LUMEL

PANEL MOUNTED METER
TYPE N21

USER'S MANUAL

CE

Contents

1. APPLICATION AND METER DESIGN

The N21 meter is a digital programmable panel mounted instrument designed to measure d.c. voltages or d.c. currents: unipolar or bipolar, temperature with use of thermocouples J (Fe-CuNi), K (NiCr-NiAl) and Pt100 resistance thermometers. The readout field is an OLED graphic display with a resolution of 32x128 points.

The eCon program is designed for the configuration of the N21 meter. The meter should be connected to a PC via a miniUSB connector located on the rear of the meter. Following parameters can be set:

- measuring input
- display precision of the result (decimal point)
- relay output operating mode
- thresholds triggering the relay output
- time delays of the relay output triggering
- individual characteristic for measuring signal
- automatic or manual temperature compensation of cold junctions
- averaging time of the measurement
- user-defined units of measured signal
- display language

Meter output signals are isolated from the input signals and power supply.

Figure 1. View of the meter

2. METER SET

Complete set of the meter includes:
- N21 meter..... 1 pc
- clamps to fix in the panel..... 4 pcs
- seal..... 1 pc
- user's manual..... 1 pc
- guarantee card ..... 1 pc
- CD ..... 1 pc

Accessories:
For the N21 meter you can order:
– USB CABLE A/miniUSB-B - 1m BLACK; Order code 20-069-00-00150.

3. BASIC REQUIREMENTS, OPERATIONAL SAFETY

The symbols in the manual mean:

Warning!
Warning of potentially hazardous situations. Especially important to be aware of before connecting the device. Failure to follow the directions marked by this symbol could result in serious injuries of the personnel and damage of the device.

Caution!
Useful notes. The notes should facilitate the operation of the device. Should pay attention, if the device is not working as expected.
Possible consequences in case of ignoring information!

In terms of operational safety the meter meets the requirements of the EN 61010-1 standard.

Comments concerning safety:

- Assembly and installation of the electrical connections should be made only by people authorized to perform assembly of electric devices.
- The person installing the meter is responsible for ensuring the safety of the implemented system.
- Always check the connections before turning the meter on.
- Opening the meter housing gives access to the live parts. The supply must be switched off and the measuring circuits disconnected before removing the meter housing.
- Removal of the meter housing cover during the warranty period voids the warranty.
- The meter is designed to be installed and used in the industrial electromagnetic environment conditions.
- The building installation should have a switch or a circuit-breaker installed. This switch should be located near the device, easy accessible by the operator and suitably marked.
- In case of damage, the meter can to repaired only by manufacturer's authorized service.
- Check the correct operation of the meter before it is used for measuring after a repair.
- Connection and/or using the meter in a way which is not compliant with the user's manual, may cause deterioration of the degree of protection.

4. INSTALLATION

4.1. Mounting

The N21 meter has separable strips with the screw terminals which enable the connection of external supply wires of 2.5 mm^2 and signal wires of 1.5 mm^2.

You must prepare a $92^{+0,6}$ x $45^{+0,6}$ mm cut-out in the panel. The thickness of the panel material should not exceed 6 mm. The meter should be mounted from the panel front with disconnected supply voltage. Check the correct position of the seal before placing the meter into the panel. When the panel is inserted in the slot, mount it in the panel with the mounting brackets (Fig. 2).

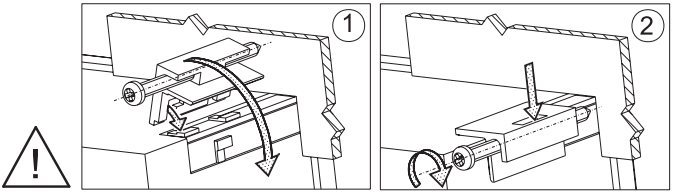


Figure 2. Meter fitting

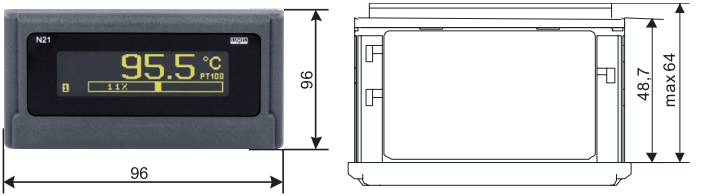


Figure 3. Meter dimensions

4.2.External Connection Diagrams

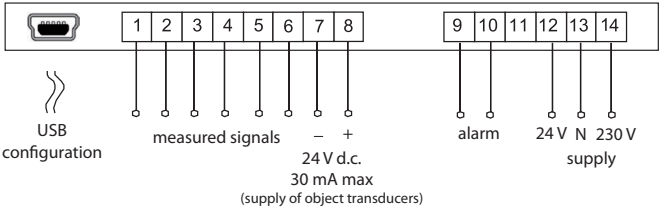
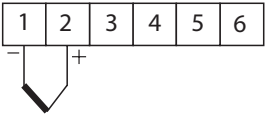


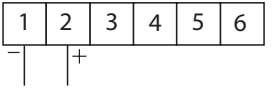
Figure 4. Electrical connections of the N21 meter

Comment concerning safety:

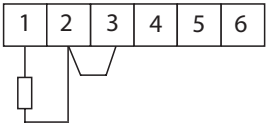
The meter is provided with a universal power supply that allows operation in a wide range of input voltages 22..253V a.c / 20..300V d.c. Life-threatening voltage also appears at the terminal 12 of the meter in the case of the use of the input terminals 13-14.



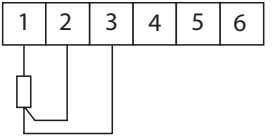
thermocouple J,K



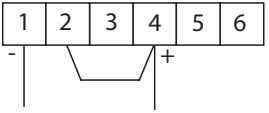
voltage input ±60mV



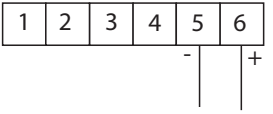
Resistance thermometer
in a 2-wire system



Resistance thermometer
in a 3-wire system



current input ±20mA



voltage input ±10V

Figure 5. Connections of measuring signals

5. OPERATION

5.1.Display description

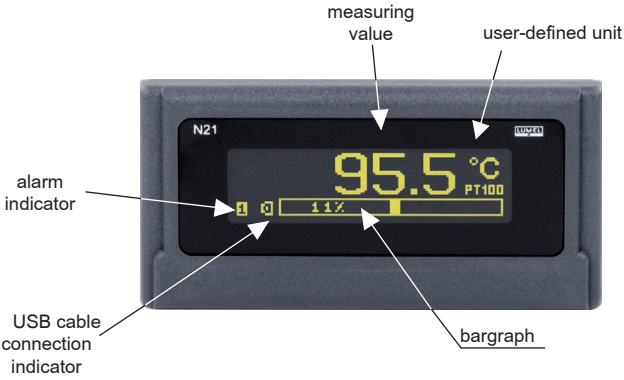


Figure 6. Front panel

5.2 Power-on status indication

The display shows information about the manufacturer, device type and software version after switching the supply on. Then the meter starts to show the measuring values according to the current configuration.

5.3. Device configuration using e-Con program

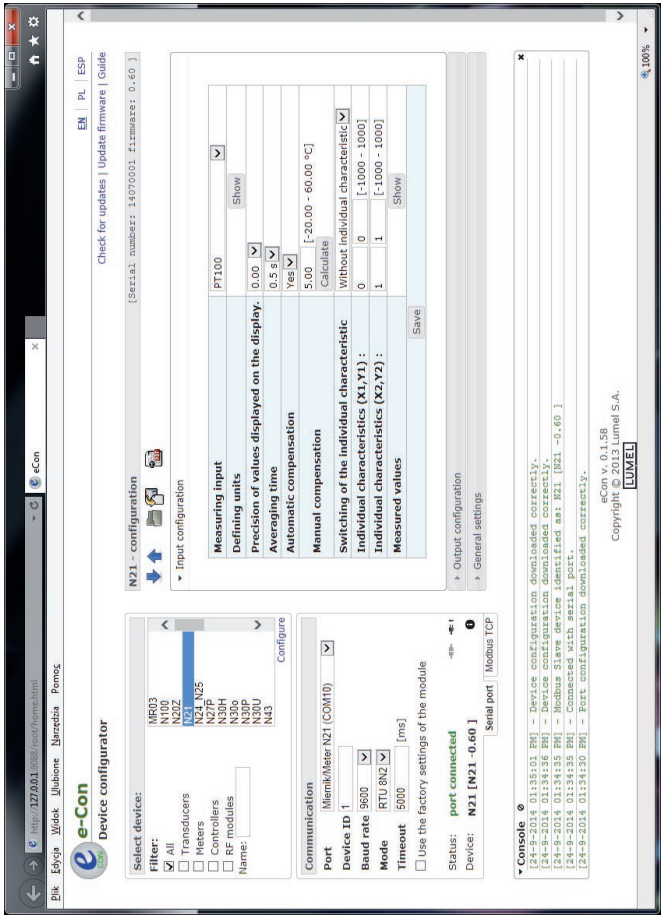


Figure 7. e-Con program window

The eCon program designed for configuration of the N21 meter is available at the manufacturer's website (www.lumel.com.pl). The meter should be connected to a PC via USB cable. The USB drivers will be installed and a new serial port will appear on the first connection. When the eCon program starts, select the port on which the device is installed in the area "***Communication***", set the transmission parameters (baud rate 9600, mode RTU 8N2), and then click the icon "***connect***".

Before changing a configuration you should read and save the current configuration for future restore the settings. You can save the parameters to a file, read from a file, as well as export the configuration to a pdf file using the eCon menu (Fig. 8).

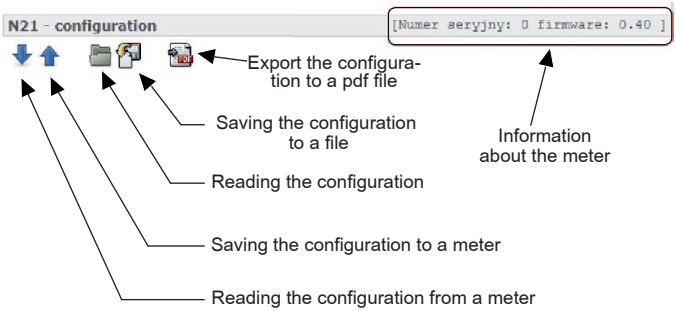


Figure 8. Read, write and export settings

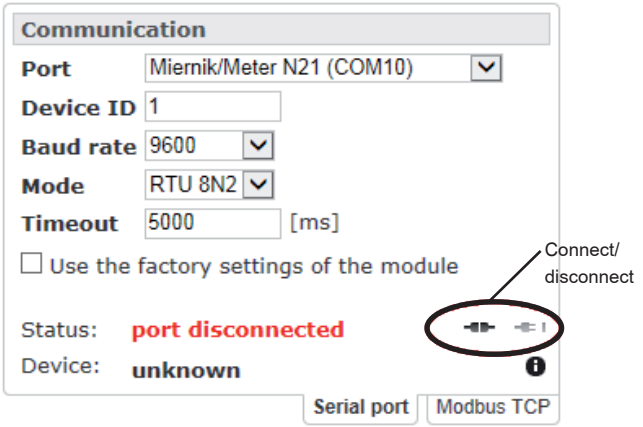


Figure 9. Establishing connection to N21 meter

5.3.1 Configuration parameters

After establishing a connection, there are configuration parameters of the meter on the right side of the program window.

Table 1

Parameter name	Parameter description	Range of parameter change	Range of parameter change
Input Configuration tab			
Measuring input	Type and range of the input signal	Voltmeter +/- 10 V Millivoltmeter +/- 60 mV Milliammete +/- 20 mA Pt100 thermocouple J thermocouple K	Voltmeter +/- 10 V

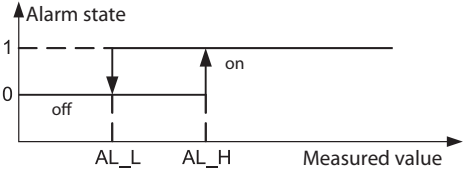
Defining units	TDesigning a pictogram representing the symbol of measuring value unit using the graphical editor. Designed pictogram can be uploaded to the meter or saved to a file. Figure 12.	Figure 13	-
Precision of the displayed values	Choice of precision of the displayed values	0 0.0 0.00 0.000	0.0
Averaging time	Averaging time of the measurement results.	0.5 s 1 s 3 s 5 s 10 s 15 s 20 s	0.5 s
Automatic compensation	Automatic temperature compensation of the thermocouple cold junctions or a line resistance for Pt100 sensor.	None On	On
Manual compensation	It is possible to set a temperature value, which will be corrected by the measurement result if an automatic temperature compensation of the thermocouple cold junction or a line resistance is disabled.	-20.00 – 60.00 °C	0.00

Enabling individual characteristic	Enabling the value of the input signal conversion to the displayed value according to the linear characteristic of user-defined coefficients.	Without individual characteristic Characteristic enabled	Without individual characte-ristic
Individual characteristic (X1,Y1)	User-defined first point of the individual characteristic. Figure 11.	-1000 - 1000	X1 = 0, Y1 = 0
Individual characteristic (X2,Y2)	User-defined second point of the individual characteristic. Figure 11.	-1000 - 1000	X2 = 1, Y2 = 1
Measuring values	Preview of the current measuring values	Figure 12.	-
Output Configuration tab			
Relay output operating mode	The method of triggering the alarm output depending on the input signal alarm thresholds. The H-OFF mode disables the output permanently, H-ON activates the output permanently. Other modes as shown in Figure 10.	H-OFF H-ON N-OFF N-ON OFF ON	H-OFF
Low threshold triggering the relay output	Lower threshold of the input signal causing the alarm output reaction (AL_L at Fig. 10)	-1999.9 – 1999.9	60.0
High threshold triggering the relay output	Upper threshold of the input signal causing the alarm output reaction (AL_H at Fig. 10)	-1999.9 – 1999.9	80.0

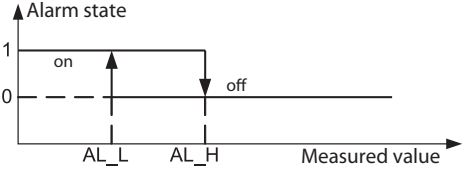
Relay activation delay	Relay activation delay relating to changes of the input signal	0 – 3600 s	0
Relay deactivation delay	Relay deactivation delay relating to changes of the input signal	0 – 3600 s	0
General Settings tab			
Saving parameters to the memory	Saving actually set parameters to the internal non-volatile memory.	Do not save Save	Do not save
Language	Setting language for dislpayed messages	Polish English	Polish

5.3.2 Alarm output operating modes

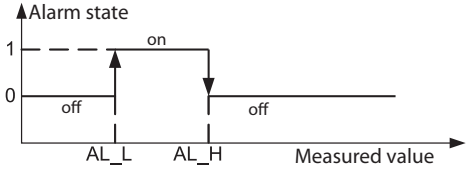
a) **N-ON**



b) **N-OFF**



c) **ON**



d) **OFF**

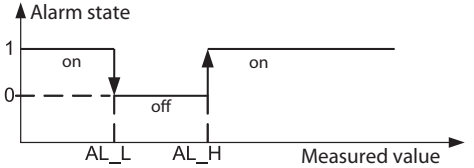


Figure 10. Relay output operating modes

5.3.3 Individual characteristic

The individual characteristic allows the conversion of the measuring value to the displayed value. It is used for imaging the measurements of non-electrical quantities using non-electrical transducers to the standard quantities. The conversion is done by an approximation of a straight line passing through the characteristic parameters points (Fig. 11).

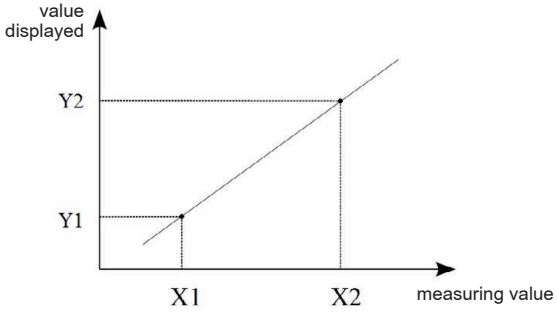


Figure 11. Individual characteristic

Example: Pressure transducer with a range of 0-500 Pa and 0-10 V voltage output is connected to the input voltage range of ± 10 V. Set the individual characteristic as follows:
X1 – 0 (lower value of the measuring range of the N21 meter)
X2 – 10 (upper value of the measuring range of the N21 meter)
X1 – 0 (lower value of the measuring range of the pressure transducer)
X2 – 500 (upper value of the measuring range of the pressure transducer)
After enabling the individual characteristic, the meter indicates directly the value in Pa.

5.3.4 Preview of the measuring values

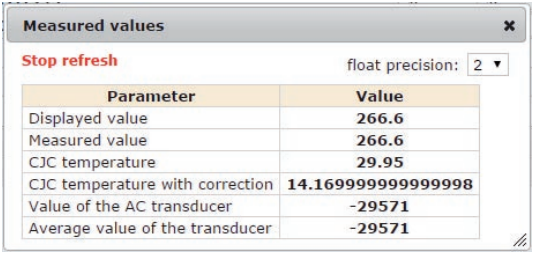


Figure 12. Preview of the measuring values

5.3.5 Editor of the measuring value unit

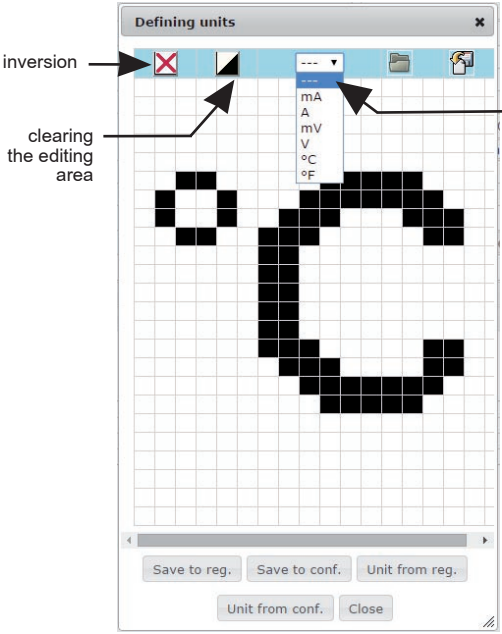


Figure 13. Editor of the measuring value unit

6. CONFIGURATION INTERFACE

6.1 USB Interface – list of parameters

The USB interface is intended only for the configuration of the meter.

- identifier 213 (0xD5)
- meter address 1
- baud rate 9.6 kbit/s
- operating mode Modbus RTU
- transmission mode 8N2
- maximum response time 100 ms
- implemented functions
  - 03 readout of registers
  - 04 readout of input registers
  - 06 one register writing
  - 16 registers writing
  - 17 device identification

Broadcast address: 253

6.2 Map of N21 meter registers

In the N21 meter, data are placed in 16 and 32-bit registers. Process variables and meter parameters are placed in the address area of registers in a way depended on the variable value type. Bits in 16-bit registers are numbered from the least significant to the most significant bit (b0-b15). The 32-bit registers contain float numbers compliant with IEEE-754 standard. Range of the registers is shown in Table 2. The 16-bit registers are shown in Table 3.

The 32-bit registers with their equivalent registers 2x16-bits are shown in Table 4. The register addresses shown in the tables are their physical addresses.

Table 2

Address range	Value type	Description
4000 - 4020	Integer (16 bits)	Meter configuration. Value set in the 16-bit register.
4500 - 4526	Integer (16 bits)	User-defined graphical icon representing the unit of the measuring value.
6000 - 6018	Float (2x16 bits, the byte order of 3210)	Value is set in the two following 16-bit registers. Registers contain exactly the same data, as 32-bit registers of 7500 range. Read only registers.
7000 – 7018	Float (2x16 bits, the byte order of 1032)	Value is set in the two following 16-bit registers. Registers contain exactly the same data, as 32-bit registers of 7500 range. Read only registers.
7500 – 7509	Float (32 bits)	Value set in the 32-bit register. Read only registers.
8012 - 8015	Integer (32 bits)	The coefficients of the individual characteristic for the measuring value conversion.

Table 3

Register address	Operations	Range	Description	Default
4000	RW	0..5	Selection of the measuring input: 0 – voltmeter ±10 V 1 – millivoltmeter ±60 mV 2 – milliammeter ±20 mA 3 – Pt100 4 – J thermocouple 5 – K thermocouple	0

4001	RW	0..5	Relay output operating mode 0 – H-OFF (disabled permanently) 1- H-ON (enabled permanently) 2 – N-OFF 3 – N-ON 4 – OFF 5 – ON	0
4002	RW	-19999.. 19999	Low threshold triggering the relay output AL_L (Fig. 10). NOTE: The value in the register contains the value of the triggering threshold x10.	600
4003	RW	-19999.. 19999	Low threshold triggering the relay output AL_L (Fig. 10). NOTE: The value in the register contains the value of the triggering threshold x10.	800
4004	RW	0..3600	Relay activation delay	0
4005	RW	0..3600	Relay deactivation delay	0
4006	RW	0..3	Precision of the displayed values 0 – 0 1 – 0.0 2 – 0.00 3 – 0.000	1
4007	-	-	reserved	
4008	-	-	reserved	
4009	RW	0.1	Enabling individual characteristic 0 – without individual characteristic 1 – individual characteristic enabled	0
4010	RW	0.1	Saving parameters to the memory: 0 – do not save 1 – save parameters NOTE: Saving is performed when the access password is set (register 4012)	0
4011	-	-	reserved	

4012	RW	0..32000	Access password to save the parameters	0
4013	RW	0.1	Enabling the automatic temperature compensation of the thermocouple cold junction/ line resistance 0 – without automatic compensation, a parameter specified in the registry 4014 is included in compensation 1 – automatic compensation	1
4014	RW	-2000..6000	The value of manual temperature compensation of the thermocouple cold junction or correction for the resistance thermometer sensor. Temperature range -20.00^{o}C...60.00 ^{o}C. NOTE: The registry value contains a temperature x100.	0
4015	RW	5, 10, 30, 50, 100, 150, 200	Averaging time of the measurement results: NOTE: The registry value contains time in seconds x10	0
4016	RW	0,1	Language of messages: 0 – POL 1 – ENG	0
4017	R	-	Serial number (MSB)	-
4018	R	-	Serial number (LSB)	-
4019	R	-	Software version	-
4020	R	-	Custom-made version	-

Table 4

16-bit register address	32-bit register address	Register type	Description
6000/7000	7500	R	Displayed value
6002/7002	7501	R	Measuring value
6004/7004	7502	R	Temperature of the thermocouple cold junction
6006/7006	7503	R	Temperature of the thermocouple cold junction with a correction
6008/7008	7504	R	Value from AC converter
6010/7010	7505	R	Averaged value from AD converter
6012/7012	7506	R	reserved
6014/7014	7507	R	reserved
6016/7016	7508	R	reserved
6018/7018	7509	R	reserved

When lower limit is exceeded, the value -99999 is set. Conversely, when upper limit is exceeded, the value 99999 is set.

Table 5

32-bit register address	Register type	Description
8012	R	Individual characteristic, parameter X1
8013	R	Individual characteristic, parameter X2
8014	R	Individual characteristic, parameter Y1
8015	R	Individual characteristic, parameter Y2

Table 5

32-bit register address	Register type	Description
4500	RW	Bit data of an image of the symbol representing the unit of the measuring value, as shown in Figure 14 and 15. Lines 1, 0.
4501	RW	Lines 3, 2
...	RW	
...	RW	
...	RW	
4526	RW	Lines 53, 52

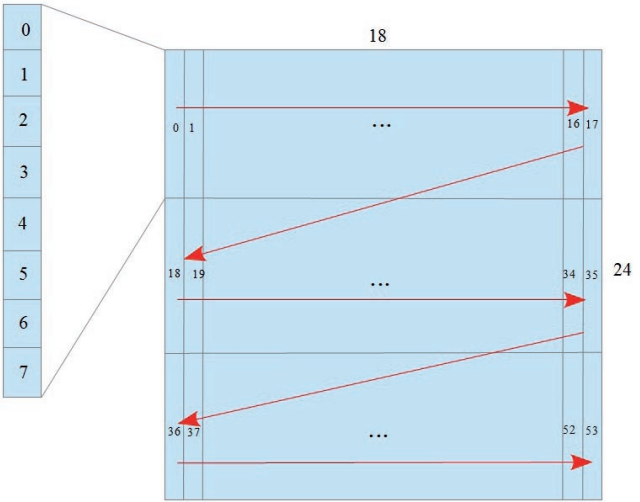
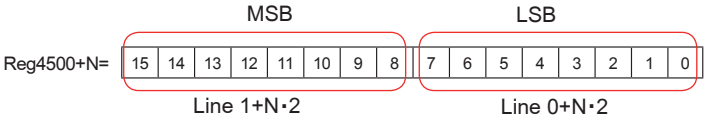


Figure 14. Designing an image of measuring value unit

The image of measuring value unit takes a display area of 18x24 points. The area is divided into 3 rows, and each row in the 18 vertical lines with 8 points each. Each line corresponds to one byte of data, in which the value 1 in a given field corresponds to turning on a given point on the display and the value 0 - turning off a given point. The definition of the whole image creates a string of 54 bytes in 16-bit 4500 registers of the meter. The values of the 8-bit lines in the 16-bit registers are arranged as shown in Figure 15.



N = {0...26}

Figure 15. Setting a line value in the 16-bit register

7. ERROR CODES

After switching the meter on the error messages may be displayed. Following list shows reasons of errors.

Overflow of the upper value of the indication range.

Overflow of the lower value of the indication range.

Saving the configuration to non-volatile memory of the meter is in progress.

Mem. error	Failure of non-volatile memory of the meter. Attempt to restore the default values. Please contact the service on a recurrent problem.
Def params	Restoring manufacturer settings.
ADC Error	Failure in communication with the measuring transducer of the meter. Please contact the service.
Update. . .	Meter's software update is in progress.

8. SOFTWARE UPDATE

The features implemented in the N21 meter enable to upgrade its software using a PC with e-Con software installed. Free eCon software and the update files are available at the website www.lumel.com.pl. Updating is done via the USB interface of the N21 meter.

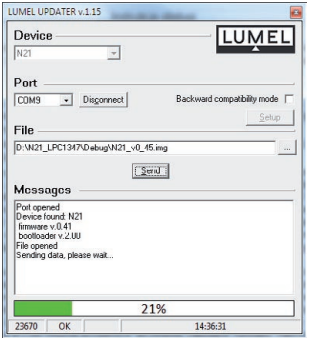


Figure 16. The program window for updating the software

Caution! Software update automatically resets meter settings to manufacturer settings, so it is recommended to save meter settings using e-Con software before upgrading.

When you start an e-Con program (Figure 7), set the communication parameters in the ***Communication*** field at the left side of e-Con window, and then click ***connect*** button. The meter will be automatically recognized. The parameters should be read and saved to a file for later restoration using the N21 – configuration field.Next select Update firmware from the menu at the top. The window of the LUMEL UPDATER (LU) program will open (Figure 18). Using this program, select the correct port on which the N21 meter was installed and press the ***Connect*** button. Information about the progress of the update process are available in the ***Messages*** window. The message ***Port opened*** is displayed when the port is open properly. The meter will display the message ***UPDATE*** and the progress bar will appear. The LU program will display information about the software version and the version of the bootloader when the meter is properly detected. At this point, you should select the correct meter upgrade file by pressing the […]. If the correct file is selected, the LU program LU will display a message ***File opened***. Press ***Send*** button. The LU program shows a progress bar and the meter displays the message ***Update***.... during the software update. The meter restarts, restores the manufacturer settings and goes to normal operation after the upgrade process is successfully completed. Information ***Done*** and duration of the update will appear in the LU program window. In the next step, you can restore previously saved settings of the meter using e-Con software.

Caution! Turning meter supply off during upgrade process may result in permanent damage!

9. TECHNICAL DATA

Measuring ranges:

Measuring ranges of Un voltage:

-72 mV…-60 mV…60 mV…72 mV	input resistance > 200 kΩ
-12 V…-10 V…10 V…12 V	input resistance > 1 MΩ

Measuring ranges of In current:

-24 mA … -20 mA … 20 mA … 24 mA	input resistance < 50 Ω ± 1 %

Temperature measurement using Pt100:

-200 °C…850 °C	current of the sensor < 300 uA max. resistance of wires < 20 Ω

Temperature measurement using thermocouple J: -50 °C…1200 °C

Temperature measurement using thermocouple K: -50 °C…1370 °C

Max. resistance the external measuring circuit:

- voltage input -60 mV...+60 mV	< 100 Ω
- voltage input -10 V...+10 V	< 100 Ω
- thermocouples	< 100 Ω

Preheating time: 30 minutes

Basic error: ≤ ± (0.1 % of the range + 1 digit)

Additional errors in rated operating conditions:

– compensation of cold junction temperature changes ≤ ± 1 °C

– compensation of wire resistance changes

  • when changing wire resistance,< 10 Ω ≤ ± 0,5 °C

  • when changing wire resistance,< 20 Ω ≤ ± 1,0 °C

– from ambient temperature changes ≤ ± (0.1 % of the range /10 K)

Averaging time: ≤ 0.5 s (default)

External transducers supply output: 24 V ± 5 % 30 mA

Relay output: NO
load 250 V~/0.5 A~
number of switching 1 x 105

Serial interfaces: USB for configuration: 1.1 / 2.0,
address 1;
8N2 mode;
baud rate 9.6 kbit/s,
max. USB cable lenght ≤ 3m
broadcast address: 253
transmission protocol: Modbus RTU
response time:100 ms

Test voltages:

- supply, alarm outputs 2.1 kV d.c.
- measuring inputs 3.2 kV d.c.
- USB interfaces 0.7 kV d.c.

Protection grade IP:

from frontal side	IP 65
for terminals	IP 20

Protection grade IK IK 06

Power input in the supply circuit: ≤ 3 VA

Weight < 0.2 kg

Overall dimensions 96 x 48 x 64 mm

Rated operating conditions:

- supply voltage	22..60 V a.c. 50..400 Hz / 20..60 V d.c. (terminals 12-13) 60..253 V a.c. 40..400 Hz / 60..300 V d.c. (terminals 13-14)
- ambient temperature	-10 .. 23 .. +55 °C
- storage temperature	- 25 .. +85 °C
- humidity	< 95% (condensation not permissible)
- external magnetic field	0..40 ..400 A/m
- sustained overload capacity:	measurement of voltage, current ±110 %
- short-term overload (1 s)	
sensor inputs	10 V
voltage inputs	2 Un
current inputs	10 In
- requirements for overcurrent protection for supply circuit	characteristic B
- working position	horizontal
- warm-up time	15 min.

Readout field: OLED display, 32x128 points, amber

Electromagnetic compatibility:

– noise immunity acc. to EN 61000-6-2

– noise emission acc. to EN 61000-6-4

Safety requirements:

according to EN 61010-1 standard

- isolation between circuits: basic
- installation category III,
- pollution grade 2,
- maximum phase-to-earth operating voltage:
  - for supply circuit 300 V
  - for measuring input 50 V
  - for remaining circuits 50 V
- altitude a.s.l. < 2000 m

10. ORDERING CODE

The N21 meter comes standard with:

– universal input

– relay output

– power output 24 V d.c.

– supply voltage 24 V a.c./d.c., 230 V a.c./d.c.

– miniUSB port for programming

N21 -	XX	X	X
Version:			
standard	00		
custom-made*	XX		
Language:			
Polish		P	
English		E	
other*		X	
Acceptance tests:			
without extra quality requirements			0
with quality inspection certificate			1
acc. to customer's request*			X

* - after agreeing with the manufacturer

ORDERING CODE EXAMPLE:
The code **N21-00E0** means:
N21 – N21 meter,
00 - standard version,
E - English version,
0 - without extra quality requirements.

N21-09

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