iSMACONTROLLI

iSMA-B-AAC20

User Manual

Hardware
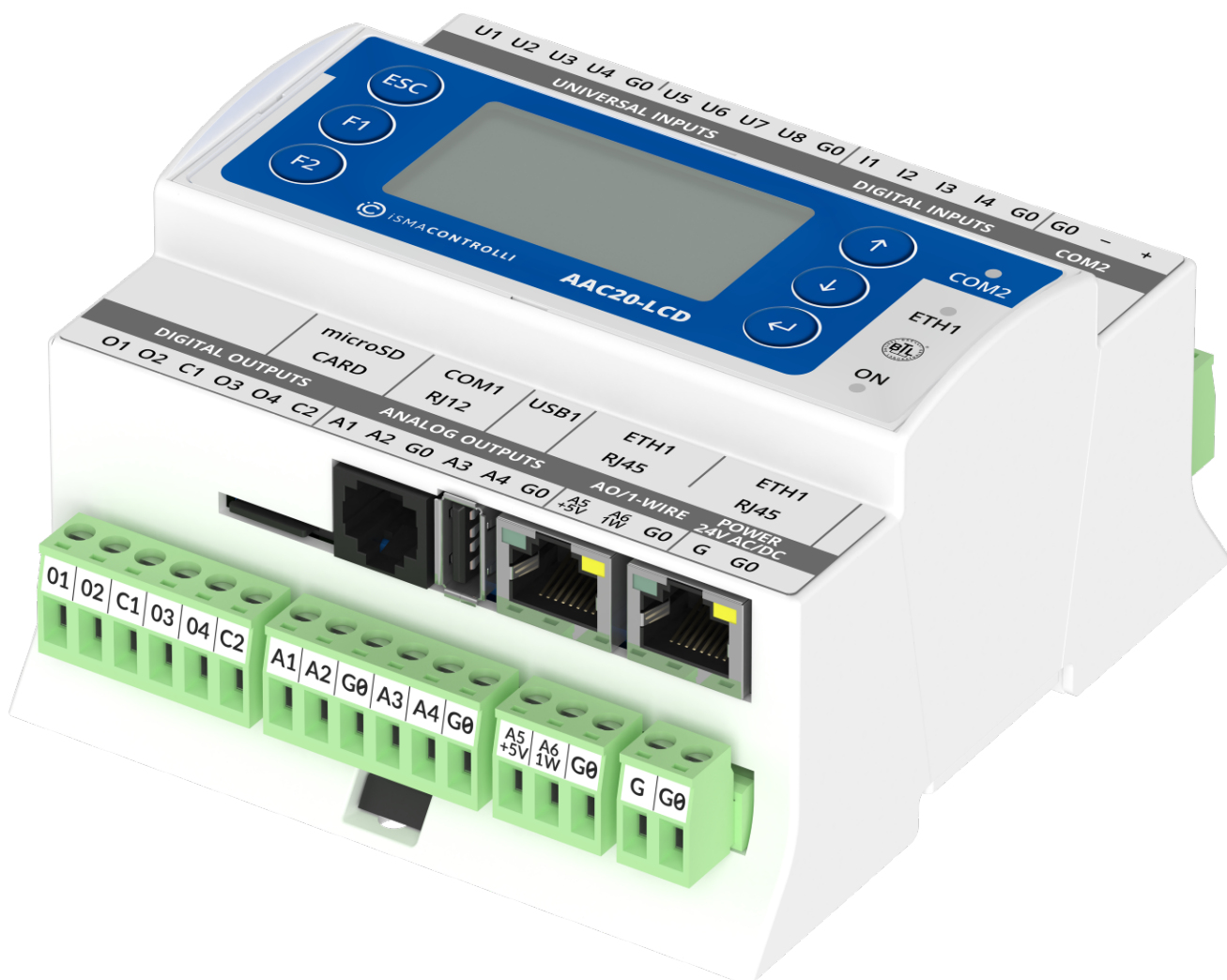
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1 Introduction

The iSMA-B-AAC20 is a universal controller with built-in different types of I/Os, which operates based on the Sedona framework environment. Using a specific set of inputs and outputs (8 UI, 4 DI, 6 AO, and 4 DO) allows to use the device in different applications. The controller provides control, data logging, alarming, scheduling, integration.

To allow IP connectivity there are 2 Ethernet ports, which operate as two independent ports. A built-in RS485 port can be used to expand the number of I/Os by connecting MINI or MIX series I/O modules or to integrate with other subsystems.

The iSMA-B-AAC20 controller communicates in BACnet and Modbus protocols, and additionally can come with M-Bus or DALI extensions.

The unique option in iSMA-B-AAC20 controllers is an LCD display, which allows for basic service of the controller.

Figure 1. The iSMA-B-AAC20 controller
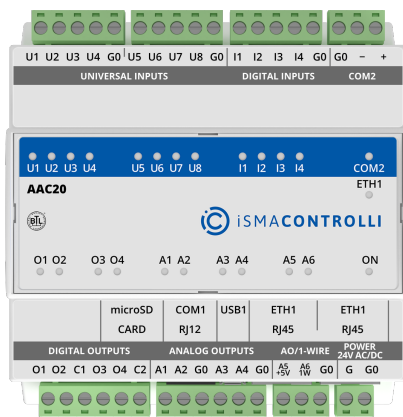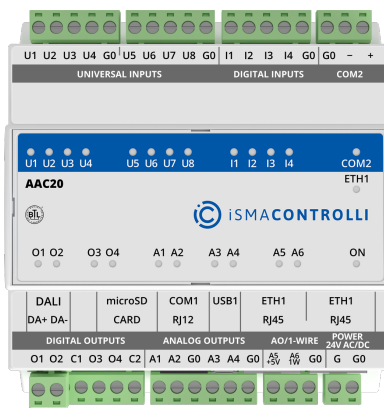

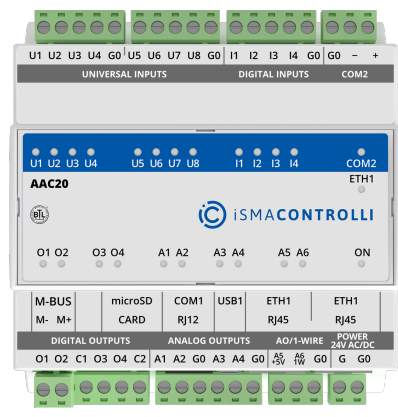*Figure 2. The iSMA-B-AAC20-D controller*

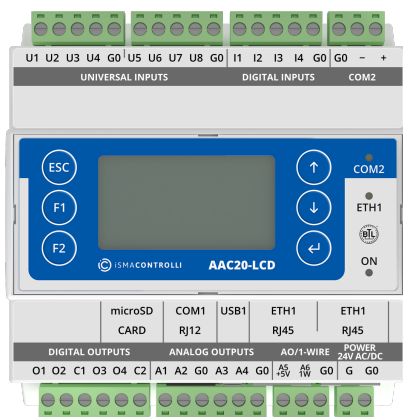*Figure 3. The iSMA-B-AAC20-M controller*

Figure 4. The iSMA-B-AAC20-LCD controller

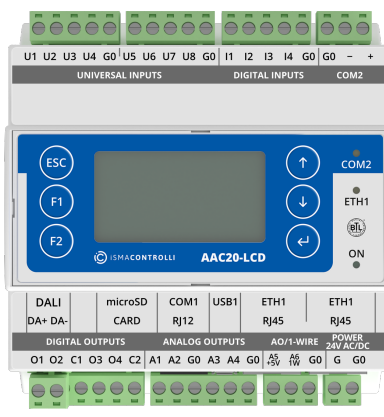*Figure 5. The iSMA-B-AAC20-LCD-D controller*

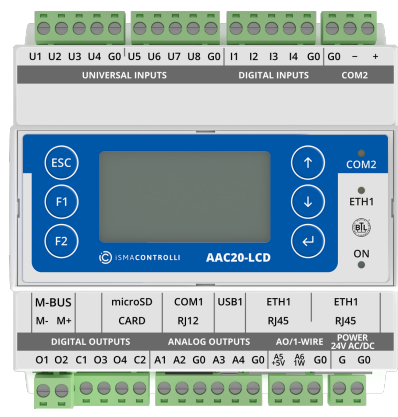*Figure 6. The iSMA-B-AAC20-LCD-M controller*

1.1 Revision History

Rev.	Date	Description
1.0	28 Feb 2022	First edition

Table 1. Revision history

2 Safety Rules

- Improper wiring of the product can damage it and lead to other hazards. Make sure that the product has been correctly wired before turning the power on.
- Before wiring or removing/mounting the product, make sure to turn the power off. Failure to do so might cause an electric shock.
- Do not touch electrically charged parts such as power terminals. Doing so might cause an electric shock.
- Do not disassemble the product. Doing so might cause an electric shock or faulty operation.
- Use the product only within the operating ranges recommended in the specification (temperature, humidity, voltage, shock, mounting direction, atmosphere, etc.). Failure to do so might cause a fire or faulty operation.
- Firmly tighten the wires to the terminal. Failure to do so might cause a fire.
- Avoid installing the product in close proximity to high-power electrical devices and cables, inductive loads, and switching devices. Proximity of such objects may cause an uncontrolled interference, resulting in an instable operation of the product.
- Proper arrangement of the power and signal cabling affects the operation of the entire control system. Avoid laying the power and signal wiring in parallel cable trays. It can cause interferences in monitored and control signals.
- It is recommended to power controllers/modules with AC/DC power suppliers. They provide better and more stable insulation for devices compared to AC/AC transformer systems, which transmit disturbances and transient phenomena like surges and bursts to devices. They also isolate products from inductive phenomena from other transformers and loads.
- Power supply systems for the product should be protected by external devices limiting overvoltage and effects of lightning discharges.
- Avoid powering the product and its controlled/monitored devices, especially high power and inductive loads, from a single power source. Powering devices from a single power source causes a risk of introducing disturbances from the loads to the control devices.
- If an AC/AC transformer is used to supply control devices, it is strongly recommended to use a maximum 100 VA Class 2 transformer to avoid unwanted inductive effects, which are dangerous for devices.
- Long monitoring and control lines may cause loops in connection with the shared power supply, causing disturbances in the operation of devices, including external communication. It is recommended to use galvanic separators.
- To protect signal and communication lines against external electromagnetic interferences, use properly grounded shielded cables and ferrite beads.
- Switching the digital output relays of large (exceeding specification) inductive loads can cause interference pulses to the electronics installed inside the product. Therefore, it is recommended to use external relays/contactors, etc. to switch such loads. The use of controllers with triac outputs also limits similar overvoltage phenomena.
- Many cases of disturbances and overvoltage in control systems are generated by switched, inductive loads supplied by alternating mains voltage (AC 120/230 V). If they do not have appropriate built-in noise reduction circuits, it is recommended to use external circuits such as snubbers, varistors, or protection diodes to limit these effects.

3 Technical Specification

Power Supply	Voltage	24 V AC/DC ± 20%
	Power consumption	7 W at 24 V DC; 10.5 VA at 24 V AC
Universal Inputs	Number of inputs	8
	Temperature input	Measurement with attached RTDS Accuracy ±0.1˚C For sensors PT1000 and NI1000 use 16-bit resolution
	Voltage input	Voltage measurement from 0 to 10 V Input impedance 100 kΩ Measurement accuracy ±0.1% Measurement resolution 3 mV at 12-bit and 1 mV at 16-bit
	Current input	Current measurement 0-20 mA Required external resistor 200 Ω Measurement accuracy: ±1.1% Measurement resolution: 15 µA at 12-bit and 5 µA at 16-bit
	Resistance input	Measurement of resistance: 0-1000 kΩ Measurement resolution for 20 kΩ load: 20 Ω at 12-bit and 1 Ω at 16-bit Measurement resolution for PT1000 and NI1000: 0.1 Ω at 16-bit Resistance measurement method: voltage divider
	Digital input	Output current ~1 mA
	Measurement resolution	12-bits (default) or 16-bits
	Processing time	10 ms/channel at 12-bits 140 ms/channel at 16-bits
Digital Inputs	Number of inputs	4
	Type	Dry contact or fast pulse counter up to 100 Hz
Analog Outputs	Number of outputs	6
	Voltage range	0-10 V DC
	Max. load current	20 mA (A6 up to 5 mA)
	Resolution	12-bits
	Accuracy	±0.5%

Digital Outputs (Relays)	Number of outputs	4
	Contact material	AgSnO2
	Resistive load	3 A at 230 V AC or 3 A at 30 V DC
	Inductive load	75 VA at 230 V AC or 30 W at 30 V DC
COM1	RS485 interface	Up to 128 devices
	Communication protocol	Modbus RTU/ASCII (client)
	Port	RJ12
	Baud rate	4800-115200
COM2	RS485 interface	Up to 128 devices
	Communication protocol	Modbus RTU/ASCII (client/server) BACnet MS/TP (client/server)
	Port	Screw connector
	Baud rate	4800-115200
ETH1	Ethernet interface	2 ports, switch mode
	Baud rate	10/100 Mb/s
USB1	USB 2.0	Type A
Communication	Open protocols	Modbus RTU/ASCII Modbus TCP/IP BACnet MS/TP BACnet IP M-Bus IP SOX protocol oBIX 1-Wire DALI (iSMA-B-AAC20-D, iSMA-B-AAC20-LCD-D) Free software: AAC20 Updater & iSMA Tool Built-in web server
Ingress Protection	IP rating	IP40
Temperature	Storage	-40˚C to +85˚C (-40°F to +185°F)
	Operating	-10˚C to +50˚C (14°F to 122°F)

Humidity	Relative	5% to 95% (without condensation)
Screw Connectors	Type	Separable
	Maximum cable size	2.5 mm2
Dimensions	Width	110 mm/4.33 in
	Length	106 mm/4.17 in
	Height	62 mm/2.44 in

Table 2. Technical specification

4 Hardware Specification

4.1 Hardware Versions

The iSMA-B-AAC20 controller is an advanced control device for building automation and HVAC systems. The controller is based in the Sedona Virtual Machine (SVM), which allows the user to quickly and easily program the controller in real time. Large number of inputs and outputs allows to integrate with other devices and sensors (AAC20 provides 8 UI, 4 DI, 6 AO, and 4 DO). In addition, to increase the versatility of the controller, it supports many open communications protocols such as BACnet, Modbus, SOX, DALI, M-Bus, 1-Wire. The AAC20 is mounted in a housing adapted for DIN rail mounting or directly on a panel. Separate, easy to remove connectors allow quick wiring without removing the entire device.

The iSMA-B-AAC20 controller comes in six versions depending on native communication protocols and hardware types (basic version and LCD equipped version, see Front Panel for iSMA-B-AAC20 and Front Panel for iSMA-B-AAC20-LCD):

- iSMA-B-AAC20: basic hardware version, native protocols: Modbus, BACnet, display port, 1-Wire, and
- iSMA-B-AAC20-LCD: LCD display, native protocols: Modbus, BACnet, display port, 1-Wire:

Figure 7. AAC20 basic communication protocols version

- iSMA-B-AAC20-M: basic hardware version, native protocols: Modbus, BACnet, display port, 1-Wire, M-Bus, and
- iSMA-B-AAC20-LCD-M: LCD display, native protocols: Modbus, BACnet, display port, 1-Wire, M-Bus:
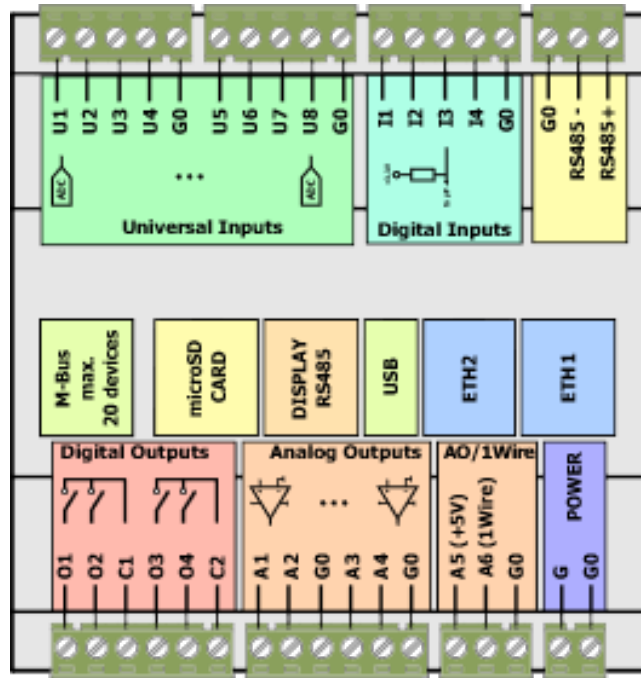
Figure 8. AAC20 extended M-Bus version

- iSMA-B-AAC20-D: basic hardware version, native protocols: Modbus, BACnet, display port, 1-Wire, DALI, and
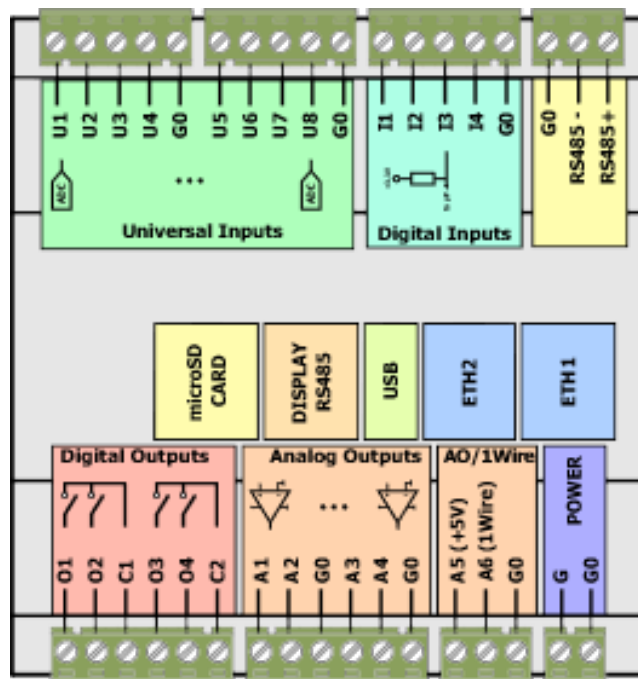- iSMA-B-AAC20-LCD-D: LCD display, native protocols: Modbus, BACnet, display port, 1-Wire, DALI:
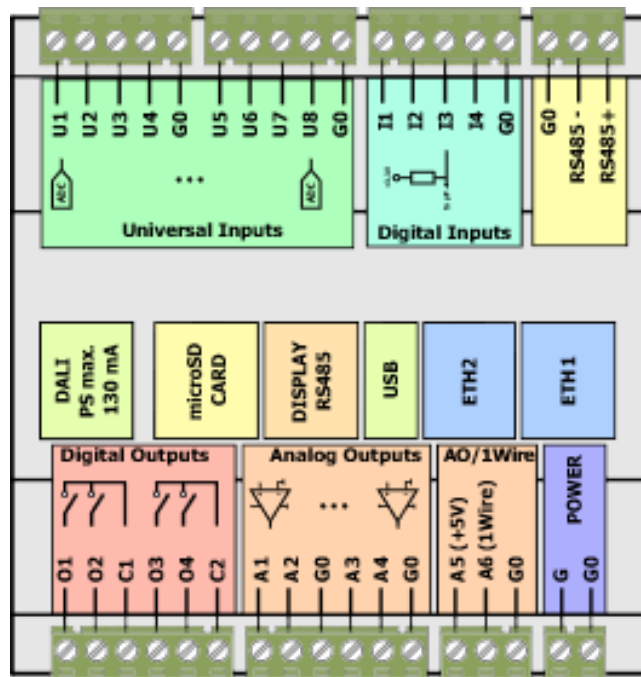
Figure 9. AAC20 extended DALI version

4.2 Power Supply

The iSMA-B-AAC20 controllers are designed to work with 24 V AC/DC power supply.
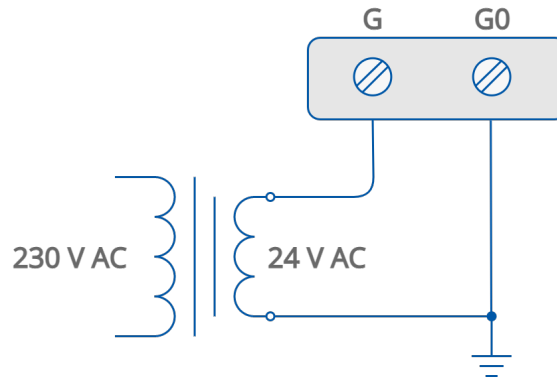
Figure 10. AC power supply connection
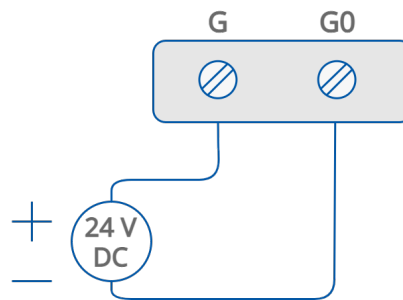
Figure 11. DC power supply connection

4.3 Grounding and Shielding

In most cases controllers are installed in enclosures along with other devices, which generate electromagnetic radiation (for example, relays, contactors, transformers, motor invertors, etc.). Such electromagnetic radiation can induce electrical noise into both power and signal lines, as well as direct radiation into the controller, causing negative effects on the system. For this reason, an appropriate grounding, shielding, and other protective steps should be taken at the installation stage to prevent negative electromagnetic radiation effects, for example:

- control cabinet grounding;
- cable shield grounding;
- using protective elements for electromagnetic switching devices;
- proper wiring;
- consideration of cable types and their cross sections;
- and other.

4.4 Front Panel for iSMA-B-AAC20
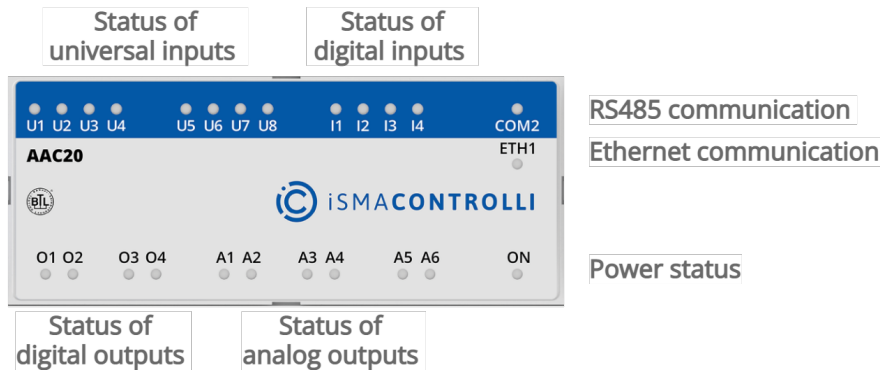
Figure 12. Front panel for AAC20

The basic iSMA-B-AAC20 hardware version (iSMA-B-AAC20, iSMA-B-AAC20-M, iSMA-B-AAC20-D) has a front panel equipped with status diodes and a DIP switch.

· The power LED (ON) is on (green) when the controller is running properly.
· The communication RS485 LED (COM2) is on (orange) for 20 ms after sending each message. If the module receives or sends a lot of messages, this LED can be lit continuously.
· The communication Ethernet LED (ETH1) is on (orange) for 20 ms after sending each message.
· U1-U8 LEDs indicate the status of the universal inputs and are lit when resistance connected to the input is less than 1 kΩ (dry contact input is active).

Note: The LED also lights up when voltage connected to the input has a very low potential.

· I1-I4 LEDs indicate the status of the digital inputs and are lit when the input is active.
· A1-A6 LEDs indicate the status of the analog outputs and are lit when output voltage or PWM factor is different from 0.
· O1-O4 LEDs indicate the status of the digital outputs and are lit when output is enabled.

4.5 Front Panel for iSMA-B-AAC20-LCD

Figure 13. Front panel for AAC20-LCD

The iSMA-B-AAC20-LCD hardware version ((iSMA-B-AAC20-LCD, iSMA-B-AAC20-LCD-M, iSMA-B-AAC20-LCD-D) has a front panel equipped with an LCD display, status diodes, and function buttons.

· The power LED (ON) is on (green) when the controller is running properly.
· The communication RS485 LED (COM2) is on (orange) for 20 ms after sending each message. If the module receives or sends a lot of messages, this LED can be lit continuously.

- The communication Ethernet LED (ETH1) is on (orange) for 20 ms after sending each message.
- The Esc button is an exit key.
- The Enter key is used to select an element or to move the cursor to the right.
- The Arrow up key is used to add or subtract elements or for a menu navigation.
- The Arrow down key is used to add or subtract elements or for a menu navigation.
- The F1 and F2 are function keys.

To find out more about operating the LCD panel, see the iSMA-B-AAC20 LCD Display User Manual available at ismacontrolli.com.

4.6 Communication

The iSMA-B-AAC20 controllers can be connected to the network with the following communication buses:

- Ethernet connection (2 ETH1 ports);
- COM1 RJ12 RS485 connection;
- COM2 RS485 connection;
- 1-Wire connection;
- M-Bus connection (for iSMA-B-AAC20-M and iSMA-B-AAC20-LCD-M);
- DALI connection (for iSMA-B-AAC20-D and iSMA-B-AAC20-LCD-D);
- USB1 port;
- SD card.

4.6.1 Ethernet
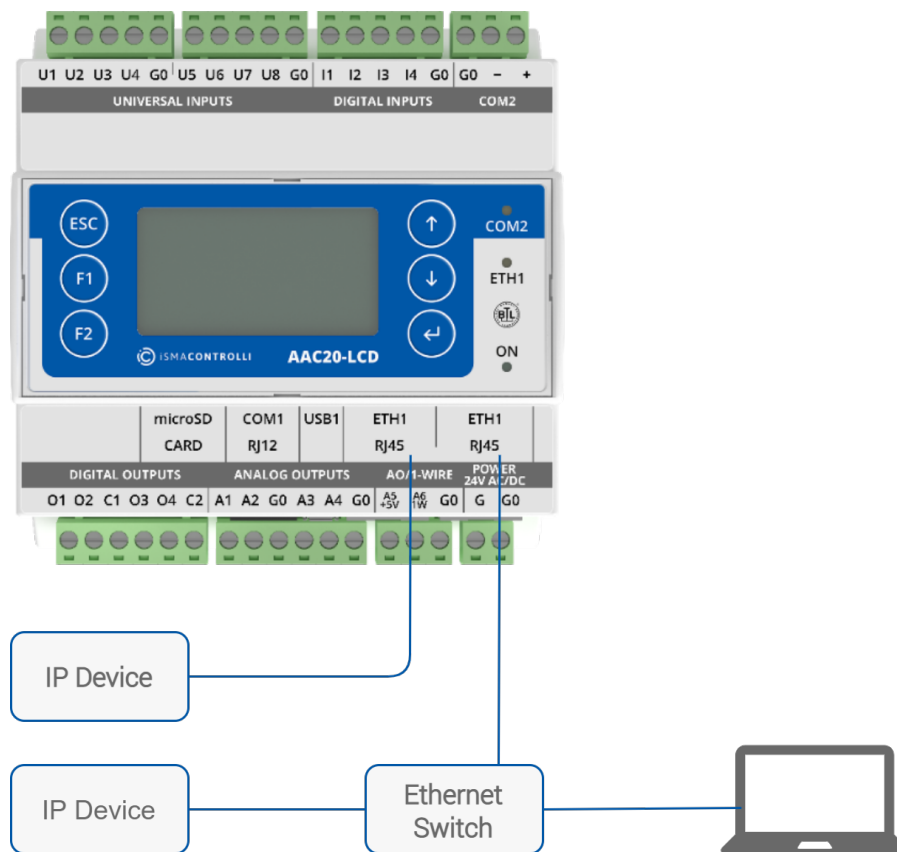
Figure 14. Ethernet connection

4.6.2 RS485 COM2
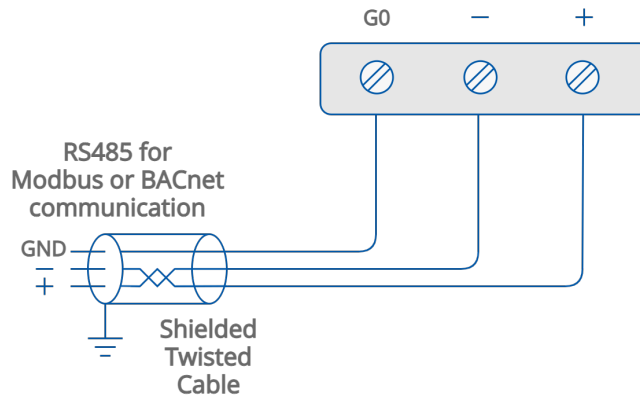
Figure 15. RS485 connection

4.6.3 1-Wire

1-Wire is a special protocol for device which is made by the Dallas company. Temperature sensors use DS18D20 chip. The 1-Wire bus uses 3 wire cable (+5 VCC, Data, GND) of maximum 100 m long (it is recommended to use shorter distance) and up to 32 sensors. All iSMA-B-AAC20 devices are equipped with a 1-Wire port which uses two analog outputs, AO5 and AO6.

> WARNING! Before connecting a 1-Wire device to the controller, please add a 1-Wire network first. It will block the possibility of increasing voltage above 5 V and protect the 1-Wire sensor against damage.
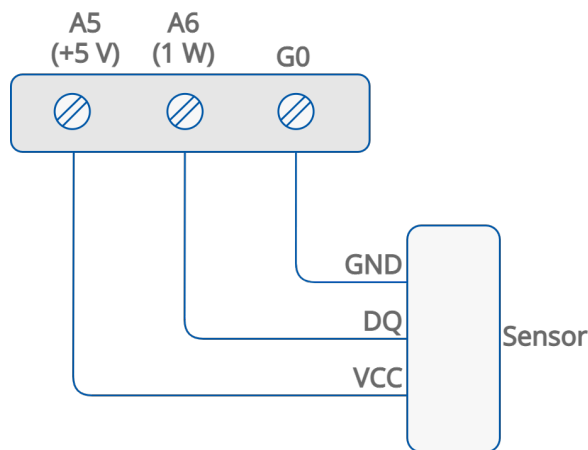
Figure 16. 1-Wire connection

4.6.4 M-Bus

The M-Bus (Meter Bus) was developed to fill the need for a system for the networking and remote reading of utility meters, for example, to measure the consumption of gas or water in the house. M-Bus devices can be connected directly only to the iSMA-B-AAC20-M

hardware version with the M-Bus interface (max. 20 devices) and with firmware version 5.1 and above.
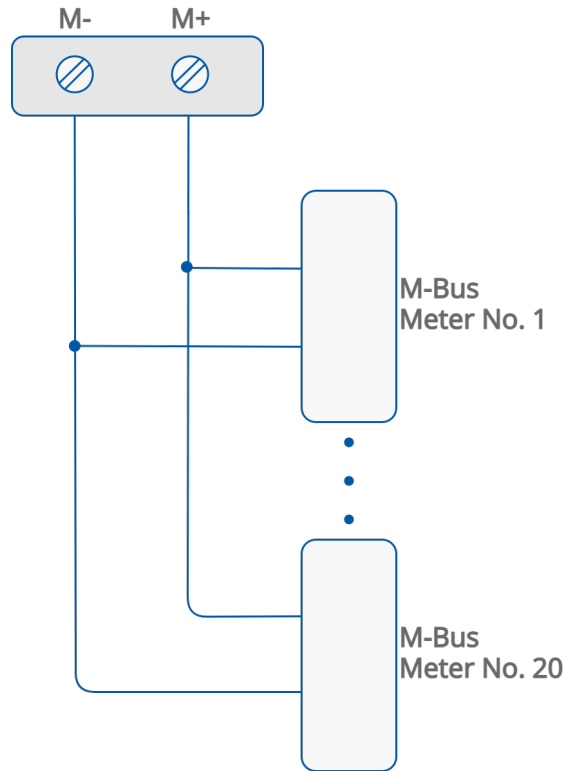
Figure 17. M-Bus connection

4.6.5 DALI

In a standard license, there are available 64 DALI devices, and this number cannot be expanded. The iSMA-B-AAC20-D has an internal power supply (default switch off in network configuration) of 130 mA, which can be used to power up, up to 64 standard DALI ballasts (64 * 2 mA = 128 mA only ballasts). However, in order to connect devices, where the rate of total power consumption exceeds 130 mA (some DALI sensors use more than 2 mA), then the internal power supply must be switched off, and the external power adapter needs to be connected.
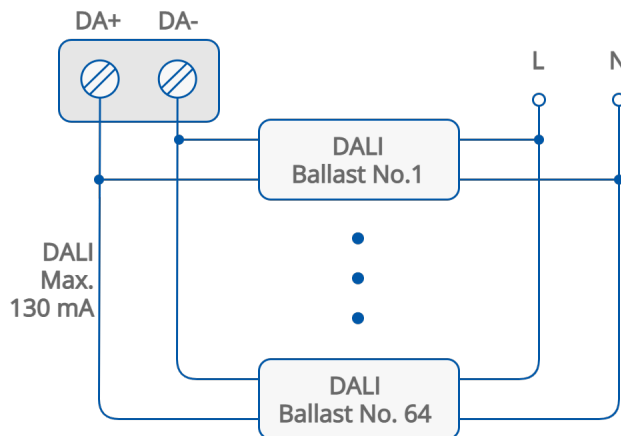
Figure 18. DALI connection

4.6.6 USB

The USB1 port allows to enter the system console of the device with an A-to-A USB cable:

- connect the device to the PC;
- open the AAC20 Updater tool;
- enter the system console using the Console button.

4.6.7 SD Card

The SD card allows to save historical data and alarms that occurred during the operation of the controller.

Note: By default the iSMA-B-AAC20 controller is not equipped with the SD card. In order to use the Historical and Alarm services, the card has to be installed to the device. The SD card may be inserted or taken out only while the controller's power supply is off.

Type	micro SD card	
File Format	FAT32	
Capacity	Min. 4 GB Max. 32 GB	
Transfer Speed	Read	15 MB/s
	Write	4 MB/s

Table 3. Parameters of an SD card

Note: Due to the FAT32 file system, cards bigger than 32 GB (e.g., 64 GB) will be read as cards with 32 GB capacity.

5 Inputs and Outputs

The iSMA-B-AAC20 is equipped with 20 inputs and outputs:

- 8 universal inputs;
- 4 digital inputs;
- 6 analog outputs;
- 4 digital outputs.

5.1 Universal Inputs

The iSMA-B-AAC20 device is equipped with 8 universal inputs.

Universal inputs support four types of input signals:

- voltage (0-10 V DC, input impedance 100 kΩ);
- current (0-20 mA);
- resistance and temperature measurement (10k thermistor, a full list of supported temperature sensors is available here: List of Supported Temperature Sensors);
- dry contact (output current 1 mA).

Current measurement is realized by voltage measurement and 200 Ω resistance. According to Ohm's law, the current is directly proportional to the voltage, and the resistance is the constant of proportionality. (I = U / R). According to the Ohm's law equation, for 20 mA current with 200 Ω resistance the output voltage is 4 V. It means that the 4 V voltage measured on the universal input corresponds to 20 mA current. The result is expressed in millivolts.

5.1.1 Universal Input Voltage Connection
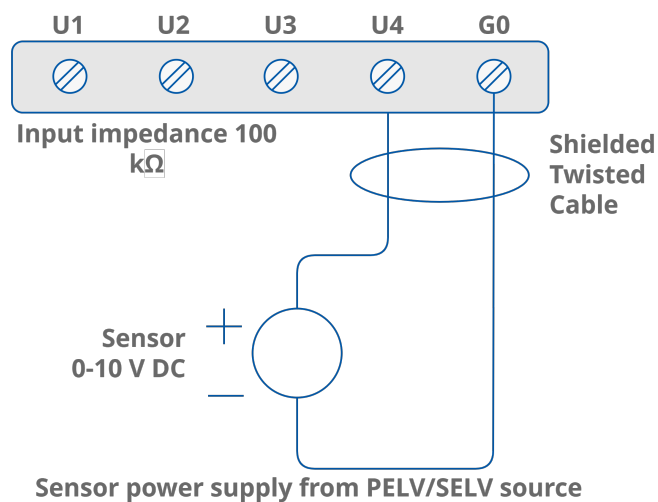
Figure 19. Universal input voltage connection

5.1.2 Universal Input Current Connection
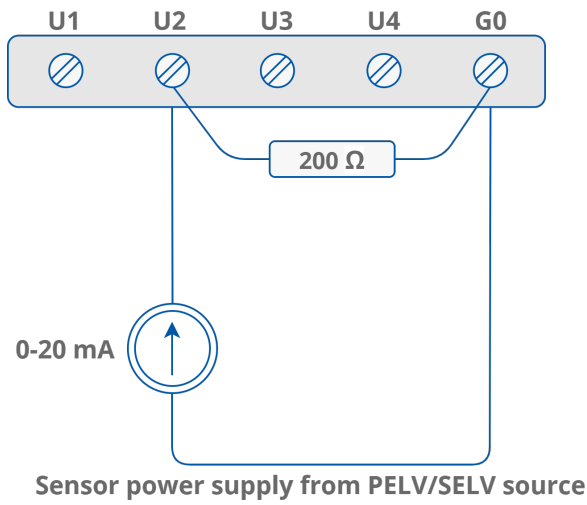
Figure 20. Universal input current connection

5.1.3 Universal Input Resistance Connection
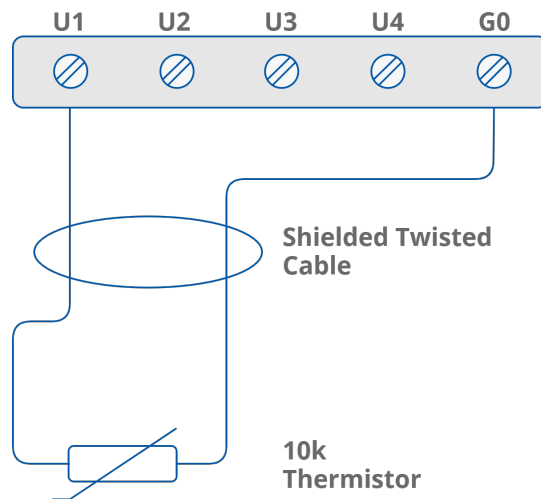
Figure 21. Universal input resistance connection

5.1.4 Universal Input Dry Contact Connection
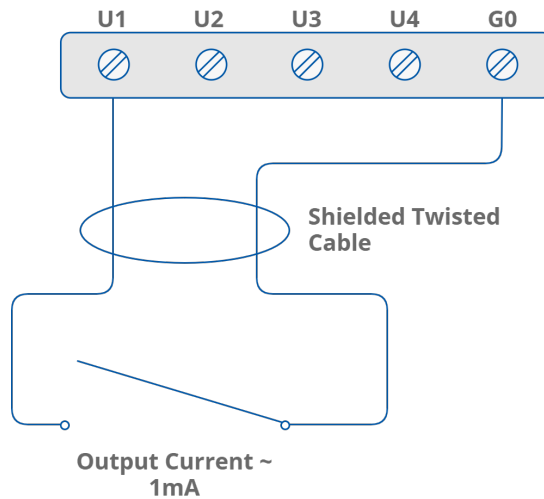
Figure 22. Universal input dry contact connection

5.2 Digital Inputs

The iSMA-B-AAC20 device is equipped with 4 digital inputs.

Digital inputs operate as standard dry contact inputs and, additionally, as high speed pulse counters up to 100 Hz.
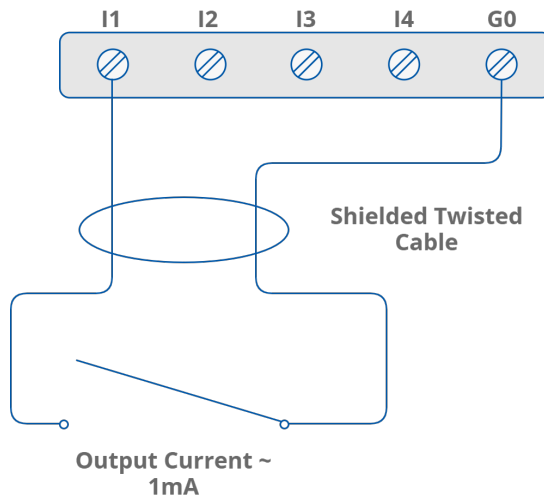
Figure 23. Digital input dry contact connection

5.2.1 Digital Input Counter

A digital input can work as a counter of dry contact pulses up to 100 Hz. The connection is identical as in case of the dry contact input.

5.3 Analog Outputs

The iSMA-B-AAC20 is equipped with 6 analog outputs.

Analog outputs provide a 0-10 V DC output with maximum load up to 20 mA. They support three types of output signals:

• voltage (0-10 V DC) with maximum load up to 20 mA;

- digital;
- pulse width modulation (PWM) 0,01 Hz, 0,1 Hz, 1 Hz, 10 Hz, 100 Hz.

5.3.1 Analog Output Voltage Connection
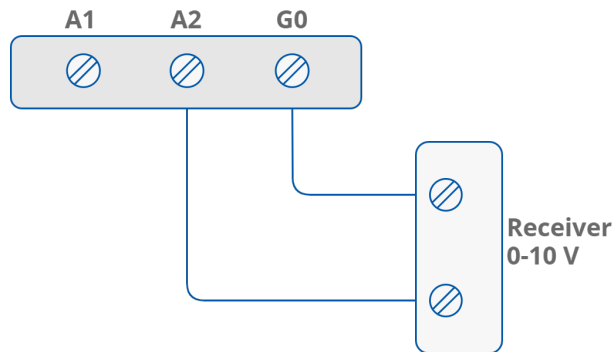
Figure 24. Analog output voltage connection

5.3.2 Analog Output Relay Connection
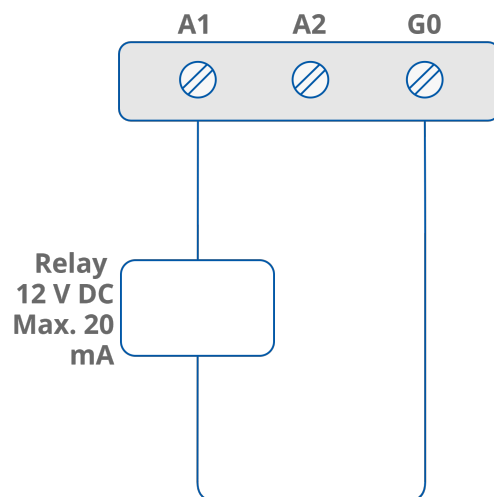
Figure 25. Analog output relay connection

5.3.3 Analog Output Actuator Connection
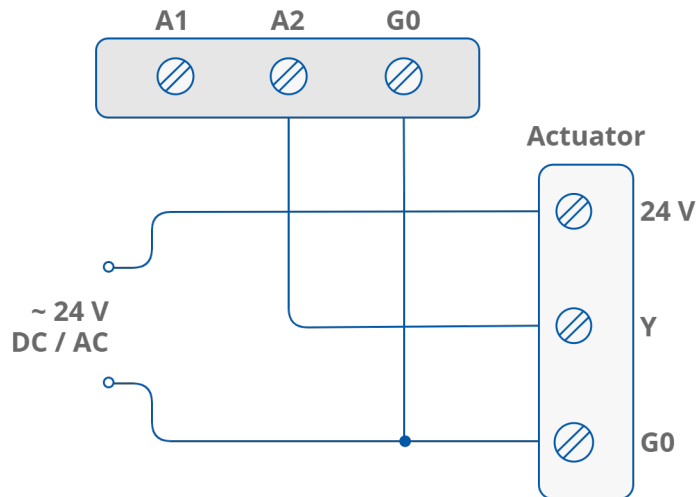
Figure 26. Analog output actuator connection

5.4 Digital Outputs

The iSMA-B-AAC20 is equipped with 4 digital outputs.

Digital outputs operate as relay outputs with maximum loads of:

- resistive load: 3 A at 230 V AC, and 3 A at 30 V DC;
- inductive load: 75 VA for 230 V AC and 30 W for 24 V DC.

5.4.1 Digital Output Electrovalve Connection
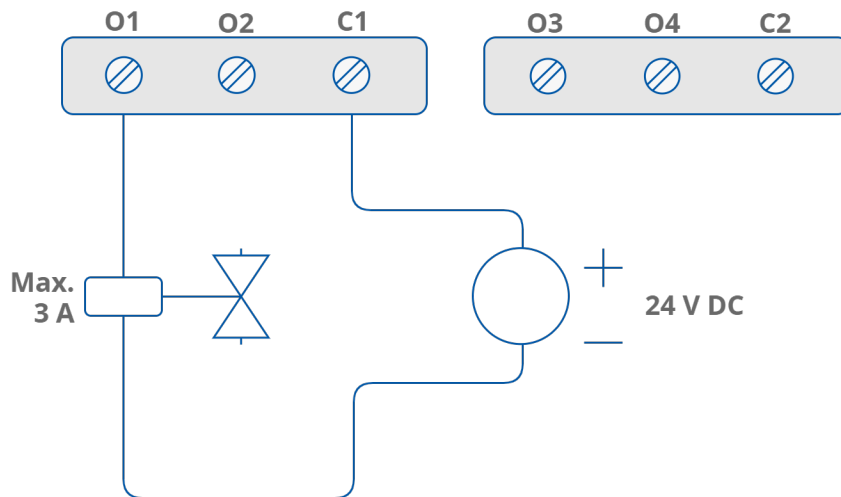
Figure 27. Digital output electrovalve connection

5.4.2 Digital Output Resistive Load Connection
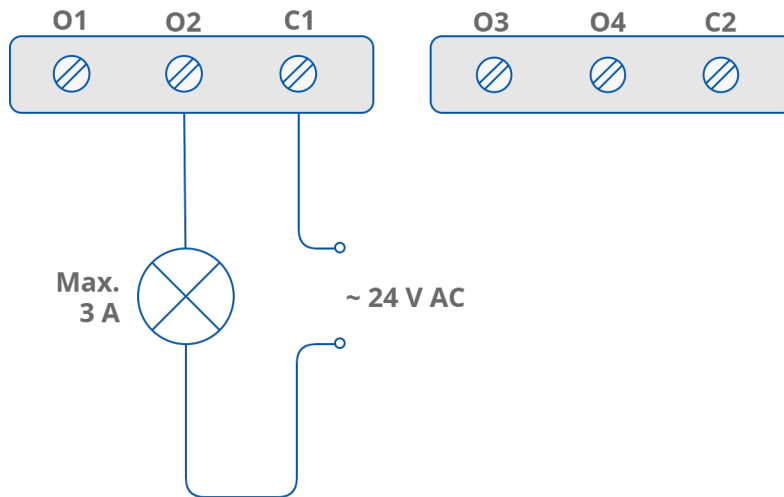
Figure 28. Digital output resistive load connection

5.4.3 Digital Output Inductive Load Connection

Every CX terminal can be supplied by different PELV/SELV source
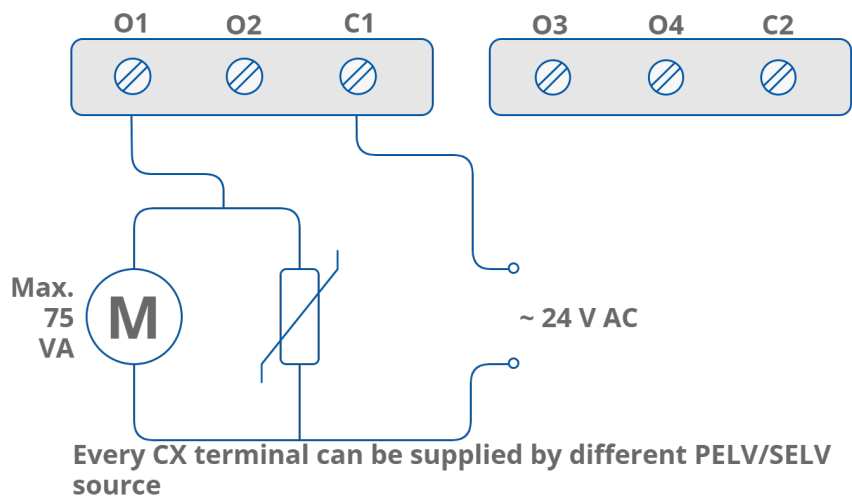
Figure 29. Digital output inductive load connection

5.5 List of Supported Temperature Sensors

- 10K3A1
- 10K4A1
- 10K
- 20K6A1
- 2.2K3A1
- 3K3A1
- 30K6A1
- TAC1
- SIE1
- SAT1
- PT1000
- NI1000
- NI1000 21C (°C)

• NI1000 LG (ºC)

No.	1
Sensor	**10K3A1**
β coefficient	3975K
Manufacturers	Cylon, Honeywell, Johnson, Satchwell, Seachange
°C	Ω
-45	491749
-40	335671
-35	241840
-30	176683
-25	131251
-20	96974
-15	72895
-10	55298
-5	42314
0	32650
5	25396
10	19904
15	15714
20	12494
25	10000
30	8056
35	6530
40	5325
45	4367
50	3601
55	2985

No.	1
60	2487
65	2082
70	1751
75	1480
80	1256
85	1070
90	916
95	787
100	678
105	587
110	510
115	444
120	388
125	340

No.	2
Sensor	**10K4A1**
β coefficient	3695K
Manufacturers	Andover, Delta Controls, Siebe, York
°C	Ω
-45	330749
-40	239831
-35	181532
-30	135233
-25	105081
-20	78930

No.	2
-15	61030
-10	47549
-5	37316
0	29490
5	23462
10	18787
15	15136
20	12268
25	10000
30	8197
35	6754
40	5594
45	4656
50	3893
55	3271
60	2760
65	2339
70	1990
75	1700
80	1458
85	1255
90	1084
95	939
100	817
105	713
110	624

No.	2
115	547
120	482
125	426

No.	3
Sensor	**10K**
β coefficient	3435K
Manufacturers	Carel
°C	Ω
-40	188500
-35	144100
-30	111300
-25	86430
-20	67770
-15	53410
-10	42470
-5	33900
0	27280
5	22050
10	17960
15	14690
20	12090
25	10000
30	8313
35	6940
40	5827

No.	3
45	4912
50	4161
55	3536
60	3020
65	2588
70	2228
75	1924
80	1668
85	1451
90	1266
95	1108
100	973
105	857
110	758
115	672
120	597
125	531

No.	4
Sensor	**20K6A1**
β coefficient	4262K
Manufacturers	Honeywell
°C	Ω
-40	806800
-35	574400
-30	413400

No.	4
-25	300400
-20	220600
-15	163480
-10	122260
-5	92220
0	70140
5	53780
10	41540
15	32340
20	25340
25	20000
30	15886
35	12698
40	10212
45	8260
50	6718
55	5494
60	4518
65	3732
70	3098
75	2586
80	2166
85	1823
90	1541
95	1308
100	1114

No.	4
105	953
110	818
115	704
120	609
125	528

No.	5
Sensor	**2.2K3A1**
β coefficient	3975K
Manufacturers	Ambiflex, Johnson
°C	Ω
-50	154464
-45	-
-40	77081
-35	-
-30	40330
-25	-
-20	22032
-15	-
-10	12519
-5	9529
0	7373
5	5719
10	4487
15	3539
20	2814

No.	5
25	2252
30	1814
35	1471
40	1199
45	983
50	812
55	672
60	561
65	469
70	395
75	333
80	284
85	241
90	207
95	177
100	154
105	132
110	116
115	-
120	88
125	-

No.	6
Sensor	**3K3A1**
β coefficient	3975K
Manufacturers	Alerton

No.	6
°C	Ω
-50	200348
-45	150524
-40	100701
-35	76853
-30	53005
-25	41048
-20	29092
-15	21868
-10	16589
-5	12694
0	9795
5	7619
10	5971
15	4714
20	3748
25	3000
30	2417
35	1959
40	1598
45	1310
50	1080
55	896
60	746
65	625
70	526

No.	6
75	444
80	377
85	321
90	275
95	236
100	204
105	176
110	153
115	133
120	117
125	102

No.	7
Sensor	**30K6A1**
β coefficient	4262K
Manufacturers	Drayton
°C	Ω
-30	622911
-25	477393
-20	331876
-15	245785
-10	183697
-5	138502
0	105305
5	60713
10	62347

No.	7
15	48511
20	38019
25	30000
30	23828
35	19046
40	15317
45	12390
50	10079
55	8243
60	6777
65	5600
70	4650
75	3879
80	3251
85	2737
90	2313
95	1963
100	1672
105	1430
110	1228
115	1058
120	915
125	793

No.	8
Sensor	**TAC1**
β coefficient	3500K
Manufacturers	TAC
°C	Ω
-40	39024
-35	29358
-30	22284
-25	17073
-20	13192
-15	10276
-10	8068
-5	6382
0	5085
5	4078
10	3294
15	2676
20	2188
25	1800
30	1488
35	1237
40	1034
45	869
50	733
55	622
60	529
65	453

No.	8
70	389
75	335
80	290
85	252
90	220
95	192
100	169
105	149
110	131
115	116
120	103
125	92

No.	9
Sensor	**SIE1**
Manufacturers	Barber Colman, Siebe
°C	Ω
-50	10732
-45	10624
-40	10517
-35	10344
-30	10172
-25	9913
-20	9654
-15	9320
-10	8933

No.	9
-5	8496
0	8044
5	7489
10	6938
15	6370
20	5798
25	5238
30	4696
35	4185
40	3707
45	3271
50	2875
55	2521
60	2206
65	1929
70	1685
75	1472
80	1287
85	1127
90	986
95	866
100	760
105	670
110	590
115	522
120	462

No.	9
125	410

No.	10
Sensor	**SAT1**
Manufacturers	Satchwell
°C	Ω
-45	9652
-40	9584
-35	9467
-30	9349
-25	9159
-20	8968
-15	8708
-10	8396
-5	8031
0	7614
5	7150
10	6649
15	6121
20	5580
25	5039
30	4513
35	4012
40	3545
45	3117
50	2730

No.	10
55	2386
60	2082
65	1816
70	1585
75	1385
80	1213
85	1064
90	937
95	828
100	734
105	654
110	585
115	525
120	474
125	429

No.	11
Sensor	**PT1000**
Manufacturers	Honeywell, Sauter, Serck, Siebe, Cylon
°C	Ω
-50	803,1
-40	842,7
-30	882,2
-20	921,6
-10	960,9
0	1000,0

No.	11
10	1039,0
20	1077,9
30	1116,7
40	1155,4
50	1194,0
60	1232,4
70	1270,8
80	1309,0
90	1347,1
100	1385,1
110	1422,9
120	1460,7
130	1498,3
140	1535,8
150	1573,3
160	1610,5
170	1647,7
180	1684,8
190	1721,7
200	1758,6
210	1795,3
220	1831,9
230	1868,4
240	1904,7
250	1941,0
260	1977,1

No.	11
270	2013,1
280	2049,0
290	2084,8
300	2120,5
310	2156,1
320	2191,5
330	2226,8
340	2262,1
350	2297,2
360	2332,1
370	2367,0
380	2401,8
390	2436,4
400	2470,9

No.	12
Sensor	**NI1000**
Manufacturers	Sauter
°C	Ω
-50	742,6
-40	791,3
-30	841,5
-20	893,0
-10	945,8
0	1000,0
10	1055,5

No.	12
20	1112,4
30	1170,6
40	1230,1
50	1291,1
60	1353,4
70	1417,2
80	1482,5
90	1549,4
100	1617,8
110	1687,9
120	1759,8
130	1833,4
140	1909,0
150	1986,6

No.	13
Sensor	**NI1000 21C (°C)**
Manufacturers	Distech
°C	Ω
-40	699,3
-30	745,5
-20	792,8
-10	841,2
0	891,0
10	942,0
20	994,3

No.	13
30	1047,8
40	1102,6
50	1158,5
60	1215,8
70	1274,3
80	1334,4
90	1407,8
100	1473,1
110	1524,0

No.	14
Sensor	**NI1000 LG (ºC)**
Manufacturers	LG
°C	Ω
-50	790,9
-40	830,8
-30	871,7
-20	913,5
-10	956,2
0	1000,0
10	1044,8
20	1090,7
30	1137,6
40	1185,7
50	1235,0
60	1285,4

No.	14
70	1337,1
80	1390,1
90	1444,4
100	1500,0
110	1557,0
120	1615,4
130	1675,2
140	1736,5
150	1799,3