LUMEL

DIGITAL PANEL METER

N20PLUS

USER'S MANUAL

CE

Contents

1. APPLICATION AND METER DESIGN 5
2. METER SET 6
3. BASIC REQUIREMENTS, OPERATIONAL SAFETY 6
4. INSTALLATION 8
5. SERVICE 10
6. MODBUS REGISTER MAP 18
7. ERROR CODES 22
8. TECHNICAL DATA 23
9. EXECUTION CODES 26

1. APPLICATION AND METER DESIGN

The N20PLUS meter is a digital programmable panel instrument destined for measurements of d.c. voltages or d.c. currents: unipolar or bipolar, temperature through thermocouples (J, K) and Pt100 resistance thermometers.

The N20PLUS meter has a built-in RS-485 interface and the MODBUS RTU protocol provided on it, by means of which it is possible to configure the meter or read measured values from it. The free eCon software (available at www.lumel.com.pl) is destined for the configuration of the N20PLUS meter. The meter should be connected to a PC computer via the RS485 to USB converter, e.g. PD10.

Following parameters can be reprogrammed:
- display colour, individually in three intervals,
- thresholds of displayed overflows
- display precision of the result (decimal point),
- highlight of the unit,
- automatic or manual compensation: temperature of ends in measurements with thermocouples, or wire resistance in Pt100 measurements,
- averaging time of the measurement,
- recalculation of indications (individual characteristic),
- working modes for two outputs of OC type, to choose from 6 work modes;
- RS-485 transmission parameters;
- MODBUS bus settings.

The meter is equipped with two OC type outputs. The output switching on is signaled by the highlight of the triangular alarm index situated at the left display side, for the suitable alarm digit. The highlight colour is always different from the colour of the displayed (measured) value.

The meter has a galvanic separation between the supply, measuring inputs and RS485 interface.

The protection grade of the meter from the front side is IP65. Dimensions 96 x 48 x 64 mm (including terminals). The meter housing is made of self-extinguishing plastic.

Fig. 1. view of the N20PLUS meter

2. METER SET

The set is composed of:
- N20PLUS meter ..... 1 pc
- clamps to fix in the panel..... 4 pcs

3. BASIC REQUIREMENTS AND OPERATIONAL SAFETY

Symbols located in this service manual mean:

WARNING!
Warning of potential, hazardous situations. Especially important, one must acquaint with this before connecting the meter. The non-observance of notices marked by these symbols can occasion severe injuries of the personnel and the damage of the meter.

CAUTION!
Designates a general useful note. If you observe it, handling of the meter is made easier. One must take note of this, when the meter is working inconsistently to the expectations.
Possible consequences if disregarded!

In the safety service scope, the N20PLUS meter meets the requirements of the EN 61010-1 standard.

Observations concerning the operational safety:

- All operations concerning transport, installation, and commissioning as well as maintenance, must be carried out by qualified, skilled personnel, and national regulations for the prevention of accidents must be observed.
- Before switching the meter on, one must check the correctness of connection to the network.
- The removal of the meter housing during the guarantee contract period may cause its cancellation.
- The meter is destined to be installed and used in industrial electromagnetic environment conditions.
- One must remember that in the building installation, a switch or a circuit-breaker should be installed. This switch should be located near the device, easy accessible by the operator, and suitably marked.

4. INSTALLATION

The meter has separable strips with screw terminals which enable the connection of external wires of 2.5 mm^2. In the version for current measurement, the plug enables permanent fixing to the socket by means of screws. One must prepare a hole of $92^{+0.6} \times 45^{+0.6}$ mm in the panel which the thickness should not exceed 6 mm. The meter must be introduced from the panel front with disconnected supply voltage. Before the insertion into the panel, one must check the correct placement of the seal. After the meter insertion into the hole, fix the meter by means of the clamps (fig. 2.).

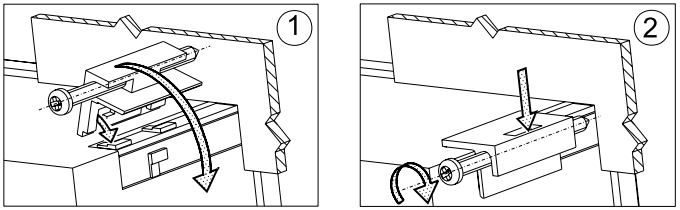


Fig. 2. Meter fixing.

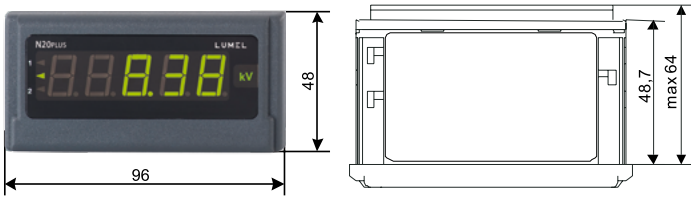


Fig. 3. Meter overall dimensions

4.1. Connection Diagrams

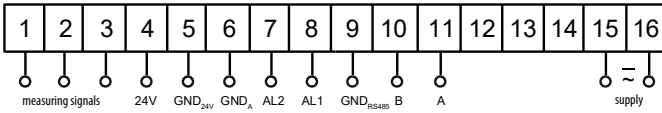
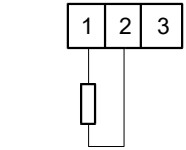
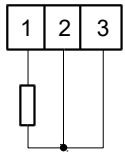


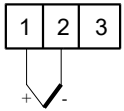
Fig. 4. Electrical connections of the N20PLUS meter



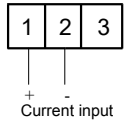
Resistance thermometer RTD in a two-wire system with manual compensation



Resistance thermometer RTD in a three-wire system with automatic compensation



Thermocouple J, K



Current input
Voltage input

Fig. 5. Connections of measurement inputs

The supply must be connected by a two-wire cable, of a suitable wire diameter, ensuring its protection by means of an installation cut-out.

5. SERVICE

5.1. Display Description

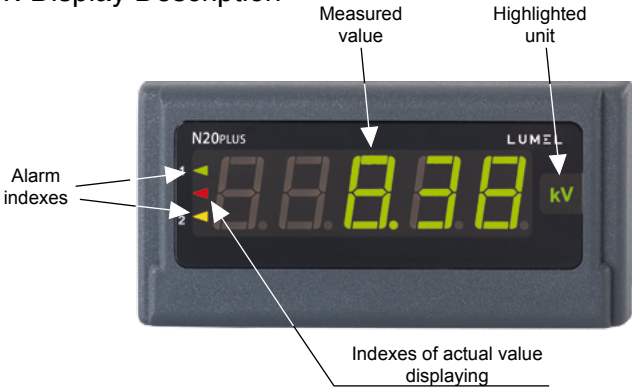


Fig. 6. Frontal panel

5.2. Messages after the Supply Connection

After connecting the supply, the meter displays the n20 PLUS X, where X the letter marking the execution of the meter: U – voltage measurement, I – current measurement, r – measurement of Pt100 temperature, t – measurement of the temperature by thermocouples, S – custom-made execution. Next, the program version is displayed in the shape r x.xx – where x.xx is the number of the actual program version or the number of the custom-made execution.
Till the time to obtain the required number of correct measurements (acc. to the table 1), the actual value from the measurement 1 is displayed, signaled by the highlighted index of the actual value.
In case of an error occurrence or an overflow of the range value, a message described in the section 7 will be displayed on the display.
Overflows of the measuring range are additionally signaled by the actual value signal index.

5.3. Meter Configuration

The free eCon software (available at www.lumel.com.pl) is destined for the N20PLUS meter configuration. The meter should be connected to a PC computer via the RS485 to USB converter, e.g. PD10, and then in the E-Con program, select the transmission parameters according to those set in the meter.

CAUTION! One must carry out the programming of meter parameters when measuring circuits are switched off!

5.4. Parameters description

5.4.1. Display settings

After choosing the group: - ***Display settings***, following elements are possible to be configured:

a) display colours of the measured value. The displayed range is divided into three zones separated by KpL and KpH values (suitably the lower threshold KpL and the upper threshold KpH of display colour change – fig.9). The colour of displayed numbers for each zone is selected from three accessible colours: green, orange and red. KpL and KpH values are set by the user and concern the displayed value (i.e. taking also into consideration the individual characteristic). The manufacturer value KpL is equal 100% of the rated value, however KpH is equal 105% of the rated value, e.g. for a 10 V meter execution they are respectively: for KpL – 10 V and for KpH – 10.5 V.

Caution! After setting the individual characteristic, KpL and KpH values are not automatically updated.

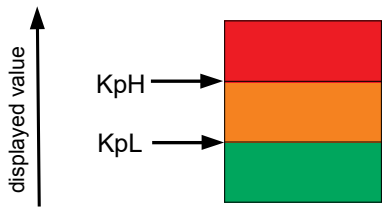


Fig. 7. Display color configuration

b) decimal point – measurement precision. We have 5 possible display configurations at choice.

When choosing, one must follow the measurement precision, e.g.: for the 10 V range – the measurement error is 0.02 V, so the choice of precision with three places after the decimal point does not give more precise measurements. When manufacturing, for executions with voltage and current measurements, the precision 000.00 is set; for executions with Pt100 temperature measurement – 0000.0; for execution with the temperature measurement through thermocouples – 00000.

c) unit highlight. The unit highlight can be enabled or disabled. When manufacturing it is enabled.

5.4.1. Measurement settings

We can configure the measurement by changing the following elements:

a) ***Compensation (***of terminal temperatures in the version with thermocouple measurement or resistance of wires for the version with Pt100 measurements). The switching of the automatic compensation off, enables to give terminal temperature values or the wire resistance used in calculations. As the resistance, one must give the sum of both wires. At the beginning, the compensation is switched by the manufacturer on.

b) ***Averaging time***: till the time to obtain the required number of correct measurements (according to the table 1), the actual value from 1 measurement is displayed. After measuring a definite number of measurements, the arithmetic mean of measured measurements is displayed. Subsequent measurements are added on the principle of “rolling window”, i.e. the earliest measurement is discarded and the most recently measured one is put in its place. The measurement of a value beyond the measuring range causes the display of overflow and the start to count correct measurements from the beginning. The time is set on 1 s by the manufacturer.

Table 1

Averaging time	Number of averaging time	Updating of displayed values
0.5 s	2	every 0.5 s
1 s	7	every 0.5 s
3 s	20	every 0.5 s
5 s	33	every 0.5 s
10 s	67	every 0.5 s
15 s	100	every 0.5 s
20 s	133	every 0.5 s

c) thresholds of displayed overflows: one can narrow limits beyond which overflows will be displayed, taking into consideration the individual characteristic.When the measured value is beyond 0…110% of the rated value (e.g. for the 10 V execution, it is the range -1…11 V), the overflow is displayed. In manufacturing conditions, the range –19999…99999 is set.

d) switching the individual characteristic on. In manufacturing conditions the characteristic is switched off.
The configuration of the individual characteristic consists in defining the points of the linear characteristic used to convert the measured value into the displayed value (Figure 8).

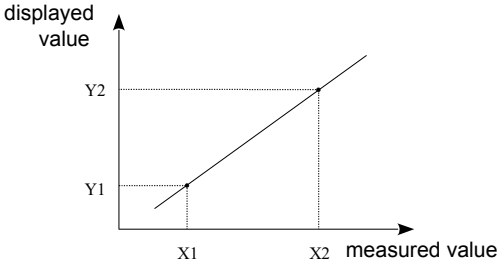


Fig. 8. Individual characteristic

For example, to get values in kV, set points X1, X2, Y1, Y2 as follows:

X1 = 0, Y1 = 0, X2 = 10, Y2 = 1

This record means that for each measured value in the range 0 ... 10, the displayed value in the range 0 ... 1 will be calculated. Having the points X1, Y1, X2, Y2, the coefficients A and B of the straight line with the equation should be determined

$$y = A \cdot x + B$$

according to the rule:

$$A = \frac{Y1 - Y2}{X1 - X2} \qquad B = Y1 - \frac{Y1 - Y2}{X1 - X2} \cdot X1$$

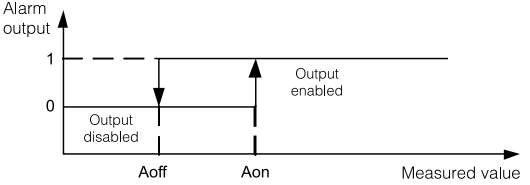
Coefficients A and B are individual characteristic parameters.

5.4.3. Setting of Alarm Parameters

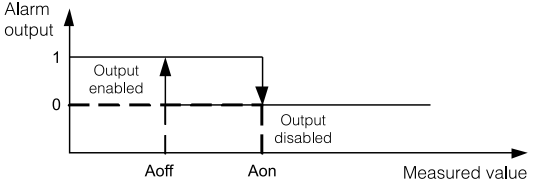
Two alarms are available in the N20PLUS meter. Both alarms are working independently and each of them has 6 working modes: n-on, n-off, on, off, hon and hoff, which are presented on the fig. 9. Alarm thresholds Aoff and Aon are set in values of the measured quantity taking into consideration the individual characteristic. In manufacturing conditions both alarms are set on the n-on mode.

Additionally, for each alarm, you can set the parameter for the delay of switching the state.

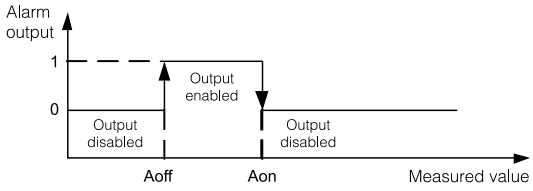
a) **n-on**



b) **n-off**



c) **on**



d) **off**

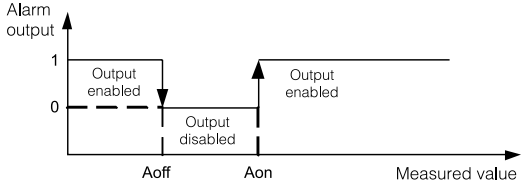


Fig. 9. Alarm types: a) n-on, b) n-off, c) on, d) off

Remaining types of the alarm: h-on – always switched on;
h-off – always switched off.

5.4.4. Communication Parameters

The N20PLUS meter is equipped with an isolated RS-485 interface and communication takes place via the Modbus RTU protocol. The following parameters are available to configure the correct communication:

- address on the Modbus, can take values from the range 1 ... 247
- baud rate, are available: 4800, 9600, 19200, 38400, 57600, 115200 bps
- transmission mode, available for selection: 8N2, 8E1, 8O1, 8N1

5.4. Manufacturer Parameters

Table 2

Parameter description	Range/value	Manufacturer value
Display colour of the measured upper value	red, green, orange	red
Display colour of the measured middle value	red, green, orange	orange
Display colour of the measured lower value	red, green, orange	green
Upper threshold - KpH	-19999…99999	105% of rated value Un, In or 200°C
Lower threshold - KpL	-19999…99999	100% of rated value Un, In, or 100°C
Decimal point	00000, 0000.0, 000.00, 00.000, 0.0000,	000.00 for U,I, 00000 for thermocouples J and K 0000.0 for Pt100
Highlight of the measured unit	switched off, switched on	switched on
Automatic compensation of the terminal temperature/wire resistance	switched off, switched on	switched on (for Pt100, thermocouples J and K), switched off for other executions
Manual compensation value:		
terminal temperature	-20…60°C	40°C
wire resistance	0…20 Ω	0 Ω
in other cases	0	0
Averaging time	0.5 s, 1 s, 3 s; 5 s, 10 s, 15 s, 20 s,	1 s
Upper overflow of the measurement	-19999…99999	99999
Lower overflow of the measurement	-19999…99999	-19999
Individual characteristic	switched off, switched on	switched off
Parameter ***a*** of the individual characteristic	-19999…99999	1
Parameter ***b*** of the individual characteristic	-19999…99999	0

Action mode of the alarm output 1	n-on, n-off, on, off, h-on, h-off	n-on
Upper value of the alarm 1 switching - Aon	-19999…99999	105% of rated value Un, In, or 200°C
Lower value of the alarm 1 switching - Aoff	-19999…99999	100% of rated value Un, In, or 100°C
Delay of the alarm 1 switching time	0…120	0 second
Action mode of the alarm output 2	n-on, n-off, on, off, h-on, h-off	n-on
Upper value of the alarm 2 switching - Aon	-19999…99999	105% of rated value Un, In, or 200°C
Lower value of the alarm 2 switching - Aoff	-19999…99999	100% of rated value Un, In, or 100°C
Delay of the alarm 2 switching time	0…120	0 second
Modbus device address	1...247	1
Baud rate	4800, 9600, 19200, 38400, 57600, 115200	9600
Transmission mode	8N2, 8E1, 8O1, 8N1	8N2

6. MAP OF MODBUS REGISTERS

In the N20PLUS meter, the data is placed in 16 and 32 bit registers. Parameters and measured values of the meter are placed in the address space in a way depending on the variable value type. In 16-bit registers, bits are numbered from the youngest to the oldest (b0-b15). 32-bit registers contain float numbers. The list of available registers is presented in Table 3. The ranges of changes in the value of registers are presented in tables 4 and 5.

Table 3

Address range	Value type	Description
4000 - 4023	Integer (16 bits)	Configuration of meter operation parameters (fixed-point parameters). Value placed in one 16-bit register.
7600 - 7609	Float (32 bits)	Configuration of meter operation parameters (floating point parameters). Value placed in one 32-bit register.
7610 - 7611	Float (32 bits)	Measured values (floating point). Value placed in one 32-bit register.
7022	Float (2x16 bits)	Registers 7600-7611 in the form of 2x16 bits (Swapped float) in the bytes sequence 1032
6022	Float (2x16 bits)	Registers 7600-7611in the form of 2x16 bits (Floating point) in the bytes sequence 3210

Table 4

Address	Register type	Description	Changes range
4000	RW	Decimal point of the display (display precision)	0 - 00000 1 - 0000.0 2 - 000.00 3 - 00.000 4 - 0.0000
4001	RW	Unit backlight	0 – off 1 – on

4002	RW	Display color for values below the KpL threshold (Fig. 7) set in register 7603	0 - orange 1 - red 2 - green
4003	RW	Display color for values between KpL and KpH thresholds (Fig. 7) set in registers 7602 and 7603	0 - orange 1 - red 2 - green
4004	RW	Display color for values above the KpH threshold (Fig. 7) set in register 7602	0 - orange 1 - red 2 - green
4005	RW	Alarm type 1 (section 5.4.3)	0 – n-on 1 – n-off 2 – on 3 – off 4 – hon 5 – hoff
4006	RW	Alarm 1 delay time	0...120
4007	RW	Alarm type 2 (section 5.4.3)	0 – n-on 1 – n-off 2 – on 3 – off 4 – hon 5 – hoff
4008	RW	Alarm 2 delay time	0...120
4009	RW	Switching on of individual characteristics.Characteristics parameters placed in registers 7600 and 7601	0 – individual char. off 1 – individual char. on
4010	RW	Averaging time (section 5.4.2 b)	0 – 0.5 s 1 – 1 s 2 – 3 s 3 – 5 s 4 – 10 s 5 – 15 s 6 – 20 s

4011	RW	Temperature compensation mode of terminal / wire resistance	0 - manual, value in reg. 7610 1 - automatic
4012	R	Restoring factory parameters of the meter	0 - do not do anything 1 - restore parameters
4013	R	The meter status, read only value, represents the current operating status.	
4014	RW	reserved	Not applicable
4015	R	reserved	Not applicable
4016	R	reserved	Not applicable
4017	R	reserved	Not applicable
4018	R	Meter's serial number (older 16 bits of 32-bit value)	Not applicable
4019	R	Meter's serial number (younger 16 bits of 32-bit value)	Not applicable
4020	RW	Modbus device address (the change requires approval by writing to the register 4023)	0...247
4021	RW	Baud rate (change requires acceptance by writing to registry 4023)	0 – 4800 1 – 9600 2 – 19200 3 – 38400 4 – 57600 5 – 115200
4022	RW	Transmission mode (change requires acceptance by writing to registry 4023)	0 – 8N2 1 – 8E1 2 – 8O1 3 - 8N1
4023	RW	Application of transmission parameters.	0 - do not do anything 1 - apply changes

Table 5

Address	Address (2x16bit „1032")	Address (2x16bit „3210")	Register type	Description	Changes range
7600	7000	6000	RW	Parameter A of the individual characteristic (section 5.4.2.d)	-19999… 99999
7601	7002	6002	RW	Parameter B of the individual characteristic (section 5.4.2.d)	-19999… 99999
7602	7004	6004	RW	Value of exceeding the upper display value	-19999… 99999
7603	7006	6006	RW	Value of exceeding the lower display value	-19999… 99999
7604	7008	6008	RW	Upper alarm trigger threshold 1	-19999… 99999
7605	7010	6010	RW	Alarm trigger lower threshold 1	-19999… 99999
7606	7012	6012	RW	Upper alarm trigger threshold 2	-19999… 99999
7607	7014	6014	RW	Alarm trigger lower threshold 2	-19999… 99999
7608	7016	6016	RW	The upper threshold for the color change of the KpH display (section 5.4.1.a)	-19999… 99999
7609	7018	6018	RW	The lower threshold for the color change of the KpL display (section 5.4.1.a)	-19999… 99999
7610	7020	6020	R	Value for manual temperature compensation of terminals / wire resistance	-20..60
7611	7022	6022	R	Measured value of the input signal	Not applicable

7. ERROR CODES

After connecting the meter to the network, messages about errors may appear. Causes of errors are presented below:

Overflow of the upper value of the programmed indication range. In the option with Pt100, it also signals the incorrect connection of the wire to the terminal 4.

Overflow of the lower value of the programmed indication range.

ErrCA Loss of meter calibration values – In such a case, one must contact an authorized service workshop.

ErrEE Incorrect values in meter configuration data. One must set up again meter parameters by means of the eCon software.

7. TECHNICAL DATA

Measuring ranges:

INPUTS:

Measuring ranges of Un voltage:

-165 mV...-150 mV...150 mV...165 mV
-1 mV...0 mV...150 mV...165 mV
-82,5 mV...-75 mV...75 mV...82.5 mV
-1 mV...0 mV...75 mV...82.5 mV
-1 V... 0 V...10 V...11 V
-11 V... -10 V...10 V...11 V

} input resistance > 1 MΩ

Measuring ranges of In current:

-1...0... 20...22 mA	input resistance 10 Ω ± 1%
3.6...4... 20...22 mA	input resistance 10 Ω ± 1%
-22...-20... 20...22 mA	input resistance 5 Ω ± 1%

Temperature measurement through Pt100:	- 50...400°C current flowing through the sensor < 300 μA
Resistance of wires connecting the resistance thermometer to the meter:	≤ 10 Ω (of one wire)
Temperature measurement through thermocouple J:	- 50...1200°C
Temperature measurement through thermocouple K:	- 50...1370°C
Preheating time:	30 min.
Intrinsic error (at manufacturer settings):	± (0.2% of the range ±1 digit)

Additional errors in rated operating conditions:

- compensation of reference junction temperature changes: ± 0.2% of the range
- compensation of wire resistance changes: ± 0.2% of the range
- from ambient temperature changes: ± (0.1% of the range/10 K)

Averaging time: ≤ 0.5s (1s by default)

Alarm outputs: outputs of OC type (30 V, 20 mA), passive outputs acc. to EN 62053-31

Output to supply external transducers: 24 V ± 5%, 30 mA

Serial interface: RS-485, address 1..247

mode: 8N2, 8E1, 8O1, 8N1
baude rate: 4.8, 9.6, 19.2, 38.4, 57.6, 115.2 kbit/s
transmission protocol: modbus RTU
time to start the answer: 100 ms

Rated operating conditions:

- supply voltage: 85...253 V a.c. (45...65 Hz) or d.c.
  20...40 V a.c. (45...65 Hz) / 20... 60 V d.c.
- ambient temperature: - 10...23...55°C
- storage temperature: - 25... + 85°C
- relative air humidity: < 95% (inadmissible condensation of water vapour)
- working position: any

Sustained overload capacity
(measurement of voltage, current): 10%

Short duration overload capacity (3 s):	
- sensor inputs	30 V
- voltage input	10 Un
- current input	10 In
Readout field	5-digit three-colour LED displays: - digit height: 14 mm, - colours: green, orange, red - indication range: -19999...99999
Ensured protection grade from frontal side	IP 65 acc. EN 60529
Overall dimensions	$96 \times 48 \times 64$ mm (with terminals)
Cut-out dimensions in panel	$92^{+0.6} \times 45^{+0.6}$ mm
Weight	< 0.25 kg
Power consumption	< 6 VA
Galvanic isolation between:	
– supply - measuring input	3.2 kV d.c.

Electromagnetic compatibility:

– noise immunity acc. to EN 61000-6-2

– noise emission acc. to EN 61000-6-4

Safety requirements acc. to EN 61010-1 standard:

– isolation between circuits	basic
– installation category	III
– pollution degree	2

– maximal phase-to-earth working voltage:
  – for supply circuit 300 V (at supply 85...253 V),
  – for measuring input 50 V,
  – for input destined for programming 50 V.

– altitude above sea level: < 2000 m

9. ORDERING CODES

Table 6

N20PLUS	X	X	XX	XX	X	X
Input:						
Pt100: -50...400 °C	1					
Thermocouple J: -50...1200 °C	2					
Thermocouple K: -50...1370 °C	3					
0...20 mA	4					
4...20 mA	5					
± 20 mA	6					
0...75 mV	7					
0...10 V	8					
± 10 V	9					
0...150 mV	A					
± 75 mV	B					
± 150 mV	C					
Supply:						
85...253 V a.c./d.c.		1				
20..40 V a.c./ 20... 60 V d.c.		2				
Unit:						
unit code number acc. to table 7			XX			
Version:						
standard				00		
custom-made				XX		
Language:						
Polish					P	
English					E	
Acceptance test:						
without additional quality requirements						0
with an extra quality inspection certificate						1
with an extra calibration certificate						2
acc.to customer's request*						X

* only after agreeing with the manufacturer

Code of the highlighted unit Table 7

Code	Unit	Code	Unit
00	without unit	24	l/h
01	V	25	ms
02	A	26	s
03	mV	27	h
04	kV	28	N
05	MA	29	kN
06	mA	30	Pa
07	kA	31	hPa
08	MA	32	kPa
09	°C	33	MPa
10	°F	34	bar
11	K	35	rad
12	Hz	36	Ω
13	kHz	37	kΩ
14	Ah	38	%
15	kAh	39	°
16	m/s	40	rev.
17	µm	41	rps
18	mm	42	rpm
19	cm	43	rph
20	m	44	m/h
21	km	45	km/h
22	l	46	imp
23	l/s	XX	on order[1)]

[1)] - After agreeing with the manufacturer

ORDERING EXAMPLE:

The Code **N20PLUS_910100E0** - means: N20ZPLUS meter with voltage input on ± 10 V, supply 85... 253 V a.c., standard version, user's manual in English, without aditional quality requirements. Unit„V"

LUMEL S.A.
ul. Słubicka 4, 65-127 Zielona Góra, Poland
tel.: +48 68 45 75 100, fax +48 68 45 75 508
www.lumel.com.pl

Technical support:
tel.: (+48 68) 45 75 143, 45 75 141, 45 75 144, 45 75 140
e-mail: export@lumel.com.pl

Export department:
tel.: (+48 68) 45 75 130, 45 75 132
e-mail: export@lumel.com.pl

Calibration & Attestation:
e-mail: laboratorium@lumel.com.pl

N20PLUS-09A