  - − COUNT-UP or COUNT-DOWN mode – adjustable limit;
  - − Functions: START, STOP/PAUSE, RESUME, RESET;
  - − Single or repeated run of the counter when the setup limit is reached;
  - − Switchable counter time correction due to a time change (new time setting) or external time synchronisation;
  - − Control of the counter via a remote control, an external contact (with or without galvanic separation) or a remote button in the NDC-net;
  - − Possibility to switch on either the internal or a remote relay (close contact) when the limit is reached.
- **Switch clock** (time interval programming)
  - − Programmable 16 intervals of switching on the output relay in a single day;
  - − Setting of the relay switch on period from 0.01 – 99 sec;
  - − Weekly calendar, setting of switch-on days (from Sunday to Saturday).
- **Data from remote sensors** (in NDC-net)
  - − Possibility to display data from 2 remote sensors connected to the NDC-net (e.g. external temperature sensor, humidity sensor, pressure sensor, ...). It is possible to set on the clock the remote sensors whose data will be displayed. If a local thermal sensor is connected, then it is possible to display just one figure from a remote sensor.
- The clock allows **alternate display** of the above data, while the user has the possibility to program the duration of their displaying in the range 0 ÷ 60s (0 – no data displayed).
- **Automatic** (depending on ambient light conditions) or **manual brightness setting** in 15 levels.

2.2 Display

The height of the display elements is 57, 100, 160 or 212 mm (readability up to 23, 40, 70 and 100 m respectively). NDC 57/x and NDC 100/x types use superbright 7-segment LED modules. Other LED colours are possible by agreement for an extra fee. NDC 160/x and NDC 212/x types use superbright elliptic LEDs to ensure their legibility even in direct sunlight (outdoor).

2.3 Synchronisation, precision

- Possibility of external time synchronisation by means of synchronisation modules (e.g. GPS receiver).
- Time display precision:
  – Autonomous time: ±30sec/month (in +20°C ÷ +30°C temperature range);
  – When an external synchronisation module is connected, the precision is given by the precision of the synchronisation.

2.4 Inputs, outputs

- RS485 interface (with galvanic insulation as an option) for the interconnection with other devices in an NDC-net.
- An input for the connection of a local button with or without galvanic separation for controlling the stop watch/counter. The maximum length of the local button's cable is 3 – 5 m (according to the level of interference).
- An input for the connection of a local thermal sensor (max. 5 m)
- Built-in output relay 2 A/250 VAC, which can be closed for 0.1 s – 99 s in the counter mode when the setup limit is reached or as the output of the switch clock.

2.5 Settings

- Time setting manual, wireless via an IR controller or automatic, when an external synchronisation module is connected.
- Manual or automatic LED brightness control based on the external illumination.
- Programming and setting of the clock via a wireless IR controller (max. perpendicular distance 15 m):
  − Time and date setting;
  − Activation of selected display modes (time, date, temperature, stop watch, counter, remote sensor) – intervals of alternating data display;
  − Limit and modes for the counter;
  − Stop watch format;
  − Stop watch and counter control;
  − Enabling/disabling of daylight saving time (DST);
  − Time shifting in the range ±23 hrs 59 min – correct displaying of times in different time zones with external synchronisation;
  − Manual time setting;
  − Counter relay switch-on time setting;
  − Selection of a local or remote sensor 1 in an NDC-net to be displayed;
  − Selection of a local or remote sensor 2 in an NDC-net to be displayed;
  − Selection of the remote input in an NDC-net (only the Master clock, see chapter *2.9 NDC-net communication network* below*)*;
  − Interval of synchronisation with other clocks in the NDC-net (only the Master clock);
  − Switching clock – times and periods of switching-on the internal relay, weekly calendar.

2.6 Modifications and dimensions

- NDC 57/x, 100/x – frame of the clock is made of high-quality anodised aluminium profiles in a matt platinum grey colour with a metallic appearance. Protection class: IP 20. Operation temperature range: -5°C ÷ +50°C.
- NDC 160/x, 212/x – outdoor clock, installed in an internal steel, powder paint coated frame; the external cover frame is made of aluminium profiles in the colour of matt natural anodised aluminium. Protection Class: IP 54. Operation temperature range: -30°C ÷ +50°C.

Display	Width	Height	Thickness	Readability range	Poznámky
NDC 57/4	360	150	38	23 m	wall-mounted
NDC 57/6	460	150	38	23 m	wall-mounted
NDC 100/4	530	200	38	40 m	wall-mounted
NDC 100/6	730	200	38	40 m	wall-mounted
NDC 160/4	685	340	110/217*	70 m	* with tilting wall bracket
NDC 160/6	990	340	110/217*	70 m	* with tilting wall bracket
NDC 212/4	890	400	110/217*	100 m	* with tilting wall bracket
NDC 212/6	1280	400	110/217*	100 m	* with tilting wall bracket

2.7 Power supply

Standard 230 VAC/50 Hz,12 VDC and 24 VDC for extra fee.

2.8 System time network

- Possibility to create unified time systems in an NDC-net without the necessity to use special master clock. The unified time network may contain NDC clocks, a synchronisation time module, remote sensors (e.g. of temperature), remote buttons to control stop watch and the counter and a remote output module (relay), controlled by the so called Master clock (i.e. standard NDC clock setup as the Master, see below).
- Adjustable network clock synchronisation interval in the range 0 – 255 min (only the Master clock).

2.9 NDC-net communication network

At the physical level, the communication network is made by an RS485 interface with the baud rate 9600. Devices with addresses 1 – 127 may be connected to the NDC-net bus, while there must be one NDC type device with a dedicated address 1 in the function of the Master in the system. The bus negotiation and communication control is always controlled by the Master device.

Devices connected to the bus may be of the following types:

- NDC clock – It displays data and, together with a remote controller, provides a user interface for the setting and controlling of the system. The network must contain one NDC clock with the address set to 1 (Master clock), which provides the control of the NDC-net.
- Synchronisation device – its role is to provide precise time to the rest of the devices. The source of that time may be a GPS signal, DCF-77, a PC, an embedded module with an RS485 line and a protocol converter to the NDC-net.
- Sensors – Within the range of the NDC-net they measure general quantities (usually temperature, but also humidity, pressure,...) and, after their processing, they send the data along the network to NDC devices for displaying. Data from one of two sensors may be allocated to each NDC clock. The sensor modules will complement the offer depending on the demand on the market and the development possibilities.
- Remote buttons – They allow to place buttons for controlling the stop watch and the counter into a longer distance from the controlled NDC within the NDC-net.
- Remote access – allows to place the switching relay or an open-collector type output to a longer distance from the controlling NDC within the NDC-net. This output may be controlled only by the Master clock.

3. DISPLAY ACCESSORIES

Depending on the selected version of the connection of displays, the supply is complemented with the necessary accessories.

3.1 Standard accessories

Type of display	Standard accessories
NDC 57/4	Power supply cable flexo 1.5 m
NDC 57/6	
NDC 100/4	
NDC 100/6	
NDC 160/4	Counter piece to power supply
NDC 160/6	
NDC 212/4	
NDC 212/6	

3.2 Optional accessories

Several modules can be connected to the NDC series clocks and to the NDC-net through a communication bus based on RS485, which communicate with the NDC-protocol. The range of such modules will be widened gradually.

4. INSTALLATION OF A DISPLAY

4.1 NDC 57/x, NDC 100/x displays, 230 VAC power supply

Connect a two-wire power supply cable to the power supply terminal on the display's power supply board. The terminals are accessible after the removal of the tiltable part of the rear wall. The cable goes through the bushing in the tiltable part, marked as "230 V". The standard length of the cable is about 2 m. The device includes a melting fuse, located on the power supply board. The details of the power supply terminals can be found in the circuit diagram.

4.2 NDC 160/x, NDC 212/x displays, 230 VAC power supply

The mains power supply connector at the back of the display is marked as "AC 230V". The connection of the mains power supply 230 VAC is done through a 4-pole mains power supply connector with an outlet for the connection of the PE wire. The type of connector and the connection of its pins can be found in the connection diagram. A melting fuse is used in the device and it is located on the power supply board.

4.3 Connection of displays in the NDC-net

Communication connectors are used for the connection of the displays into the communication network. The connectors are located at the back of the display and they are marked as "RS485" and "17 V / RS485". The type of the connector used and its connection are described in detail in the clock's circuit diagram. If some voltage is outlet on a connector's contacts (e.g. +17 VDC, GND), that voltage is then used for powering modules from the optional accessories (temperature sensor, GPS receiver, ...).

The displays are interconnected in parallel by a two-wire or, if necessary, 3-wire communication cable, according to the recommendations for the RS485 interface. The manufacturer recommends to use the FTP 24AWG 4x2x0.53 CAT5 cable, which is largely used in the creation of structured cabling of computer networks. Only one or two pairs of wires of the cable are used.

4.4 Connection of communication modules and optional accessories

The clock is equipped with a communication connector (17 V / RS485), which allows to connect communication modules from optional accessories (GPS receiver, remote thermal sensor, ...).

The modules may be powered by the voltage from the clock, taken out to the communication connectors. In such a case the module is **galvanically connected to the clock and to the NDC-net.** Such a solution is usually suitable when no clock network is created (i.e. 1 clock is interconnected with just 1 module); when the distance between the clock and the module is short (up to about 5 m) or in an environment without industrial interference (however at maximum about 20 m).

In the case of required galvanic separation of devices, it is necessary to use the respective modules in the **modification with galvanic separation** and to provide the powering of the modules from separate power supplies. In such a case galvanic separation of individual devices in the NDC-net between each-other and from the mains is guaranteed. This solution is necessary when the device network is larger, and is installed along power cables, metal piping or near other sources of interference, in an outdoor environment, between buildings, etc. The power supply is connected to the module through a data distribution box, while its distance from the module should not exceed 20 m.

5. SETTING, CONTROLLING AND PROGRAMMING OF THE NDC CLOCKS

5.1 Table of the menu, default settings

MENU	Submenu	Display (alteration parameter/value)	Default setting (after reset)
diSP	**DISPLAY**		
	Time reading period	tMPE	15 s
	Date reading period	dtPE	5 s
	Coundown reading period	CdPE	0 s
	Sensor 1 reading period	S1PE	0 s
	Sensor 2 reading period	S2PE	0 s
	Stopwatch reading period	StPE	0 s
tIME	**TIME**		
	Year setting	yEAr	current
	Month setting	Mon	current
	Day setting	dAy	current
	Hour setting	Hour	current
	Minute setting	Min	current
	Shift of hours setting	Sh_H	0
	Shift of minutes setting	Sh_M	0
	Automatic switching of Daylight saving time on/off	dSt	On
Cnt	**COUNTER**		
	Count direction setting	Cdir	uP
	Limit – days setting	LM_d	0
	Limit – hours setting	LM_H	0
	Limit – minutes setting	LM_M	0
	Limit – seconds setting	LM_S	0
	Relay period setting	rLPE	0
	Counter repeat setting	CrPt	OFF
	Counter correction enable/disable	Ccor	On
Set	**SET**		
	Brightness setting	BriG	15 (max)
	Display address setting	diAd	001 (Master)
	Configuration, see submenu	ConF	–
	Sensor 1 address setting	S1Ad	000
	Sensor 2 address setting	S2Ad	000
	Push-button address setting	PbAd	000
	Remote output address setting	roAd	000
	Synchronization period setting	SyPE	1
	Stopwatch mode setting – for NDC xxx/4	StMo	M99
	– for NDC xxx/6		M59
PrG	**PROGRAM**		
	Switch on time	S_tM	all 00:00
	Relay period	rEL	all 0
	Week days	WdA	all OFF

ConF submenu, network configuration (Configuration)

ConF	Configuration run	run
	Device list	LiSt
	Reset to default settings	rSt

5.2 Layout of IR controller's buttons

▲ up button
► right button
◄ left button
▼ down button

Button	Colour	Description of function
ESC		ESC to one level up
SELECT		Select device
0 – 9		Enter digits
◄/►		Switch between values, DP position, +/-
▲		Move up in the menu
▼		Move down in the menu
OK		Confirmation button
►		Start
II		Pause
■		Stop
RESET		Reset

5.3 Work with the menu, control through the IR controller

In the display mode, the clock does not accept any control codes from the IR controller except the code of the **SELECT** button. That prevents inadvertent simultaneous setting of several clocks, if they are too close to each other (within the range of the IR). When you push the **SELECT** button, the display will show its address in the {Axxx} format, where xxx is a number from the range 0 to 126. The required clock is selected by entering its three-digit address **0 – 9** buttons without the need to confirm. When a correct address is entered, {Menu} will be displayed on the respective clock, which means that the clock is in the setting mode. If an incorrect address is set or the address is not entered within 3 seconds, the display will move automatically into the standard displaying mode. {Menu} will be displayed only upon entering the menu to confirm the correctness of the previous steps, but is it not displayed when browsing in the menu.

Arrow buttons ▲ and ▼ are used for browsing in the menu. A selected submenu should be confirmed by the **OK** button. When the browsing stops in a submenu, after 2 seconds the value of the displayed parameter and its name will be displayed alternately (value for 0.5 sec / name for 1.5 sec). It is possible to continue with browsing also in this mode, until the required parameter is found.

To change the value of a parameter confirm that parameter with the **OK** button – its value will be displayed permanently and it is possible to modify it with numerical buttons. A digit that is being modified will blink. If the value of the parameter is a non-numerical one (ON/OFF, decimal point, minus sign), use the ◄/► buttons to switch to the required value. Confirm the new value by pressing the **OK** button. If the new value is not confirmed within 7 seconds, a move one level up will occur (i.e. to the list of parameters) and the original value will remain unchanged.

If the value being confirmed is outside the allowed range, an error message {Err} will be displayed for 3 sec after the confirmation. In this case no modification of the value being set will occur (the original one will be retained).

In any setting phase it is possible to cancel the setting by pressing the **ESC** button without modifying the parameter being set. This button is used for the return one level up in the menu, up to the complete ending of the menu. If no activity is registered in the setting mode (i.e. the menu) for 60 sec, the display will return automatically into the display mode.

5.4 Data display period setting {diSP}

({MEnu}→){diSP}→{tMPE}
({MEnu}→){diSP}→{dtPE}
({MEnu}→){diSP}→{CdPE}
({MEnu}→){diSP}→{S1PE}
({MEnu}→){diSP}→{S2PE}
({MEnu}→){diSP}→{StPE}

In this menu you can define the periods for which individual data of the clock will be displayed alternately. The respective data is displayed for the set period (e.g. time, {tMPE}) and in the order in which the items are arranged in the menu. If any parameter is set to 0, the respective item will not be displayed.

To start the setting, in the main menu activate the {diSP} item and confirm it with the **OK** button (see Chapter *5. SETTING, CONTROLLING AND PROGRAMMING OF THE NDC CLOCKS*).

The periods of displaying individual data items is specified in seconds, while it is possible to set that parameter for the following items:

{tMPE}	Time Period	default 15;
{dtPE}	Date Period	default 5;
{CdPE}	Coundown Period	default 0;
{S1PE}	Sensor 1 Period	default 0;
{S2PE}	Sensor 1 Period	default 0;
{StPE}	Stopwatch period	default 0.

The range of allowed values of these items is between 0 and 60. If no local or remote (thermal) sensor is connected, it is necessary to leave both {S1PE} and {S2PE} = 0.

5.5 Time setting {tIME}

To set the clock, first it is necessary to activate the {tIME} item in the main menu and confirm it with the **OK** button.

5.5.1 Time setting {Hour}, {Min}

({MEnu}→){tIME}→{Hour}
({MEnu}→){tIME}→{Min}

The time setting consists of the setting of two values:

{Hour} setting of hours in the range 0 – 23;
{Min} setting minutes in the range 0 – 59.

In the case of correct setting and confirming of minutes, **the seconds will be reset** at the moment of confirmation.

Note:

1. *Before the time setting itself, it is necessary to check and set correctly the time zone (shift against the UTC) for which the set time is to be valid (items {Sh_H} and {Sh_M}). This is important for the correct move to the winter/summer time; otherwise the move will occur on an incorrect hour (if automatic switching to the winter/summer time (DST) is enabled, see chapter 5.5.4 Switching between the summer/winter time (Daylight Saving Time) {dSt}). For the Central European Time (CET) the shift is +1 hour, for the UTC/GMT time the shift is 0. When the time zone is set, the clock will display the local time.*
2. *If the local time is set first and the time zone second, the clock will display the shifted time.*

5.5.2 Date setting {YEAr}, {Mon}, {dAY}

({MEnu}→){tIME}→{YEAr}
({MEnu}→){tIME}→{Mon}
({MEnu}→){tIME}→{dAY}

The date setting consists of setting the values of:

{YEAr} setting of the year in the range 0 – 99 for the years 2000 – 2099;
{Mon} month setting in the range 1 – 12;
{dAY} day setting in the range 1 – 31 (or 28, 29, 30, 31, depending on the specific month and year).

5.5.3 Time zones, time shift setting {Sh_H}, {Sh_M}

({MEnu}→){tIME}→{Sh_H}
({MEnu}→){tIME}→{Sh_M}

In order to be able to switch correctly to the summer/winter time and display correctly the time in other time zones (e.g. in Tokyo, New York, etc.), which are shifted against the reference time (UTC), the clock allows to set a time correction (shift) against the synchronisation or internal time by up to ±23 hours and 59 minutes.

Setting of the correction:

{Sh_H} setting of the correction of the time zone, hours in the range ±0 – 23 default 0;
{Sh_M} setting of the correction of the time zone, minutes in the range 0 – 59 default 0.

When setting the hours of the time zone correction {Sh_H}, it is also necessary to specify whether the correction will be added to the internal time or whether it will be subtracted from it. With the ◄/► buttons set the minus (-) sign before the numerical value to subtract the correction or no sign (+) to add the correction.

5.5.4 Switching between the summer/winter time (Daylight Saving Time) {dSt}

({MEnu}→){tIME}→{dSt}

The clock allows to set whether the switchover to the summer/winter time should occur or not.

{dSt} Automatic switching {On}/{OFF} defalult {On}.

If this function is on, the clock will be set to the summer time on the last March Sunday (from 1:00 to 2:00 UTC). When the correct time zone is set, this transition will take place in the correct local time.

This function is just a program one, while it is based on the current time and date, which have to be set correctly (or time synchronisation has to be ensured).

Note: If the clock (clock network) is connected to a synchronisation device (GPS receiver, etc.) which itself provides the correction of the summer/winter time, this function has to be switched off on all clocks otherwise the clocks will show incorrect time during the summer time (1 hr ahead).

5.6 General settings {SEt}

For the general setting of the clock first it is necessary to activate {SEt} item in the main menu and confirm it with the **OK** button.

5.6.1 Brightness setting {BriG}

({MEnu}→){SEt}→{BriG}

The value of the display brightness may be set in 15 levels or an automatic brightness setting, which controls the display's brighness depending on the ambient light, may be set.

When you activate and select the {BriG} item, its current value, 1 – 15 or {Auto} will be displayed. With the up ▲ and down ▼ buttons set the required brightness level. The display will change its brightness accordingly. If {Auto} is set, the display's brightness will be controlled automatically according to the ambient light.

*Note: In contrast with other settings, the set value remains stored in the memory without confirmation. To return to the menu, press the **OK** or **ESC** button, othwewise the return will occur after 7 sec of inactivity.*

5.6.2 Display address setting {diAd}

({MEnu}→){SEt}→{diAd}

The address of a device is used for unique identification of a device in the network of a number of NDC clocks. In general, each device in the NDC-net (NDC, sensor, synchronisation module,...) has to have a unique address.

Address setting:

{diAd} Address setting in the range 1 – 126 default 1.

After the selection and confirmation of the {diAd} parameter the current value of the address will be displayed. The range of the allowed values of the address is 1 – 126. Address 0 is reserved as the global one for addressing all connected devices, address 127 is reserved for the device that provides the time synchronisation, e.g. a GPS synchronisation module.

In each NDC-net in which synchronisation is required, one NDC clock has to be set as the Master. The Master has **a dedicated address 1**, i.e. the Master is specified by setting that address. Master also secures the control of the whole NDC-net. In the case of non-existence or availability of a synchronisation device, it also takes over the time synchronisation.

Note: Even if just one NDC clock is interconnected with a synchronisation device (e.g. GPS), it has to be set as the Master (i.e. address 1).

5.6.3 Network configuration {ConF}

({MEnu}→){SEt}→{ConF}

See a detailed description in a separate chapter 6. *INSTALLATION AND CONFIGURATION OF THE NDC-net*.

5.6.4 Allocation of sensors, temperature display, address setting {S1Ad}, {S2Ad}

({MEnu}→){SEt}→{S1Ad}
({MEnu}→){SEt}→{S2Ad}

An NDC-net may contain any number of sensors and NDC clocks (up to the maximum number of enabled addreses). An NDC clock may display data from at maximum two sensors. By entering addresses {S1Ad} and {S2Ad} you will specify from which sensor the data will be displayed. The data from a single sensor may be displayed on a number of NDC clocks, notably on those that have its address in the items {S1Ad} or {S2Ad}.

If a local thermal sensor is connected and there is a requirement to display that temperature on the respective clock, it is necessary to set the {S1Ad} or {S2Ad} address equal to the given clock (= {diAd}). So, for example, if you want to display the local temperature on the clock with address “A005”, set the sensor’s address, {S1Ad} or {S2Ad} on that clock to “A005”. If no sensor is connected, the display will display dashes (- - - - - -) on all positions.

If you want to display a data from a remote sensor (if it is connected), it is necessary to set the adresss fo that remote sensor. You can find the address in the list of devices in the network (see chapter *6.3 Viewing of the list of devices {LiSt}*). So, if, for example, you want to display the temperature of a remote sensor whose address is “A043” on the display, set the address of the sensor, {S1Ad} or {S2Ad}, on that clock to “A043”. If the remote sensor with address “A043” is connected correctly, the clock will show its data, otherwise the text {noSEnS}, (NDC xxx/6) or {noSE} (NDC xxx/4) will be shown, which means that there is no sensor with that address in the network or there may be problems with the communication with that module.

If there is a synchronisation module with an integrated thermal sensor in the NDC-net and there is a requirement to display its temperature data on some clocks, it is necessary to set the address of that sensor, {S1Ad} or {S2Ad}, to „A127” on those clocks, since the address of the synchronisation module is fixed (“A127“). The addresses of the rest of the modlules are configurable by DIP switches on them.

Note: For the future, it is counted with the development of sensor modules that will provide display data (e.g. module providing details of temperature and humidity, temperature and atmospheric pressure...). If it is necessary to display both details, for both parameters, {S1Ad} and {S2Ad}, it is necessary to set the same address of the remote sensor. Figure 1 will be displayed in the display interval {S1PE} and Figure 2 in the display interval {S2PE}.

5.6.5 Allocation of the remote button, address setting {PbAd}

({MEnu}→){SEt}→{PbAd}

If it is necessary to control the stopwatch/counter from a remote location, it is possible to use the remote output module. With that module it is then possible to control the stopwatch and counter functions within the range of the NDC-net communication network.

With one remomote input module it is possible to control those stopwatches and counters running on different NDC clocks that have its address set by item {PbAd}. In an NDC-net it is also possible to connect a number of remote input modules and allocate them to individual clocks by means of the {PbAd} address.

5.6.6 Allocation of a remote input, address setting {roAd}

({MEnu}→){SEt}→{roAd}

In an NDC-net it is possible to connect a remote output module, which has one switching relay output and one open collector output. These outputs can be controlled only by the Master clock (address “A001”). On the master clock it is therefore necessary to set the address of the remote output {roAd} identical with the address of the remote output module. The events at which outputs on a remote module are activated are identical with the events at which the internal relay on the clock switches, i.e. when the counter limits are reached or when the switching tooks place in the switching clock mode. The period of output module relay

switch on state is identical with the set switch on state of the internal relay set by {rLPE} or {rE0} – {rE15} in the {rEL} submenu.

5.6.7 Setting of the time synchronisation period {SyPE}

({MEnu}→){SEt}→{SyPE}

The time synchronisation period specifies how often an NDC clock or a network of NDC clocks will be synchronised in an NDC-net. If there is no synchronisation module in the network, of if it does not sent synchronisation data into the network, the synchronisation role is taken upon by the clock with address "A001", so-called Master clock. The period is specified in minutes.

{SyPE} period setting in the range 0 – 255 defalult 1.

If 0 is set, the time synchronisation is switched off, i.e. the clock (or a clock network) is not synchronised.

5.6.8 Stopwatch mode setting {StMo} (only for 6-digit NDC clocks)

({MEnu}→){SEt}→{StMo}

6-character stopwatch (NDC xxx/6) can work in two modes:

a/ In the hourly mode {M_59}
In this mode, when 59 minutes and 59 seconds are reached, the stopwatch will move to a new hour (0:59:59 →1:00:00→...→99:59:59).

b/ In the minute mode {M_99}
In this mode, after reaching the state 59 minutes and 59 seconds, the stopwatch will continue with counting minutes up to 99th minute (0:59:59 →0:60:00→...→0:99:59).

After reaching the maximum time, the stopwatch will start counting from the beginning.

Setting of the mode.

{StMo} setting of {M_59}/{M_99} (hour/minute mode), NDC xxx/4 default {M_99};
NDC xxx/6 default {M_59}.

After choosing the {StMo} parameter, the display will show the current mode of the stop watch. By the *Switch between values* button ◄/► it is possible to switch between the hour and minute mode of the stopwatch.

Note: The 4-digit clock (NDC xxx/4) always works in the minute mode of the stopwatch, i.e. up to 99:59.

5.7 Stopwatch

The NDC clock may be used in the stopwatch mode. For displaying stopwatch data, it is necesssary to set the {StPE} parameter to the required period of displaying, see chapter *5.4 Data display period setting {diSP}*. If you want to ensure only the displaying of the stopwatch, set the parameters for the rest of the displayed data to 0.

Types NDC xxx/4 display the time measurement by distinguishing of seconds:hundreths of seconds, with automatic switching to minutes:seconds when seconds are filled up, up to the maximum 99:59. NDC xxx/6 types allow to work in two modes, so-called hourly one (up to 99:59:59) and a minute one (up to 0:99:59). See more detailed information in chapter *5.6.8 Stopwatch mode setting {StMo} (only for 6-digit NDC clocks)*.

If the stopwatch is not stopped, when it reaches the maximum displayed value according to the selected mode, it is reset automatically and continues with the measurement from the beginning.

5.7.1 Control of the stopwatch

The stopwatch can be controlled only if the measured time is currently shown on the display (e.g. in the case of alternating display together with other data). Therefore we recommend not to alternate the stopwatch display with other data and to display it alone.

5.7.1.1 Stopwatch control by a remote controller

When the clock is switched on or when it is reset, the display will show 00:00:00 or 00:00 and it is ready for further operation.

The stopwatch is started by the **START** ► button. If the **PAUSE** ⏸ button is pressed during the running, the display will "freeze" the current value of the measured time (intermediate time), which the measurement will continue in the background. After the pressing of the **START** ►button again the display will show the measured time again.

If, during the measurement you press the **STOP** ■ button, the display will show the current value of the measured time and stop the measurement. When you press the **STOP** ■ button when an intermediate time is displayed (i.e. after the previous pressing of the **PAUSE** ⏸ button) the time measurement running in the background will stop and the final time will be displayed.

If the stowatch is in the stop mode, it is possible to start it again with the **START** ►button from the measured time it displays.

The resetting of the stopwatch is done by the **RESET** button, but in order to do that, the time measurement must be stopped (stop condition after pressing the **STOP** ■ button).

5.7.1.2 Control of the stopwatch by a local button (TRIGGER INPUT)

The local button must be connected to the TRIGGER INPUT, see the connection diagram. This method of control only supports the START and PAUSE functions, which are implemented by a short pressing of the button (< 2.5 seconds). To activate the RESET button, you need to keep the button depressed for more than 2.5 seconds.

Let us assume a reset state of the stopwatch (00:)00:00 (after switching on or reset). Short pressing of the button will start a time measurement (intermediate time), while the measurement will keep running in the background (PAUSE). After the next pressing of the button, the measured time will be displayed again (START), and so on.

The resetting of the stopwatch is done by a long pressing of the button in the PAUSE state.

5.7.1.3 Control of the stopwatch by a remote button

The remote button must be connected to the NDC-net and its address must be allocated to the clock/stopwatch that is to be controlled by it, see chapter *5.6.5 Allocation of the remote button, address setting {PbAd}*.

The stopwatch is controlled in the same way by the local button.

5.8 Counting up/down (Counter) {Cnt}

The counter allows to work in one of two modes, specifically the UP mode or the DOWN mode. In the UP mode, the counter counts the time from the value (00:)00:00 up until a preset value. In the DOWN mode the counter counts the time from the set value downwards to (00:)00:00. When the end of the interval is reached, the built-in relay is switched on, while the duration of the switch-on state can be adjusted. In the settings it is also possible to choose whether after ending the counting up/down the whole cycle is started again and how the time counting should behave when the internal time setting is changed from outside.

During counting up/down, time is shown in the following format:

a) NDC xxx/4

DD **.** HH	the dot blinks each second;
HH **:** MM	the colon blinks each second;
MM : **SS**	the colon is on permanently, seconds change;
SS	seconds change.

b) NDC xxx/6

DD . HH **:** MM	the colon blinks each second;
HH : MM : **SS**	the colon is permanently on, seconds change;
MM : **SS**	seconds change;
SS	seconds change.

A detailed description of the above properties is contained in the following chapters, so please read them carefully.

5.8.1 Counting direction setting {Cdir}

({MEnu}→){Cnt}→{Cdir}

To count time up, please select the UP mode [the counting starts on (00:)00:00 and ends on a preset limit], to count time down, choose the DOWN mode [the counting starts on a preset limit and ends on (00:)00:00].

Setting of the count direction (mode):

{Cdir} (counting direction) {uP}/{dn} default UP.

The {uP}/{dn} values are switched between by the ◄/► buttons and confirmed by the **OK** button.

5.8.2 Counting limit setting {LM_d}, {LM_H}, {LM_M}, {LM_S}

({MEnu}→){Cnt}→{LM_d}
({MEnu}→){Cnt}→{LM_H}
({MEnu}→){Cnt}→{LM_M}
({MEnu}→){Cnt}→{LM_S}

In this menu, the start or end value of the limit is set (according to the selected counting direction). The limit is in the format: days:hours:minutes:seconds (DD:HH:MM:SS), while individual items are set separately.

For the setting, in the main menu it is necessary to activate the {Cnt} item and confirm it by the **OK** button (see chapter *5. SETTING, CONTROLLING AND PROGRAMMING OF THE NDC CLOCKS*).

Limit setting:

{LM_d}	Limit – days	default 0;
{LM_H}	Limit – hours	default 0;
{LM_M}	Limit – minutes	default 0;
{LM_S}	Limit – seconds	default 0.

Ranges of the allowed values of limit items:

{LM_d}	days	0 – 99 as a standard;
{LM_H}	hod.	0 – 23 as a standard (0 – 99 when ignoring the {LM_d} value setting);
{LM_M}	min.	0 – 59 as a standard (0 – 99 when ignoring the {LM_d}, {LM_H} value setting);
{LM_S}	sec.	0 – 59 as a standard (0 – 99 when ignoring the {LM_d}, {LM_H}, {LM_M} value setting).

Note:
Upon entering a non-standard value for any item, all items with a larger time value will be ignored. This allows to adjust counting to special requirements.

Example after setting	*DD : HH : MM : SS*	*the accepted value will be*	*DD : HH : MM : SS*
	23 : 19 : 59 : 30		*23 : 19 : 59 : 30*
	15 : 87 : 24 : 14		*00 : 87 : 24 : 14*
	05 : 87 : 94 : 10		*00 : 00 : 94 : 10*

5.8.3 Output relay control, switch on time setting {rLPE}

({MEnu}→){Cnt}→{rLPE}

In both modes of the counter it is possible to select the activation of the output relay upon reaching the end of the set interval - limit. Each NDC clock on which a counter is running, may activate its local relay output. Through this menu the relay on period upon reaching the counter limit is set {rLPE}

{rLPE} relay period 0 – 99 sec (0.01 – 0.99 sec; 0.1 – 9.9 sec; 1 – 99 sec) default 0.

The on period is set in seconds. The value is entered as a double-digit number, while the position of the decimal point is set by the ◄/► buttons as necessary a nd confirmed by the **OK** button.

It is also possible to control a remote output by a counter event. A precondition for that is that the remote output must be allocated to that clock (see chapter *5.6.6 Allocation of a remote input, address setting {roAd}*) and the clock must be set as a Master. Then the output will be switched on simultaneously with the internal relay.

Note:
1. *If the set relay on period is 0 sec, the relay will not be switched on **at the selected time**!*
2. *Switching of the relay is signalized by the LED in the right lower corner (after second or minute reading), that is turned on all the time while relay is switched on.*

5.8.4 Counter repeat setting {CrPt}

({MEnu}→){Cnt}→{CrPt}

The {CrPt} parameters specifies how the counter should behave when it reaches the limit. If ON is set, when the counter reaches the limit, it will startu up again. If OFF is set, when the counter reaches the limit, it will keep displaying the end value. In the UP mode it will be the set time limit and in the DOWN mode it will be (00:)00:00.

{CrPt} counter repeat enabled {On}/{OFF} default OFF.

Note: If the relay on period {rLPE} > 0 s, the relay will be stitched on for the whole set period, irrespective of whether the counter started counting again or not ({CrPt} = On).

5.8.5 Enabling of the counter's time correction {Ccor}

({MEnu}→){Cnt}→{Ccor}

If the ON options is chosen, the final period of the counter's counting up/down period will be identical with the set period irrespective of whether during the counting up/down there is or there is not a change in the setting of the NDC clock. The time of ending the counting therefore can differ from the expected period of counting. A change in the time may occur deliberately by resetting the clock by a remote control or automatically by receiving synchronisation from an NDC net (from the synchronisation module or from the Master clock).

If the the selected option is OFF, the counting up/down period wil be shorter or longer by the difference caused by a change in the time, it will however, end at the pre-set time.

{CrPt} Counter correction {On}/{OFF} default On.

5.8.6 Controlling of the counter

The counter may be controlled only when the time counted up/down is currently displayed on the display (e.g. when altered with other data). Therefore it is recommended not to alter the counter data with other data and to display them alone.

5.8.6.1 Controlling the counter by a remote controller

The counter is started by pressing the **START ►** button. If, during the counter's running, no control button is depressed, the counter will count up to the value of the set limit (in the UP mode) or down to (00:)00:00 (in the DOWN mode). If automatic starting restarting of the counter is enabled ({CrPt} item), when the counter reaches the limit, it will be started again from the beginning.

If you depress the **PAUSE II** button when the counter is running, the display will "freeze" the current value of the counted time (intermediate time), while the counting up/down of the time runs in the background. After pressing the **START ►**again, the display will display the time counted up/down.

If you press the **STOP ■** button during the counter's running, the display will show the current value of the counted time and stop the counding up/down. The pressing of the **STOP ■** button during the dispaying of the intermediate time (i.e. after previous depressing of the **PAUSE II**) the counting up/down of the time that was running in the background will stop and the resulting time will be displayed.

If the counter is in the "stop" condition, it is possible to start it again with the **START ►**button from the time it displays.

The counter's reset is done by pressing the **RESET** button, the counting up/down of hte time, however, must be stopped (stop condition after pressing the **STOP ■** button).

5.8.6.2 Controlling the counter by a local button (TRIGGER INPUT)

The local button must be connected to the TRIGGER INPUT, see the connection diagram. This method of controlling supports only the START and PAUSE functions, which are implemented by a short pressing of the button (< 2.5 sekunds). For the RESET function it is necessary to keep the button depressed for more than 2.5 seconds.

Let us assume the initial state of the counter after power on or after a reset, showing (00:)00:00 (for counting up) or the preset limit (for counting down). A short depressing of the button will start the time counting (START), a short repeated depressing will "freeze" the current value of the counted up/down time on the display (intermediate time), while the counting up/down of the time runs in the background (PAUSE). By further pressing of the button, the display will show again the counted up/down time (START), and so on.

The counter's reset is done by a long depressing of the button in the PAUSE state.

5.8.6.3 Controlling of the counter by a remote button

The remote button must be connected into the NDC-net and its adddress must be allocated to the clock/counter that is to be controlled by it, see chapter *5.6.5 Allocation of the remote button, address setting {PbAd}*.

The counter is controlled in the same way as in the case of a local button.

5.9 Switch clock, time interval programming {PrG}

The clock allows to set up to 16 times of switching on the output relay in a single day, the period of the switch-on state of the relay and a weekly calendar when the switching is active. In order to switch on the relay, the following conditions have to be met:

1. The switch on time has arrived and;
2. The relay switch on period > 0 s and;
3. The day given in the weekly calendar is set as active.

If at least one of the above conditions is not met, the relay will not switch on!

The programming of the time intervals is first necessary to activate in the main menu by the {PrG} item and then confirm it with the **OK** button.

5.9.1 Setting the switch on times {S_tM}

({MEnu}→){PrG}→{S_tM}→{tM0}→...→{tM15}

In this part of the menu you can set up to 16 times, {tM0} through {tM15}, at which the output relay of the clock will be activated for the required period. When choosing the {S_tM} item, set the time of swithing on that is to be set with the arrow buttons ▲ / ▼. After confirming with the **OK** button you can enter the required value.

{tM0}	Relay switch on time 00:00 through 23:59 (HH:MM)	default 00:00;
...	...	...
{tM15}	Relay switch on period 00:00 through 23:59 (HH:MM)	default 00:00.

The switch on time is set in minutes. It is suitable to occupy the sequence starting from {tM0}.

5.9.2 Setting of the relay switch on period {rEL}

({MEnu}→){PrG}→{rEL}→{rE0}→...→{rE15}

By this menu you set the relay switch on times {rE0} thorugh {rE15}, which correspond with the switching times {tM0} through {tM15}, i.e. the period {tM0} corresponds with the switch on time {rE0}, etc. ({rE0} ≈ {tM0}, {rE1} ≈ {tM1}, ...). After selecting the {rEL} item, select the time {rE0} through {rE15}, and period of the switch on state to be set with the ▲ / ▼ buttons. After confirmation with the **OK** button enter the required value.

{rE0}	Relay switch on period 0 – 99 sec (0.01 – 0.99 sec; 0.1 – 9.9 sec; 1 – 99 sec)	default 0;
...	...	...
{rE15}	Relay switch on period 0 – 99 sec (0.01 – 0.99 sec; 0.1 – 9.9 sec; 1 – 99 sec)	default 0.

The switch on period is in seconds. The value is set as a two-digit number, while the position of the decimal point is set with the *Switch between values* button ◄/► as necessary.

If no remote output is allocated to the clock (see chapter *5.6.6 Allocation of a remote input, address setting {roAd}*) and the clock is set as a Master, the output will be switched on simultaneously with the internal relay.

Note:

1. *If the set relay on period is 0 sec, the relay will not be switched on **at the selected time**!*
2. *Switching of the relay is signalized by the LED in the right lower corner (after second or minute reading), that is turned on all the time while relay is switched on.*

5.9.3 Weekly calendar, setting of switch-on days {Wda}

({MEnu}→){PrG}→{Wda}

Each day in a week (Monday to Sunday) can be allocated an {ON} or {OFF} value, which defines, whether the relay will be switched on in a given day. If the respective day has the {On} flag (e.g. during workdays Monday – Friday), the relay switching function at the set time during a day will be active. And vice versa, if a respective day has the {OFF} flag (e.g. weekends), the relay will not be switched on that day.

After selecting the {Wda} item, select the required day with the ▲/▼ buttons. After confirmation with the **OK** button, the current value will be displayed. The required activity state (ON/OFF) can be set with the ◄/► buttons and confirmd with the **OK** button.

{Sund}	activity on/off state ({On}/{OFF})	default {OFF};
{Mond}	activity on/off state ({On}/{OFF})	default {OFF};
...	...	...
{SAtu}	activity on/off state ({On}/{OFF})	default {OFF}.

The names of the days shown in the display are abbreviations of the English names of the days (see the table).

Display	***Meaning***
{Sund}	Sunday
{Mond}	Monday
{tuES}	Tuesday
{Wen}	Wednesday
{thur}	Thursday
{Frid}	Friday
{SAtu}	Saturday

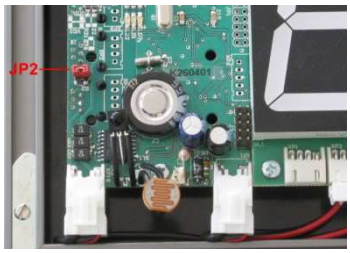
6. INSTALLATION AND CONFIGURATION OF THE NDC-net

6.1 Connection into the NDC-net (Master setting, RS485 terminating resistor)

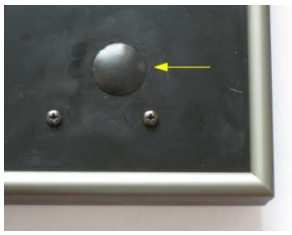
Before the connection into the communication network, gradually set unique addresses for all devices that are going to be connected into the network and allocate the “A001” address to just one NDC device (clock), i.e. set it to be the Master.

Connect the devices into the RS485 network. On the RS485 bus ending devices terminating resistors must be connected (i.e. on the first and last devices on the bus). There are two versions of NDC clocks:

1. Shorting jumper JP2 is accessible from inside of the device (PCB 260-4). In order to get access to the CPU board, it is necessary to open the display by loosening 4 allen screws at the back of the display, countersunk into the perimeter frame ((NDC 57/...m, NDC 100/...m). Terminating resistor 120R is connected by inserting a shorting jumper on the JP2 pins (see fig.). **If the pins are open, terminating resistor is not connected.**



2. Shorting jumper JP2 is accessible from outside of the device (PCB 260-5). There is visible blinding plug on the lower right corner of the NDC 57/x and NDC 100/xm clock rear panel (see the left fig.). Remove the plug by gently picking it up on the side using a wide flat screwdriver, avoid scratching the paint. When the plug is removed shorting jumper is accesible by fingers or needle nose pliers. Terminating resistor 120R is connected by inserting a shorting jumper to the ON position of JP2 pins. **If the jumper is in the OFF position, terminating resistor is not connected** (see the right fig.).



Finally, connect the power supply and test the synchronisation, e.g. by allowing all other clocks except the Master one to have deliberately set incorrect time and letting them to by synchronised with the Mater clock after they are connected into the NDC net after a period set under the {SyPE} parameter.

6.2 Configuration of the network {run}

({MEnu}→){SEt}→{ConF}→{run}

During the configuration of the network, the ID table of devices in the NDC Master clock is zeroed. Then the Master clock gradually addresses to all devices (addresses) in the whole range 2 – 127. The addressed devices, which are physically connected to the NDC-net, return their addresses, types of device and other data. The Master clock records those devices gradually into its ID table of devices. On the basis of a compiled ID table, the Master will setup a hierarchy, timing and sequence of addressing individual devices for further communication.

On the clock set as the Master, select the Network Configuration, {ConF}. Then with the ▲/ ▼ buttons browse to {run} and confirm by pressing **OK**. This item is not available, if the device does not have the address set to 1. Immediately after starting the configuration, the display will go off for about 5 seconds and then, after about 7 seconds, it will display a blinking text {buSY}. When an ID table is created, the clock will show {donE} and return to {run} in the {ConF} submenu.

During the configuration of the network, it is not allowed to:

− Activate any NDC through the remote controller;

− Disconnect or connect power supply to/from individual devices;

− Disconnect or connect communication cables between devices;

Otherwise the ID table of devices may not correspond with the reality and the configuration may have to be repeated.

6.3 Viewing of the list of devices {LiSt}

({MEnu}→){SEt}→{ConF}→{LiSt}

The list of found devices (ID table) can be viewed by activating the {LiSt} item. This item is not available, if the NDC device does not have its address set to 1. You can browse in the list with the ▲ /▼ buttons, and thus display type abbreviations of all found devices. 2 seconds after the browsing is stopped the address of the device and its type are displayed alternately (address for 1.5 sec, type for 0.5 sec). The list of possible types of devices and their abbreviations is contained in the table below. The address of a device is shown in the {Axxx} format, where xxx is the number between 1 and 127.

Display	***Type of device***
{ndc}	NDC clock
{SEnS}	remote sensor
{Sync}	synchronisation device
{SE:Sy}	synchronisation module combined with a thermal sensor
{butt}	remote input
{outP}	remote output

If there are fewer connected devices on the list than in reality, it is necessary to check:

1. Whether the missing devices have connected power supply;
2. Whether the missing devices are connected properly to the NDC net;
3. Whether the missing devices have set the same address.

7. BACKUP OF DATA DURING A POWER CUT

7.1 Time, date

The time date **is backed up** by a built-in backup capacitor, which allows to maintain the correct time for the period of several days without power supply. When the power is connected, the electronics ensures continual recharging of the backup capacitor, so it does not require any maintenance.

7.2 Stopwatch

The stopwatch **data are not backuped**, i.e. after a power cut or power up of the clock, the stopwatch data will always be (00:)00:00, i.e. the stopwatch will be zeroed irrespective of the condition in which it was at the time of the power cut.

7.3 Counting up/down (Counter)

Counting of the time up/down is **is backed up** and it remains active also when the clock is off (i.e. without power supply) and irrespective of the state in which the counter was at the time of the switching off (active, pause, ...). During the time in which the NDC clock was off, the relay output cannot be activated. If the clock in the counter mode is switched off for a time that is longer than the time up to the end of the set limit, and the activation of the relay output is enabled, when the power supply is resumed, the relay output will be switched-on immediately.

8. RESET – RESTORING OF ORIGINAL VALUES {rSt}

({MEnu}→){SEt}→{ConF}→{rSt}

A reset will restore the original settings of the clock, see chapter *5*

Table of the menu, default settings. After selecting the {ConF} item with the ▲ /▼ arrows, browse to the {rSt} and confirm by pressing the **OK** button. During the setting of the defalut values, the display will go off for about 2 s and then it will show {donE} and the clock will return automatically into the display mode.

9. SERVICE CENTER ADDRESS

In case of a display failure, please contact the manufacturer directly:

ELEN, s.r.o.
Lubochnianska 16
080 06 Lubotice
SLOVAKIA

Tel.: +421 / 51 77 33 700
+421 / 51 75 99 140

Fax: +421 / 51 75 99 142

GSM gate: +421 / 911 637 716
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http: www.elen.eu