

designer's electronic signature	auditor's electronic signature

INVESTOR<sup>1</sup> Western Balkan Six Chamber Investment Forum  
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OBJECT<sup>2</sup> MIXED HIGH SCHOOL "DANILO KIŠ", Budva, Montenegro

LOCATION<sup>3</sup> c.p. 1617/1 cadastral district Budva  
Municipality Budva

TYPE OF TECHNICAL DOCUMENTATION<sup>4</sup> ADAPTATION PROJECT OF PARTS OF THE FACILITY

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<sup>1</sup> Investor's name

<sup>2</sup> The name of the object

<sup>3</sup> Construction site, planning document, urban plot, cadastral plot

<sup>4</sup> Conceptual solution, conceptual project, main project, i.e. the project of the finished object project (if it is the cover page of the entire technical documentation)

<sup>5</sup> The name of the company, legal entity, or entrepreneur who created the technical documentation

<sup>6</sup> The name of the responsible person in the company, legal entity, that is, the name and surname of the entrepreneur

<sup>7</sup> Name and surname of the main engineer.

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INVESTOR <sup>1</sup>: Western Balkan Six Chamber Investment Forum  
Piazza della Borsa nr. 14 34121 Trieste Italy

OBJECT <sup>2</sup>: JU SECONDARY MIXED SCHOOL "Danilo Kiš", Budva,  
Montenegro

LOCATION <sup>3</sup>: kp 1617/1, KO Budva  
Municipality of Budva

PART OF THE TECHNICAL DOCUMENTS <sup>4</sup>: ADAPTATION PROJECT OF PARTS OF THE FACILITY  
INSTALLATION OF EXTRA LOW VOLTAGE

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<sup>1</sup> Name of the investor

<sup>2</sup> Name of the projected object

<sup>3</sup> Construction site, planning document, urban plot, cadastral plot

<sup>4</sup> Architectural project, construction project, electrotechnical project, i.e. mechanical project (if it is the cover page of the part of the technical documentation)

<sup>5</sup> The name of the company, legal entity, or entrepreneur that created part of the technical documentation technical documentation

<sup>6</sup> The name of the responsible person in the company, legal entity, that is, the name and surname of the entrepreneur

<sup>7</sup> Name and surname of the responsible engineer

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## **I TEXTUAL DOCUMENTATION**

## **1 TECHNICAL DESCRIPTION OF THE FACILITY**

### **1.1 INTRODUCTION**

The subject of this investment-technical documentation is the electrical installation of extra low voltage for the building JU SECONDARY MIXED SCHOOL "DANILO KIŠ", which is located on cadastral plot no. 1617/1 KO Budva, Municipality of Budva, Investor Western Balkan Six Chamber Investment Forum Piazza della Borsa nr. 14 34121 Trieste Italy.

The documentation provides technical solutions at the level of the Adaptation Project of parts of the facility – extra low voltage installation in accordance with the project task.

According to the architectural and construction solution, the subject of adaptation processed in this project is the restaurant part (on the ground floor) and the block with classrooms (on the first floor) of the mixed school Danilo Kiš, which is located in ul. A victim of fascism in Budva. The building was built in a skeletal system of AB beams and columns with brick walls, P+1 floors, and the clear height of the ground floor is 3.40 m, and the upper floor is 3.00 m. The facility is intended for education.

The project envisages:

- Installation of structural cable system - SKS
- Installation of an automatic fire alarm system
- Gas detection in kitchens
- Installation of the IP video surveillance system
- Installation of a sound system

During the development of this project, the appropriate legal provisions, special regulations, technical norms, quality norms, standards and professional recommendations were complied with.

## 1.2 ELECTRICAL INSTALLATIONS OF EXTRA LOW CURRENT - TECHNICAL DESCRIPTION

### 1.2.1 Installation of structural cable system - SKS

There is one RACK closet in the building, on the first floor in the "Reception" room. The project envisages that the optical SM cable will be brought to the planned RACK cabinet from the existing one located on the same floor, but in a part of the building that is not intended for adaptation.

Telecommunication connectors are shielded FTP RJ-45 cat.6, modular and installed in installation boxes, in accordance with the measurements and estimates of high and low current electrical installations. Connections are placed at a certain height from the height of the finished floor defined on the drawings of the electrical installations of low and extra low current.

S/FTP cat.6 LSZH cables are laid from the Rack cabinet to each connector in the facility. The cables are routed partly along the wall under the plaster, and partly through the concrete floor liner, in installation pipes with an internal diameter of Ø16mm. The computer S/FTP network is a universal installation according to the EIA/TIA T-568B standard. This type of installation can support all types of telephone and computer networks.

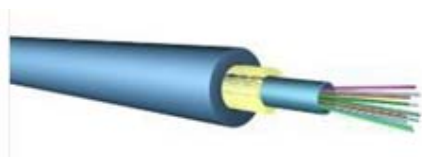
System elements:

#### Rack cabinet



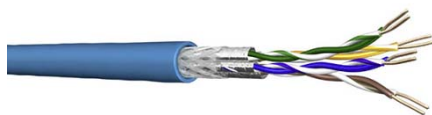
- 41U / 19"
- Wheels and feet with leveling
- glass door with lock
- glass front door
- ventilation unit
- cable entry on top and bottom
- load capacity 300 kg
- 600x600x2000mmmm ( WxDxH )

#### Singlemode optical cable



- System cable or equivalent (for a 25-year warranty) loose tube, indoor/outdoor, CPR rating Dca-s2-d2-a1
- protection against rodents
- attenuation (dB/km) 1310nm-1625nm: ≤0.39; 1550nm: ≤0.25

#### S/FTP (Wall) cable cat. 6 LSZH



- System cable (for a 25-year warranty) - Construction S/FTP Cat.6 250 MHz
- CPR rating Dca-s2-d2-a1
- dense twisting of pairs, the whole bundle protected by foil, plastic cross

It is used to connect RJ-45 sockets located in wall installation boxes by rooms (defined by the low and extra low Electrical Installation Project) with the associated ports. The provided cable enables data transfer at a speed of 1 Gb/s, which is more than enough considering that the terminals that will be connected to the LAN network do not have ports that require speeds higher than the specified.

**Connectors RJ-45 cat. 6**

RJ-45 cat connectors are provided for horizontal cable installation. 6, according to the international standard ISO/IEC 8877, which enable the transmission of data in class D according to the standard ISO/IEC 11801. In each room, it is planned to install the required number of RJ 45 sockets. The rear side of the RJ-45 connector has a so-called IDC connectors (Insulation Displacement Contact) for permanent fixing of rigid S/FTP (FTP Wall) cables using a special tool. This kind of contact is of the highest quality at high speeds. S/FTP patch cords are placed on the side of the sockets, where there is an RJ-45 connector on one side, and on the other RJ-45 if the socket is a computer socket, or RJ 11 6/4 if the socket is a telephone socket, where use two central pins in the RJ-11 connector.

In case the User wants to create a computer network for the business premises, a switch with the appropriate number of ports and patch cables cat. 6 are connected to the modules in the communication hub. In this way, the connectors from the premises are connected to a common switch in the local computer network, with possible performance of 10/100/1000Mbps, depending on the switch device.

After building the described system, it is necessary to perform the necessary measurements and create a protocol with the results.

The passage of telecommunication cables is achieved through suitable halogen-free installation pipes. The principle scheme of divorce is given in the drawing.

The project solution for the realization of horizontal cabling defines copper cables with 4 twisted pairs, minimum performance level of category 6. Conductors (solid wire) should have a diameter of *0.57 mm* (23 AWG). The design solution determines the use of cables with shielded (screened) twisted pairs — *S/ FTP (Foiled Twisted Pair)* category 6. Standard *ISO/IEC 11801* defines the maximum length of horizontal cabling of 90 meters. The selected routes for the cables in the facility ensure that this condition is met.

When laying the installation cable with twisted pairs, care should be taken not to violate the minimum bending radius of *20 mm* (four times the diameter of the cable), and that the distance from the electrical installation of high current should be at least 30 mm. Each RJ45 jack should have a female 8-pin *IEC 603.7* category 6 modular connector for 100Ω.

Appropriate category 6 installation S/FTP cables will be connected to the socket connectors. During installation, care should be taken that the spread of the twisted pairs of the installation cable when connecting to the back of the socket connector does not exceed *13 mm*. Connections represent the place where the fixed installation of the cable system begins. From the front side of the computer jack connector, by connecting a flexible cable, the User's equipment (computer or telephone) is connected to the telephone/computer system.

The connection of active communication equipment for the realization of a local computer network should be done by placing an active device on the communication node, while using as many modules as desired, while the rest of the modules would remain intended for telephone installation. Connecting active equipment to hub modules and redirecting tel. the line to certain connectors is made with *patch cords*. These flexible cables consist of 4 pairs of twisted *copper* conductors that meet the requirements for Category 6 cables from the *ISO/IEC 11801 / Annex C standard* . These S/FTP cables can be up to 5 meters long (in this project, with their average length of 50cm-1m) and at their ends should be mounted appropriate 8-pin *RJ-45* (male) connectors (*RJ-45-Plug*) category 6 in accordance with the *IEC 603.7* standard. These connectors should be connected to the cable using the same wiring system used for the connectors (*T-568B*).

A switch with the appropriate number of ports is placed on the communication hub and patch cables of category 6 are connected to the modules in the communication hub. In this way, the connectors are connected to a common switch in the local computer network, with possible performance of 10/100/1000Mbps, depending on the switch device. The principle diagram of connection and distribution of cables is given in the graphic attachments.

Note: Delivery and installation of the telephone switchboard and active equipment is the responsibility of the Investor.



### 1.2.2 Installation of automatic fire alarm

The building will be covered by a stable fire alarm installation. The system envisages an addressable switchboard that enables a fire alarm. With this project is planarized automatic fire alarm in the kitchen, which is not intended for adaptation in all phases of this project, but due to the importance of this installation, we included it in the project.

The signaling system consists of:

1. Alarm centers;
2. Devices for detecting smoke, elevated temperature and fire in protected rooms;
3. Devices for activating / deactivating the fire protection system;
4. Executive elements of the system;
5. Transmission paths of signals and commands.

The fire alarm system is intended for the early detection and detection of smoke and/or elevated temperature - flames in protected rooms, as well as a sudden increase in temperature, which is made possible by the installed sensors (optical, thermal and optical-thermal detectors, as well as manual fire detectors). around the protected premises, then processing the signals coming from the sensor to the control panel and forwarding the signal through the output of the fire control panel to the executive elements of the system.

#### **The central unit of the system**

The central unit provides the following functions:

- control of system performance and error signaling in case of deviation from the expected parameters;
- receiving and registering information about the occurrence of a fire;
- alarming and reporting in case of fire;
- signals for controlling fire doors, elevators, air conditioning and power supply in the facility in accordance with *the Fire Protection Elaboration* ;

The control panel provides a clear presentation of pre-alarm and alarm conditions, as well as other phenomena, by means of LED indicators, and by printing the location and time of the registered event on the display. Also, the control center processes and stores information collected in continuous two-way communication with all peripheral elements (first of all, with addressable detectors) and provides executive control functions according to the given program.

The central unit is primarily powered from a separate circuit of the facility's general consumption installation. The backup source of power is represented by accumulator batteries, which are constantly replenished and kept in a state of readiness. In the event of an interruption of the supply from the primary source of electricity, the batteries automatically and without interruption take over the power supply of the system. The control unit periodically examines the capacity of the batteries and, in case it detects their wear and tear, gives the appropriate signal.

Addressable elements of the system (detectors, sirens, input-output modules) are connected in a loop, i.e. they share the same cable pair. Each device on the loop has its own address, set, in the specific case, through the system configuration software. The control panel constantly communicates with the detectors and if one of them is in an alarm or error state, the control panel identifies the device in question and gives the appropriate signal. Also, the control center through its relay outputs and/or control modules can initiate executive functions provided in the event of a fire (cut off the facility's electricity supply, turn off the air conditioning system, open evacuation exits, close fire doors and dampers, start broadcasting an alarm message through the sound system and fig.).

## Fire control panel



- color touchscreen with a diagonal of 4.3" and 6 function keys, a key for viewing multiple alarms, 6 LED status indicators
- with 2 loops (with 240 addressable elements each)
- 4A power supply for large case
- large case measuring 497 x 380 x 97mm (WxHxD), with space for two 12V/17Ah rechargeable batteries
- it does not have the ability to add loop extensions
- networking capability in HORNET+
- the board has 4 monitored configurable I/O channels and one configurable relay.

### Calculation of batteries for the FCP switchboard

The capacity of the battery must ensure the operation of the system in a quiet state for 72 hours and in an alarm state for 30 minutes.

#### Ulazni podaci:

1. required time of autonomous work	tn ( h )
2. quiescent current of connected devices	In ( A )
3. alarm current of connected devices	Ia ( A )
4. quiescent current of the power station	Icn ( A )
5. alarm current of the Ica switchboard	Ica ( A )
6. required time of autonomous operation in alarm (0.5h)	ta ( h )
7. safety factor (1.1 .. 1.3)	F

Potreban kapacitet akumulatora se izračunava prema:

$$Bk = F \times (tn \times (In + Icn) + ta \times (Ia + Ica))$$

ELEMENTS	calm current	alarm current	number of elements	total quiescent current	total alarm current
	(mA)	(mA)	(pc)	(mA)	(mA)
Central	165.0	185.0	1	165.0	185.0
Loop module	35.0	50.0	1	35.0	50.0
Communication module	30.0	250.0	1	30.0	250.0
Optical fire detector	0.2	10.0	33	4.0	330.0
Thermal fire detector	0.2	10.0	7	2.0	70.0
Optical thermal fire detector	0.09	40.0	0	0.0	0.0
I/O module	0.08	20.0	0	0.0	0.0
Addressable hand pager	0.08	5.0	6	6.0	30.0
Alarm siren	0.50	23.0	8	8.0	184.0
				<b>250.0</b>	<b>1099.0</b>

required quiet time(s)	72		capacity in: quiet operation (mAh)	<b>18000</b>
required time in alarm (h)	0.5		alarm capacity (mAh)	<b>549.5</b>
total required capacity:				<b>(mAh) 18549.5</b>
safety factor:				1,2
<b>TOTAL battery capacity:</b>				<b>~ (Ah) 22.3</b>

Bearing in mind the above data, the following calculation was obtained:

**Cmin = 22.3 Ah** . So that two accumulator batteries with a total capacity of 34 Ah satisfy the installed ones requirements.

### Calculation of the voltage drop on the cables in the fire detection and alarm system

In the continuation of the documentation, voltage drop calculation for loops will be attached, while this part will show the guidelines we used in the given calculation. The limitations that we will have to adhere to during the calculation are the following:

- loop length 2000m/50μF
- cable resistance (max. 40Ω)
- current (500mA)
- minimum loop voltage (14V)

When creating this part of the documentation, we used the given guidelines, which are shown in the following table:

<b>Cables:</b>	2 wire shielded cable Twisted 5/10cm Total maximum capacity 0.5uF Maximum length 2000m Maximum resistance (considering the sum of the positive and negative conductor) 40Ohm  It is necessary to consult the configuration software, Previdia/STUDIO, for the proper cable sizing in relation to the power consumption of the connected devices, or to the following table for a rough estimate:
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Total loop length	Wire section	American Wire Gauge
Up to 1000m	2 x 1 mm <sup>2</sup>	17 AWG
Up to 1500m	2 x 1.5 mm <sup>2</sup>	16 AWG
Up to 2000m	2 x 2 mm <sup>2</sup>	14 AWG

Since the loop in the project is 500m long, we decided on the cable J- H( St)H FE180/E90 2x2x0.5mm<sup>2</sup>.

The resistance of the cable must be below 40Ω, which will be confirmed by calculation, and the formula through which we got the calculation is given below.

$$R = \frac{\varphi * L}{S} * 2$$

The maximum current in the loop must not be higher than 500mA. During alarming, not all detectors will be in working condition, so we will assume that 10% of them will be in alarm condition, while the rest will be in quiet condition. Also for manual call points and IO modules we will assume that they are all in alarm state. For the sirens, we will take the alarm current values, because they are always active in the alarm state. The project envisages cable JH(St)H FE180/E90 2x2x0.5mm<sup>2</sup>. Two conductors are required for the system, while the other two are spare.

When making this calculation, we used the nominal voltage of the central unit U=27.5 Vdc, while the minimum value of the loop voltage is 14 Vdc. Therefore, the "output" voltage of the loop (at the terminals of the switchboard) can be permanently raised to 34Vdc, without the risk of any damage to the switchboard itself or to the devices connected in the loop. This technology will not be used during this calculation. The formula we used for the voltage drop in the loop is as follows:

$$V_{\text{drop}} = \frac{\varphi * L * I}{S} * 2$$

The calculation of the loop is given in the following attachment.

## Fire detection systems

### LOOP CALCULATOR

DATE	PROJECT NAME					LOOP N°
	JU SREDNJAMJEŠOVITA ŠKOLA "Danilo Kiš", Budva, Crna Gora					1
SUMMARY OF LOOP DEVICES						
DEVICE CODE	DESCRIPTION	TOTAL N° of DEVICES	STAND BY CONSUMPTION (mA)	ALARM CONSUMPTION (mA)	N° of DEVICES IN ALARM	TOTAL CONSUMPTION (mA)
ED100	Smoke Detector	33	0,2	10,00	4	45,80
ED200	Heat detector	7	0,2	10,00	2	21,00
ED300	Smoke and heat detector		0,2	7,00		0,00
IL0010	Remote indicator		0	14,00		0,00
EC0020	Manual call point	6	0,08	5,00	6	30,00
EM312SR	1 IN and 1 OUT module		0,08	20,00		0,00
EM344R	4 IN and 4 OUT module		0,08	20,00		0,00
EM110	1 IN module		0,08	20,00		0,00
EM411R	Conventional line interface		0,08	20,00		0,00
EU311	1 IN and 1 OUT micromodule		0,08	20,00		0,00
EM320AC	2 IN and 2 OUT module @230Vac		0,08	10,00		0,00
ES2011RE	Loop powered sounder		0,9	3,00		0,00
ES2021RE	Loop powered sounder-flasher	8	0,9	21,00	8	168,00
ESB1011	Sounder base		0,5	3,00		0,00
ESB2011	Sounder-flasher base		0,5	21,00		0,00
TOTAL LOOP CONSUMPTION (mA)				264,80		
				OK		
INSTALLATION DATA						
CABLE CROSS-SECTION (mm²)			0,5			
LOOP LENGTH (m)			500			
LOOP OUTPUT VOLTAGE (V)			27,5			
RESULTS						
CABLE RESISTANCE (Ω)			34,00	OK		
MINIMUM VOLTAGE CALCULATED ON THE LOOP (V)			18,50	OK		

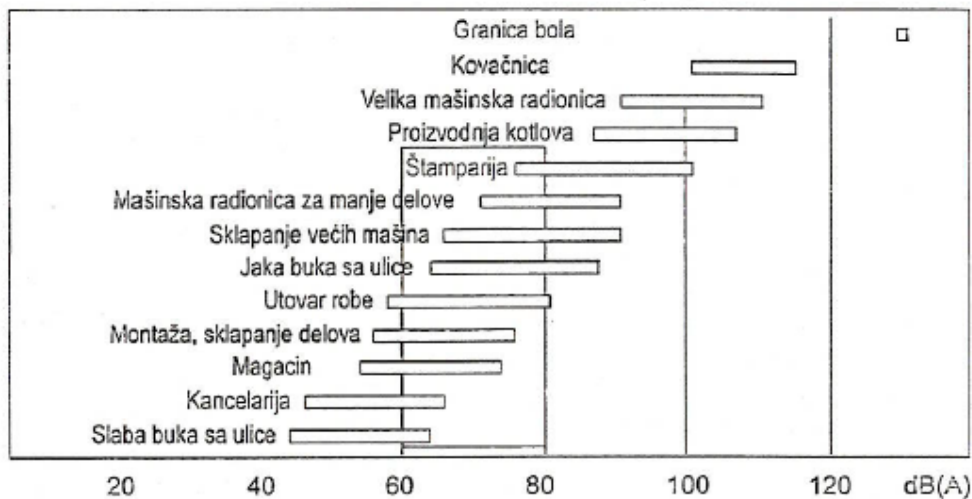
## Calculation for the design of sound signaling

With this calculation, we will present the guidelines with the help of which we determined how many devices are needed for a given facility. More precisely, we will show what is the maximum distance from the sound signaling, while at the same time the person can be warned and informed without hindrance.

The rule that we will use in the calculation is better known as the 6dB(A) rule, which states that by doubling the distance from the sound source, the sound level decreases by 6db(A).

Now we will apply this to the given object.

First, we will determine the ambient noise level in the building. The following graphic shows the noise level for different environments as well as a tabular representation.



Noise level in different environments

Location	Noise level [dB(A)]
Business premises	55
Educational institutions	45
Industry	80
Workshops	85
Facilities in a densely populated area	70
Facilities on the outskirts in a rural area	40

We will take that for our case the ambient sound level is 75 dB, and we will raise it by 5dB as required by most standards. It means that the minimum level to be achieved is 80 dB.

The volume of installed sound signaling devices usually ranges between 100 and 110 dB, so in further consideration we will assume that our siren reaches a maximum level of 105 dB. Now we have to determine at what distance from the sound source that is 105 dB, it will emit a volume of 80 dB.

We determine this from the aforementioned 6dB rule, i.e. from the following table:

Distance (m)	1	2	3	4	5	6	7	8	9	10	16	32
Loss [dB(A)]	0	6	9.2	12	13.9	15.5	16.9	18	19	20	24	30

Since our attenuation is 25 dB, it means that we can install the sound signaling device at a distance of approximately 16 meters.

## Detectors

An adequate type of automatic detector for each of the rooms is determined based on the expected early manifestations of the fire, the purpose of the room, the fire load, as well as possible disturbing influences. The required number of detectors in the monitored area and their placement is defined in accordance with the manufacturer's recommendations.

The addressable automatic smoke (optical) fire detector has an opto-electronic chamber for the detection of dark and light smoke particles with increased immunity to false alarms. It represents the basic type of detector in the system and is used in all administrative areas. It is intended as a basic type of fire detector and is mounted on the ceiling of the room. In the case of a suspended ceiling, the optical detector is also used to cover the space between the suspended ceiling and the ceiling. The rule applied is that one detector monitors an area of 60 m<sup>2</sup> for ceiling heights <6 m, except in extinguishing zones where, as a rule, the monitored area is reduced by 50% for two-zone dependency, i.e. the area covered by the smoke detector is 30 m<sup>2</sup>. Accordingly, the maximum distance between two optical smoke detectors is  $1.2 \times \sqrt{60} = 9\text{m}$ , and the maximum distance of the detector from the wall is 4.5m, i.e. in extinguishing zones  $1.2 \times \sqrt{30} = 6.5\text{m}$ , and the maximum distance of the detector from the wall is 3.2m. In passages and corridors that are narrower than 3 m, the distances between detectors do not exceed 15 m.

The thermal fire detector is equipped with one thermal sensor, while the optical-thermal sensor has an opto-electronic chamber with two optical sensors for detecting dark and light smoke particles, as well as one additional thermal sensor that increases immunity to false alarms. They cover 20m<sup>2</sup> and the height of the space up to 7.5 meters.

All detectors are resistant to standard disturbances that may occur (dust, fibers, insects, humidity, condensation, EM influences, corrosive vapors, vibrations, shocks, etc.), have an alarm indicator visible in a 360° circle, as well as a built-in isolator of the line from short connections and disconnections. The detectors are mounted on a base made of synthetic material resistant to shocks, vibrations and scratches with terminal contacts without screws. In places where detectors are installed in areas without a suspended ceiling or on the roof structure, additional supports for surface mounting are provided into which the cable is inserted from the side. When mounting the detector, it is necessary that the place where the detector is installed is coordinated with the position of other elements that are installed in the ceiling (lights, elements of mechanical installations) and building elements (beams, walls, etc.), whereby: - the distance of the detector from the wall should be minimal 50 cm, - the distance of the detector from the beam (rib) should be at least 50 cm, - the distance of the detector from the place of air injection should be min. 50 cm, - the distance of the detector from the lamp should be at least twice the height of the lamp. When laying the cables, in places where the installation of the detector is planned, the cables should be left in a slightly longer length in order to be able to carry out the aforementioned alignment.

### Optical detector



- ISP technology (Intelligent Signal Processing)
- one optical sensor
- automatic and manual adjustment

### Thermal detector



- ISP technology (Intelligent Signal Processing)
- thermistor technology
- automatic and manual adjustment

**Optical-thermal detector**

- ISP technology (Intelligent Signal Processing)
- one optical sensor and thermistor
- automatic and manual adjustment

**Detector stand**

- - built-in jumper that ensures continuity in case of disassembly of the associated detector
- - material: polycarbonate
- -dimensions: Ø110mm x 24mm

**Detector stand**

- connecting the cable above the building
- 4 prepared openings for Ø16mm pipe
- lock against unauthorized removal

**Manual fire detectors**

They are provided in visible and accessible places, along the evacuation routes. It is used for manual activation of the alarm in the event of a fire, without checking time and thus has a role in fire protection for direct alarming. Any alarm caused by their activation is considered a sure sign that there has been a fire and it works without a time delay. The detector consists of detector electronics with direct activation by breaking the protective glass and a red casing. A short circuit line isolator is built into the detector. The detectors are mounted at a height of  $1.5 \pm 0.2$  m from the floor level.

**Handheld call point**

- LED status indicator: green-standby; yellow-error; red-alarm
- two integrated isolators
- automatic and manual adjustment



## Alarming

Alarming in case of fire is provided as follows:

- by activating electronic sirens with the required sound levels;

The sirens are mounted on the wall, according to the graphic documentation at a height of 2.2m, corrections are possible on the spot (mechanic plan of the MEP or interior project). One of 24 different warning tones can be programmed on the siren .

### Siren



- automatic addressing by the central office
- sound pressure 101dB(A)@1m
- 14 types of melody available

### Tip

The project envisages the installation of a machine with a recorded voice message, intended for telephone reporting of alarms and errors.

## Alarm plan

With this alarm concept, in the event of a fire, personnel can make decisions within an automatic sequence of operations. In this way, false alarms are not transmitted to the fire department. The impact of any human error is reduced by the technology of applied solutions.

The fire alarm system supports two operating modes "day" and "night" in accordance with the Rulebook on technical norms for stable fire alarm installations ("Official Gazette of the FRY", no. 87/93).

Upon alarming of the automatic fire detector in the "day" operating mode, an internal light and sound alarm is given on the operating console of the fire alarm control panel. This is the first warning sign for the person on duty. In the event that the person on duty is not present, after the expiration of the pre-programmed time (from 20 - 60 seconds), which is also called "presence time", a general alarm occurs in the facility.

In a normal situation, the operator on duty, who is always present, confirms that he has received the information from the system by pressing a button. This confirms the presence and at the same time starts another programmable time, "reconnaissance time".

The reconnaissance time depends on the size and geometry of the monitored object and is defined separately for each object during the functional testing of the system. This time usually lasts 3 to 5 minutes.

Upon confirmation of presence, the person on duty on the operating console reads the exact location of the detector in the alarm, goes to the scene and in the event of a fire presses the nearest manual detector (as a confirmation of the alarm in the system) and proceeds to extinguish the fire in accordance with the pre-determined operational plan in case of fire.

In the event that the automatic detector reacted to some disturbing influences (strong dust, water vapor, etc.), and the person on duty determines by inspection that it is a "false alarm", returns to the operating console, cancels the "internal" alarm and the system continues to function in regular mode of operation.







Alarms from manual detectors do not have a delay and immediately give a general alarm condition in the building, considering that they are considered a reliable sign that a fire has actually occurred.

The control unit has the ability to switch the operating mode from "daily" to "night" mode. This switching must be done semi-automatically, i.e. automatically (via the switching clock) from day to night work, and manually from night to day work.

In the "night" operating mode, all alarms in the system are considered relevant and are automatically forwarded to the person on duty and/or the fire department without the previously described reconnaissance and confirmation time.

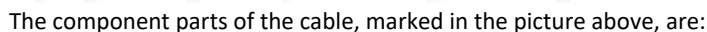
The alarm plan is defined by the Main Fire Protection Project and provides the following:

- warning persons in danger for timely evacuation
- involving the person on duty and the fireman on duty, that is, the local fire department
- alerting the nearest fire department
- alerting personnel who have special duties in case of fire
- taking all measures in case of failure or disconnection of certain zones.

<b>ALARM</b>	GRUPA AUTOMATSKIH JAVLJAČA – REŽIM "DAN"	GRUPA AUTOMATSKIH JAVLJAČA – REŽIM "NOĆ"	GRUPA RUČNIH JAVLJAČA
NADZOR PRISUTNOSTI	 NE DA ?	 NE	 NE
NADZOR IZVIDANJA	NE DA ?	NE	NE
POŽAR	NE DA ?	NE	DA ? 
RESET			
<b>OPŠTI ALARM</b>			

The cable distribution of the system will be realized with a paired, shielded, halogen-free cable, which will be pulled into halogen-free installation pipes of the appropriate section before laying.

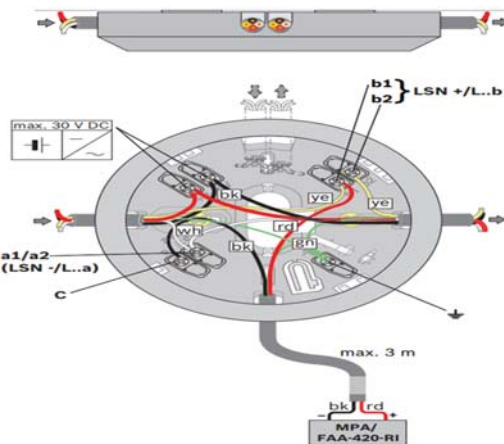
For connecting system elements, a fire-resistant cable of type JE-H(St)H 2x2x0.8mm FE 180/ E90 is specified, the construction of which is shown in the following picture:



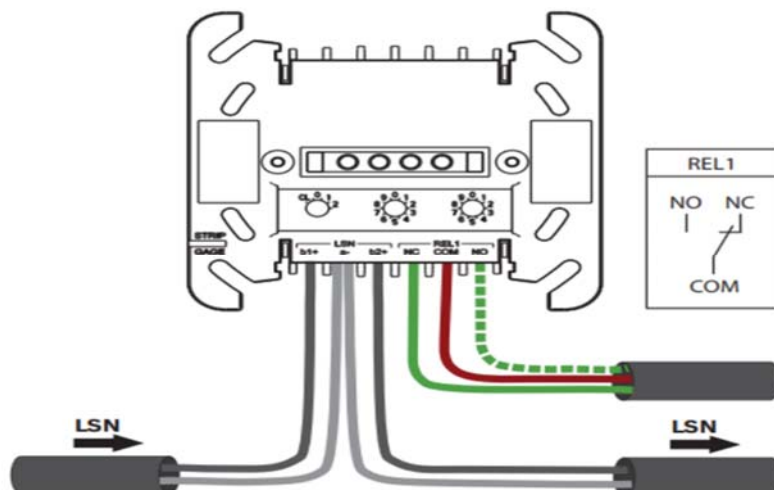
1. conductor (solid section copper wire, diameter 1mm)
2. conductor insulation (flame-retardant mass based on halogen-free polymers)
3. cable core (2x 2 conductors twisted into pairs)
4. inner jacket (polyester tape + glass fiber tape)
5. sheath made of polyester laminated with aluminum, with a longitudinally placed draining copper wire, diameter 0.8 mm (protection against EM-interference)
6. cable insulation (flammable compound based on halogen-free polymers)

The specified type of cable, in the event of a fire, ensures the integrity of the circuit for 90 minutes, according to the DIN 4102-12 standard.

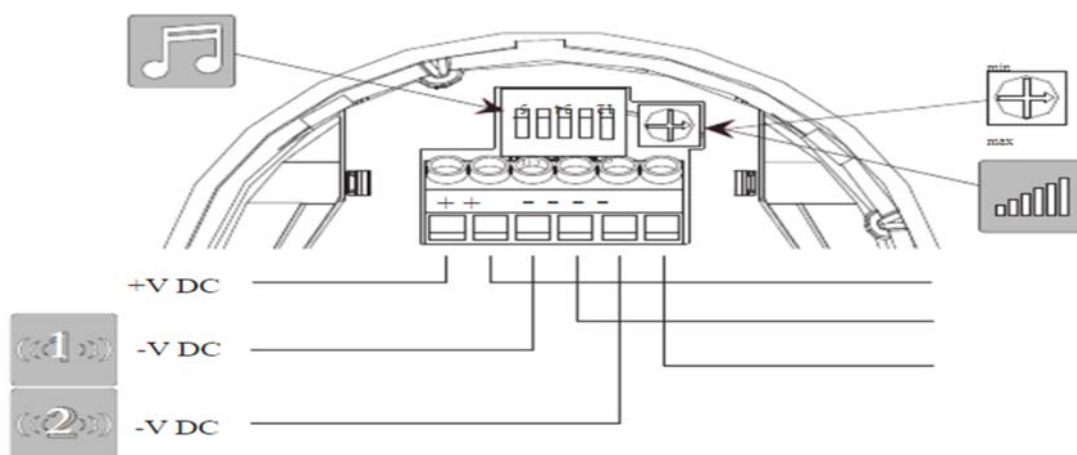
Detail of connecting the bases of the detector in a loop, as well as the parallel indicator with the detector.



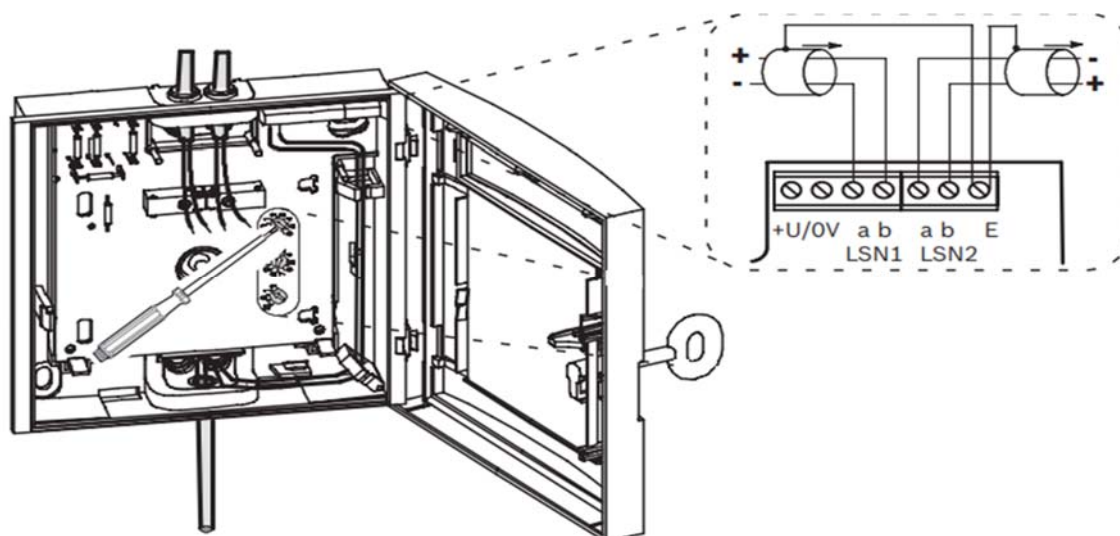
18



IO module connection detail 1/1



Detail of connecting sirens in a loop



Detail of connection of manual call points in a loop

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**Conditions for functional testing and maintenance of a stable fire alarm installation**

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The following documentation must be obtained for functional testing of a stable installation:

1. The project of the derived state of the stable installation for reporting,
2. Whistleblowing plan
3. Instructions for operation and maintenance of the call center
4. Program of operation of the control center and management of ventilation, air conditioning, dampers, doors and disconnections
5. Inspection and testing control book
6. All reports and certificates on the testing of installed equipment
7. Test lists and protocols for electrical installations

During the functional testing of a stable installation, the operation of each built-in element - each detector, each alarm element and all elements for signal transmission - must be examined, as well as the operation of the alarm center and all the functions and controls it performs. After eliminating all observed disturbances and malfunctions and retesting, a report is issued on the functionality of the stable fire alarm installation.

at least a free space around each automatic call point

750mm.

The user of the stable installation is obliged to ensure an inspection of the installation:

1. After the fire
2. After the appearance of signs of impaired operational readiness
3. In case of improper functioning
4. When changing technology
5. When changing the purpose of land that affects the application of technical surveillance measures

Measures of regular maintenance of stable installations must be entered in the control book.

The operation of the stable installation is checked by the responsible person of the user at intervals of no longer than two months.

During the regular inspection of work, the following must be examined:

1. At least one detector per primary line
2. All alarming elements
3. All signaling transmitters and receivers
4. All automatic shut-off devices  
off ventilation, drives, etc.
6. Power supply devices (visual inspection of connections and electrolyte level)

Periodic inspections of the stable installation are performed at least once a year.

The periodic inspection includes a functional control of the stable installation and a detailed inspection of all components.

During the annual periodic inspection, the following must be performed:

1. Checking the control book on the performed preliminary inspection, and the list of works that were subsequently carried out on the installation
2. Inspection and testing of the connector on the battery, the level and density of the electrolyte in each cell, as well as the measurement of battery capacity
3. Checking the operation of indicators and control elements on the alarm center, as well as all disconnections and control of technological equipment
4. Testing the operation of alarm elements, transmitters and receivers of remote fire and malfunction signaling
5. Examination of interference indicators - simulating failures on primary lines and electrical power supply devices.
6. Checking the operation of each individual fire detector according to the manufacturer's instructions
7. Inspection of cables, lines, distribution cabinets, terminals and distribution boxes (that they are undamaged and adequately protected and marked)

A detailed inspection of all components of a stable installation must be carried out every five years.

### 1.2.3 Gas detection in kitchens

In areas where there is a possibility of increasing the concentration of flammable and explosive gases, LPG detection is foreseen. With this project is planarized detection of propane -butane gas in the kitchen, which is not intended for adaptation in all phases of this project, but due to the very importance of this installation and the fact that it does not involve changes in other phases, we included this detection in the project.

(Propane-Butane) detector is positioned on the wall, at a height of 30 cm from the floor, because at that level is the highest concentration of LPG (it is heavier than air and concentrates near the floor). In addition, the detector must be positioned less than 4m horizontally from the gas device. Places protected from splashing water on the device box are chosen for installation.

#### Central gas detection unit



- conventional
- three zones
- up to 32 detectors per zone

#### Propane and butane detector



- conventional
- operating voltage 12 VDC
- 4-wire
- 1 x relay output

#### Siren for gas detection



- conventional
- siren and flash
- 17-60V DC
- IP65

### 1.2.4 Installation of the video surveillance system

The video surveillance system in the facility is based on IP technology. The main purpose and goal of the surveillance security system is:

- Provide protection of critical infrastructure from unauthorized access and actions,
- Provide supervision of corridors and multifunctional halls
- act preventively against break-ins and damage to property and provide assistance in identifying perpetrators,
- to enable subsequent analysis of archived video material.

In accordance with the security aspect, the solution envisages the installation of high-quality color and day/night cameras.

**Dome camera**

- 5Mpx/20fps, turret
- fixed lens 2.8mm
- Onvif, 12VDC/PoE,

**Anti-vandal bullet**

- 5Mpx/20fps, bullet
- fixed lens 3.3mm
- Onvif, 12VDC/PoE

The central NVR device is located in the RACK cabinet and enables the connection of all cameras in the building. The NVR device has the ability to power cameras at a distance of up to 100m.

**NVR device**

- 16 channels
- supports 8Mpx/5Mpx/4Mpx/3Mpx/1080p
- 2xHDD

Archiving of video material should be done using an efficient compression algorithm (recording only changes between video frames) and will enable archiving of recorded material for at least 15 days.

The installation of the system will be carried out in the same way as the installation of other telecommunication systems, partly in cable racks and partly in halogen-free, installation pipes of the appropriate diameter.

The laying of installation cables must be carried out under the constant supervision of the technical staff of the selected company, which will perform assembly, connection, testing, commissioning and delivery of the installation with the issuance of a guarantee.

The system distribution scheme, equipment layout and cable routing are shown in the drawings in the graphic part of the project.

### 1.2.5 Installation of the sound system

The sound system, in addition to broadcasting music, also has the function of automatically broadcasting messages with instructions for action in case of danger.

The elements of the system are:

- Amplifier with integrated sound source
- Speakers

The central equipment is positioned on the shelf in the bar of the restaurant.

The complete installation for connecting elements of the sound system is provided with "halogen-free" cables that do not support combustion, do not spread fire and do not generate toxic gases. The installation is performed with shielded cables with copper conductors of the type LiHCH 2 x 2.5 mm<sup>2</sup>.

The planned lines are laid partly on the cable racks provided in the direction of the main horizontal laying, partly in "halogen free" pipes on the wall on spacer clamps.

#### Amplifier



- 4 speaker zones with volume control
- 4  $\Omega$  and 100, 70 and 25 V lines
- total 240W RMS, 120W per zone
- dimensions 420 x 89 x 300 mm deep, 2U

#### Built-in speaker



- built-in installation
- with 100V line converter
- power 6W RMS
- tap: 100V - 6 W / 3 W RMS
- 6 1/2" double diaphragm
- frequency 140 - 20 000 Hz
- sensitivity 92 dB  $\pm$ 3 dB at 1 W/1 m
- color white RAL9016
- dimensions 175 mm  $\varnothing$  x 80 mm;  
168 mm  $\varnothing$  (bore)

#### Upgraded speaker



- with 100V line converter
- power 40W RMS, max 80W
- frequency 80-20 000 Hz
- sensitivity 86dB at 1W/1m
- color white RAL9003
- IP 66
- dimensions 162 x 262 x 147 mm

RESPONSIBLE DESIGNER

Slobodan Marković, B.Sc.Eng.



## **2 TECHNICAL REQUIREMENTS FOR WORK PERFORMANCE**

### **2.1 GENERAL PART**

When performing the works, it is mandatory to meet the following technical conditions:

Technical conditions, as an integral part of the project, oblige the Contractor as well as other participants in the implementation of the investment to adhere to the solutions given by the project during the execution of the works.

The investor is obliged to provide professional supervision over the execution of the works.

Before starting the works, the contractor is obliged to review the project, drawings with measurements and preliminary calculation, to propose certain suggestions in the direction of improving the solution, and after coordination with the designer and the supervisory authority, to prepare a dynamic plan and approaches to the realization of the investment.

The contractor is obliged to obtain the written consent of the supervisory authority for all deviations from the project during the execution of the works, and for major changes the supervisory authority will seek the consent of the investor and designer. All changes must be made in the design of the derived state.

On the basis of the project and valid regulations, the Contractor will record the routes of the entire installation and the locations of the switchboards, and only after receiving approval from the supervisory authority will he begin work.

The entire material and equipment, which will be used for the construction of the installations, must be of first-class quality and fully correspond to the standards for the intended materials and equipment. After bringing the material to the construction site, the supervisory authority is obliged to inspect the material and record its condition in the construction diary.

For the complete equipment installed on the building, the Contractor must obtain certification documentation. The installation must be carried out according to the current Rulebook on technical standards for low-voltage electrical installations ("Official Gazette SF-RJ" no. 53/88, 54/88 and 29/95).

During the execution of works, the Contractor is obliged to keep an up-to-date construction diary with all the data that such a diary should contain. All requests, announcements and notifications from the supervisory authority, designer, contractor or investor must be properly recorded in the diary.

The Contractor is obliged to remove all deficiencies found by the supervisory authority during the inspection of the works as soon as possible at his own expense.

When handing over the works, the contractor is obliged to hand over to the investor certificates and guarantee sheets for all installed equipment.

For the correctness of the performed works, the Contractor provides a guarantee that cannot be shorter than the agreed one, counting from the day of the commission inspection of the installation. During the warranty period, the contractor is obliged to remove all damages that may occur as a result of poor material or unsound workmanship as soon as possible at his own expense.

For the reliable and correct functioning of communication equipment, the quality of electrical installations in the building is very important, especially from the level of quality of grounding and phase balance.

For everything that is not expressly stated in these conditions, the Contractor is obliged to comply with applicable regulations and standards.

### **2.2 TELECOMMUNICATION INSTALLATIONS**

Any continuation or branching of lines is allowed only in entry boxes and cabinets. Installation of pipes in the wall begins after rough plastering and when it has dried well.

PVC pipes are laid in hollow channels in the wall, and steel, seam-black pipes are attached to the steel structure by welding or using metal brackets (as holders).



In the case of installing several pipes in one direction (either on the wall or on the rack), the pipes are laid next to each other, in the installation plane, and not one above the other.

The front side of the PVC pipe must lie in the level of the brick (that is, the wall mass), so that the pipe is covered with the entire layer of plaster.

It is not allowed to deepen the channels in reinforced concrete walls and columns, but they are left during the construction of the walls and columns.

PVC and steel seamed black pipes should always be laid in a straight line, both horizontally and vertically.

When laying horizontally, the pipes are allowed to have a slight slope towards the boxes, so that condensed water does not remain in the pipes. If, during the horizontal laying of pipes, it is necessary, due to some obstacle, to temporarily deviate from the direction, it is allowed to go around the obstacle in a slight arc and return to the adopted direction of laying.

At room corners or wall outlets, changing the pipe laying direction is performed by bending the pipe in the shape of an arc. A well-executed arch, when placed in the wall, must be covered with at least an entire layer of plaster.

Changing the direction of pipes on free wall surfaces is carried out in boxes.

Laying risers in chimney walls is not allowed, and such laying of other pipes should be avoided.

In the case of parallel guided pipes, that is, telephone installation cables in pipes and other installations, the following regulations must be observed:

- at 0.10 m, pipes, or cables, for telephone installation are placed under the ceiling;
- at 0.10 m, below these pipes, i.e. cables, pipes, i.e. cables, for signal installation are placed;
- at 0.10 m, under the pipes or cables for signal installation, pipes or cables for high current electrical installations are placed.

In any other case, when pipes or cables for telephone installation run parallel to pipes or cables for high current, the distance between them must be at least 0.20 m.

When crossing pipes for telephone installation with pipes for high current, if this is unavoidable, you should

intersections should be made at right angles, and the distance between pipes must be at least 10 mm, with special insulation measures of at least 3 mm.

At a long distance between distribution boxes or if there are more pipes at a distance between distribution boxes

curve, before the pipe is plastered, a steel wire should be inserted through it for later routing of the lines.

Before plastering the pipes, all junction boxes should be closed with paper so that they are not filled with plaster or paint during the plastering and painting of the walls.

In the case of parallel laid pipes for telephone lines, for bells and for strong current, in places where vertical pipes are separated from horizontal pipes and vice versa, distribution boxes are placed on an oblique line that forms an angle of 45 degrees with the pipes.

It is allowed that two telephone lines come out of one pipe in one room.

Minimum mutual distances when laying cables in parallel:

- telecommunications next to signal is 0.05 m,
- telecommunication next to energy is 0.30 m.

No other plug box or any outlet from the pipe (e.g. electric lighting, thermal current, etc.) may be placed around the telephone socket, at a distance of less than 20 cm, except for the radio antenna and the signal bell, which must be on distance of at least 10 cm.

The insulated conductors are pulled into the pipe only when the glue is dry.

Telephone lines, if possible, must be continuous.

It is not allowed to continue the conductors in the pipes.

Continuation of the conductors is done with connectors and brackets in the cabinets. In the case of a smaller number of lines, the connection is made in the lead-in boxes, on the terminals of the same.

It is not allowed to run any other lines through the pipes for telephone lines.

The cable that only passes through the cabinet is attached to the wall of the cabinet with cable clamps or cornered.

The telephone lines in the distribution cabinet or box should be arranged so that replacing or adding new lines can be done easily. This also applies to other lines of signal installations.

In order to connect to the connectors, the textile or lead sheath of the insulated conductor is removed by 25 mm, and the rubber or PVC insulation by 20 mm. In the case of hidden screws or where there is an

obstacle that does not allow the wire to fall out of the screw, the stripping of the insulation can be reduced to 10 mm, but only if the insulation of the connecting wire on the connector is 2-3 mm away from the screw. The wire is placed under the screw so that it is tightened when screwing.

In case of connection to soldering spikes, the rubber insulation must be about 5 mm away from the spike.

Lead cables must be connected immediately upon opening.

The cores of the cable must not be straight, stretched, but connected in an arc to the connectors in the soldering spikes. In this way, a small reserve is left so that in the event of a break, the connector or the soldering spike can be reattached by straightening the arc.

The connection of the lines on the coupling or screw must be well processed, i.e. it must not have any fibers lying on the bare conductor or more firmly outside the insulation.

Instead of the usual telephone installations with installation pipes placed in the wall or on the wall, in larger business and industrial buildings, if it is technically and economically justified, telephone installations can be carried out with installation channels in the floor, side walls or ceiling.

For the production of telephone installations with installation channels, only those installation systems that are approved by ZJ TK can be used. Installation in buildings, as well as JUS standards for electrical equipment. installations. When building telephone installations with installation channels, the following conditions must be taken into account:

in the installation channels in which the telephone installation lines intended for connection to the telephone network are laid on site, if the possibility of electricity is excluded. impact of these lines on telephone installation lines. This means that when making telephone installations with installation channels, special channels must be installed (for example, for low-current installations), and for multi-part channels, special fields for telephone installation lines must be used. During the said laying, the lines must be clearly marked to which type of installation they belong. It is not allowed to place high current electrical installation lines in the channels for the telephone installation.

Telephone installations with installation channels can only be built in dry rooms, the dimensions of the channels should be determined in such a way that the required number of installation cables and conductors can be easily and safely inserted into them.

Telephone installations with installation wall channels must be made in such a way as to provide full mechanical protection to the installation cables and conductors. Installation of ducts, distribution boxes, connection boxes and other materials is done for each installation system according to the manufacturer's installation instructions.

After making the internal telephone installation, the insulation resistance should be measured. The obtained results must be within the following limits:

- between the conductors of the same telephone line as the conductors of distribution lines - at least 20 megohms;
- between each conductor and ground at least 10 megohms.

## **2.3 LAYING OF ROAD INSTALLATIONS**

### **2.3.1 General conditions for laying S/FTP cables**

1. These technical conditions are part of the main project for the LAN network, and the contractor must adhere to them when performing the works.

2. All works must be performed in accordance with the main and contractor's project, international standards and norms of the equipment manufacturer, i.e. the entire installation must be performed in accordance with the international standard ISO/IEC 11801, and according to the technical description, drawings, specifications of equipment and materials .

3. Upon delivery of equipment and materials to the construction site, the supervisory authority is obliged to perform a visual inspection of the arrived equipment and to enter their condition in the construction diary.

4. During the execution of the works, minor changes in the project are approved by the supervisory authority, and major changes are approved by the authority that performed the technical review of the investment-technical documentation with the designer's consent.

5. The supervisory body should record the work on assembly and testing of installations, as well as all changes in the project, in the construction diary.

6. Supervision of these works is carried out by electrical engineers, specialized in this type of work.

7. Anything that proves to be of insufficient quality during the work or later, the contractor is obliged to remove at his own expense.

8. The contractor is obliged to carefully study the project in order to avoid possible disagreements and misunderstandings, and if there are certain deviations between the project and the existing condition of the building, to propose adjustments to the project.

9. After the installation of the device and the installation of the cable system, it is necessary for maintenance to carry out periodic (daily, weekly, monthly) inspections and tests of the installed equipment, and to write the findings and remarks in the control book. These periodic inspections and tests are essential to maintain a high level of availability of the structured cabling system.

### 2.3.2 Special conditions for laying S/FTP cables

1. Before starting the works, the contractor is obliged to precisely determine and mark the position of all elements of the designed system (sockets, distribution cabinets, active equipment, cable ducts, etc.).

2. The contractor should specify the places where the designed installations are connected to the existing installations, as well as determine and execute the connections for the electrical installation.

3. For the cabling of computer networks, use cables of category 6 or more according to the ISO/IEC standard, certified for operation at 450MHz.

4. The global structure of the network is of the star type (multiple stars). Each connection is point-to-point.

5. Any place where multiple S/FTP cables are connected is called a communication hub. The communication hub can be the main one for the entire network, the main one for one location, the main one for one building or local.

6. In the communication hub, active network equipment and patch panels are installed in a distribution cabinet of appropriate size.

7. Communication hubs are located in rooms where office conditions prevail.

8. All RACK cabinets are closed (except the opening for the introduction of cables and the opening for ventilation), and on the front side they have a door with glass that can be locked.

9. For RACK cabinets that are mounted on the wall, certain reinforcements and openings for attachment to the wall should be provided. Fasten to the wall with suitable dowels and screws.

10. S/FTP cables terminate at a panel or socket.

11. The S/FTP cable must not be interrupted and continued.

12. The S/FTP cable is passed through the ducts, or fixed with OG clamps to the wall at a distance of 30-50 cm, or passed through a ribbed hose installed in the wall.

13. Routes of laying S/FTP cables and their marking are given in the Graphical Documentation.

14. After passing the cables, cover the ducts with a suitable cover along the entire length.

15. The S/FTP cable must not be twisted longitudinally, tied in a knot, pinched, or damaged in any way when it is pulled through and attached.

16. The S/FTP cable must not stretch when pulled through.

17. The S/FTP cable is installed vertically or horizontally. Slanting of U/FTP cables is not allowed.

18. When laying the cables, care must be taken to avoid possible damage to the cables. In places where the cable routes change direction, slight curves must be made to bend the cables, the radius of which must not be less than eight times the outer diameter of the cable.

19. The S/FTP cable must not be placed near a device, object or source that could damage the cable.

20. The S/FTP cable must not be placed and routed near heat sources (heat pipes, radiators, heater furnaces), and if this cannot be avoided, appropriate thermal insulation must be performed.

21. The S/FTP cable outside the building is placed inside a one-piece PE hose, the ends of which inside the building are protected from atmospheric influences.
22. RJ sockets are placed at a height of 20-40 cm from the floor.
23. Leave a reserve of 10 cm in the cable on the side of the RJ socket, and 30-100 cm on the side of the patch panel, depending on where the patch panel is mounted (in a wall cabinet or RACK cabinet)
24. Immediately after pulling through, mark each cable with the same number on both ends (stickers).
25. Take the numbers of the cables according to the numbers of the sockets, so that the numbers increase clockwise, viewed from the entrance door to the room.
26. After routing the S/FTP cables, check the cables for breaks and short circuits. Terminate all correct cables with a socket or on a patch panel, according to the project documentation.
27. If there is a break or a short circuit, pull out the cable and replace it with a new one.
28. Installation of RJ sockets and patch panels should be performed with a professional tool.
29. After installing the sockets and patch panels, test the performance of each line.
30. Patch cables of appropriate lengths are used to connect wall sockets and terminal equipment, that is, patch panels and active equipment.
31. Parallel laying of cables with electrical power cables should be done at a minimum distance of 20 cm, or 10 cm, if the S/FTP cable is screened (shielded).
32. S/FTP cables should be crossed with electrical power cables at an angle of 90 degrees.

## 2.4 RACK CABINET

A distribution or rack cabinet represents the concentration of cables and communication equipment. The height of rack cabinets, as well as the elements placed in them, is expressed in units of  $U$  (some manufacturers also use the designation  $E$ ), which is 44.45 mm. Larger rack cabinets should have fans and vents on the upper side for blowing air from the rack upwards, while on the lower side there is an opening for drawing in fresh air. The back of the rack cabinet should also be accessible, unless it is mounted on a wall. The cabinet on the front and back sides should have two perforated vertical rails for mounting the equipment.

The RACK cabinet is a free-standing 41U/19", glass door with lock, wheels and feet with leveling, front and rear rails 19", with unit numbers, dimensions 600x600x2000 mm, load capacity up to 300 kg.

The power supply panels should contain no less than seven power sockets with earthing, for mains supply 220V/50Hz and a central switch. Communication devices are connected to these sockets, while the power supply panel itself is connected to the direct outlet of the low-voltage network, provided for in the power installation project. All moving metal parts of the rack cabinet, as well as the metal housings of all active devices that are powered by 220 V voltage, must be connected to the potential equalization rail inside the rack cabinet, and the rack cabinet is connected with the N2XH-J 1x16mm<sup>2</sup> cable to the rail for potential equalization in the nearest power distribution cabinet.

The shelf is placed in the lower unfilled part of the rack cabinet and is used to store spare material, tools and documentation. In addition, the shelves can be used to place communication equipment that is not intended for mounting in a rack (*stand-alone*). Other unfilled rack cabinet spaces can be closed with gap filler masks.

The rack cabinet should be closed from the front with a glass door with a key, on the upper side there must be an opening with fans for blowing air from the rack upwards (or install fans as separate panels), while on the lower side there must be an opening for drawing in fresh air and cable entry.

At this stage, no provision is made for specifying active equipment, and it should be emphasized that only passive elements are installed in the RACK cabinet.

## 2.5 QUALITY TESTING OF PERFORMED INSTALLATIONS

The segment length must conform to the IEEE 802.3u 100 Base-TX standard of 100 meters per segment, using 22 AWG UTP cable.

It is necessary to measure the actual length that has been installed after laying the cable.

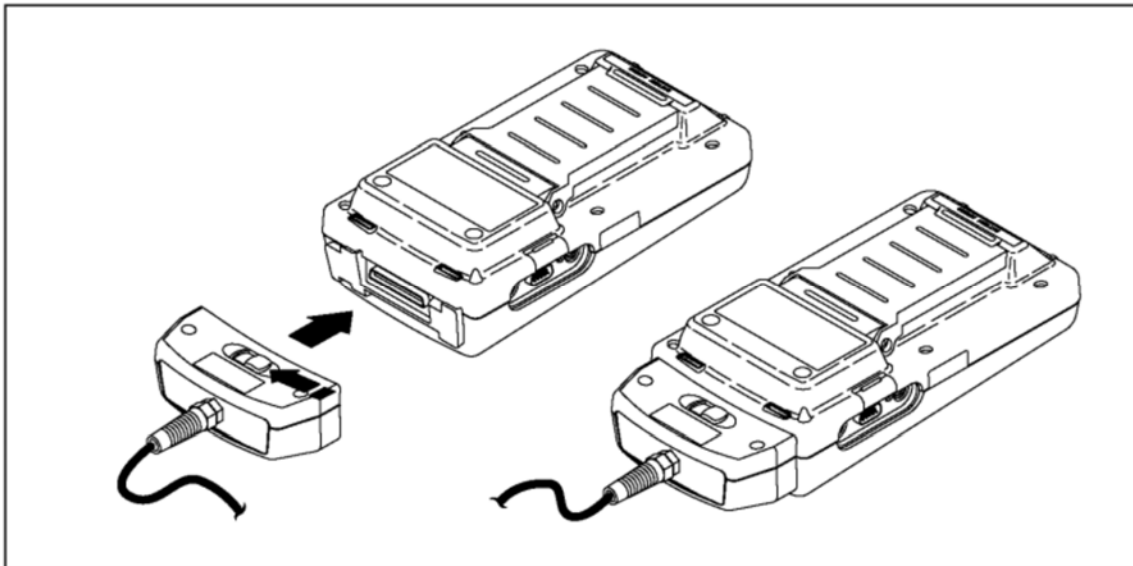
This length should not exceed 90 meters between the patch panel and the sockets in the premises (due to the attenuation introduced by the connectors).

It is also necessary to check whether the pairs on the connectors are correctly arranged. The standards that must be met are ISO/IEC 11801 class E.

The check is performed using a device for testing and measuring the performance of twisted pair cables in local networks.

It consists of two units that are placed on opposite sides of the cable and that communicate with each other.

The main unit initiates all tests, while the remote one closes the loops, collects and sends the results of each measurement.



Both units are synchronized and all tests are performed automatically.

Rulebook on technical and other conditions for the design, construction and use of electronic communication networks, electronic communication infrastructure and related equipment in buildings, adopted by the Agency for Electronic Communications and Postal Services of Montenegro, 2015. defines the examination and measurement of EKM building in Articles 84-90, which are listed below.

#### **Article 84**

By examining the constructed electronic communication networks of buildings, it is determined, on the basis of standards-defined measurement procedures, the results of which are relevant, repeatable and credible, whether the requirements stipulated by the relevant regulations and standards have been met. Examination of electronic communication networks of buildings includes examination of all constructed network segments:

1. accesses the external access network (NA);
2. generic building cabling system (GC);
3. cabling of terminal equipment.

Depending on the designed solution and supported applications, the examination of electronic communication networks of buildings includes examination of:

1. ICT-cabling, which includes:
  - generic ICT cabling of business premises and appropriate cabling of access to the external network for access;
  - generic ICT-cabling of apartments, associated floor ICT-distributions and associated ICT-backbones, i.e. associated cabling of access to the external network for access.
2. BCT-cabling, which includes:

- generic BCT-cabling of apartments, associated floor BCT-distributions and associated BCT-backbones, i.e. associated cabling of access to the external network for access;
- optional generic BCT-cabling of business premises, associated floor BCT-distributions and associated BCT-backbones, i.e. associated cabling of access to the external network for access.
- 3. BCT-network - of common antenna systems (ZAS, MATV/SMATV) and cable television system (CATV);
- 4. optional generic CCCB-cabling of apartments;
- 5. additional application-specific cabling for the needs of applications that are not supported by generic cabling;
- 6. installation of electrical supply and grounding and potential equalization for the needs of the building's electronic communication network.

The following applies to testing generic building cabling:

1. permanent connections (PL) and consolidation connections (CPL) must be tested, if no consolidation cable (CPC) is installed and the corresponding PL is formed (if the PL also contains an adapter cable (e.g. consolidation cable - CPC), all test results are valid only for PL in that configuration and with that CPC);
2. channel scan (CH) is optional; if a channel is tested, all connecting/switching cables that will be used in that channel must be connected, and all test results are valid only for the CH in that configuration and with those connecting/switching cables;
3. testing, measurement accuracy and connection are defined in appropriate reference planes; connection of test devices, which can be central transceivers or transmitters (T1) and remote transceivers or receivers (T2), depends on the configuration and subject of the test - connection with test connecting cables (TCR) and/or connecting cables of EC equipment; the concrete planes of PL/CH are defined by the reference example, according to which the cabling that is the subject of the test was performed; end points on switch panels PP1 and PP2 or additional connection point/user connection - xO);
4. test sample:
  - in principle, 100% of installed connections/channels are tested;
  - exceptionally, for balanced ICT cabling, when testing the parameters of external influences (AXT; foreign crosstalk), a representative sample of at least 3% (but not less than 15) of disturbed connections/channels is examined, using the selection procedure of disturbed connections/channels according to standard EN/IEC 61935-1 with the option of reducing the required number of tests, if the measurement results show a suitable margin according to the limit value of the tested parameter;
  - the corresponding total test result of the parameters in question are reported for each connection/channel/HNI/BO as "satisfies/does not satisfy".
5. if some connections/channels/HNI/BO are not satisfactory, the causes should be diagnosed and eliminated and the tests repeated; if the causes cannot be diagnosed and/or eliminated, the relevant links/channels/HNI/BO should be clearly marked as faulty.

Application-specific cabling for the needs of applications that are not supported by generic cabling is tested for 100% of the connections/channels in accordance with the applicable regulations and standards of the relevant applications, i.e. relevant European, international and Montenegrin cabling standards for information technology.

The BCT-networks of the building (ZAS/MATV/SMATV, CATV) are tested at the BCT-network interface of each apartment (HNI) and on all associated diffuse connections (BO).

Installations of electric power supply, grounding and potential equalization for the needs of EKM of buildings are tested in accordance with the relevant regulations.

## **Article 85**

Before testing the cabling, a visual inspection of the installation must be carried out to identify and eliminate visible defects (e.g. damage to the cable and/or connecting accessories, disturbances in the required geometrical relationships between the cable pairs (crushing of the cable, unraveling, etc.), inappropriate bending radii, too long cables, inadequate distance from sources of electromagnetic interference).

When testing the cabling of the building, the following procedures should be carried out:

1. verification ;

2. certification ;
3. qualification .

Verification refers exclusively to verifying connectivity (connectivity test). It is mandatory for all types of cabling, and it includes the examination of the basic prerequisites for the functionality of cabling (eg short circuits of metal lines/shields). It is recommended that the verification be carried out before the final construction works (eg installation of insulation, plasterboard, etc.), as well as after them.

Certification includes confirming the compliance of the performed cabling installation with a specific standard. It is tested whether the transmission performance of the cabling meets the requirements of a certain quality class of the corresponding standard. Certification is mandatory for generic cabling, as well as for application-specific cabling, if there are special standards for the same with defined requirements regarding its transmission parameters.

The qualification includes cabling testing to directly demonstrate the ability to support a specific network application (eg 100BASE-T, IEEE802.3 1000BASE-T). The qualification is optional for generic cabling and for application-specific cabling, for which there is a separate standard according to which certification is performed, and mandatory for application-specific cabling, for which there is no separate standard to be used for certification.

#### **Article 86**

The building's electronic communication networks can only be examined by natural/legal persons who are authorized to do so based on the relevant regulations.

Before the examination, the examiner must:

1. to give the investor's representative the calibration sheets of the test devices for inspection, as proof of their calibration within the terms prescribed by the manufacturer of the device, but not longer than one year;
2. to carry out the normalization of the measuring system in accordance with the appropriate standard, that is, the instructions of the manufacturer of the measuring device.

For each test (Article 85 paragraph 2), the examiner must submit a report on the conducted test, which must have the following content:

1. data about the project (designation of the project, etc.);
2. data on the facility (campus, building, floor, etc.);
3. information about the examiner (name and surname, legal entity);
4. date and time of examination;
5. relevant environmental conditions (temperature, etc.);
6. data on test devices:
  - type , manufacturer and serial number;
  - operating system software version ;
  - database version with limit values of transmission parameters;
  - measurement class ;
  - calibration status .
7. data on measuring adapters, reference connectors, measuring connecting cables, terminal elements and other relevant test accessories:
  - type , manufacturer and reference number;
  - relevant performance.
8. data on tested cabling:
  - identification mark of the channel/connection (CH/PL) when testing the cabling, i.e. the BCT-network interface of the apartment (HNI) and the diffuse socket (BO) when testing the common antenna system (ZAS), in accordance with the marks in the technical documentation of the performed state;
  - type , construction and category of cable (e.g. BL-F/UTP-Cat 6; OF-50/125-OM3 ; CX -BCT-C) and any associated parameters whose values are entered into the measuring instrument for calculation purposes ( eg when calculating the length - for copper cabling: nominal propagation velocity - (NVP), for optical cabling: effective group index of refraction (IOR));



- type , construction and category of connecting accessories when testing cabling (eg BL-GG45/Cat 7; OF-MM-LC, CX-BCT-CF) and additional elements and equipment when testing ZAS;
- manufacturers of cables, connecting accessories and other equipment as part of the tested system.

9. details of the measuring system:

- configuration of the measuring procedure, as well as configuration and setting of the measuring device;
- configuration/measurement interfaces of the test subject (channel, permanent connection, consolidation connection, backbone, horizontal distribution, HNI, BO, etc.);
- channel/connection class , frequency range, wavelengths;
- use of termination elements and their location (final impedances, etc.);
- name , issue and date of issue of the standard that defines the measurement procedure according to which the test is performed;
- the name , issue and date of issue of the standard in which the limit values are prescribed, which are used for comparison with the measurement results;
- specification of the programmed *auto-test* procedure (if used).

10. measurement accuracy ;

11. details of the measurement parameter;

12. limit values of the tested parameters, ie required results;

13. test results for each individual parameter; if the instrument has the ability to print the results directly to a printer or to a printable file, the results are attached in the original print format;

14. the overall result for the individual tested connection/channel expressed as "satisfactory/unsatisfactory";

15. comments regarding the testing, functionality and safety of the installation.

Each report on the conducted examination should be certified by the examiner's signature, seal and signature of the responsible person/legal entity responsible for the accuracy of the examination.

Test results are submitted along with written reports on an electronic medium in the native format of the measuring device manufacturer, including software for their review, or in one of the standardized document formats (eg \*.pdf), but in such a way that it is not possible to change the content of the document.

**Examination of generic ICT cabling**

Article 87

Balanced cabling for the needs of ICT applications is tested according to EN 50346 using measurement procedures, devices and accessories in accordance with EN/IEC 61935-1. Exceptionally, for testing classes A, B and C, measurement procedures, devices and accessories that do not comply with EN/IEC 61935-1 can also be used .

The required tests for individual cabling classes are shown in table 15. The test results for the specified ICT-cabling transmission parameters must meet the requirements of EN 50173-1 for the relevant class.

The length of the connection/channel is informative, ie. does not represent a test criterion for the "pass/fail" rating, but can be determined as physical (e.g. based on the markings on the cable) or electrical (by calculation, based on the measured propagation delay and the entered data on the nominal signal propagation speed for the cable in question ).

The certification of the satisfaction of the parameters of external foreign influences is applied, if it does not arise automatically as a consequence of the construction quality of the associated components, based on the appropriate criteria from the EN 50173-1 standard (the amount of the coupling *attenuation parameter* ).

**Table: Verification and certification of balanced cabling**



Vrsta Ispitivanja	Parametar koji se ispituje	Ispituju se za klasu									
		A	B	C	D	E	E <sub>A</sub>	F	F <sub>A</sub>	BCT-B	CCCB
Verifikacija: <i>Osnovni parametri</i>	Neprekinutost *	•	•	•	•	•	•	•	•	•	•
	Ispravnost spajanja *	•	•	•	•	•	•	•	•	•	•
	Dužina	x	x	x	x	x	x	x	x	x	x
Sertifikacija: <i>Parametri unutrašnjeg prenosa</i>	Jednosmjerni otpor petlje	•	•	•	•	•	•	•	•		•
	Kašnjenje prostiranja	•	•	•	•	•	•	•	•	•	•
	Klizanje kašnjenja			•	•	•	•	•	•		
	IL	•	•	•	•	•	•	•	•	•	•
	RL			•	•	•	•	•	•	•	
	NEXT	•	•	•	•	•	•	•	•		
	PS NEXT				•	•	•	•	•		
	ACR – N				•	•	•	•	•		
	PS ACR – N				•	•	•	•	•		
	ACR - F				•	•	•	•	•		
	PS ACR - F				•	•	•	•	•		
Sertifikacija: <i>Parametri spoljnjih stranih uticaja</i>	PS ANEXT					(○)	○	○	○		
	PS ANEXT <sub>avg</sub>					(○)	○	○	○		
	PS AACR - F					(○)	○	○			
	PS AACR - F <sub>avg</sub>					(○)	○	○			

• = 100% veza/kanala;  
○ = uzorak od minimalno 3 % (ali ne manje od 15) veza/kanala; izbor uzorka prema EN/IEC 61935-1  
( ) = samo u slučaju da je potrebna podrška aplikacijama sa brzinama prenosa do 10 Gb/s;  
x = dužina je informativni, a ne ispitni kriterijum na osnovu koga se odlučuje;  
\* obuhvata ispitivanje prekida i kratkih spojeva pripadajućih vodova/oklopa i ispravnosti spajanja provodnika na odgovarajuće kontaktespojnih pribora (razdvojene, obrnute i ukrštene parice)

## Article 88

Optical cabling for the needs of ICT applications is tested according to the EN 50346 standard, using test procedures, devices and accessories in accordance with the ISO/IEC 14763-3 standard.

The necessary tests to be performed are shown in table 16. The test results for the specified transmission parameters must meet the requirements of the EN 50173-1 standard, i.e. the requirements of the optical power reserve (OPB) of the connection/channel in question based on the appropriate calculation from the project documentation.

The length can be determined as physical (eg based on the markings on the cable) or optical (by calculation based on the measured propagation delay and the manufacturer's information on the effective group index of refraction (IOR) of the optical cable in question).

**Table: Verification and certification of optical cabling**

Vrsta Ispitivanja	Parametar koji se ispituje	Ispituje se
Verifikacija: <i>Osnovni parametri</i>	Neprekinutost	100% veza/kanala
	Polaritet	
Sertifikacija: <i>Parametri prenosa</i>	Slabljenje	
	Dužina (kašnjenje prostiranja)	

## Examination of generic BCT-cabling

### Article 89

The required tests for balanced BCT-cabling (BCT-B class) are shown in table 15. The test results for the specified transmission parameters must meet the requirements of the EN 50173-1 standard for the class in question.

Coaxial BCT-cabling is verified for continuity, short-circuits and the correctness of the conductor/shield connection.

## Examination of the BCT network Article 90

Building BCT networks (ZAS/MATV/SMATV, CATV) are certified using test procedures, devices and accessories in accordance with the EN 60728-1 standard. In doing so, a set of signal quality parameters prescribed by the relevant standards of the EN 60728-1 standard series is tested. The test results for the network interface of each apartment (HNI) and the associated diffuse connections (BO) must be within the limits prescribed by the relevant standards of the EN 60728-1 series of standards, as shown in the figure.

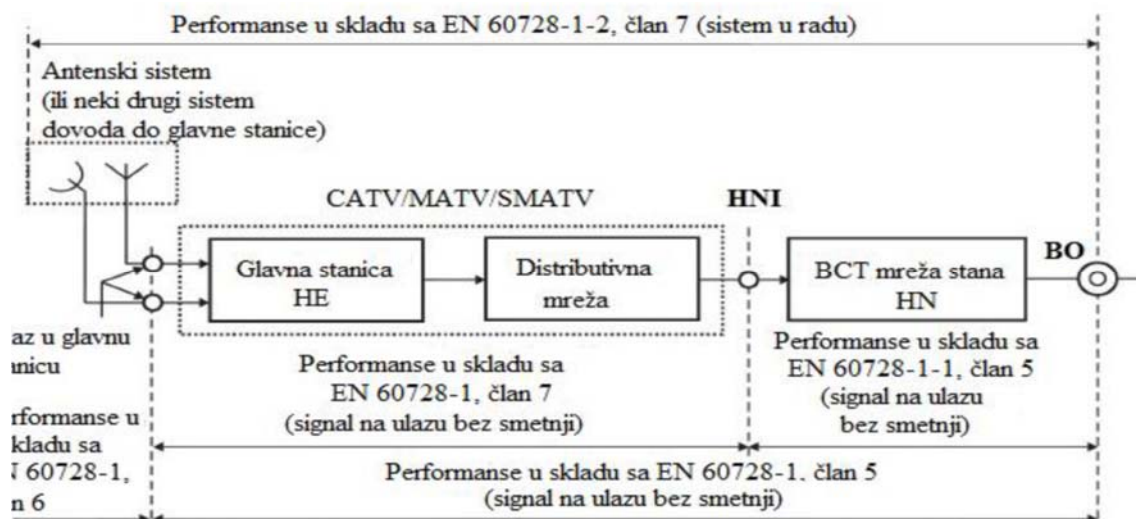


Figure: Requirements for BCT networks

## 2.6 TECHNICAL REQUIREMENTS FOR PERFORMING WORK ON CONNECTION TO TK INFRASTRUCTURE

### 2.6.1. Sewer routing

The choice of the route of the TK sewerage and the routing of the trench before the start of construction significantly affects the quality of the works, that is, later on the functionality and service life of the TK sewerage. For these reasons, attention should be paid to the routing when starting the works. When determining the sewerage route, the designer chose the most favorable route, adhering to the UTU conditions for route selection and field conditions. Of course, deviations may occur during routing, but it must not endanger the safety of the route, as well as the safety of other underground installations if they are located near the route. When locating the planned manholes, take care that their position allows the construction of sewerage under the sidewalk or along the very outer edge of the sidewalk if it is not possible to place the sewerage completely under the sidewalk due to the large curvature of the streets. Sewers and shafts are located under or next to the sidewalk for two reasons:

- the least risk of physical damage;
- the easiest work during their exploitation, that is, pulling and installing cables.

Since PVC pipes are flexible and have a low coefficient of friction, this enables the sewerage between two TK manholes not to always be straight, and that the way of stacking the pipes can be changed between the manholes and the distance between the manholes can be increased. The projected route is shown in the graphic attachment.

### 2.6.2. Digging a trench

After the routing is done, the trench is dug.

As a rule, the trench should be so deep that the minimum distance from the ground surface to the top of the pipe in the uppermost row is:

- a. for pipes placed in the pavement: 50 cm;
- b. for pipes laid in asphalt: 80 cm;

The depth of the trench is determined by taking into account the thickness of the sand substrate, the number of pipe rows and the distance between the rows. The width of the trench is determined based on the number of pipes per row, the distance between the pipes, the width of the space required for manipulating the pipes and the depth of the trench.

Taking into account these parameters, the trench should be:

- a. 45 x 71cm (width x depth) for TK sewerage capacity 1x2xPVC Ø110mm in the sidewalk ;
- b. 45 x 101cm (width x depth) for TK sewer capacity 1x2xPVC Ø110mm in asphalt ;
- c. 60 x 71cm (width x depth) for TK sewerage capacity 1x3xPVC Ø110mm in the sidewalk
- d. 60 x 101cm (width x depth) for TK sewage capacity 1x3xPVC Ø110mm in asphalt;

When digging the trench, it is necessary to widen the trench on the parts of the route where there are breaks (deviations from the straight direction), in order to mitigate the bending of the PVC pipe (appendix 9). When excavating the trench, remove larger stones and place them on one side of the trench, and the excavated soil on the other side, so that it does not mix with the excavated soil that is returned to the trench after covering the PVC pipe with fine sand. Excavated material should be deposited at least 50 cm from the edge of the trench. If there is a danger of the trench collapsing, the trench is dug up. The opening of the trench is done in such a way that the formwork is placed from boards on the side walls of the trench, which is opened with billets. When the prescribed depth of the trench is excavated, start leveling the bottom of the trench. The leveling is done in such a way that at the two end points of each connecting shaft, vertical wooden levelers are placed, which make up the established depths of the trench excavation at that place. Tighten the rope between the placed levelers above the trench at a height of 2 cm, and then use the third wooden leveler to find the prescribed depth of the trench every 5-10 cm. At the end of the leveling, start leveling the trench with an ax or shovel. If during digging you come across underground installations that are not marked in the cadastre of installations and cannot be bypassed in the prescribed manner, it is necessary to move the said installations in agreement with the Supervisory Authority, the owners of underground installations and the Designer.

### 2.6.3 Continuation of PVC pipes

Continuation of PVC pipes is done using PVC connectors or using pipes with expansion. To make the joint watertight, the joint must be glued. When continuing the pipe with the extension, the end of the pipe with the extension on the inside and the unexpanded end of the other pipe on the outside are well cleaned, wiped and smeared with a thin layer of adhesive axially from the inside to the outside. Then the unexpanded end of one tube is inserted into the expanded end of the other tube. The joint must not be touched for several minutes, and after 1-2 hours it can be exposed to stress: laying in a trench, bending, etc. The above-mentioned procedure is also applied when connecting pipes using couplings, where the inner surface of the coupling is coated with glue.

When making a joint using glue, the instructions for using the glue must be followed. Examination of PVC

the pipes waterproof with compressed air at a pressure of 1.5 bar. Pipes are considered correctly installed if the tested pressure does not drop within 1 minute. The designer proposes PVC pipes with expansion, where the joints are sealed using rubber rings.

#### 2.6.4 Bending of PVC pipes

If the circumstances on the ground (construction site) do not allow a straight trench for sewage, it is necessary to bend PVC pipes or use flexible PVC pipes. For larger changes of direction, PVC arches must be used. At the point of the bend, you should use as long pipes as possible and the number of extensions should be as small as possible. For a curve with a small radius, it is necessary to use pipes 12 m long, and the connection point should not be located in the middle of the curve. A wooden stake should be placed behind each joint in the curve so that the joints are not loaded during further work.

PVC pipes must be bent slowly and evenly so that there are no impermissible stresses in the material. Fasten the bent pipes with pegs, and place combs between the pipes. The permissible bend radius of the bent pipe depends on the dimensions of the pipe, the external temperature and the bending procedure. PVC arches are used for larger curves. They are installed in the same way as PVC pipes.

#### 2.6.5 Introduction of the PVC pipe into the shaft

The introduction of PVC pipes into the shafts is done by means of PVC inlets, which have an extension for connecting to the PVC pipe on one side, and an extension with rounding on the other side. They are installed in the same way as PVC pipes. It is mandatory to pay attention when introducing PVC pipes into the shafts so that the direction of the pipe is in the direction of the cover, due to the easier accessibility of the sewer pipes during exploitation, when passing the cables.

#### 2.6.6 Base for PVC pipes

A base for PVC pipes is placed at the bottom of the trench. The substrate consists of a layer of fine sand about 10 cm thick (attachments no. 6, 7). The sand should have a grain size of 0 - 4 mm. The layer of fine sand is lightly compacted using a suitable device or a wooden rammer if the Contractor does not have the necessary machinery. The upper surface of the layer is leveled with a rake. If there is no material in the excavated soil (sand, pebbles) with a grain size greater than 4 mm, excavated soil can be used for the base.

In the event that there is a danger that the sand will be washed away by underground water, the base is made of a mixture of cement and sand in a ratio of 1:20. PVC pipes are then coated with the same mixture.

#### 2. 6.7 Laying PVC pipe and backfilling the trench

Pipes are placed on a compacted and leveled base made of fine sand. The distance between the pipes of 3 cm is maintained using PVC spacers (combs). The combs are placed at a distance of no more than 1.5 m. If there is a risk of sand washing into the base, then it is necessary to put a concrete base of cement and sand in a ratio of 1:20, and place the combs at a distance of 3.0 m. The inside of dirty pipes must be cleaned before laying. During this cleaning, be careful not to damage the inner surface of the pipe. Before laying the pipes, it is also necessary to check whether all the edges are damaged or improperly processed. Only pipes with properly processed and undamaged edges may be installed. Before laying the pipes, inspect the installed pipe base. The surface must be flat and must not contain stones, foreign objects and sharp objects that can damage the pipes.

After laying and continuing the PVC pipes, the pipes are backfilled with fine sand of 0-4 mm. The sand is carefully compacted between the pipes with a wooden flat rammer. The thickness of the layer above the pipe is about 10 cm (attachments number 6, 7). The sand is also the same as for the 0-4 mm granulation base. In case there is a danger that the sand will be washed away, then cover the pipes with a mixture of cement and sand in a ratio of 1:20. If there is no material (sand, pebbles) larger than 4 mm in the excavated soil, excavated soil can be used instead of fine sand to backfill the PVC pipe.

After the compacted layer of sand above the pipe, the trench is backfilled with excavated soil. Backfilling is done in layers of 20-30 cm that are well compacted. At a height of 25-30 cm above ground level, place a warning tape along the entire length of the trench. Lay the tape in the middle of the trench so that the inscription on the tape "ATTENTION PTT KABAL" faces the outside of the trench. If the prescribed depth cannot be reached during excavation, that is, if the distance from the surface of the ground to the top row of pipes is less than 50 cm for the sidewalk, i.e. 80 cm for the roadway, protective measures must be applied as applied to the existing sewage system. If the specified distance is between 30 and 50 cm, concrete the pipe, and if it is less than 30 cm above the top row of pipes, place a reinforced concrete layer (MB 20) and use mandatory PVC pipes with a wall thickness of 5.3 cm. Should protective measures be applied and which type, it is decided by the Supervisory Authority in cooperation with the Designer.

#### 2.6.8 Distances from other underground installations

On the route of the sewage system, it often happens that during excavation, installations are encountered for which the owners did not have data. In order to protect the sewerage and future cables in it from various disturbances and damage, care must be taken about the distance between the PVC pipe sewerage and other underground installations. Carry out the necessary protective measures between individual installations in agreement with the owners of the installations.

The minimum distance between PVC pipe sewerage and underground electrical installations is

- 0.3 m without the application of protective measures;
- 0.1 m with the application of protective measures.

Protective measures must be taken at points of intersection and approach, as well as on a length of 0.5m on both sides of the threatened section. Figure 1 of attachment 8 shows the method of performing protection at the intersection of the sewage system and the electric cable when the distance between them is less than 0.3 m.

The minimum distance between underground heating pipes and PVC pipe sewerage should be:

- 1.0 m without the application of protective measures;
- 0.1 m with the application of protective measures.

Protection is carried out by placing a protective layer of a mixture of cement and sand in a ratio of 1:20 between the heating pipe and the PVC pipe.

## 2.7 APPENDIX ON PROTECTION AT WORK

When carrying out works on the construction of the building, it is mandatory to observe the dangers that may arise when using electrical equipment and to adhere to the following measures to prevent them:

#### 2.7.1 Dangers and harm that may occur when using electrical installations and electrical equipment

- Danger of short circuit current
- Danger of overloading
- Danger of excessive touch and step voltage
- Danger of accidentally touching live parts

- Unauthorized voltage drop
- Danger from moisture, water, dust, explosive and flammable materials and chemical influences
- The impact and danger of static electricity
- The influence of electromagnetic and electric fields
- Danger of sudden power failure
- Risk of fire

#### 2.7.2 Anticipated measures to eliminate hazards and harm

##### **Danger of short circuit current**

This kind of danger does not exist with designed telecommunications and signaling installations, except for automatic fire alarm installations.

##### **Danger of overloading**

neither cables nor devices can be overloaded .

##### **Danger of excessive touch and step voltage**

Protection against excessively high contact voltage is solved by a whole system of protective measures: a system of zeroing with a protective line system, a system of reduced voltage 24V and the like. The central grounding of the facility is provided through a strip grounding device, to which all protective lines and metal parts of the facility that do not belong to circuits and all central devices of telecommunication and signal installations are connected.

##### **Risk of accidentally touching live parts**

This protection is provided by the correct selection of equipment, devices and cables, as well as by placing them in appropriate cabinets, by pulling them into pipes, separating them with protective nets, separating them with protective fences and the like, as well as by locating them so that the equipment is not exposed to mechanical damage. The design of the device prevents accidental contact with live parts.

##### **Protection against unauthorized voltage drop**

Protection against unauthorized voltage drops is provided by proper dimensioning of power cables, both main power supply and cable outlets for individual consumers.

##### **Protection against moisture, water, dust, explosive and flammable materials and chemical influences**

Protection was carried out by the correct selection of equipment, distribution cabinets and rooms for housing central devices.

##### **Danger of static electricity**

The danger of static electricity is eliminated by proper grounding.

##### **Danger from the influence of electromagnetic and electric fields**

By correctly choosing the distance between power, signal and telecommunication lines as well as the selection of electrostatic and electromagnetic protection inside and outside the lines is eliminated stated danger.

**Danger of sudden power failure**

The danger is eliminated by the application of emergency power supply, which is reflected in the correct selection of autonomous or external batteries, necessary for the operation of telecommunication and signaling devices in the facility, which enables independent operation in terms of legal provisions.

**2.7.3 General notes and obligations of the contractor from the aspect of occupational safety**

All electrical equipment and material provided for in this project must comply with all applicable technical regulations and standards.

The contractor is obliged to make a special report on the arrangement of the construction site and work on the construction site. The manufacturer of tools for mechanized work is obliged to submit instructions for safe work and to confirm that the prescribed measures and occupational safety norms have been applied to the tool, i.e., to submit with the work tool, a certificate of applied occupational safety regulations.

The work organization is obliged to notify the competent labor inspection authority about the start of work 8 days before starting work .

The work organization is obliged to draft normative acts in the field of occupational safety .

The labor organization is obliged to train workers in occupational safety and to familiarize workers with working conditions, hazards and harms related to work, and to check the worker's ability to work independently and safely.

The work organization is obliged to determine workplaces with special working conditions, if such positions exist.

The work organization in which explosive mixtures appear must have the Rulebook on the handling of electrical installations, which are explosively protected, as well as records on the performance of works, repairs and maintenance of those installations . That ordinance should provide for mandatory periodic inspections of those facilities, as well as the deadlines for these inspections, with the provision that they cannot be longer than one year.

When procuring work tools and devices from the documentation, which is attached to the work tools and devices, data on their acoustic properties must also be obtained, from which it will be seen that the noise at the workplace and in the work rooms will not exceed the permitted values. If it is necessary to take special measures (noise attenuators, elastic supports, etc.) in order to fulfill the conditions on permissible values, these measures must also be indicated in the aforementioned documentation.

During handling and manipulation in the plant, it is mandatory to use protective equipment and tools.

**2.7.4 Instructions for the management of construction waste, i.e. hazardous waste generated during construction, use, i.e. removal of an object, in accordance with a special regulation**

The waste generated during the construction of electrical installations of low current is classified as non-hazardous solid waste and does not have the characteristics of hazardous waste. The phases of managing this waste are the transport and disposal of solid waste, which includes the collection of waste in the vehicle and transport to the designated disposal location where the vehicle is unloaded. Waste collection is the activity of systematic collection, sorting and/or mixing of waste for transport. The works provided for in this project are exclusively of the prescribed nature of the classic execution of construction works. Take the excavated material to the landfill. Parts of the installation material will be brought to the construction site and installed. The resulting waste, material during preparatory work, the remains of the



packaging of individual elements that are installed, etc., must be carefully picked up and taken to the designated landfill. After the completion of the works, arrange the entire used belt of the construction site and restore it to its original condition, return the excess material to the warehouse.

**Environmental protection measures**

Environmental protection measures consist, first of all, in the selection of quality materials, their proper installation, and regular monitoring and maintenance of the planned buildings. In addition, the rehabilitation of the construction site will refer to the arrangement of the environment after the completion of construction.

**Fire protection measures**

When applying fire protection measures, comply with the Law on Protection and Rescue (Official Gazette of the Republic of Croatia 13/07, 32/11 and 54/16).

During the execution of the designed works, it is necessary to accurately determine the position of the existing electrical installations. Pay special attention to easily flammable materials that can cause a fire on the construction site (oil, boards, beams, slats, etc.). Such materials should be kept away from heat sources and stored in appropriate fireproof areas.

**Rehabilitation of the environment**

After the completion of the works, the entire used belt of the construction site should be arranged and restored to its original condition, the excess material should be returned to the warehouse, and the waste material from the construction site should be taken to the appropriate landfill. Road and pedestrian surfaces should be repaired, grass areas should be planned and sown with grass, and road canals should be cleaned. When carrying out the works, all planned excavations in the vicinity of existing installations should be carried out manually, taking care not to damage existing installations and to damage the roots as little as possible.

RESPONSIBLE ENGINEER

Slobodan Marković, dipl.ing.el..



### 3 QUALITY CONTROL AND ASSURANCE PROGRAM

All installation material and equipment used to perform this type of installation must comply with the standards. Materials that do not meet the standards must not be used. When bringing materials to the construction site, and before assembly, it is necessary to inspect the materials by expert supervision and make a record. All works should be performed with quality and professional workforce.

A cable break can occur for a number of reasons, including:

- cable break during installation or installation of a defective cable
- mechanical interruption of the cable (cutting, damage to the network cable and connector, etc.)
- cable break caused by disconnection of the UTP connector.

In order to reduce the possibility of such interruptions, and therefore to significantly increase the reliability of the entire network, the following procedures are recommended:

- when laying the cable and mounting the connection box, follow the rules as much as possible, it is mandatory to check the correctness of each installed connector
- install network equipment with appropriate patch panels in special cabinets, which would prevent access to this equipment by unauthorized persons,
- warn all network users of the consequences of a cable break. Any intervention on the cable of the central segment and on the network equipment on it is performed exclusively by the system administrator.

In order to reduce the possibility of such interruptions, and thus to significantly increase the reliability and availability of the network, the following procedures are recommended:

- when laying the cable and mounting the connection boxes, follow the above rules as much as possible, it is mandatory to check the correctness of each installed component before and after installation
- to warn all network users about the consequences of breaking the cable.

The problem of computer network reliability is viewed from the following aspects:

- breaks the cable of the central segment of the network
- breaks the cable of the local network segment and
- failure of network equipment.

A break on the local network segment, as already pointed out, makes it impossible to use the network from the workstation connected to that segment.

The most common reasons for local segment termination are:

- disconnection of the cable from the concentrator to the junction box during installation or installation of a defective cable
- mechanical interruption of the cable from the concentrator to the connection box (cutting, tearing, damage to the network cable and connector, etc.)
- using a faulty connection cable from the junction box to the network adapter in the computer
- interruption caused by disconnection of the RJ-45 connector from the junction box or network adapter in the computer.

Possible failures of network equipment, primarily those connected to the central segment of the network, affect the reduction of network reliability.

These failures occur most often as a result of damage to the network adapter and other computer components, as a result of exceeding the signal threshold on the cable.

The appearance of exceeding the signal threshold on the cable can be caused in different ways: induction due to atmospheric discharge, sudden increase (shock) of voltage in the electrical network, potential difference between the grounding on different components in the network, etc.

In order to prevent the aforementioned phenomena, it is recommended:

- follow the given instructions when installing the cables,
- use quality power supply for network equipment and
- power the server through an uninterruptible power supply (UPS).

Regardless of the choice of network operating system, it is common for the network server to have a special shutdown procedure, which must be started before turning off the computer.

If there is an interruption of the server's power supply, when it is turned on again, the operating system will try to correct the errors caused by the forced shutdown of the computer.

In most cases, the aforementioned correction will be successfully performed, although it is not excluded that there may be data loss or permanent damage to the operating system that would require its reinstallation, and thus the loss of all user data from the server.

In order to prevent such situations, it is necessary to connect the network server to the power supply through a special device for uninterrupted power supply - UPS.

In addition, it is recommended to install appropriate hardware and software that enable:

- notifying all workstations that there has been an interruption in the power supply of the network server and that, after a certain period of time (e.g. 5 min), the shutdown procedure is started. Users in that case have enough time to save their data on the network drive,
- automatically starts and performs the regular shutdown procedure
- automatically restarts the network server after power is restored.

In addition to the above, the UPS also stabilizes the supply voltage of the network server, which is of great importance both for reliable functioning and for the durability of the components and the computer as a whole.

The aforementioned software for using the UPS is built into most modern operating systems, or comes as a separate driver for the UPS, and the serial (COM) port is used for the hardware connection to the UPS.

Failure of the concentrator disables work in the network of those workstations that are connected to the network through it.

The way to prevent such occurrences is listed above.

### **3.1 LIST OF APPLIED REGULATIONS, RECOMMENDATIONS AND VALID STANDARDS ACCORDING TO WHICH THE FACILITY WAS DESIGNED AND ACCORDING TO WHICH WORK WILL BE PERFORMED:**

- Rulebook on technical standards for low-voltage electrical installations ("SL.list SFRJ" no. 53/88)
- Yugoslav standards - Electrical installations in buildings - Safety requirements JUSN.B2.741/1989
- Law on Spatial Planning and Building Construction ("Official Gazette of Montenegro" No. 64/17)
- Law on Occupational Safety (Official Gazette of the Republic of Montenegro, No. 79/04, Official Gazette of Montenegro, No. 26/10 and 40/11)
- Law on occupational health and safety ("Official Gazette of Montenegro" No. 34/14)
- Law on Protection and Rescue ("Official Gazette of Montenegro" No. 13/07, 05/08, 86/09, 32/11 and 54/16)
- Law on Protection of Persons and Property ("Official Gazette of Montenegro" No. 1/14 and 6/2014)
- Law on Electronic Communications ("Official Gazette of Montenegro" No. 40/13, 56/13 and 02/17)
- Law on Digital Broadcasting ("Official Gazette of Montenegro" no. 34/11 and 31/12)
- Law on Protection of Personal Data ("Official Gazette of Montenegro" No. 79/08, 70/09 and 44/12 and 22/2017)
- Law on electronic document ("Official Gazette of Montenegro" no. 05/08, and 40/11)
- Law on Electronic Identification and Electronic Signature ("Official Gazette of Montenegro" No. 31/17)
- Rulebook on the method of preparation, dimensions and detailed content of technical documentation ("Official Gazette of Montenegro" number 044/18)
- Rulebook on the method of auditing the conceptual and main project ("Official Gazette of Montenegro" No. 30/14)
- Rulebook on the manner and procedure of professional supervision ("Official Gazette of Montenegro" No. 06/09)
- Rulebook on the method of technical inspection ("Official Gazette of Montenegro" number 33/09 and 57/13)

- Rulebook on the manner of keeping and content of the construction diary, construction book and inspection book ("Official Gazette of Montenegro" No. 81/08)
- Rulebook on technical and other conditions for the design, construction and use of electronic communication networks, electronic communication infrastructure and related equipment in buildings, adopted by the Agency for Electronic Communications and Postal Services of Montenegro, 2015.
- Rulebook on the joint use of electronic communication infrastructure and related equipment, adopted by the Agency for Electronic Communications and Postal Activities of Montenegro, 2014.
- Rulebook on radio equipment and telecommunication terminal equipment, ("Official Gazette of Montenegro" number 46/14)
- Rulebook on the width of protective zones and the type of radio corridors in which the planning and construction of other facilities is not allowed, 2014.
- Rulebook on determining the list of standards in the field of radio equipment and telecommunication terminal equipment, 2014.
- Rulebook on technical norms for stable installations for the detection of explosive gases and vapors ("Official Gazette of the FRY" No. 24/93)
- Rulebook on technical norms for stable fire alarm installations ("Official Gazette of the FRY" No. 87/93)
- Rulebook on technical requirements for the protection of garages for passenger cars against fire and explosions ("Official Gazette of Montenegro" No. 9/12)
- Rulebook on technical norms for the preparation of technical documentation with which systems, equipment and devices for fire detection and alarming must be supplied ("Official Gazette of the FRY" No. 30/95)
- Rulebook on closer conditions and methods of adaptation of facilities for access and movement of persons with reduced mobility and persons with disabilities
- EN 50173-1 Information technology - Generic cabling systems - Part 1: General requirements
- EN 50173-2 Information technology - Generic cabling systems - Part 2: Office premises
- EN 50173-3 Information technology - Generic cabling systems - Part 3: Industrial premises
- EN 50173-4 Information technology - Generic cabling systems - Part 4: Homes
- EN 50173-5 Information technology - Generic cabling systems - Part 5: Data centers
- EN 50174-1 Information technology - Cabling installation - Part 1: Installation specification and quality assurance
- EN 50174-2 Information technology - Cabling installation - Part 2: Installation planning and practices inside buildings
- EN 50174-3 Information technology - Cabling installation Part 3: Installation planning and practices outside buildings
- EN 60728-1 Cable networks for television signals, sound signals and interactive services - Part 1: System performance of forward paths
- EN 50117-2-4 Coaxial cables - Part 2: Sectional specification for cables used in cabled distribution networks - indoor drop cables for systems operating at 5 MHz - 3 000 MHz.
- EN 50117-2-3 Coaxial cables used in cabled distribution networks. - Part 4: Sectional specification for distribution and trunk cables
- EN 50117-2-5 Coaxial cables used in cabled distribution networks - Part 2-5: Sectional specification for outdoor drop cables for systems operating at 5 MHz - 3000 MHz
- EN 50290-2-1 Communication cables -- Part 2-1: Common design rules and construction
- EN 50310 Application of equipotential bonding and earthing in buildings with information technology equipment
- EN 50346 Information technology - Cabling installation - Testing of installed cabling
- EN 50441-1 Unscreened cables for indoor residential telecommunication installations - Part 1: class 1
- EN 50441-2 Screened cables for indoor residential telecommunication installations – Part 2: class 2
- EN 50441-3 Screened cables for indoor residential telecommunication installations – Part 3: class 3

- EN 60603-7-3 Connectors for electronic equipment - Part 7-3: Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 100MHz (currently under preparation)
- EN 60603-7-5 Connectors for electronic equipment: - Part 7-5: Detail specification for 8-way, shielded, free and fixed connectors, for data transmissions with frequencies up to 250 MHz (currently under preparation)
- EN 60603-7-7 Connectors for electronic equipment: - Part 7-7: Detail specification for 8-- way, shielded, free and fixed connectors, for data transmissions with frequencies up to 600 MHz (category 7, shielded)
- EN 60966-2-4 Radiofrequency and coaxial cable assemblies - Part 2-4: Detail specification for cable assemblies for radio and TV receivers (Frequency range Oto 3 000 MHz, IEC 61169-2 connectors).
- EN 60966-2-5 Radiofrequency and coaxial cable assemblies - Part 2-5: Detail specification for cable assemblies for radio and TV receivers (Frequency range Oto 1 000 MHz, IEC 61169-2 connectors).
- EN 60966-2-6 Radiofrequency and coaxial cable assemblies - Part 2-6: Detail specification for cable assemblies for radio and TV receivers (Frequency range Oto 3 000 MHz, IEC 60169-24 connectors).
- EN 61169-2 Radiofrequency connectors - Part 2: Sectiona1 specification - Radiofrequency coaxial connectors of type 9.52 EN 61169-24 Radiofrequency connectors - Part 24: Sectional specification - Radiofrequency coaxial connectors with screw coupling, typically for use in 75 ohm cable distribution systems (type F).
- EN 50083 Cabled distribution systems for television, sound and interactive multimedia signals
- EN 50083-1 Safety requirements.
- EN 50083-2 EMC for equipment.
- EN 50083-3 Active broadband equipment;
- EN 50083-4 Passive broadband equipment;
- EN 50083-5 Headend equipment;
- EN 50083-6 Optical equipment;
- EN 50083-7 System performance.
- EN 50083-8 EMC for networks.
- EN 50083-9 Interface for DVBIMPEG2 transport stream.
- EN 50083-10 System performance for return path.

## **II    NUMERICAL DOCUMENTATION**

## **4.1 MATERIAL SPECIFICATION**

**MATERIAL SPECIFICATION**  
**of extra low voltage electrical installation**

a row. no.	Item description	one measures	quantity
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**1 Installation of structural cable system**

**RACK**

1.1.	Procurement and delivery of a free-standing RACK cabinet with the following characteristics: -height 41U -dim. 600x600x2000mm - glass door with lock, wheels and feet with leveling, front and rear rails 19" - load capacity up to 300kg. Total for material:	pcs	1
1.2.	Procurement and delivery of power supply panel 19", 7 x SCHUKO and switch, PVC, 1.25HU. The panel is installed in a RACK cabinet. Total for material:	pcs	1
1.3.	Procurement and delivery of connectors for optical cables to be installed in a rack cabinet. Double adapter (2 inputs, 2 outputs), enables the connection of two optical fibers (with their connectors), supplied with protective caps and a transparent support for inscriptions of 2 modules, 2 sockets for ST optical connector (2xST). The item also includes splicing of optics on both fibers. Total for material:	pcs	1
1.4.	Procurement and delivery of heavy duty fixed shelves - for racks with a depth of 600mm. Total for material:	pcs	3
1.5.	Supply, delivery and installation of a fan panel 19"/1U with 4 fans and a thermostat (LCD), for cabinets with a depth of 600 mm. Total for the material:	pcs	1
1.6.	Supply and delivery of cable organizers. Total for material:	pcs	12
1.7.	Procurement and delivery of an empty modular patch panel with 24 slots for RJ-45 cat.6 modules that is placed in a RACK. In the patch panel, install RJ-45 modules for installing the SKS system and video surveillance and connect to SFTP cat. 6 and UTP cat.6 cables that are laid around the building. Total for material:	pcs	6
1.8.	Procurement and delivery of RJ45 cat.6 modules in patch panels. Total for material:	pcs	128
1.9.	Procurement and delivery of S/FTP cat. 6 patch cords with final RJ-45 connectors on both sides, length 1m-3m. Total for material:	pcs	135

1.10.	Procurement and delivery of switches with the following characteristics: -48 x 10/100/1000 RJ45 Ports -4 x 1GB SFP Ports -manageable	pcs	3
1.11.	Procurement and delivery of POE switches with the following characteristics: -24 x 10/100/1000 Mbps RJ45 Port -2 x Gigabit SFP Slot -POE budget 384W, 30W per port	pcs	1
1.12.	Procurement and delivery of a UPS that is positioned in a Rack with the following characteristics: -500W -750VA -mounting in a 2U rack cabinet -autonomy time 16min (50%), 5.5min (100%) -voltage regulation -weight 17.27kg -charging time 3h	pcs	1
<b><i>Equipment per area</i></b>			
1.13.	Procurement, delivery and installation of two-modular installation accessories: PVC box 2M for wall mounting armature 2M decorative mask 2M Total for material:	comp.	1
1.14.	Procurement and delivery of FTP RJ-45 cat.6 sockets for installation in modular accessories (defined by pre-measurement and pre-calculation of low and extra low voltage) and for access points. The connectors are terminated at the ends with SFTP cat.6 cables. Total for material:	pcs	107
1.15.	Procurement and delivery of indoor access point devices with the following features: wireless 300Mb/s gigabit access point 2.4GHz 802.11b/g/n power 200mW (22dBm), PoE 802.3af, Multi-SSID, VLAN, QoS, EAP Controller Software. Total for material:	pcs	7
1.16.	Procurement and delivery of a halogen-free installation tube with an internal diameter of Ø16mm, through which S/FTP cat.6 AWG23 LSHF are passed. Total for material:	m	2200
1.17.	Supply and delivery of halogen-free S/FTP cat. 6 AWG23 LSHF cabal. Total for material:	m	3150
1.18.	Supply and delivery of 10m long HDMI cables with end HDMI connectors on both sides. Calculate per piece. Total for material:	pcs	4
1.19.	Procurement and delivery of S/FTP cat. 6 patch cords with final RJ-45 connectors on both sides, length 1m-3m. Total for material:	pcs	7



## 2 Installation of the IP video surveillance system

2.1.	Procurement and delivery of NVR with the following characteristics: -16-channel, resolution up to 5Mpx -supports 8Mpx/5Mpx/4Mpx/3Mpx/1080p -1x6TB HDD -decoding capacity @25fps per channel -H.264/H.265 compression -bandwidth 32Mbps -2xHDMI, 1xVGA Total for material:	pcs	1
2.2.	Procurement and delivery of 4TB HDD. Total for material:	pcs	2
2.3.	Procurement and delivery of an IP camera with the following characteristics: -Dome housing -resolution 5Mpx/20fps -lens motorized 3.3-12 mm (92° - 32.9°) -optical sensor 1/2.7" Smartsens SC233AI -Onvif -IP 67 - compression H.265 -SD card slot -IR range 20-30m 0.0085Lux@F1.2, 0Lux IR ON -True WDR 120dB -VCA analytics -dimensions Ø111.5 x 99.6 mm Total for material:	pcs	10
2.4.	Procurement, delivery and installation of mount box.	pcs	10
2.5.	Procurement and delivery of an IP camera with the following characteristics: -Bullet housing -resolution 5Mpx/20fps -lens motorized 3.3-12 mm (92° - 32.9°) -optical sensor 1/2.7" Smartsens SC233AI -Onvif -IP 67 - compression H.265 -SD card slot -IR range 20-30m 0.0085Lux@F1.2, 0Lux IR ON -True WDR 120dB -VCA analytics -dimensions 217.7 x 80.5 x 80.5 mm Total for material:	pcs	4
2.6.	Procurement and delivery of wall bracket. Total for material:	pcs	4
2.7.	Procurement, delivery and laying of halogen-free installation pipes with an internal diameter of Ø16mm. Total for material:	m	400
2.8.	Procurement, delivery and laying of S/FTP cat. 6 AWG23 LSHF cables, for connecting elements of the video surveillance system. Total for material:	m	650
2.9.	Supply and delivery of final RJ-45 connectors at the end of the cable. The cable is used to connect cameras with S/FTP cables. Total for material:	pcs	14

### 3 Installation of an automatic fire alarm system

#### 3.1. Procurement and delivery of a fire control panel with the following characteristics:

- color touchscreen with a diagonal of 4.3" and 6 function keys, a key for viewing multiple alarms, 6 LEDs
- status indicators
- multi-protocol
- Ethernet and RS485 port
- with 2 loops (with 240 addressable elements each)
- 4A power supply for the large case
- large case with dimensions 497 x 380 x 97mm (WxHxD), with space for two 12V/17Ah rechargeable batteries
- no possibility adding loop extensions
- networking capability in HORNET+
- the board has 4 monitored configurable I/O channels and one configurable relay.

Total for material:

pcs 1

#### 3.2.

Procurement and delivery of batteries with the following characteristics:

- nominal voltage: 12V
- nominal capacity: 17Ah
- recommended operating temperature: 25±3°C
- connector type: F3 declared service life: 5 years

Total for material:

pcs 2

#### 3.3. Procurement and delivery of an answering machine with the following characteristics:

- communication module for Previdia Compact centrale
- GSM and PSTN
- 100 voice messages on the board (up to 8 min.)
- automatic reporting via landline and GSM network to 15 telephone numbers
- integrated automatic digital communicator ( Contact ID, SIA-IP) -30 programmable SMS
- 32 phone numbers (voice, digital, SMS)
- 1x input / 1x output terminal for fixed line, SIM card slot, connector for external GSM antenna
- certified in accordance with EN 54-21
- consumption @27.6V: 40mA (stand-by)/ 150mA (max.)

Total for material:

pcs 1

- 3.4. Procurement and delivery of an addressable optical smoke detector with the following characteristics:
- automatic addressing by the central office
  - grid with 500µm diameter openings, for protection from dust and insects
  - LED status indicator: green-standby; yellow-error; red-alarm
  - automatic compensation for soiling of the optical chamber
  - possibility to adjust the sensitivity
  - complete diagnostics of the state of the detector by the control center
  - smoke level memory in 5 min intervals. before the last detected alarm; -
  - built-in short-circuit isolator
  - consumption: 200µA (standby)/ 10mA (alarm) @27.6Vdc
- Total for material:
- pcs 9
- 3.5. Procurement and delivery of an addressable smoke and heat detector with the following characteristics:
- reliable operation and high resistance to interference
  - the possibility of programming five operating modes: PLUS, OR, AND, SMOKE and HEAT - 3-color LED-signaling
  - complete diagnostics of the detector's condition
  - temperature memory measured in an interval of 5 min. before the last detected alarm
  - operating voltage: 19-30 Vdc
  - consumption: 90µA (standby)/ 40mA (alarm)
- Total for material:
- pcs 33
- 3.6. Procurement and delivery of an addressable heat detector with the following characteristics:
- automatic addressing by the central office
  - the possibility of programming the operating mode (A1R/ B/ A2S/ BR) - LED status indicator: green-standby; yellow-error; red-alarm
  - complete diagnostics of the state of the detector by the central office
  - memory of the temperature measured in an interval of 5 min. before the last detected alarm
  - built-in short-circuit isolator
  - consumption: 200µA (standby)/ 10mA (alarm) @27.6Vdc
- Total for material:
- pcs 7
- 3.7. Procurement and delivery of a base for an automatic detector with the following characteristics:
- built-in jumper that ensures continuity in case of dismantling the associated detector
  - material: polycarbonate
  - dimensions: Ø110mm x 24mm
- Total for material:
- pcs 40

3.8.

Procurement and delivery of an analog-addressable manual pager with the following features:

- automatic addressing by the control panel
- LED status indicator: green-standby; yellow-error; red-alarm -activation by pressing the resettable plastic element
- built-in short circuit isolator
- consumption: 80μA (standby)/ 5mA (alarm) @27.6Vdc

Total for material:

pcs 6

3.9.

Procurement and delivery of an addressable siren flasher, for internal or external installation, with the following characteristics:

- automatic addressing by the control panel
- sound pressure 101dB(A)@1m
- 14 types of melody available
- built-in short-circuit isolator
- consumption: 200μA (standby)/ 20mA ( alarm) @27.6Vdc
- possibility of external mounting (IP65 degree of protection)
- case in red color

Total for material:

pcs 8

3.10.

Supply of halogen-free installation pipes with an internal diameter of Ø16mm. Total for material:

m 400

3.11.

Procurement and delivery of halogen-free J-H(St)H FE180/E90 2x2x0.8mm cable. Total for material:

m 500

3.12.

Procurement and delivery of S/FTP cat. 6 AWG23 LSHF cables. Total for material:

m 5

#### 4 Gas detection in the kitchen

4.1.	Procurement and delivery of a conventional switchboard for extinguishing control, capacity of 3 zones to which up to 32 detectors per zone can be connected	pcs	1
4.2.	Supply and delivery of batteries 12V/7Ah.	pcs	1
4.3.	Procurement and delivery of propane butane gas detector.	pcs	1
4.4.	Procurement and delivery of a conventional alarm siren with flash.	pcs	1
4.5.	Procurement and delivery of a panel with "GAS".	pcs	1
4.6.	Delivery and laying of installation halogen free cable type JH(St)H 2x2x0.8mm FE180/E60.	m	40
4.7.	Procurement and delivery of flexible hose, halogen-free, diameter - fi16mm. Total for material:	m	30

#### 5 Installation of an ambient sound system

5.1.	Supply and delivery of amplifiers with the following characteristics: -USB/SD/MP3 player -4 speaker zones with volume control -4 $\Omega$ and 100, 70 and 25 V lines -total 240W RMS, 120W per zone -pagging -dimensions 420 x 89 x 300 mm depth, 2U Total for material:	pcs	1
5.2.	Procurement and delivery of speakers with the following characteristics: -built-in installation -with 100V line converter -power 6W RMS -tap: 100V - 6 W / 3 W RMS -6 1/2" double membrane -frequency 140 - 20,000 Hz -sensitivity 92 dB $\pm$ 3 dB at 1 W/1 m - color white RAL9016 - dimensions 175 mm $\varnothing$ x 80 mm; 168 mm $\varnothing$ (opening) Total for material:	pcs	8

5.3. Procurement and delivery of speakers with the following characteristics:

- surface mounting
- with 100V line converter
- power 40W RMS, max 80W
- tap: 100V - 40 W / 20 W / 10 W / 5 W RMS or 8Ω
- 5" membrane
- frequency 80- 20,000 Hz
- sensitivity 86dB at 1W/1m
- color white RAL9003 -IP 66
- dimensions 162 x 262 x 147 mm

Total for material:

pcs 6

5.4. Procurement and delivery of halogen-free installation pipes with an internal diameter of Ø16mm. Total for material:

m 150

5.5. Delivery of halogen free cable, capacity 2x2.5mm, type LiHCH 2x2.5mm, or similar for connecting elements of ambient sound. Total for material:

pcs 200

*Responsible designer*

*Slobodan Marković, B.Sc.*

## **4.2 BILL OF QUANTITIES OF MATERIALS AND WORKS**

**BILL OF QUANTITIES**  
*of works and materials of electrical installations of extra low voltage*

This bill of quantities foresees the delivery and installation of all material specified by position and all small unspecified material required for complete construction and installation as specified by position, testing and putting into proper operation as well as bringing to the correct original state the places damaged in the already performed works and constructions. All materials used must be of first-class quality and meet standards. The work must be performed by professional workers, and fully in accordance with the valid technical regulations for the same type of work. The price includes the price of materials, labor costs and all taxes and contributions on the material. The price includes the preparation of all possibly necessary workshop documentation, testing and commissioning of all installation elements listed by position. The listed equipment manufacturers are not exclusive. The contractor can also install other equipment or material, but under the condition that this equipment or material has the same electrotechnical and constructive characteristics as the above, which is confirmed by an expert - the supervisory authority.

a row. no.	Item description	one measu res	quantity	one the price	the forest
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**1 Installation of structural cable system**

***RACK***

1.1.	Procurement, delivery and installation of a free-standing RACK cabinet with the following characteristics: -height 41U -dim. 600x600x2000mm - glass door with lock, wheels and feet with leveling, front and rear rails 19" - load capacity up to 300kg. Total for material and work:	pcs	1		
1.2.	Supply, delivery and installation of power supply panel 19", 7 x SCHUKO and switch, PVC, 1.25HU. The panel is installed in a RACK cabinet. Total for material and work:	pcs	1		
1.3.	Procurement, delivery and installation of connectors for optical cables to be installed in a rack cabinet. Double adapter (2 inputs, 2 outputs), enables the connection of two optical fibers (with their connectors), supplied with protective caps and a transparent support for inscriptions of 2 modules, 2 sockets for ST optical connector (2xST). The item also includes splicing of optics on both fibers. Total for material and labor:	pcs	1		
1.4.	Procurement, delivery and installation of fixed shelves heavy duty - for rack depth 600mm. Total for material and labor:	pcs	3		
1.5.	Supply, delivery and installation of a fan panel 19"/1U with 4 fans and a thermostat (LCD), for cabinets with a depth of 600 mm. Total for material and work:	pcs	1		



1.6.	Supply, delivery and installation of cable organizers. Total for material and labor:	pcs	12
1.7.	Procurement, delivery and installation of an empty modular patch panel with 24 slots for RJ-45 cat.6 modules, which is placed in a RACK. In the patch panel, install RJ-45 modules for installing the SKS system and video surveillance and connect to SFTP cat. 6 and UTP cat.6 cables that are laid around the building. Total for material and labor:	pcs	6
1.8.	Procurement, delivery and installation of RJ45 cat.6 modules in patch panels. Total for material and labor:	pcs	128
1.9.	Procurement and delivery of S/FTP cat. 6 patch cords with final RJ-45 connectors on both sides, length 1m-3m. Total for material:	pcs	135
1.10.	Procurement, delivery and installation of switches with the following characteristics: 48 x 10/100/1000 RJ45 Ports -4 x 1GB SFP Ports -manageable.	pcs	3
1.11.	Procurement, delivery and installation of a POE switch with the following characteristics: -24 x 10/100/1000 Mbps RJ45 Port -2 x Gigabit SFP Slot - POE budget 384W, 30W per port	pcs	1
1.12.	Procurement, delivery and installation of a UPS that is positioned in a Rack with the following characteristics: -500W -750VA -mounting in a 2U rack cabinet -autonomy time 16min (50%), 5.5min (100%) -voltage regulation -weight 17.27kg -charging time 3h	pcs	1

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***Equipment per area***


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1.13.	Procurement, delivery and installation of two-modular installation accessories : PVC box 2M for wall mounting armature 2M decorative mask 2M Total for material and labor:	comp.	1
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- |       |  |                   |
|-------|--|-------------------|
| 1.14. | Procurement, delivery and installation of FTP RJ-45 cat.6 sockets for installation in modular accessories (defined by pre-measurement and pre-calculation of low and extra low voltage) and for access points. The connectors are terminated at the ends with SFTP cat.6 cables. Total for material and labor:   | pcs    107        |
| 1.15. | Procurement, delivery and installation of indoor access point devices with the following characteristics: wireless 300Mb/s gigabit access point 2.4GHz 802.11b/g/n power 200mW (22dBm), PoE 802.3af, Multi-SSID, VLAN, QoS, EAP Controller Software. Total for material and labor:   | pcs    7          |
| 1.16. | Procurement, delivery and laying of a halogen-free installation pipe with an internal diameter of Ø16mm,, through which S/FTP cat.6 AWG23 LSHF are passed. The installation pipe is laid in the wall with the creation of slits and the repair of damaged surfaces, as well as under the suspended ceiling. The item includes all the small materials needed for their installation, electrical connection on both sides, halogen-free installation hoses, cleaning as well as restoring damaged surfaces to their original state. Total for material and labor: | m    2200         |
| 1.17. | Procurement, delivery and drawing of halogen-free S/FTP cat. 6 AWG23 LSHF cable. The cable is passed through the installation pipe with an outer diameter of Ø16mm, partly along the wall under the plaster, partly under the suspended ceiling, and partly through the concrete floor liner to the corresponding connectors in the rooms. The calculation should be done by the required meter. Total for material and labor:   | m    3150         |
| 1.18. | Procurement, delivery and routing of 10m long HDMI cables with end HDMI connectors on both sides. The cable is passed through the installation pipe with an outer diameter of Ø16mm, partly on the wall under the plaster, and partly on the ceiling under the plaster. Calculate per piece. Total for material and labor:   | pcs    4          |
| 1.19. | Procurement and delivery of S/FTP cat. 6 patch cords with final RJ-45 connectors on both sides, length 1m-3m. Total for material:  | pcs    7          |
| 1.20. | Small prefabricated and unspecified material.  | flat<br>rate    1 |

1.21.	Measurements and testing of SKS systems in accordance with Articles 84, 85, 86, 87 and 88 of the Rulebook (Regulation on technical and other conditions for the design, construction and use of electronic communication networks, electronic communication infrastructure and related equipment in buildings, adopted by the Agency for electronic communications and postal activity of Montenegro, 2015) and according to valid standards. Issuance of measurement protocols and a certified report on the measurement and correctness of all installations.	flat rate	1
1.22.	System setup and commissioning services:	flat rate	1

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**Total SKS installations**


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## 2 Installation of the IP video surveillance system

2.1.	Procurement, delivery and installation of NVR with the following characteristics: -16-channel, resolution up to 5Mpx -supports 8Mpx/5Mpx/4Mpx/3Mpx/1080p -1x6TB HDD -decoding capacity @25fps per channel -H.264/H. 265 compression -bandwidth 32Mbps -2xHDMI, 1xVGA Total for material and labor:	pcs	1
2.2.	Procurement, delivery and installation of 4TB HDD. Total for material and labor:	pcs	2
2.3.	Procurement, delivery and installation of an IP camera with the following characteristics: -Dome housing -resolution 5Mpx/20fps -lens motorized 3.3-12 mm (92° - 32.9°) -optical sensor 1/2.7" Smartsens SC233AI -Onvif -IP 67 -compression H.265 -SD card slot -IR range 20-30m 0.0085Lux@F1.2, 0Lux IR ON -True WDR 120dB -VCA analytics -dimensions Ø111.5 x 99.6 mm Total for material and labor:	pcs	10
2.4.	Procurement, delivery and installation of mount box.	pcs	10

2.5.	Procurement, delivery and installation of an IP camera with the following characteristics: -Bullet housing -resolution 5Mpx/20fps -lens motorized 3.3-12 mm (92° - 32.9°) -optical sensor 1/2.7" Smartsens SC233AI -Onvif -IP 67 -compression H.265 -SD card slot -IR range 20-30m 0.0085Lux@F1.2, 0Lux IR ON -True WDR 120dB -VCA analytics -dimensions 217.7 x 80.5 x 80.5 mm Total for material and labor:	com	4
2.6.	Procurement, delivery and installation of wall bracket. Total for material and labor:	com	4
2.7.	Procurement, delivery and laying of halogen-free installation pipes with an internal diameter of Ø16mm, through which the cables for connecting the elements of the video surveillance system are passed. The installation pipe is laid in the wall with the creation of slits and the repair of damaged surfaces, as well as under the suspended ceiling. The item includes all the small materials needed for their installation, electrical connection on both sides, halogen-free installation hoses, cleaning as well as restoring damaged surfaces to their original state. Total for material and labor:	m	400
2.8.	Procurement, delivery and laying of S/FTP cat. 6 AWG23 LSHF cables, for connecting elements of the video surveillance system. Total for material and labor:	m	650
2.9.	Supply and delivery of final RJ-45 connectors at the end of the cable. The cable is used to connect cameras with S/FTP cables. Total for material and labor:	pcs	14
2.10.	Small prefabricated and unspecified material.	flat rate	1
2.11.	Necessary measurements and tests on all cable routes:	flat rate	1
2.12.	System commissioning, user training. Calculation by position:	flat rate	1

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**Total installation of IP video surveillance system**


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### 3 Installation of an automatic fire alarm system

#### 3.1. Procurement, delivery and installation of a fire control panel with the following characteristics:

- color touchscreen with a diagonal of 4.3" and 6 function keys, a key for viewing multiple alarms, 6 LED-status indicators
- multi-protocol
- Ethernet and RS485 port
- with 2 loops (with 240 addressable elements each)
- 4A power supply for the large case
- large case with dimensions 497 x 380 x 97mm (WxHxD), with space for two 12V/17Ah rechargeable batteries
- no possibility adding loop extensions
- networking capability in HORNET+ - the board has 4 monitored configurable I/O channels and one configurable relay.

Total for material and labor:

pcs 1

#### 3.2. Procurement, delivery and installation of batteries with the following characteristics:

- nominal voltage: 12V
- nominal capacity: 17Ah
- recommended operating temperature: 25±3°C
- connector type: F3 declared service life: 5 years

Total for material and labor:

pcs 2

#### 3.3. Procurement, delivery and installation of an answering machine with the following characteristics:

- communication module for Previdia Compact centrale - GSM and PSTN
- 100 voice messages on the board (up to 8 min.) - automatic reporting via landline and GSM network to 15 telephone numbers
- integrated automatic digital communicator (Contact ID, SIA-IP)
- 30 programmable SMS
- 32 phone numbers (voice, digital, SMS)
- 1x input / 1x output terminal for fixed line, SIM card slot, connector for external GSM antenna
- certified in accordance with EN 54-21
- consumption @27.6V: 40mA (stand-by)/ 150mA (max.)

Total for material and labor:

pcs 1

- 3.4. Procurement, delivery and installation of an addressable optical smoke detector with the following characteristics:
- automatic addressing by the central office -grid with 500µm diameter openings, for protection from dust and insects
  - LED status indicator: green-standby; yellow-error; red-alarm
  - automatic compensation for soiling of the optical chamber
  - possibility to adjust the sensitivity
  - complete diagnostics of the state of the detector by the control center
  - smoke level memory in 5 min intervals. before the last detected alarm;
  - built-in short-circuit isolator -consumption: 200µA (standby)/ 10mA (alarm) @27.6Vdc
- Total for material and labor:
- pcs 9
- 3.5. Procurement, delivery and installation of an addressable smoke and heat detector with the following characteristics:
- reliable operation and high resistance to interference
  - the possibility of programming five operating modes: PLUS, OR, AND, SMOKE and HEAT - 3-color LED-signaling - complete diagnostics of the detector's condition
  - memory of the temperature measured in an interval of 5 min. before the last detected alarm
  - operating voltage: 19-30 Vdc
  - consumption: 90µA (standby)/ 40mA (alarm)
- Total for material and labor:
- pcs 33
- 3.6. Procurement, delivery and installation of an addressable heat detector with the following characteristics:
- automatic addressing by the central office
  - the possibility of programming the operating mode (A1R/ B/ A2S/ BR)
  - LED status indicator: green-standby; yellow-error; red-alarm - complete diagnostics of the state of the detector by the central office
  - memory of the temperature measured in an interval of 5 min. before the last detected alarm
  - built-in short-circuit isolator -consumption: 200µA (standby)/ 10mA (alarm) @27.6Vdc
- pcs 7
- 3.7. Procurement, delivery and installation of a base for an automatic detector with the following characteristics:
- built-in jumper that ensures continuity in case of dismantling the associated detector
  - material: polycarbonate
  - dimensions: Ø110mm x 24mm
- Total for material and labor:
- pcs 40

- |   |                             |
|---|-----------------------------|
| <p>3.8. Procurement, delivery and installation of an analog-addressable manual call point with the following characteristics:</p> <ul style="list-style-type: none"> <li>- automatic addressing by the control panel</li> <li>- LED status indicator: green-standby; yellow-error; red-alarm</li> <li>- activation by pressing the resettable plastic element -built-in short circuit isolator</li> <li>- consumption: 80µA (standby)/ 5mA (alarm) @27.6Vdc</li> </ul> <p>Total for material and labor:</p>   | <p>pcs      6</p>           |
| <p>3.9. Supply, delivery and installation of an addressable flash siren, for internal or external installation, with the following characteristics:</p> <ul style="list-style-type: none"> <li>- automatic addressing by the control panel</li> <li>- sound pressure 101dB(A)@1m</li> <li>- 14 types of melody available</li> <li>- built-in short-circuit isolator</li> <li>- consumption: 200µA (standby)/ 20mA (alarm) @27.6Vdc</li> <li>- possibility of external mounting (IP65 degree of protection)</li> <li>- case in red color</li> </ul> <p>Total for material and labor:</p> | <p>pcs      8</p>           |
| <p>3.10. Procurement, delivery and laying of halogen-free installation pipes with an internal diameter of Ø16mm, through which JH(St)H FE180/E90 2x2x0.8mm cables are passed for connecting elements of the fire protection system and S/FTP cat.6 cable for connecting the fire control panel with the communicator. The installation pipe is laid partly on the wall under the plaster, and partly on the ceiling and under the suspended ceiling. Total for material and labor:</p>  | <p>m      400</p>           |
| <p>3.11. Procurement, delivery and routing of halogen-free J-H(St)H FE180/E90 2x2x0.8mm cable. The cable is passed through halogen-free installation pipes with an internal diameter of Ø16mm, partly on the wall under the plaster, and partly on the ceiling, and serves to connect the elements of the fire protection system. Total for material and labor:</p>   | <p>m      500</p>           |
| <p>3.12. Procurement, delivery and routing of S/FTP cat. 6 AWG23 LSHF cables, are used to connect the fire control panel to the call station located in the Rack cabinet. Total for material and labor:</p>   | <p>m      5</p>             |
| <p>3.13. Programming and setting of the fire alarm control panel in accordance with the Rulebook on technical standards for stable fire alarm installations (Official Gazette of the SRJ No. 87/93) with the issuance of a certified Test Record with a listing containing a list of alarm and executive elements and a list of programmed executive function.</p>  | <p>flat<br/>rate      1</p> |

3.14.	Small prefabricated and unspecified material	flat rate	1
3.15.	Necessary measurements and tests on cable routes	flat rate	1
3.16.	System commissioning, user training. Calculation by position:	flat rate	1

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**Total installation of automatic fire alarm system**


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**4 Gas detection in the kitchen**

4.1.	Procurement, delivery and installation of a conventional switchboardr for extinguishing control, capacity of 3 zones to which up to 32 detectors per zone can be connected.	pcs	1
4.2.	Supply, delivery and installation of batteries 12V/7Ah.	pcs	1
4.3.	Procurement, delivery and installation of propane butane gas detector.	pcs	1
4.4.	Procurement, delivery and installation of a conventional alarm siren with flasher.	pcs	1
4.5.	Procurement, delivery and installation of a panel with the inscription "GAS".	pcs	1
4.6.	Delivery and laying of installation halogen free cable type JH(St)H 2x2x0.8mm FE180/E60. The cable is led partly through the racks, and partly through a halogen-free ribbed hose fi16, attached to the ceiling clip.	m	40
4.7.	Procurement, delivery and laying of flexible hose, halogen-free, diameter - fi16mm. Total for material and labor:	m	30
4.8.	Small, prefabricated and unspecified material	pcs	1
4.9.	System configuration and commissioning, user training	flat rate	1

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**Total Gas detection in the kitchen**


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## 5 Installation of an ambient sound system

- 5.1. Procurement, delivery and installation of amplifiers with the following characteristics:  
 -USB/SD/MP3 player  
 -4 speaker zones with volume control  
 -4  $\Omega$  and 100, 70 and 25 V lines  
 -total 240W RMS, 120W per zone  
 -pagging  
 -dimensions 420 x 89 x 300 mm deep, 2U  
 Total for material and labor:
- pcs 1
- 5.2. Procurement, delivery and installation of speakers with the following characteristics:  
 -recessed installation  
 -with 100V line converter  
 -power 6W RMS -tap: 100V  
 - 6 W / 3 W RMS -6 1/2" double membrane  
 -frequency 140 - 20,000 Hz  
 -sensitivity 92 dB  $\pm$ 3 dB at 1 W/1 m  
 - color white RAL9016 - dimensions 175 mm  $\varnothing$  x 80 mm; 168 mm  $\varnothing$  (opening)  
 Total for material and labor:
- pcs 8
- 5.3. Procurement, delivery and installation of speakers with the following characteristics:  
 - surface mounting  
 - with 100V line converter  
 - power 40W RMS, max 80W  
 - tap: 100V - 40 W / 20 W /10 W / 5 W RMS or 8 $\Omega$  - 5" membrane  
 - frequency 80-20,000 Hz -sensitivity 86dB at 1W/1m  
 -color white RAL9003 -IP 66  
 -dimensions 162 x 262 x 147 mm  
 Total for material and labor:
- pcs 6
- 5.4. Procurement, delivery and laying of halogen-free installation pipes with an internal diameter of  $\varnothing$ 16mm, through which LiHCH 2x2.5mm cables are passed for connecting the elements of the ambient sound system. The installation pipe is laid partly on the wall under the plaster, partly under the suspended ceiling. Total for material and labor:
- m 150
- 5.5. Delivery and laying of halogen free cable, capacity 2x2.5mm, type LiHCH 2x2.5mm, or similar for connecting elements of ambient sound. Total for material and labor:
- pcs 200
- 5.6. Small prefabricated and unspecified material
- flat rate 1

5.7.	Commissioning the system	flat rate	1
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**Total installation of ambient sound system**

6	Creation of the project of the derived condition (maintenance)	flat rate
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In total, the design of the finished state (maintenance):

**RECAPITULATION**

1	Installation of structural cable system
2	Installation of the IP video surveillance system
3	Installation of an automatic fire alarm system
4	Gas detection in the kitchen
5	Installation of an ambient sound system
6	Creation of the project of the derived condition (maintenance)

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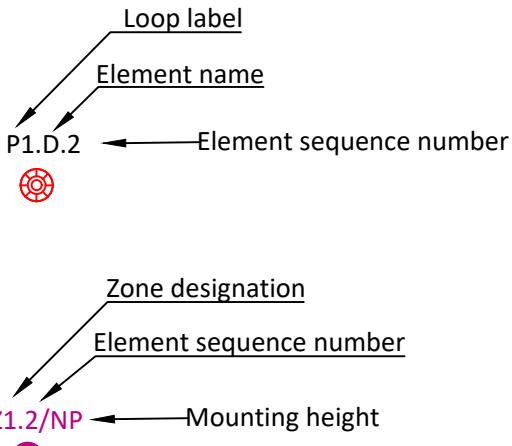
**TOTAL excluding VAT**
**VAT AMOUNT (21%)**
**TOTAL with VAT**

*Responsibe designer*

*Slobodan Marković, B.Sc.*

### **III GRAPHIC DOCUMENTATION**

No.	The room	Surface area
1	reception	8.62 m²
2	storage room	17.06 m²
3	hall	72.50 m²
4	computer cabinet	85.25 m²
5	Toilet	11.45 m²
6	multifunctional hall	123.85 m²
7	multifunctional hall	58.40 m²
8	animation cabinet	56.10 m²
9	apartment	65.38 m²
IN TOTAL		498.61 m²



Installation height of the device:

- Detectors on the ceiling - NP
- Manual call points - at a height of 1.5 m
- Sirens - at a height of 2.2m
- Built-in speakers - ceiling level
- Surface speakers - 2.7m
- Interior cameras - ceiling level
- External cameras - at a height of 3.0m
- Access points - ceiling level

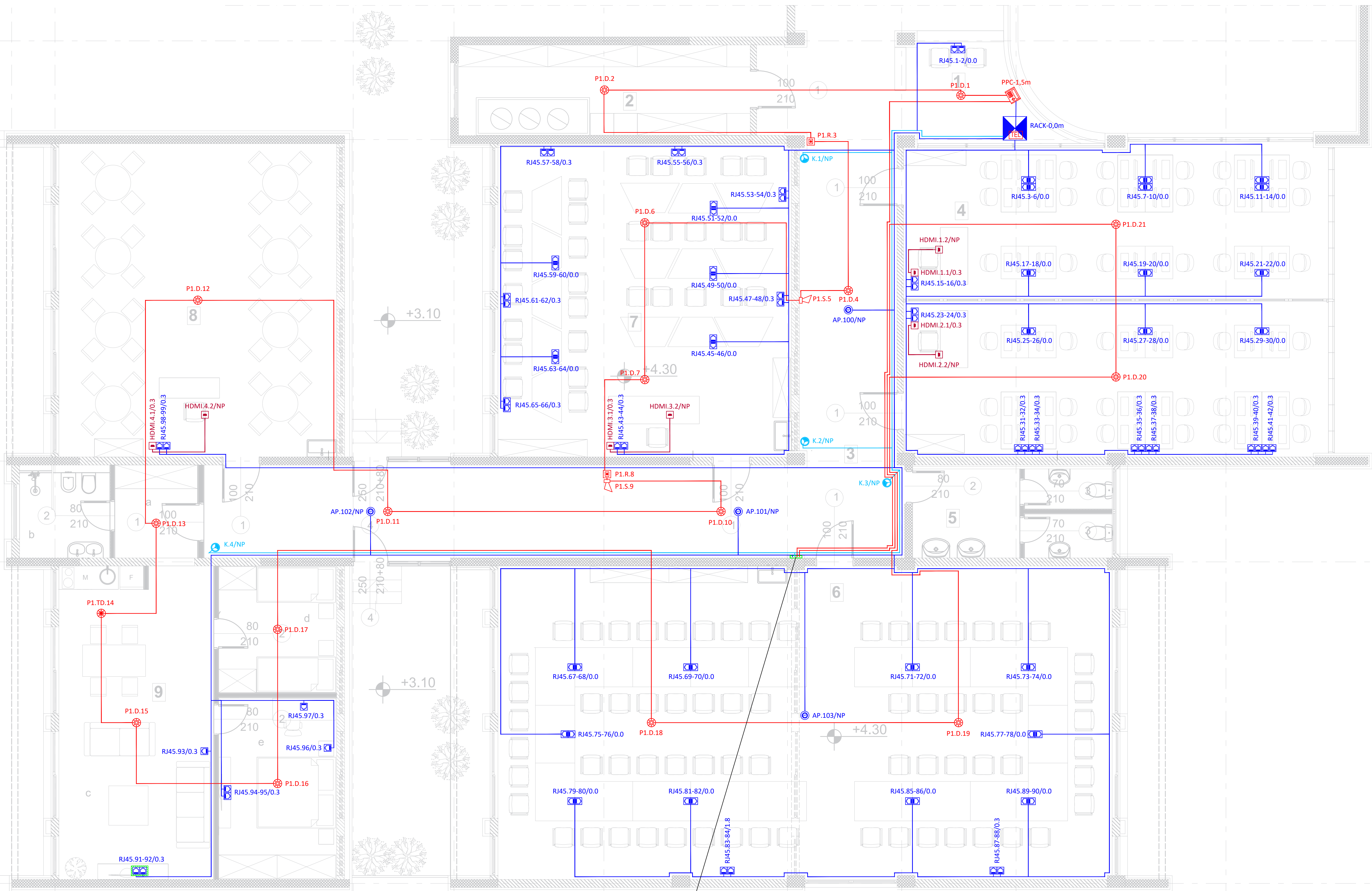
LEGEND OF THE SYMBOL	
Symbol	Description
	RJ-45 Cat.6 modular socket 1M
	Access point
	Indoor Dome Camera
	External bullet camera
	Amplifier
	Built-in speaker
	Surface speaker
	Optical fire detector
	Thermal fire detector
	Outside siren
	Internal siren
	Manual fire alarm

LEGEND OF THE CONDUCTOR	
Symbol	Description
	S/FTP cat.6 LSZH conductor
	S/FTP cat.6 LSZH conductor for cameras
	J-H(S)H FE180/E90 2x2x0.8mm conductor
	LIHCH 2x2.5 mm2 conductor

DESIGNER: <b>ENpro ing</b> Enproing DOO bul. vojvode Stanka Radonjica br.47, Izabela 1, stan 43, Podgorica tel: +382(0)67 215 992		INVESTOR: Western Balkan Six Chamber Investment Forum Piazza della Borsa nr. 14 34121 Trieste Italy	
Objekat: MIXED HIGH SCHOOL "DANILO KIŠ", Budva, Montenegro		Location: c.p 1617/1 cadastral district Budva Municipality Budva	
Leading designer: Zagorka Božović Pejanović, dipl. ing. arh.		Type of technical documentation: Adaptation project of parts of the facility	
Authorized designer: Slobodan Marković, dipl.inž.el. br. lic. UPI 107/7-1164/2		Part of technical documentation: Electrical engineering project- extra low voltage	SCALE: 1:50
Assistant designer: Marko Vujović, spec.sci.el.		Inlosure: Base of the ground floor - SKS, video surveillance, sound system and automatic fire alarm	No. off attachment: 1
Drafting date and M.P.		Date of revision and M.P.	Page no. 68



No.	The room	Surface area
1	restaurant hall	177.15 m²
2	bar	14.57 m²
3	entrance corridor	23.30 m²
4	kitchen block	65.30 m²
4	Toilet	8.43 m²
5	wardrobe	5.31 m²
6	wardrobe	5.27 m²
7	covered terrace	59.46 m²
8	terrace	38.32 m²
IN TOTAL		397.11 m²



Installation height of the device:

- Detectors on the ceiling - NP
- Manual call points - at a height of 1.5 m
- Sirens - at a height of 2.2m
- Interior cameras - ceiling level
- Access points - ceiling level

Legend:

- Loop label
- The name of the element
- Element sequence number

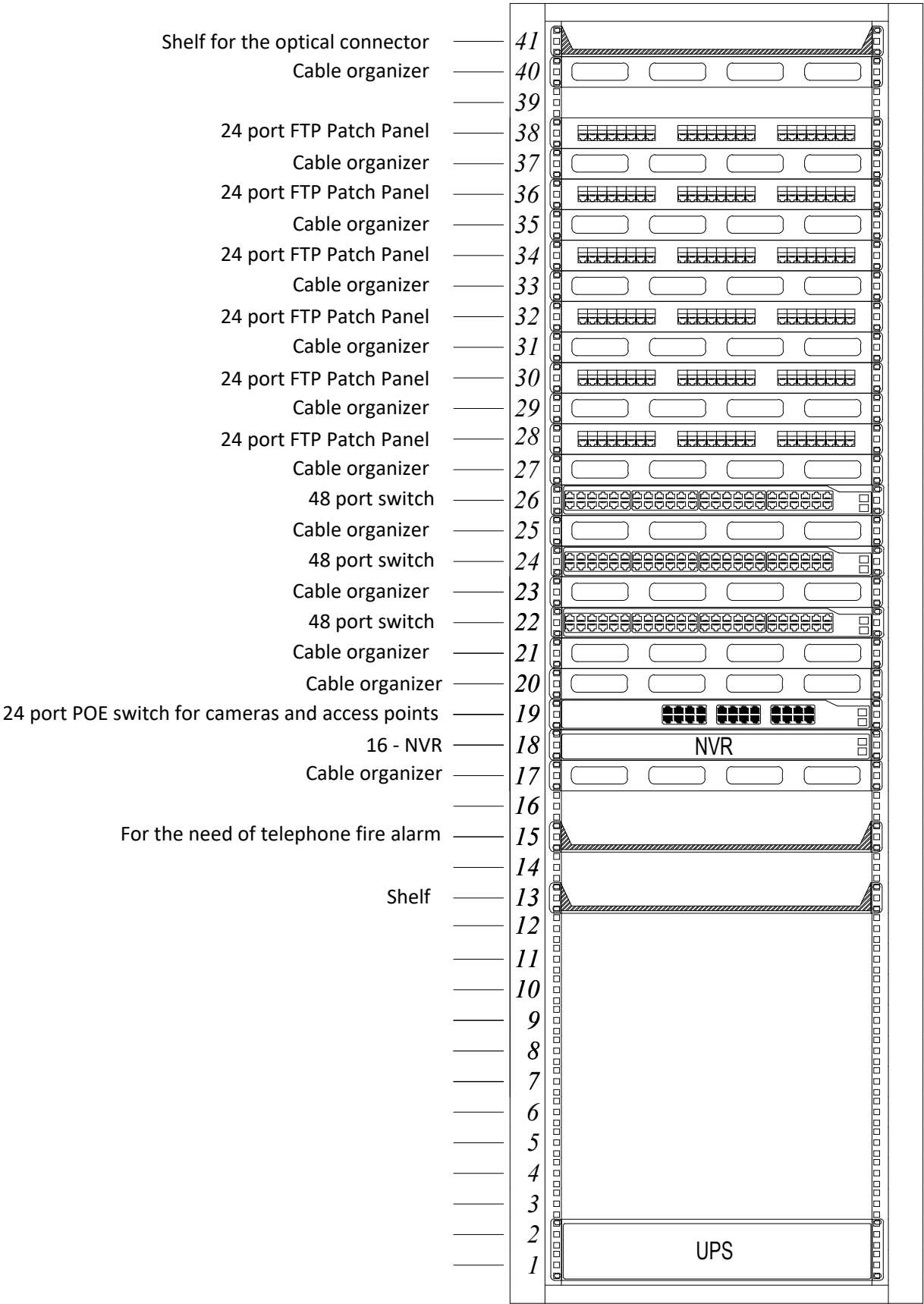
LEGEND OF THE SYMBOL	
Symbol	Description
	RACK cabinet
	RJ-45 Cat.6 modular socket 1M
	Access point
	HDMI socket 1M
	Indoor Dome Camera
	Fire control center
	Fire alarm by phone
	Optical fire detector
	Internal siren
	Internal siren

LEGEND OFF THE SYMBOL	
Symbol	Description
	S/FTP cat.6 LSZH conductor
	HDMI conductor
	S/FTP cat.6 LSZH conductor for cameras
	J-H(S)H FE180/E90 2x2x0.8mm conductor

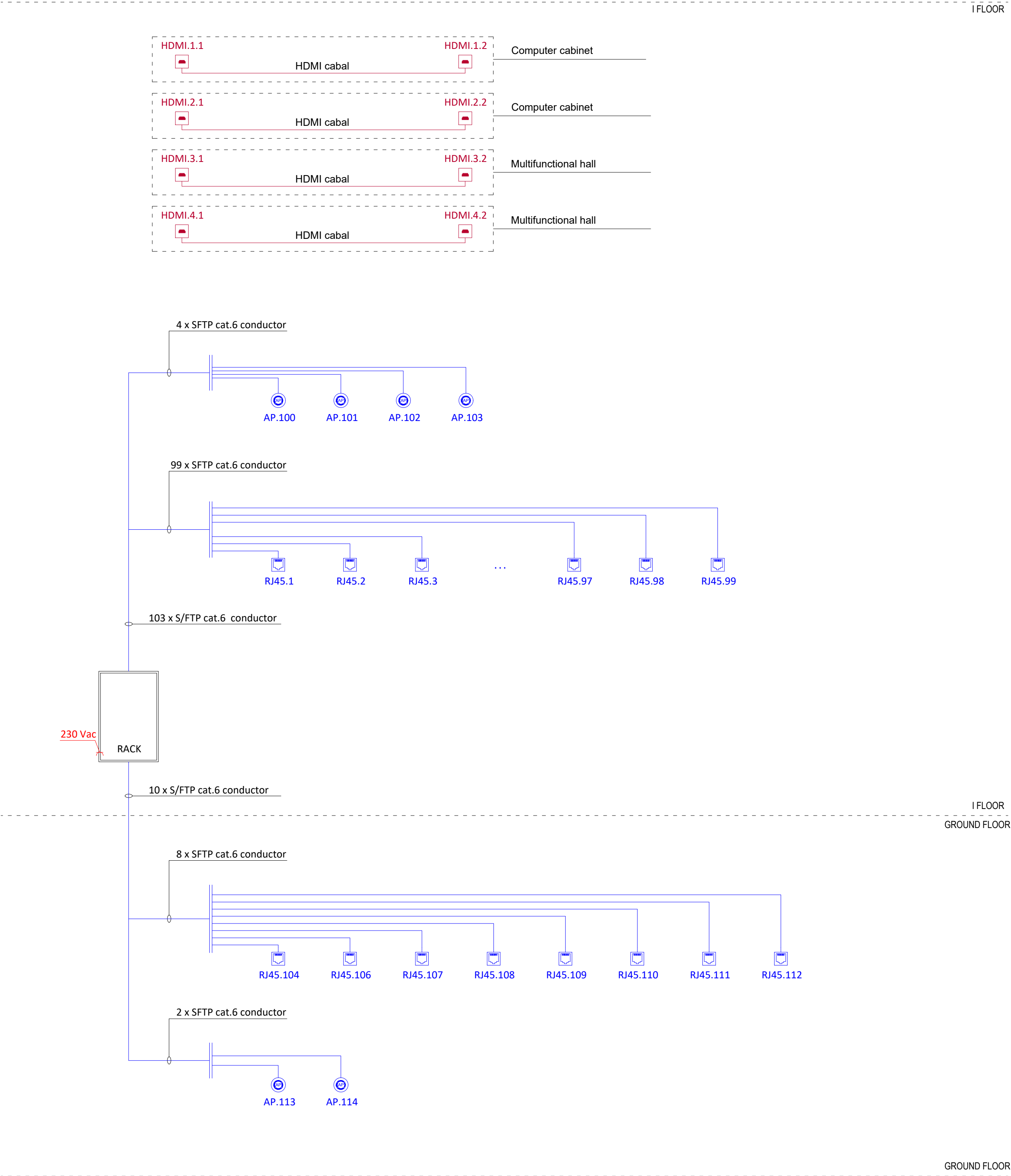
10 x S/FTP cat.6 LSZH conductor from RACK cabinet for the needs of rj45 sockets  
10 x S/FTP cat.6 LSZH conductor from RACK cabinet for video surveillance purposes  
2 x J-H(S)H FE180/E90 2x2x0.8mm conductor for automatic fire alarm




DESIGNER: <b>ENpro ing</b> Enproing DOO bui. vojvode Stanka Radonjica br.47, Izabela 1, stan 43, Podgorica tel: +382(0)67 215 992	INVESTOR: Western Balkan Six Chamber Investment Forum Piazza della Borsa nr. 14 34121 Trieste Italy
Objekat: MIXED HIGH SCHOOL "DANILO KIŠ", Budva, Montenegro	Location: c.p 1617/1 cadastral district Budva Municipality Budva
Leading designer: Željka Božović Pejanović, dipl. ing. arh.	Type of technical documentation: Adaptation project of parts of the facility
Authorized designer: Slobodan Marković, dipl.inž.el. br. lic. UPI 107/7-1164/2	Part of technical documentation: Electrical engineering project- extra low voltage
Assistant designer: Marko Vujović, spec.sci.el.	Inclosure: Base floor - SKS, video surveillance and automatic fire alarm
Drafting date and M.P.	Date of revision and M.P.



RACK



DESIGNER: <b>ENpro ing</b> Enproing DOO bul. vojvode Stanka Radonjića br.47, Iamela 1, stan 43., Podgorica tel: +382(0)67 215 992		INVESTOR:  Western Balkan Six Chamber Investment Forum Piazza della Borsa nr. 14 34121 Trieste Italy		
Objekat: MIXED HIGH SCHOOL "DANILO KIŠ", Budva, Montenegro		Location: c.p 1617/1 cadastral district Budva Municipality Budva		
Leading designer: Zagorka Božović Pejanović, dipl. ing. arh.		Type of tehcnical documentation: Adaptation project of parts of the facility		
Authorized designer: Slobodan Marković, dipl.inž.el. br. lic. UPI 107/7-1164/2		Part of tehcnical documentation: Electrical engineering project- extra low voltage	SCALE:  	
Assistant designer: Marko Vujović, spec.sci.el.		Inclosure: Block scheme- Rack cabinet	No. off attachment 3	Page no. 70
Drafting date and M.P		Date of revision and M.P		
February, 2024. year				

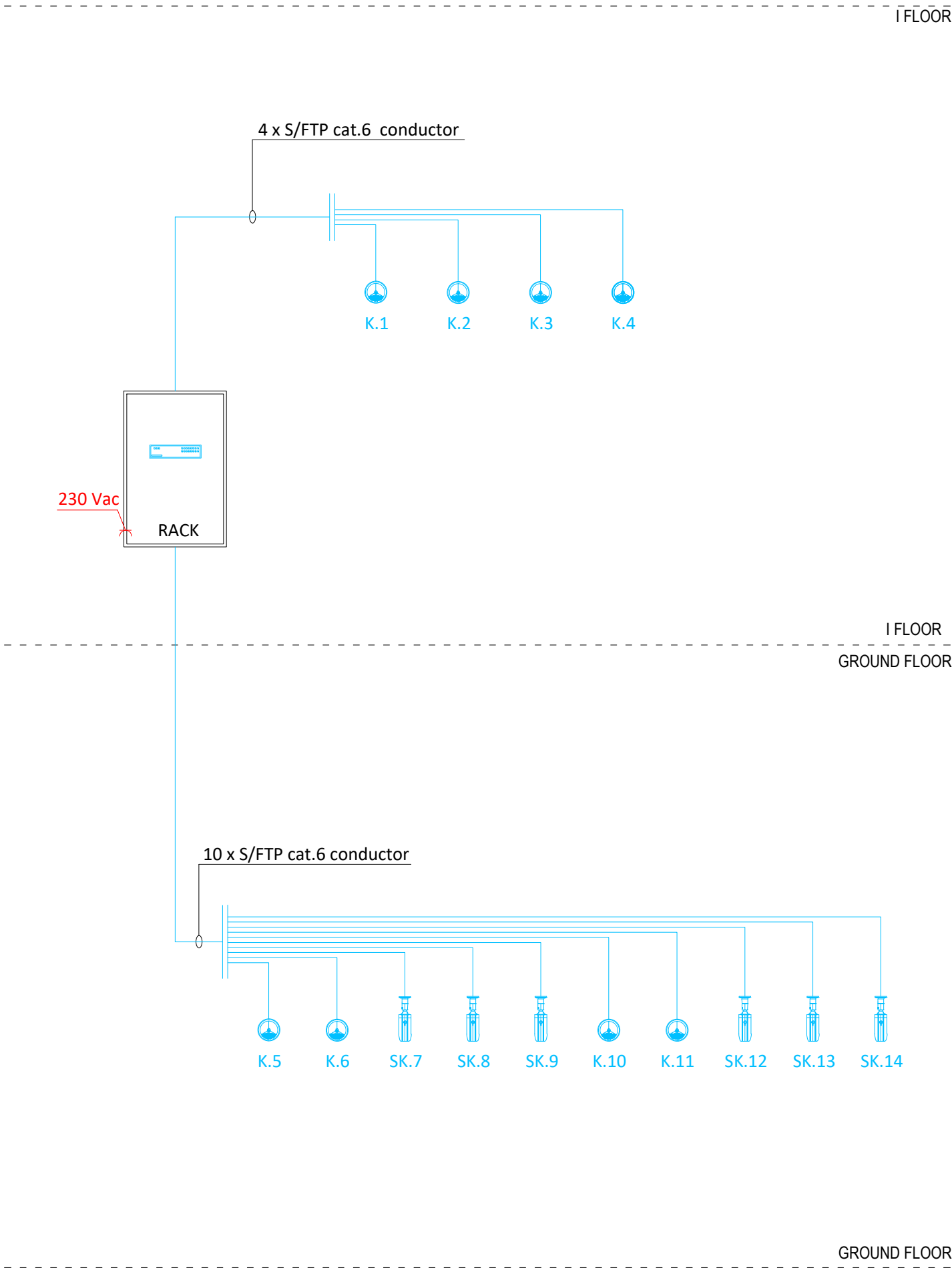





LEGEND OFF THE SYMBOL	
Symbol	Description
	RJ-45 Cat.6 modular socket 1M
	Access point
	HDMI socket 1M


LEGENDA PROVODNIKA	
Simbol	Opis
	S/FTP cat.6 LSZH conductor
	HDMI conductor

DESIGNER: <div>ENpro ing</div> Enproing DOO bul. vojvode Stanka Radonjića br.47, lamela 1, stan 43., Podgorica tel: +382(0)67 215 992		INVESTOR: Western Balkan Six Chamber Investment Forum Piazza della Borsa nr. 14 34121 Trieste Italy	
Objekat: MIXED HIGH SCHOOL "DANILO KIŠ", Budva, Montenegro		Location: c.p 1617/1 cadastral district Budva Municipality Budva	
Leading designer: Zagorka Božović Pejanović, dipl. ing. arh.		Type of tehcnical documentation: Adaptation project of parts of the facility	
Authorized designer: Slobodan Marković, dipl.inž.el. br. lic. UPI 107/7-1164/2		Part of tehcnical documentation: Electrical engineering project- extra low voltage	SCALE:
Assistant designer: Marko Vujović, spec.sci.el.		Inclosure: Block scheme - Installations SKS system to connectors	No. off attachment 4 Page no. 71
Drafting date and M.P		Date of revision and M.P	
February, 2024. year			












LEGEND OF THE SYMBOL	
Symbol	Description
	16-channel NVR switch
	Indoor Dome Camera
	External bullet camera


LEGEND OF THE CONDUCTOR	
Simbol	Description
	S/FTP cat.6 LSZH conductor for cameras

DESIGNER: <b>ENpro ing</b> Enproing DOO bul. vojvode Stanka Radonjića br.47, Iamela 1, stan 43., Podgorica tel: +382(0)67 215 992		INVESTOR: Western Balkan Six Chamber Investment Forum Piazza della Borsa nr. 14 34121 Trieste Italy		
Objekat: MIXED HIGH SCHOOL "DANILO KIŠ", Budva, Montenegro		Location: c.p 1617/1 cadastral district Budva Municipality Budva		
Leading designer: Zagorka Božović Pejanović, dipl. ing. arh.		Type of tehcnical documentation: Adaptation project of parts of the facility		
Authorized designer: Slobodan Marković, dipl.inž.el. br. lic. UPI 107/7-1164/2		Part of tehcnical documentation: Electrical engineering project- extra low voltage		SCALE:
Assistant designer: Marko Vujović, spec.sci.el.		Inclousure: Block scheme- video surveillance installations	No. off attachment 5	Page no. 72
Drafting date and M.P		Date of revision and M.P		
February, 2024. year				

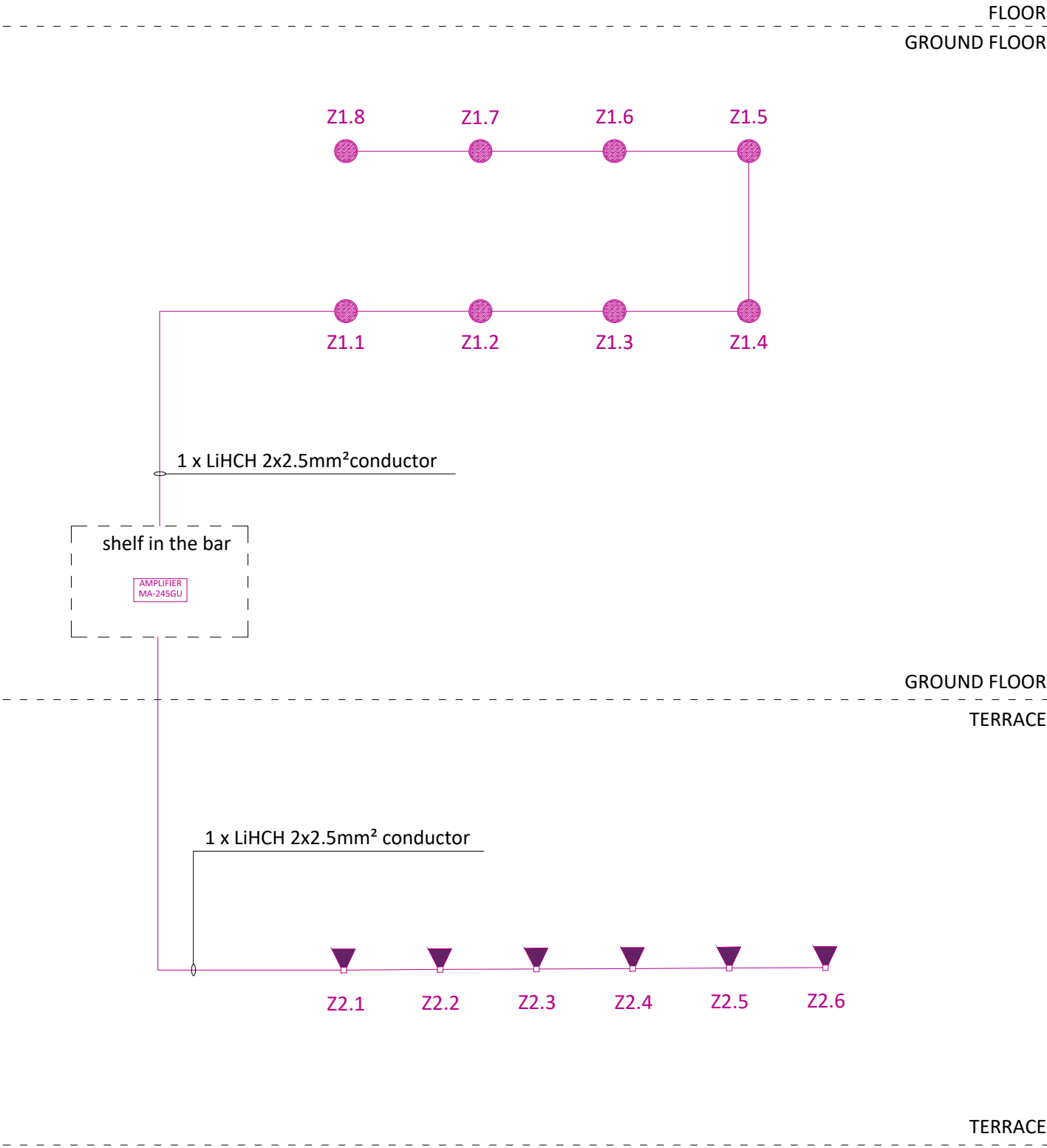




LEGEND OF THE SYMBOL	
Symbol	Description
	Fire control center
	Fire alarm by phone
	Optical fire detector
	Thermal fire detector
	Internal siren
	Outside siren
	Manual fire alarm

LEGEND OF THE CONDUCTOR	
Simbol	Description
	J-H(St)H FE180/E90 2x2x0.8mm conductor

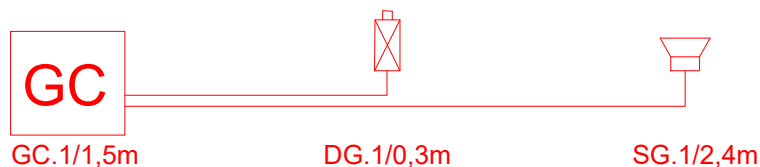
DESIGNER: <b>ENpro ing</b> Enproing DOO bul. vojvode Stanka Radonjića br.47, lamela 1, stan 43., Podgorica tel: +382(0)67 215 992		INVESTOR: Western Balkan Six Chamber Investment Forum Piazza della Borsa nr. 14 34121 Trieste Italy		
Objekat: MIXED HIGH SCHOOL "DANILO KIŠ", Budva, Montenegro		Location: c.p 1617/1 cadastral district Budva Municipality Budva		
Leading designer: Zagorka Božović Pejanović, dipl. ing. arh.		Type of tehcnical documentation: Adaptation project of parts of the facility		
Authorized designer: Slobodan Marković, dipl.inž.el. br. lic. UPI 107/7-1164/2		Part of tehcnical documentation: Electrical engineering project- extra low voltage		SCALE:
Assistant designer: Marko Vujović, spec.sci.el.		Inclosure: Block scheme - automatic fire alarm	No. off attachment 6	Page no. 73
Drafting date and M.P		Date of revision and M.P		
February, 2024. year				



LEGEND OF THE SYMBOL	
Symbol	Description
<div>AMPLIFIER MA-245GU</div>	Media amplifier
<div></div>	Built-in speaker
<div></div>	Upgrade speaker

LEGEND OF THE CONDUCTOR	
Symbol	Description
<div></div>	LiHCH 2x2.5mm <sup>2</sup> conductor for sound system installation

DESIGNER: <div>ENproing</div> <div>Enproing DOO bul. vojvode Stanka Radonjića br.47, Iamela 1, stan 43., Podgorica tel: +382(0)67 215 992</div>		INVESTOR:  Western Balkan Six Chamber Investment Forum Piazza della Borsa nr. 14 34121 Trieste Italy	
Objekat: MIXED HIGH SCHOOL "DANILO KIŠ", Budva, Montenegro		Location: c.p 1617/1 cadastral district Budva Municipality Budva	
Leading designer: Zagorka Božović Pejanović, dipl. ing. arh.		Type of tehcnical documentation: Adaptation project of parts of the facility	
Authorized designer: Slobodan Marković, dipl.inž.el. br. lic. UPI 107/7-1164/2		Part of tehcnical documentation: Electrical engineering project- extra low voltage	SCALE:
Assistant designer: Marko Vujović, spec.sci.el.		Inclosure: Block scheme- sound system installation	No. off attachment 7  Page no. 74
Drafting date and M.P		Date of revision and M.P	
February, 2024. year			



KITCHEN

#### LEGEND OF THE SYMBOL

Symbol	Description
	LPG central kitchen
	LPG detector
	LPG horn

#### LEGEND OF THE CONDUCTOR

Symbol	Description
	J-H(St)H FE180/E90 2x2x0.8mm provodnik

DESIGNER:

**ENpro**  
**ing**

Enproing DOO  
buĹ. vojvode Stanka Radonjića br.47,  
lamela 1, stan 43., Podgorica  
tel: +382(0)67 215 992

INVESTOR:

Western Balkan Six Chamber Investment Forum  
Piazza della Borsa nr. 14 34121 Trieste Italy

Objekat:

MIXED HIGH SCHOOL "DANILO KIŠ", Budva, Montenegro

Location:

c.p 1617/1 cadastral district Budva  
Municipality Budva

Leading designer:

Zagorka Božović Pejanović,  
dipl. ing. arh.

Type of tehcnical documentation:

Adaptation project of parts of the facility

Authorized designer:

Slobodan Marković, dipl.inž.el.  
br. lic. UPI 107/7-1164/2

Part of tehcnical documentation:

Electrical engineering project- extra low voltage

SCALE:

Assistant designer:

Marko Vujović, spec.sci.el.

Inclosure: Block scheme -

gas detection in kitchen

No. off attachment

8

Page no.

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Drafting date and M.P

Date of revision and M.P

February, 2024. year