CE51 TOGETHER

D.T2.1.1 Report on Energy Multifunctional Meter, thermocamera & Energy Audit kit, Thematic Equipment linked to DT3.1.5

Version 1
5.2017

PP3 - University of Maribor

Finalized by the University of Maribor (PP3)

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1. Introduction

One of the activities within the project is to prepare a common report on purchased thematic equipment used as energy audit kit for performing project activities. According to the application form of project Together, each project partner has allocated specific amount for purchase of ordinary multifunctional tools called in the project "energy audit kit", including at least thermographic camera (see Table 1).

EAV, Paks and SIEA has bought an upgraded energy audit kit including the ordinary multifunctional tools, for carrying out internal professional pilot buildings energy audits, for that reason they do not have allocated any budget under D.T3.1.3 section. Therefore, this thematic equipment is closely linked to elaboration of energy audit report on partner's level. Among others, Paks has "a CAD software for creating intelligent 3D models, engineering drawings and enabling to explore the key physical, constructional features" procured, which will be used also for delivering D.T3.1.5 – "Report on modelling the energy efficiency refurbishments of selected pilot buildings owned by Paks".

UM has decided to procure an upgraded kit, including the ordinary multifunctional tools, to be used during the training and practical activities targeting buildings managers and during the pilot actions where buildings users will be involved and trained in carrying out the energy audits with the help of external auditor.

Table 1: Allocated budget per project partner due to the application form

Project Partner	Country	BL5: D.T2.1.1 thematic equipment for energy audit kit	D.T3.1.3 External audit services for realizing a professional and certified energy audits
LP_Treviso	Italy	2.200,00 €	36.800,00 €
PP2_EAV	Czech Republic	6.600,00 €	/
PP3_UM	Slovenia	7.000,00 €	15.000,00 €
PP4_ZAGREB	Croatia	2.200,00 €	/
PP5_PNEC	Poland	2.200,00 €	24.300,00 €
PP6_PAKS	Hungary	16.200,00 €	/
PP7_HEGDYVIDEK	Hungary	2.200,00 €	18.000,00 €
PP8_SIEA	Slovakia	10.500,00 €	/

Figure 1: TOGETHER partnership map

Report presents a purchased energy audit kit on a partnership level. Expressed are the main purposes of equipment usage for project activities, as of involvement stakeholders, target groups in training activities or performance of energy audits. For better comparison of energy audit kit and type of procurements, all technical characteristics are gathered in Tables. Under the annexes all datasheets for all devices of energy audit kits are listed.

2. Methods used

In order to prepare a report on energy multifunctional meter, thermocamera & energy audit kit, thematic equipment linked to DT3.1.5, the following methods have been used:

- A questionnaire: a questionnaire regarding the description of purchased thematic equipment on partners level have been prepared and fellfield by the partners in order to define a country specific information

- Communication with partners: UM (PP3) as a lead for the deliverable was during the preparation of the deliverable frequently communicating with all the partners, who were providing completed templates, giving comments and improvements of the report.

3. Energy audit kit of LP Province of Treviso

3.1. The contribution of purchased thematic equipment for the project activities

LP Province of Treviso is implementing the energy audit with the support of an external company (IQS Srl from Milano); therefore, the thematic equipment purchased with the TOGETHER budget serves for carrying out other type of activities, mainly devoted to the target group involvement in the pilot actions.

Stated that thematic equipment purchased and described is professional and of good quality, it would be not indicated for performing certified energy audits as matter of fact the IQS company is using more specialised and expensive equipment for processing the energy audit in the 20 pilot buildings, included in the PA1 cluster.

The “light” energy kit purchased by Treviso is currently presented to the target groups (students, teachers and experts of the involved associated Municipalities) during the performance of the energy audit under progress. The interaction is more active with the students of the secondary schools (high schools) as the students are more matured and have the adequate basics. Moreover, Province of Treviso will use this equipment for guaranteeing an additional value and opportunity to engage the end-users in the project. It is planned to send to the local partners such as municipalities and schools a letter presenting this equipment and possibility to borrow it.

The thematic equipment will be made available to the teachers and students for introducing the pilot actions, as a visible tool of engagement and of learning. Moreover, the thematic equipment will be used in all the planned activities impacting with the buildings stakeholders, including the communication activities, such as the creation of short videos and digital content to be uploaded in the project web site and social media channels:

https://www.facebook.com/TogetherPRTV2016/photos/pcb.944661418967984/944657238968402/?type=3&theater

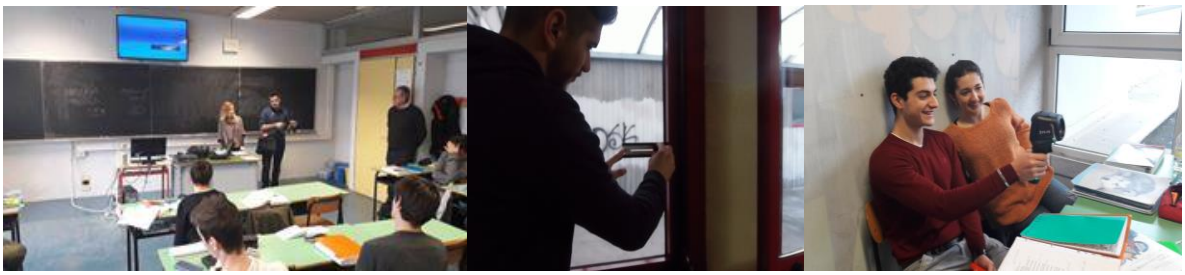


Figure 2: Involvement of target groups by purchased thematic equipment

With the stricter reference to the contribution to the energy audits, the thematic equipment purchased is not directly used for the energy audit but as a tool for involving and enhancing the engagement of the experts of the municipalities. They are put at the disposal of the involved municipalities and will be of extreme use when performing the training activities under WP T1, due to the practical approach of the lessons. Moreover, in terms of reference of the procurement for the energy audit, it is planned that IQS Srl organises within the month of March 2017, a training workshop for introducing the energy audit procedures, the regulations in force. The team of the Province of Treviso will present the thematic equipment, their functionalities.

The internal staff of the Province of Treviso have the adequate knowledge to use the thematic equipment. When the thematic equipment will be lent by the schools and municipalities, the internal staff will verify if the teachers have the adequate knowledge to introduce them and manage them. On occasion of the training sessions, the Company together with the internal staff of the Province of Treviso will introduce the thematic equipment for a correct use and maintenance.

In the process of public procurement any deviation a part the delay in respect to the originally planned deadline set in the Application form has occurred. The costs of the thermo-camera and multifunctional meter are less than planned at the beginning in the Application form.

3.2. Technical properties of purchased thematic equipment

Table 2: Thermal IR camera

Type of procurement	Purchase of the thematic equipment in the Electronic market of the Public Administration (MePA) though the so called “ODA – Direct Order”
National law for public procurement in your country	National Decree “50/2016” Implementation of Directives 2014/23 / EU, 2014/24 / EU and 2014/25 / EU on the award of concession contracts, the Government and on procurement by entities procurement procedures in the water, energy, transport and postal services, as well as to revise the current rules on public contracts for works, services and supplies The Program for the Rationalization of Public Authority Purchases was launched with the 2000 Budget Law with the aim of optimizing public purchases of goods and services and developing provisioning models based on innovative processes and technologies.
Purchased thematic equipment (title)	**FLIR E 4**
Purchased thematic equipment (function)	**Thermal IR camera**

Technical data	From the 4800-pixel thermal image clarity of the E4's incredible 320x240 detector with 76,800 pixels, FLIR Ex-Series cameras offer a resolution to fit the target size, working distance, and detail required for your application as well as your budget. Display: 3" color LCD • On-board 640 x 480 Digital Camera • Easy-to-use, weighs only 1.2lbs • 2% accuracy • File format: Radiometric jpg • Swappable Li-ion Battery with 4 hour life • Spot Measurement mode • Simultaneous storage of IR/Visual/MSX images Each includes power supply/charger with four plugs, rechargeable battery, FLIR Tools software, USB cable, and hard transport case. E8 also includes extra battery and external battery charger.
Pictures of the thematic equipment	 
Internal inventory number	149638
Person in charge of the thematic equipment	Antonio Zonta – Project Coordinator
Place where the thematic equipment is available	Via Cal di Breda, 116 31100 Treviso Building n. 9 Room n. 8A. 42
Costs in Euro	845,00 € without VAT 1.039,90 € with VAT (22 %)

Table 3: Multi-functional meter

Type of procurement	Purchase of the thematic equipment in the Electronic market of the Public Administration (MePA) though the so called "ODA – Direct Order"
National law for public procurement in your country	National Decree "50/2016" Implementation of Directives 2014/23 / EU, 2014/24 / EU and 2014/25 / EU on the award of concession contracts, the Government and on procurement by entities procurement procedures in the water, energy, transport and postal services, as well as to revise the current rules on public contracts for works, services and supplies The Program for the Rationalization of Public Authority Purchases was launched with the 2000 Budget Law with the aim of optimizing public purchases of goods and services and developing provisioning models based on innovative processes and technologies.
Purchased thematic equipment (title)	**HT200 Heat Stress - WBGT Meter**
Purchased thematic equipment (function)	Multi-functional meter
Technical data	Extech's Heat Stress WBGT (Wet Bulb Globe Temperature) Meter accurately determines the Heat Stress level (how hot it feels outside) by factoring a combination of humidity, temperature, air movement, and direct solar radiation. These factors all affect how hot our bodies get, as well as our ability to cool down. It's perfect for monitoring the Heat Index on hot humid days to prevent heat stroke during road or building construction, outdoor activities, sporting events, or in the workplace *Features* • Uses a capacitance sensor to accurately measure Wet Bulb Globe Temperature (WBGT), Black Globe Temperature (TG), Relative Humidity (%RH), Air Temperature (TA), Wet Bulb (WT) and Dew Point (DEW) • Heat Stress Index measures how hot it feels when humidity is combined with temperature, air movement, and radiant heat • Black Globe Temperature (TG) monitors the effects of direct solar radiation on an exposed surface • In/Out function displays the WBGT value with or without direct sun exposure • WBGT high/low alarm settings • Memory stores up to 50 readings • Backlit LCD • Min/Max and Data Hold • Low battery indicator • Auto power off with disable • Complete with 9V battery and hard carrying case

Pictures of the thematic equipment	 
Internal inventory number	149639
Person in charge of the thematic equipment	Antonio Zonta – Project Coordinator
Place where the thematic equipment is available	Via Cal di Breda, 116 31100 Treviso Building n. 9 Room n. 8A 42
Costs in Euro	449,00 € without VAT 547,78 € with VAT (22 %)

4. Energy audit kit of PP2 Energy Agency Vysočiny

4.1. The contribution of purchased thematic equipment for the project activities

PP2 EAV will elaborate energy audits by itself. Therefore, Energy audit equipment were carefully chosen and purchased in good quality in compare at a reasonable price.

Laser distance meter (BOSCH DLE 70) is necessary for elaboration of energy audit equipment, because EAV checks the real dimensions of the building within local review of the building. The project documentation may not match with current state, which could cause distorted results.

Multimeter is necessary for verification of distributed load of electrical wiring of the building and determine a real electric consumption of the building.

IR thermometer is necessary for measuring of very-high temperatures, which would out of range while measuring by thermocamera. IR thermometer is use for temperature measuring of steam lines, flue pipes and other elements and components in boiler rooms.

Thermocamera determinates the issues of the building from heat losses point of view. It will be used for searching of thermal bridges in the building and define the most problematic premises of the building. This information is necessary for elaboration of energy audit of the building. The thermal images of the building will be part of the energy audit.

With Software for energy audit elaboration (Energie 2016) energy parameters for energy audits will be calculated. The software will be upgraded from current version 2014, which allows that all calculations will be made according to national rules for energy audits in Czech Republic; National decree 406/2000 Coll. EAV experts have the adequate knowledge to use the thematic equipment for performance of energy audits, therefore they do not expect any troubles or problems in relation to use of the equipment.

EAV plans to use Thermocamera and IR thermometer for local training activities too. These devices are user friendly and easy to understand for the general public. Thermocamera and IR thermometer show to users how the heat is lost through walls, roof, floor etc. There will be practical exercises demonstrated on existing buildings. Other interesting exercise is determine of temperature differences of walls to interior (to less or more heated room) and walls to exterior. Other energy audit equipment as laser distance meter, multimeter and software, are not applicable for use within training activities.

The costs of energy audit equipment are less than planned at the beginning in the Application form. The remaining of the budget for BL5 will be used for purchase of smart meters (PA2).

4.2. Technical properties of purchased thematic equipment

Table 4: Laser distance meter

Type of procurement	The energy audit equipment costs are under 5.000€ so we are not forced to organise public procurement, nevertheless we have made a market research (three bid procedure)
National law for public procurement in your country	National Decree 134/2016 Coll. The national rules are not stricter then the EU rules.
Purchased thematic equipment (title)	BOSCH DLE 70
Purchased thematic equipment (function)	**Laser distance meter**
Technical data	BOSCH DLE 70 – Laser distance meter Laser diode 635 nm, < 1 mW Measurement range 0,05 – 70,00 Laser class 2 Measurement accuracy, typical ± 1.5 mm Measurement time, typical < 0.5 s Measurement time, max. 4 s
Pictures of the thematic equipment	
Internal inventory number	DRM 164-14
Person in charge of the thematic equipment	Zdeněk Bohutínský, energy expert
Place where the thematic equipment is available	Nerudova 1498/8, 586 01 Jihlava
Costs in Euro	90,70 € with VAT (21 %)

Table 5: Multimeter

Type of procurement	The energy audit equipment costs are under 5.000€ so we are not forced to organise public procurement, nevertheless we have made a market research (three bid procedure)
National law for public procurement in your country	National Decree 134/2016 Coll. The national rules are not stricter then the EU rules.
Purchased thematic equipment (title)	Voltcraft VC 521
Purchased thematic equipment (function)	**Multimeter**
Technical data	Voltcraft VC-521 – multimeter Reading range – resistance 0 – 40 MΩ Frequency reading range 10 Hz – 10 k Hz Reading range – capacity 1 nF -100 µF Temperature -20 to +760 °C Can be calibrated to ISO/DakkS Measurement type Average Reading category CAT III 600 V Voltage DC reading range (max.) 600 V Voltage reading range DC (min.) 0.1 mV Amperage reading range DC (min.) 0.01 A Frequency range 50/60 Hz Basic accuracy 1.2 % A AC reading range (min.) 0.01 A Voltage metering AC/DC V AC reading range (max.) 600 V AC resistance 10 MΩ DC resistance 10 MΩ Calibrated to ISO standards A DC reading range (max.) 400 A V AC reading range (min.) 1 mV Amperage reading range AC (max.) 400 A
Pictures of the thematic equipment	

	
Internal inventory number	DRM 165-17
Person in charge of the thematic equipment	Zdeněk Bohutínský, energy expert
Place where the thematic equipment is available	Nerudova 1498/8, 586 01 Jihlava
Costs in Euro	78,80 € with VAT (21 %)

Table 6: IR thermometer

Type of procurement	The energy audit equipment costs are under 5.000€ so we are not forced to organise public procurement, nevertheless we have made a market research (three bid procedure)
National law for public procurement in your country	National Decree 134/2016 Coll. The national rules are not stricter then the EU rules.
Purchased thematic equipment (title)	Voltcraft IR-800-20D
Purchased thematic equipment (function)	**IR thermometer**
Technical data	Voltcraft IR 800-20D Calibration possible to ISO/DKD Emissivity adjustable from 0.1 to 1.0 Measurement range – temperature -50 to +650°C Optics 12/1 Pick-up time < 150ms Power supply 9V battery pack Temperature resolution 0.1°C Calibration possible to ISO/DKD
Pictures of the thematic equipment	

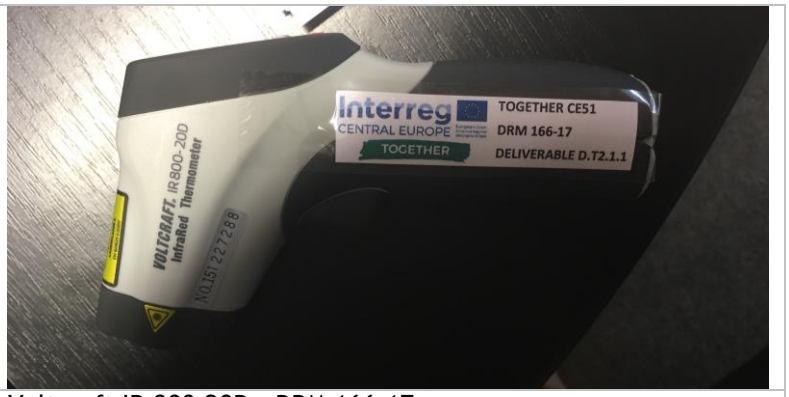
	
Internal inventory number	Voltcraft IR 800-20D – DRM 166-17
Person in charge of the thematic equipment	Zdeněk Bohutínský, energy expert
Place where the thematic equipment is available	Nerudova 1498/8, 586 01 Jihlava
Costs in Euro	103,30 € with VAT (21 %)

Table 7: Calculation software

Type of procurement	The energy audit equipment costs are under 5.000€ so we are not forced to organise public procurement, nevertheless we have made a market research (three bid procedure)
National law for public procurement in your country	National Decree 134/2016 Coll. The national rules are not stricter then the EU rules.
Purchased thematic equipment (title)	Energie 2016 – energy calculation SW
Purchased thematic equipment (function)	**Software for calculation of energy audit parameters**
Technical data	Calculation of average heat transfer coefficient and its evaluation in accordance with ČSN 730540-2 (2011) Calculation of specific heat flows through penetration and ventilation according to EN ISO 13790, EN ISO 13370 and EN ISO 13789. Calculation of energy needs for heating and cooling according to EN ISO 13790 and EN 832 for both single and multi-zone buildings, considering monthly calculations or directly after the heating period including the effects of intermittent heating or cooling. Calculation of supplied energy for heating, cooling, hot water preparation, lighting, forced ventilation and air humidity adjustment in accordance with TNI 730331 and methodology for Decree of the Czech Ministry of Industry and Trade No. 78/2013 Coll. Calculation of total and non-renewable primary energy and CO2 emissions. Calculating the parameters of the reference building according to Decree of the Ministry of Industry and Trade of the Czech Republic No. 78/2013 Coll. And according to ČSN 730540-2 Processing of the energy performance certificate of buildings according to Decree of the Ministry of Industry and Trade of the Czech Republic No. 78/2013 Coll. And the envelope label of the building according to ČSN 730540-2.

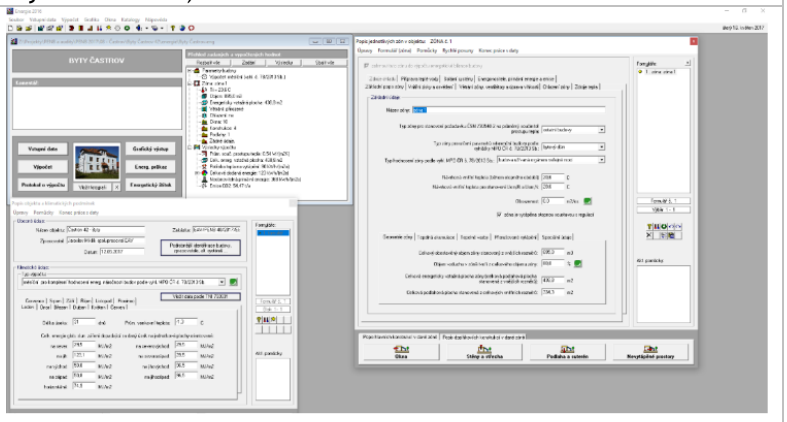
	Evaluation of parameters of low energy and passive family and residential buildings according to TNI 730329 and TNI 730330 Taking into account the production of energy by solar collectors, photovoltaic systems and cogeneration units, including the possibility of exporting to the public network Rich possibilities of modeling (Trombe walls, translucent thermal insulation, conservatories, earth exchanger, solar gains not only through translucent structures but also over walls and roofs, more different heat and cold sources in each zone ...). A comfortable user interface in Windows. Extensive help with offering recommended values. Catalogs of building materials, constructions and boundary conditions for easier entry of input data. Auxiliary calculations for easier entry of input values (eg for window heat transmission coefficient depending on their layout and size).
Pictures of the thematic equipment	
Internal inventory number	Testo 871 – DRM 168-17
Person in charge of the thematic equipment	Zdeněk Bohutínský, energy expert
Place where the thematic equipment is available	Nerudova 1498/8, 586 01 Jihlava
Costs in Euro	355,00 € with VAT (21 %)

Table 8: Thermal IR camera

Type of procurement	The energy audit equipment costs are under 5.000€ so we are not forced to organise public procurement, nevertheless we have made a market research (three bid procedure)
National law for public procurement in your country	National Decree 134/2016 Coll. The national rules are not stricter then the EU rules.
Purchased thematic equipment (title)	Testo 871
Purchased thematic equipment (function)	**Thermal IR camera**
Technical data	Infrared resolution: 240 x 180 pixels Thermal sensitivity (NETD): 90 mK Field of view/min. focusing distance: 35° x 26° / < 0,5 m Geometric resolution (IFOV): 2.6 mrad testo SuperResolution (Pixel/IFOV): 480 x 360 pixels 1.6 mrad

	Image refresh rate: 9 Hz Focus Fixed focus Spectral range: 7.5 to14 µm
Pictures of the thematic equipment	
Internal inventory number	Testo 871 – DHM 167-17
Person in charge of the thematic equipment	Zdeněk Bohutínský, energy expert
Place where the thematic equipment is available	Nerudova 1498/8, 586 01 Jihlava
Costs in Euro	2.265,00 € with VAT (21 %)

5. Energy audit kit of PP3 University of Maribor

5.1. The contribution of purchased thematic equipment for the project activities

PP3 University of Maribor is performing energy audits of pilot buildings with the support of an external company. The auditor is obligated to perform audits according to all national laws in Slovenia:

- Rules on the methodology for the production and content of energy audits (Official Gazette of the Republic of Slovenia Act Nr. 41/2016)

- Official Gazette of the Republic of Slovenia Act Nr. 41/2016, based on European Directive efficiency 2012/27/EU, SIST ISO 50002 or SIST EN 164247

UM intends to use purchased thematic equipment in the scope of energy audits performance, even they will perform energy audits for pilot buildings by external services. According to the first version of application form, UM's amount (Euro 7.000,00), includes the costs to purchase an ordinary multifunctional tools for measuring pressure, temperature, humidity CO2, laser distance meter and a thermo-camera. In the end of year 2015, right before the approval of project TOGETHER, UM was successful in another call for European funds. That gave UM the opportunity to build Institute of Energy technology located in the city of Krško. This way UM have come up with many useful energy audit accessories that will be used and upgraded within the project for energy audit performance. Therefore, there were no longer a need to purchase all above described devices. UM has considered their position with equipment and found out that purchasing a different thematic equipment will be better choice. This way UM avoided double purchasing of thematic equipment. UM has spent in total 4.215,22 € for energy audit kit, which is 2.784,78 € less than originally planned in the first application form. Usage of already existing equipment and purchasing accessories with other devices will not affect project activities, but exactly the opposite, this way UM has obtain equipment which can cover a wider spectrum than originally planned.

UM will perform measurements with this equipment and produce all necessary reports, which will be included in the final report by external auditor. Within the energy audits UM intends to use following devices:

- TESTO 890-2 professional infrared camera for carrying out analysing building shells at a single glance, performing routine inspections as part of electrical and mechanical maintenance checks, showing critical temperatures on circuit boards, carrying detailed energy analysis and analysing energy distribution systems. It will be used for determination of thermal bridges, lack of thermal insulation and reviewing existing situation on the building envelope.

- TESTO 635-2 U-value set for measuring the U-value of building walls. This way the U-value will be calculated and compared to the computer aided programme for heat losses calculation.

- METREL MI 2892 Power Master is a hand-held three-phase power quality analyser with a large easy-to-read graphical colour display, which will help to detect harmonics, phasors and waveforms anomalies in the electrical installation.

- METREL MI 6201 MULTINORM, which is a portable multifunctional handheld instrument for measuring microclimate, sound and light parameters and it is an invaluable tool for the monitoring and evaluation of indoor environmental conditions according to national and European standards, **will be upgraded with CO_2 and CO probes to perform measurements of carbon monoxide and carbon dioxide concentration in the ambient air.** These two parameters are in most cases overlooked, but from aspect of indoor environmental conditions are having important role as temperature in premises. CO_2 and CO concentrations are directly

affecting people well-being in premises, so it has to be investigated if concentrations are exceeding the permissible limits. METREL MI 6201 MULTINORM will be also used for measurement of indoor temperature and light parameters, which will result in a comprehensive review of indoor environmental conditions.

- TROTEC BZ 30 is an air quality data logger, which will be used for simultaneous recording of humidity and temperature values plus CO_2 concentrations. This device allows data logging, so the measurements will be carried out on weekly basis. This way UM will analyse indoor environmental conditions through entire week, which will give a complete view on how the indoor environmental conditions are changing according to the users habits.

The purchased thematic equipment will be also used during the local trainings and practical activities targeting buildings managers, owners, users and students. UM intents to focus on students, because most of pilot building are closely linked to students as building users. Students are not behaving like typical target group e.g. managers, owners, decision makers, because they are not daily involved in energy efficiency topics, but rather spending their time for studying and enjoying free time with their friends. For that reason, it is hard to get their attention to change their behaviour and act more energy efficient. The purchased equipment will help UM to attract student's attention and make local trainings more interesting for them. The equipment will be used to show how energy efficiency can be achieved with minimal impact on indoor environmental conditions on real cases, so these way students will understand that energy efficiency does not necessary mean savings on comfort, but on energy costs. This way focus will not be just on theoretical part, which can be in some cases boring and devastating part of trainings, but on practical as well with usage of this equipment.

Energy auditor will also have to organize presentation of the energy audit report due to their contract obligations. UM will use this presentation as training sessions for building owners, managers and employees, this way will be enabled first-hand presented explanation of potential measures for energy efficiency.

5.2. Technical properties of purchased thematic equipment

Table 9: CO_2 Probe

Type of procurement	ZJN-3 Nr. 51/2017-JN; three bid procedure
National law for public procurement in your country	University of Maribor is public institution, therefore we have to obligate national rules for public procurements. The current system for public procurement in Slovenia is based on Public procurement act (ZJN-3). This act is reproduced by the former one and also taking into account the European Directive 2014/24/EU and 2014/24/EU. All amounts for technical equipment under 20.000,00 €, do not require any specifics, but three-bid procedure has to be applied in case of all procurements.
Purchased thematic equipment (title)	**Metrel A1180 probe**
Purchased thematic equipment (function)	The Metrel A1180 is a CO_2 Probe that measures concentration of carbon dioxide in the ambient air. It is fully compatible with METREL MI 6201 MULTINORM, which is a portable multifunctional handheld instrument for measuring microclimate, sound and light parameters and it is an invaluable tool for the monitoring and evaluation of indoor environmental conditions according to national and European

	standards. Specially designed housing enables connection of a few probes at the same time for testing of several parameters simultaneously.
Technical data	CO_2 concentration measurement probe – A1180: - Responsible: indoor air quality measurement; - Measurement range: 0 ppm…5000 ppm; - Resolution: 1 ppm; - Accuracy: ±(3% of rdg + 40 ppm).
Pictures of the thematic equipment	
Internal inventory number	2180
Person in charge of the thematic equipment	Franc Rihl, Technical assistant, University of Maribor, Faculty of Energy Technology
Place where the thematic equipment is available	Institute of Energy Technology, Vrbina 18, SI-8270 Krško, Room Nr. P3
Costs in Euro	511,20 € without VAT 623,66 € with VAT (22 %)

Table 10: CO Probe

Type of procurement	ZJN-3 Nr. 51/2017-JN; three bid procedure
National law for public procurement in your country	University of Maribor is public institution, therefore we have to obligate national rules for public procurements. The current system for public procurement in Slovenia is based on Public procurement act (ZJN-3). This act is reproduced by the former one and also taking into account the European Directive 2014/24/EU and 2014/24/EU. All amounts for technical equipment under 20.000,00 €, do not require any specifics, but three-bid procedure has to be applied in case of all procurements.
Purchased thematic equipment (title)	**Metrel A1181 probe**
Purchased thematic equipment (function)	The Metrel A1180 is a CO Probe that measures concentration of carbon monoxide in the ambient air. It is fully compatible with METREL MI 6201 MULTINORM, which is a portable multifunctional handheld instrument for measuring microclimate, sound and light parameters and it is an invaluable tool for the monitoring and evaluation of indoor environmental conditions according to national and European standards. Specially designed housing enables connection of a few probes at the same time for testing of several parameters simultaneously.
Technical data	CO concentration measurement probe - A1181: - Responsible for Indoor air quality measurement;

	- Measurement range: 0 ppm...500 ppm; - Resolution: 1 ppm; - Accuracy: ±(5% of rdg + 5 ppm).
Pictures of the thematic equipment	
Internal inventory number	2179
Person in charge of the thematic equipment	Franc Rihl, Technical assistant, University of Maribor, Faculty of Energy Technology
Place where the thematic equipment is available	Institute of Energy Technology, Vrbina 18, SI-8270 Krško, Room Nr. P3
Costs in Euro	293,40 € without VAT 357,95 € with VAT (22 %)

Table 11: Air quality data logger

Type of procurement	ZJN-3 Nr. 50/2017-JN; three bid procedure
National law for public procurement in your country	University of Maribor is public institution, therefore we have to obligate national rules for public procurements. The current system for public procurement in Slovenia is based on Public procurement act (ZJN-3). This act is reproduced by the former one and also taking into account the European Directive 2014/24/EU and 2014/24/EU. All amounts for technical equipment under 20.000,00 €, do not require any specifics, but three-bid procedure has to be applied in case of all procurements.
Purchased thematic equipment (title)	**10 pieces of TROTEC BZ30**
Purchased thematic equipment (function)	TROTEC BZ30 CO_2 air quality data logger is the ideal combination measuring device for architects, experts and every heating, ventilation and air conditioning engineer. It is further equipped with a large data memory for 50,000 measured values for the long-term recording of carbon dioxide concentrations, air temperature and humidity values in freely definable measuring intervals from 1 second to 12 hours. The recorded data can be conveniently transferred to the connected PC via a fast USB connection and there analysed and logged using the analysis software included in the scope of delivery. Owing to the integrated Li-Ion battery, the BZ30 is also suited for mobile application in addition to the stationary table installation. The simultaneous recording of humidity and temperature values plus CO_2 concentrations offers property managers or landlords optimal possibilities to monitor the ventilation habits.

<table>
<tr><td>Technical data</td><td>
<table>
<tr><th colspan="3">Technical data</th></tr>
<tr><th colspan="2">Article number</th><th>3.510.205.015</th></tr>
<tr><td colspan="2">Sensor</td><td>NDIR sensor (nondispersive infrared)</td></tr>
<tr><td rowspan="3">Carbon dioxide</td><td>Measuring range</td><td>0 ppm up to 9999 ppm CO_2</td></tr>
<tr><td>Accuracy</td><td>±75 ppm or ±5 % of measured value</td></tr>
<tr><td>Resolution</td><td>1 ppm</td></tr>
<tr><td rowspan="3">Temperature</td><td>Measuring range</td><td>-5 °C up to 50 °C / 23 °F up to 122 °F</td></tr>
<tr><td>Accuracy</td><td>±1 °C</td></tr>
<tr><td>Resolution</td><td>0.1 °C</td></tr>
<tr><td rowspan="3">Humidity</td><td>Measuring range</td><td>0.1 % RH up to 99.9 % RH</td></tr>
<tr><td>Accuracy</td><td>±5 % RH</td></tr>
<tr><td>Resolution</td><td>0.1 % RH</td></tr>
<tr><td colspan="2">Measuring interval</td><td>2 s</td></tr>
<tr><td colspan="2">Functions</td><td>Minimum value display, Maximum value display, Hold function, Switching function °C/°F, Backlit display, CO_2acoustic alarm function, CO_2sensor, Feel-good indication, Date, Time</td></tr>
<tr><td colspan="2">Additional functions</td><td>Freely selectable measuring cycle from 1 second to 12 hours, Continuous or ring recording max. 50,000 measured values</td></tr>
<tr><td colspan="2">PC interface</td><td>USB</td></tr>
<tr><td colspan="2">Power supply</td><td>1x 3.7 V, Li-ion battery or 230 V power adapter</td></tr>
<tr><td colspan="2">Dimensions</td><td>110 mm x 61 mm x 105 mm</td></tr>
<tr><td colspan="2">Weight</td><td>74 g</td></tr>
<tr><td colspan="2">Scope of delivery</td><td>Measuring device, Battery(-ies), Power adapter, USB connection cable, CD-ROM with Smartgraph PC software, Operating manual</td></tr>
</table>
</td></tr>
<tr><td>Pictures of the thematic equipment</td><td>  </td></tr>
<tr><td>Internal inventory number</td><td>2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190</td></tr>
<tr><td>Person in charge of the thematic equipment</td><td>Franc Rihl, Technical assistant, University of Maribor, Faculty of Energy Technology</td></tr>
<tr><td>Place where the thematic equipment is available</td><td>Institute of Energy Technology, Vrbina 18, SI-8270 Krško, Room Nr. P3</td></tr>
</table>

Costs in Euro	2.650,50 € without VAT 3.233,61 € with VAT (22 %)

Table 12: Multifunctional handheld instrument

Existing equipment	
Title	**METREL MI 6201 MULTINORM**
Function	METREL MI 6201 MULTINORM is a portable multifunctional handheld instrument for measuring microclimate, sound and light parameters and it is an invaluable tool for the monitoring and evaluation of indoor environmental conditions according to national and European standards. Specially designed housing enables connection of a few probes at the same time for testing of several parameters simultaneously.
Technical data	MEASURING FUNCTIONS: - Air temperature; - Air velocity; - Air flow; - Relative humidity; - Dew point; - Temperature difference (option); - K thermocouple temperature (option); - Illuminance; - Luminance (option); - Contrast (option); - Black globe radiant temperature (option); - CO and CO2 concentration (option); - Sound level; - Real time 1/1 and 1/3 octave analysis.

Table 13: Professional thermal IR camera

Existing equipment	
Title	**TESTO 890-2 professional infrared camera**
Function	Professional infrared camera that is ensurepped for carrying out safe high temperature measurements, analysing building shells at a single glance, performing routine inspections as part of electrical and mechanical maintenance checks, showing critical temperatures on circuit boards, carrying detailed energy analysis and analysing energy distribution systems.
Technical data	The 890-2 Deluxe includes a 15° telephoto lens bridging the gap between you and hard to reach areas. The Site Recognition barcode and database solution to easily stores information in its proper location, keeping muliple readings grouped together. Add to all of this, the ability of Radiometric Video Capture for detailed frame by frame post analysis and trending, the 890-2 Deluxe is an amazing thermal imager. - Large 4.3“ Rotating TouchScreen - Quality resolution 640 x 480 - Patented SuperResolution provides 1280 x 960 resolution images when downloaded to IRSoft - 42° lens wide angle, and 15° telephoto lens included

	- High Temperature Option (2192°F) - Site Recognition & Database Application - Radiometric Video Recording - Atmospheric Corrections - Solar Mode - Isotherms - Bluetooth Voice Annotation - Lens Protection Glass - Customizable Reporting Software - Rotating display and swivel handle allow for ease of use in a variety of applications - Included 2GB SD card for storage - Video Output via USB allows for immediate viewing on a computer screen - Additional spare battery and external rapid charger included

Table 14: U-value promo set

Existing equipment	
Title	**TESTO 635-2 U-value promo set**
Function	The testo 635-2 U-value set is designed to calculate the U-value in order to evaluate the heat insulation capability of a component (walls, windows).

<table>
<tr><td>Technical data</td><td>
<table>
<tr><th colspan="2">Temperature - NTC</th></tr>
<tr><td>Measuring range</td><td>-40 to +150 °C</td></tr>
<tr><td>Accuracy</td><td>±0,2 °C (-25 to +74,9 °C)
±0,4 °C (-40 to →25,1 °C)
±0,4 °C (75 to +99,9 °C)
±0,5 % of mv (Remaining Range)</td></tr>
<tr><td>Resolution</td><td>0,1 °C</td></tr>
<tr><th colspan="2">Temperature - TC Type K (NiCr-Ni)</th></tr>
<tr><td>Measuring range</td><td>-200 to +1370 °C</td></tr>
<tr><td>Accuracy</td><td>±0,3 °C (-60 to +60 °C)
±(0,2 °C + 0,3 % of mv) (Remaining Range)</td></tr>
<tr><td>Resolution</td><td>0,1 °C</td></tr>
<tr><th colspan="2">Humidity - Capacitive</th></tr>
<tr><td>Measuring range</td><td>0 to 100 %RH</td></tr>
<tr><td>Accuracy</td><td>See probe data</td></tr>
<tr><td>Resolution</td><td>0,1</td></tr>
<tr><th colspan="2">Absolute Pressure</th></tr>
<tr><td>Measuring range</td><td>0 to 2000 hPa</td></tr>
<tr><td>Accuracy</td><td>See probe data</td></tr>
<tr><td>Resolution</td><td>0,1 hPa</td></tr>
</table>
</td></tr>
</table>

Table 15: Three phase power quality analyser

Existing equipment	
Title	**METREL MI 6892**
Function	METREL MI 2892 Power Master is a hand-held three phase power quality analyser with a large easy-to-read graphical colour display enabling the user to detect harmonics, phasors and waveforms anomalies in the installation simply by connecting the device. The instrument is designed for a long term recording as well as for troubleshooting power quality problems in three-phase and single-phase power distribution systems. The handy Quick Set buttons makes the instrument more user friendly and are allowing faster data overview for troubleshooting. Advanced PC SW package PowerView3 enables detailed analysis of recorded data, direct reading from the microSD memory card, analysis of long term records and automatic creation of professional test report.
Technical data	MEASURING FUNCTIONS: - Voltage: TRMS, peak, crest factor (4-channel); - Current: TRMS, peak, crest factor (4-channel); - Power (active, reactive, apparent); - Power measurements fully compliant with IEEE 1459 (active, nonactive, fundamental, harmonic, load

	unbalance); - Unbalance, flicker measurement; - Harmonic and interharmonic analysis up to 50th harmonics, THD measurement; - Energy (active, reactive, generated, consumed); - Capturing and recording of power supply events (shutdowns, interruptions, swells, dips); - Inrush currents monitoring and recording; - Waveform/inrush displaying, snapshot and recording; - Transients recording; - Power quality analysis according to EN 50160; - Recording up to 7 adjustable alarms; - Temperature measurement; - Power factor cos φ.

6. Energy audit kit of PP4 City of Zagreb

6.1. The contribution of purchased thematic equipment for the project activities

PP4 City of Zagreb has opted for this equipment because of the already conducted energy audits and in the aim of a more detailed control of the same, as the audits have been carried out several years ago. Zagreb is going to do an evaluation of already existing energy audits and energy certificates with the procured equipment. This was the idea, because energy audits were performed by different companies, different rules of certification during period 2012 - 2015, and many possible changes of the building state. Therefore, they have basic facts, energy audits and all necessary to perform measures of specific points to check the state of the art of the building as compared to the existing energy audit and certificate for each pilot building during the project. Zagreb will provide an executive summary of already possessed audits with integrated appendixes according to measures and analysis performed by using purchased thematic equipment.

This equipment shall have an educational purpose as the users will learn more about energy efficiency and become better informed of more rational energy usage in the object. Therefore, besides using it for evaluating existing audits, this equipment will be used in local training activities. According to the Guidebook on certification, the purpose of which is mostly technical, this equipment can show the validity of the certificate as concerns the suggested measures of energy efficiency and educate the users on the terms and effects of energy efficiency. On the occasion of onsite visits, the members of energy teams will have the opportunity to use the equipment thereby benefiting from this to learn more about the equipment itself, and about the need to save energy. As Zagreb is going to do on site visits in order to evaluate each building, they are going to educate the energy team of that building how to conduct measuring, what are the results, how to compare two different facts (temperature, heat bridges, etc.). As part of the training, we plan to monitor teams' progress connected to behaviour change (is the heating is off during night, as well as other activities that will show whether the behavioural changes are being implemented). This will allow the users to see the way energy is spent in the building. The equipment will be on disposal to energy teams (included in the project) whenever they need it. In this way, the activities are expected to have a more lasting impression on the users, which will influence their energy behaviour in the long run.

Zagreb doesn’t expect problems with using this equipment. The staff working with the equipment is trained and on the occasion of working with the schools, the teachers and other personnel using the equipment will first be trained in its usage and maintenance. The manufacturer has also provided detailed instructions of use and the representatives of the manufacturer are also on disposal in case of need.

6.2. Technical properties of purchased thematic equipment

Table 16: Thermal IR camera

Type of procurement	Public procurement
National law for public procurement in your country	National law for public procurement (NN 120/16)
Purchased thematic equipment (title)	FLIR E6
Purchased thematic equipment (function)	**Thermal IR camera**
Technical data	FLIR E& Thermal camera offers: • Display: 3" color LCD • On-board 640 x 480 Digital Camera • Easy-to-use, weighs only 1.2lbs • 2% accuracy • File format: Radiometric jpg • Swappable Li-ion Battery with 4 hour life • Spot Measurement mode • Simultaneous storage of IR/Visual/MSX images • Picture in Picture image (E6 and E8) • Manual level and span thermal tuning (E6 and E8) • Area Box Measurement mode (E5, E6 and E8)
Pictures of the thematic equipment	

	
Internal inventory number	099450
Person in charge of the thematic equipment	Marko Kućan mechanical engineer, Senior Advisor for Energy Management
Place where the thematic equipment is available	Street of popa Dukljanina 3, 10000 Zagreb Croatia Third floor, room number 306
Costs in Euro	1.752,45 € without VAT 2.190,56 € with VAT (25 %) For both devices!

Table 17: Hygrometer and thermometer

Type of procurement	Public procurement
National law for public procurement in your country	National law for public procurement (NN 120/16)
Purchased thematic equipment (title)	DTM 550
Purchased thematic equipment (function)	**Hygrometer and thermometer**
Technical data	DTM 550 hygrometer and thermometer offers: • Temperature:-20˚C to +100˚C • Humidity:0% ~ 100 %RH • 3 1/2 Digit, Back light display • Use highly accurate RTD temperature sensor • MAX, DATA, HOLD function • Automatic low battery indication • Valox housing to withstand accidental drops

Pictures of the thematic equipment	
Internal inventory number	017817
Person in charge of the thematic equipment	Marko Kućan mechanical engineer, Senior Advisor for Energy Management
Place where the thematic equipment is available	Street of popa Dukljanina 3, 10000 Zagreb Croatia Third floor, room number 306
Costs in Euro	1.752,45 € without VAT 2.190,56 € with VAT (25 %) For both devices!

7. Energy audit kit of PP5 Association of Municipalities Polish Network “Energie Cités”

7.1. The contribution of purchased thematic equipment for the project activities

PP5 PNEC will mostly use purchased thematic equipment during training and awareness raising activities (e.g. during on-site visits) since the Energy Audits will be carried out by external company, (with their own equipment) since PNEC does not have necessary competences to do the audits itself. When needed, representative of PNEC may take part in the audit and made relevant equipment available on the spot.

During local trainings representatives of PNEC will explain why such devices are used, what do they measure, why these factors are important and how the measurement data can be used to improve energy characteristics and internal air quality in buildings. During on-site visits the devices will be used to further increase target groups capacities by allowing them to check energy situation of their particular buildings (and see how the devices work in "real life").

This will help project target groups (building decision makers, owners, managers and users) to better understand what factors influence energy consumption and internal air quality in buildings, what's the energy situation of their particular buildings and how they can adapt their behaviours and procedures to improve this situation. The equipment will be also used during pilot action to check its real impact on the situation of pilot buildings.

The equipment - thermocamera and multifunctional meter - was selected to complement the data that will be obtained via smart meters. While smart metering devices inform how much energy is used and what are the consumption changes over time, the kit will help to understand the variables affecting energy consumption and internal air quality (e.g. technical state of the building; temperature, humidity and CO_2 concentration in different rooms). Decision on the selection of particular types and models of thermocamera and multifunctional meter was based on thorough analysis of the market and comparing available qualities with prices. Testo 868 thermocamera and Extech SD800 co2/humidity/temperature data logger have adequate quality for project purposes and prices that fit within the established budget.

The equipment will be handled with the adequate care, therefore PNEC doesn't expect any major problems. Still, there is a risk that the equipment will malfunction or break by accident (there is a 2-year guarantee though) or that it will be improperly used/maintained due to the lack of experience of the user or unclear instructions. To avoid the latter PNEC will organise internal training on measuring methodologies, handling the equipment and identifying external factors that may influence the measurement.

7.2. Technical properties of purchased thematic equipment

Table 18: Thermal IR camera

Type of procurement	Three bid procedure
National law for public procurement in your country	Act of 29 January 2004 – Polish Public Procurement Law
Purchased thematic equipment (title)	Testo 868
Purchased thematic equipment (function)	**Thermal IR camera**
Technical data	Infrared image output ▪ Infrared resolution: 160x120 ▪ Thermal sensitivity: 100 mK ▪ Field of view/min. focusing distance: 31° x 23° / < 0.5 m ▪ Geometric resolution: 3.4 mrad ▪ SuperResolution: 320 x 240 pixels / 2.1 mrad ▪ IR image refresh rate: 9 Hz ▪ Focus: fixed ▪ Spectral range: 7.5 - 14 µm Visual image output ▪ Image size / min. focusing distance: min 3.1 MP/0.5 m Image presentation ▪ Display: 8.9 cm (3.5") TFT, QVGA (320 x 240 pixels) ▪ Display options: Infrared image / Real image ▪ Interface: WLAN / USB 2.0 micro B ▪ Colour palettes: 4 options: IRON / Rainbow HC / Cold-hot / Grey Measurement ▪ Measuring range: -30 to 650 °C ▪ Accuracy: -30 to -21 °C ± 3 °C / -20 to 650 °C ± 2 °C ▪ Emissivity / reflected temperature adjustment: 0.01 to 1/manual ▪ Assist: Automatic emission value and RTC detection ▪ Measurement functions: single point measurement, coldspot, hotspot, differential temperature, ScaleAssist, IFOV warner Digital camera ▪ Digital camera: YES ▪ Fullscreen mode: YES ▪ File format: .jpg ▪ Video streaming: USB, WiFI via the App Image storage: ▪ File format: . jpg, .bmt, option of exporting in: . jpg, .bmt, .png, .csv and .xls ▪ Memory capacity: Internal mass storage 2.8 GB; > 2000 images (without SuperResolution) More information may be found in the attached data sheet (appendix 1).

Pictures of the thematic equipment	
Internal inventory number	2/2017
Person in charge of the thematic equipment	Patrycja Płonka, Project Manager
Place where the thematic equipment is available	17/20 Sławkowska Str. 31-016 Cracow Poland
Costs in Euro	6.503,25 PLN (approx. 1.512,38 €) without VAT 7.999,00 PLN (approx. 1.860,23 €) with VAT (23 %)

Table 19: Multifunctional data logger

Type of procurement	Three bid procedure
National law for public procurement in your country	Act of 29 January 2004 – Polish Public Procurement Law
Purchased thematic equipment (title)	Extech SD800
Purchased thematic equipment (function)	**Co2/humidity/temperature data logger**
Technical data	Features: • checking CO_2 concentrations, temperature and humidity • triple LCD simultaneously displaying all 3 values • measurement ranges - CO_2 concentration: 0 to 4,000 ppm - Temperature: 32 to 122 ºF (0 to 50 ºC) - Humidity: 10 to 95% RH • data logger date/time stamps and stores readings on an SD card in excel format • selectable data sampling rate: 5, 10, 30, 60, 120, 300,

	600 seconds • set includes 6 AAA batteries, 2G SD memory card, universal AC adaptor and mounting bracket Specifications: • CO_2 concentration range: 0 to 4,000 ppm • Resolution: 1ppm • Temperature range: 32 to 122 ºF (0 to 50 ºC) • Resolution: 0.1 ºF/ºC • Humidity range: 10 to 95% RH • Resolution: 0.1% • Datalogging: 2.000K data using 2G SD memory card • Dimensions: 5.2 x 3.1 x 1.3" (132 x 80 x 32 mm) • Weight: 9.9oz (282g) Application: • monitoring air quality in schools, office buildings, greenhouses, hospitals and other spaces where high levels of carbon dioxide are generated More information may be found in the attached data sheet (appendix 2).
Pictures of the thematic equipment	

	
Internal inventory number	1/2017
Person in charge of the thematic equipment	Patrycja Płonka, Project Manager
Place where the thematic equipment is available	17/20 Sławkowska Str. 31-016 Cracow Poland
Costs in Euro	1.340,00 PLN (approx. 311,63 €) without VAT 1.648,20 PLN (approx. 383,30 €) with VAT (23 %)

8. Energy audit kit of PP6 South Transdanubian Regional Development Agency and PP9 Municipality of Paks

8.1. Partners change

A partner change procedure was started during on 31th of December 2016. As STRDA has taken part in TOGETHER project as PP6, it has started to organize the takeover of the project. Municipality of Paks, which has already taken part in the project as Associated Partner (AS26) made an official decision to replace STRDA in the partnership. As this document was delivered before the partner withdrawal, the document makes reference to the original partnership composition.

The ArchiCAD programme has been procured by STRDA in the first period for a cost of € 8.574,57 but its utilisation was planned for the later periods due to the partner change procedure started just after the closure of I project period. STRDA has transferred the right of using the ArchiCAD Net 2software purchased in PR1 and PAKS has committed itself to the use and maintain the programmes with two separate declarations on the 30 November. This way STRDA has officially declared that the software will be used by the new-coming partner, Municipality of Paks for project purposes, which organisation has officially undertaken this role.

As the sum of the thematic equipment already procured by STRDA and those that have been procured by PAKS exceed the amount of 15.000 (i.e. Investment according to the programme rule), the interested partner will deliver the "investment – factsheet" as soon as the whole set of thematic equipment listed in the application form is completed.

8.2. The contribution of purchased thematic equipment for the project activities

STRDA has planned to purchase of energy audit kit for the auditing of 11 public buildings. It included: thermocamera with accessories for measurement of U-values, related visualizing and evaluation softwares. Equipment was planned to be used by internal staff of STRDA, which possessed the needed knowledge. Two employees of STRDA (Mr Gábor Béres, Mr Balázs Borkovits) have attended at a training on energy audits in 2015, organized by the Chamber of Hungarian Architects, and have the skills of conducting energy audits. Mr Béres holds a degree on urban and countryside planning, has remarkable experiences in urban planning and architecture and works for several settlements as chief architect. He's an expert in analysing buildings from architectural point of view. Mr Borkovits is an economist and also holds a degree in electric engineering, his responsibility is the analysis of the performance of building engineering systems.

The CAD program was planned to be procured in order to support the detailed modelling of the involved buildings and evaluation of the possible energy efficiency actions. The CAD software is used to create intelligent 3D models and engineering drawings. It enables extended to explore the projects' key physical, constructional and functional characteristics digitally, before the energy refurbishment is built.

Due to the partner change, PAks will prepare the models for the pilot buildings before launching energy efficiency investments. Paks's employees possess the necessary skills for modelling with CAD. Based on the models a report containing detailed plans for the EE refurbishments of the pilot buildings will be provided by Paks with the use of the thematic equipment (a new deliverable has been created in the contracting phase of the project, D.T3.1.5). I6 covers the energy audits and the CAD program will support the detailed modelling of the involved buildings and evaluation of the possible energy efficiency actions.

STRDA has procured the above mentioned software in June 2016, which was duly payed and installed in the 1st period at the office of STRDA. However this investment is related to DT3.1.5 'Report on modelling the energy efficiency refurbishments of selected pilot buildings owned by Paks' that will be implemented in a later stage of the project by creating intelligent 3D models and engineering drawings to enable exploring the projects' key physical, constructional and functional characteristics digitally before the energy refurbishment is built. Due to this reason, Municipality of Paks – which organization will be responsible to deliver this activity – will have total access to the software during the implementation and follow-up period of the project.

At the mean time Municipality of Paks declared that starting from 1 Dec 2016 it is committed to use the ArchiCAD 19 NET 2 software – procured in TOGETHER TOwards a Goal of Efficiency Through Energy Reduction (CE51) project by South Transdanubian Regional Development Agency (STRDA), under WP I6 Improving energy management through energy audit equipment in 11 public buildings at Paks. According to the relevant declaration signed by STRDA, Municipality of Paks will be entitled to use the software from 1 Dec 2016 until the termination of the follow up period of the project. Municipality of Paks is aware of the activities related to the procurement of the software – namely to deliver a report on modelling the energy efficiency refurbishments of selected public buildings owned by Paks (D.T3.1.5) – and declares that it will exclusively use the software to implement this activity.

The WinWatt software was procured by Paks in the 2nd period.

The thermocamera will be procured at the very beginning of the 3rd period. Quotations already have been asked based on 3 bids procedure, but the procurement has to be repeated due to the partner change.

8.3. Technical properties of purchased thematic equipment

Table 20: Calculation software

Type of procurement	Three bid procedure
National law for public procurement in your country	2015. évi CXLIII. törvény. a közbeszerzésekről.
Purchased thematic equipment (title)	**ArchiCAD 19 NET02 software**
Purchased thematic equipment (function)	ARCHICAD is an architectural BIM CAD software for Macintosh and Windows developed by the Hungarian company Graphisoft. ARCHICAD offers computer aided solutions for handling all common aspects of aesthetics and engineering during the whole design process of the built environment — buildings, interiors, urban areas, etc.
Technical data	ARCHICAD is a complete design suite with 2D and 3D drafting, visualization and other building information modeling functions for architects, designers and planners. A wide range of software applications are integrated in ARCHICAD to cover most of the design needs of an architectural office: ▪ 2D CAD software — drawing tools for creating accurate and detailed technical drawings ▪ 3D Modeling software — a 3D CAD interface specially developed for architects capable of creating various kind of building forms ▪ Architectural rendering and Visualization software — a high performance rendering tool to produce photo-realistic pictures or videos ▪ Desktop publishing software — with similar features to mainstream DTP software to compose printed materials using technical drawings pixel-based images and texts ▪ Document management tool — a central data storage server with remote access, versioning tool with backup and restore features ▪ Building Information Modeling software — not just a collection of the above-mentioned applications with an integrated user interface but a novel approach to building design called BIM
Pictures of the thematic equipment	As it is a software, pictures cannot be taken.
Internal inventory number	/
Person in charge of the thematic equipment	Bán Róbert managing director, Tolna County Development Agency legal successor of STRDA, responsible for maintaining the project results of the 1st period, when the software has been procured
Place where the thematic equipment is available	Municipality of Paks, Town Hall 7030 Paks, Dózsa György út 55-61
Costs in Euro	7.400,31 € with VAT (27 %)

Table 21: Calculation software

Type of procurement	Three bid procedure

National law for public procurement in your country	2015. évi CXLIII. törvény. a közbeszerzésekről.
Purchased thematic equipment (title)	**WinWatt building engineering software**
Purchased thematic equipment (function)	Calculation software
Technical data	Software for calculating energy performance of buildings – generally used for energy certifications in Hungary
Pictures of the thematic equipment	As it is a software, pictures cannot be taken.
Internal inventory number	/
Person in charge of the thematic equipment	Neiner András projectmanager Municipality of Paks
Place where the thematic equipment is available	Municipality of Paks, Town Hall 7030 Paks, Dózsa György út 55-61
Costs in Euro	1.037,88 € with VAT (27 %)

Table 22: Thermal IR camera

Type of procurement	Three bid procedure
National law for public procurement in your country	2015. évi CXLIII. törvény. a közbeszerzésekről.
Purchased thematic equipment (title)	TESTO 882 thermal IR camera
Purchased thematic equipment (function)	The thermocamera reveals heat loss points and allows to easily visualise the insulation, ventilation problems. It will be used at the on the spot checks of the energy certification process at the pilot buildings. Besides, it is also possible to find heat points resulted from malfunctions of different equipment.
Technical data	Testo 882 is a precise one-hand thermal imaging camera with pistol grip design from Testo. Special measuring modes including moisture image or high temperature option make it ideal for a wide variety of different applications. • Easy, one-handed operation for easy thermal imaging • Image quality: thermal image resolution 320 x 240 pixels, with optional SuperResolution Technology can be enhanced to 640 x 480 pixels • Thermal sensitivity < 50 mK, 32° lens, automatic hot/cold spot recognition • Built-in digital camera with power LEDs for real images with every thermal image

Pictures of the thematic equipment	
Internal inventory number	/
Person in charge of the thematic equipment	Neiner András project manager, Municipality of Paks
Place where the thematic equipment is available	Municipality of Paks, Town Hall 7030 Paks, Dózsa György út 55-61
Costs in Euro	5.448,30 € with VAT (27 %)

9. Energy audit kit of PP7 Municipality of 12th District of Budapest

9.1. The contribution of purchased thematic equipment for the project activities

PP7 intends to use this equipment for guaranteeing an additional value and opportunity to engage the end- users and different target groups in the scope of local trainings, and not for Energy Audit. The equipment can measure specific values, which are sticking out from the average and that helps preventing the building operators and staff to call the service provider and all the measurement values will help them to better understand the whole buildings energy characteristics. It will help project target groups (building decision makers, owners, managers and users) to better understand what factors influence energy consumption in buildings, what the energy situation of their particular buildings is and how they can adapt their behaviours and procedures to improve this situation. The stakeholders, the building operators and the technical assistant staff members can practice with these equipment in order to build capacity. The equipment also can be used as a demonstrational tool for the trainings raising awareness (for example during on-site visits) and communication activities, such as the creation of short videos and digital content to be uploaded in the project web site and social media channels.

The purchased equipment will not be used in energy audit performance, because PP7 will perform it with the help of external experts, who will do the Energy Audit with their own equipment, since PP7 does not have necessary competences to do the audits itself. The equipment will be handled by PP7 and utilised during trainings and on-site visits, as already mentioned. When needed, representative of PP7 may take part in the audit and made relevant equipment available on the spot.

The equipment will be handled with adequate care, that's why PP7 do not expect any kind of problem. If malfunction, or other problem happens all equipment have 1-3 years guarantee. The equipment will be used by experienced people and all new users will be trained. Handling the equipment are easy, all of them are simple to use, and so the new users will not have any problems working with the equipment properly or having any kind of risks.

9.2. Technical properties of purchased thematic equipment

Table 23: Thermohygrometer

Type of procurement	Three bid procedure
National law for public procurement in your country	/
Purchased thematic equipment (title)	Greisinger GFTB 200
Purchased thematic equipment (function)	**Thermohygrometer**
Technical data	Specifications Measuring ranges: Temperature: -25,0 ... +70,0 °C (basic accuracy 0.1 °C) Humidity: 0,0 ... 100.0 % r.F. (recommended range:11 ... 90 % r.F.) Pressure: 10,0 ... 1100,0 mbar Power: 9 V Size, width: 67 mm Size, height: 106 mm Calibration: manufacturing standard
Pictures of the thematic equipment	
Internal inventory number	/
Person in charge of the thematic equipment	Zoltán Rózsa, Gábor Bodnár thematic experts
Place where the thematic equipment is available	Budapest XII-th District Municipality
Costs in Euro	184,00 € with VAT (27 %)

Table 24: Multifunctional meter

Type of procurement	3-bid offer
National law for public procurement in your country	/
Purchased thematic equipment (title)	Voltcraft DT-8820
Purchased thematic equipment (function)	**Thermo, hygrometer, photometer,sound level meter**
Technical data	Specifications Thermometer: K type -20 ... +50 °C (inner) -20 ... +750 °C

	(external) basic accuracy 0,1 °C Sound level: 35 ... 130 dB, accuracy 0,1 dB, frequency response 32 Hz - 10 kHz Photometer: 0,01 - 20 000 Lux, accuracy 0,01 Lux Hygrometer: 25 - 95% RH, accuracy 0,1% Size: depth: 30 mm Size: width: 85 mm Weight: 250 g Basic accuracy: ± 3 % Manufacturer number: DT 8820 Size, height: 85 mm Sensory tense: K type Power: 9 V Temperature range: -20 ... +50 °C / -20 ... +750 °C (K type)
Pictures of the thematic equipment	
Internal inventory number	/
Person in charge of the thematic equipment	Zoltán Rózsa, Gábor Bodnár thematic experts
Place where the thematic equipment is available	Budapest XII-th District Municipality
Costs in Euro	102,00 € with VAT (27 %)

Table 25: Thermal imager for Android

Type of procurement	Three bid procedure
National law for public procurement in your country	/
Purchased thematic equipment (title)	Seek Thermal Compact XR SK1002AN
Purchased thematic equipment (function)	**Thermal imager for Android**
Technical data	Specifications Resolution: 206 x 156 pixel Focus position: manual Manufacturer number: Seek Thermal Compact XR Android Size, lenght: 45 mm Size, height: 18 mm Size, width: 20 mm Measuring range: -40 °C - +330 °C Optics: 20° Jack: micro USB Weight: 13 g

Pictures of the thematic equipment	
Internal inventory number	/
Person in charge of the thematic equipment	Zoltán Rózsa, Gábor Bodnár thematic experts
Place where the thematic equipment is available	Budapest XII-th District Municipality
Costs in Euro	490,00 € with VAT (27 %)

Table 26: IR Thermometer

Type of procurement	Three bid procedure
National law for public procurement in your country	/
Purchased thematic equipment (title)	Fluke VT04
Purchased thematic equipment (function)	IR Thermometer
Technical data	Specifications Focusing: fix-focus Accuracy: ±2°C/±2 % Degree of efficiency: 0.95 Temperature measurement range: -10 … +250 °C Optics: 28° x 28° Power: Li-ion accumulator
Pictures of the thematic equipment	
Internal inventory number	/
Person in charge of the thematic equipment	Zoltán Rózsa, Gábor Bodnár thematic experts
Place where the thematic equipment is available	Budapest XII-th District Municipality

Costs in Euro	646,00 € with VAT (27 %)

10. Energy audit kit of PP8 Slovak innovation and Energy Agency

10.1. The contribution of purchased thematic equipment for the project activities

PP8 SIEA will perform all energy audits by themselves, therefore they are forced to carry them out in accordance with national directives in Slovakia. Directive of Ministry of Economy 179/2015 about energy audit is prepared in accordance with Directive 2012/27/EU on energy efficiency describes and states requirements for energy audits in Slovakia. According to the directive (179/2015) it is among others necessary to evaluate the state of the energy production and distribution in the building (grounds) as well as the thermal performance of the building. In order to do this crucial step properly, it is necessary to create analyze the surface temperatures of various elements (walls, thermal bridges, energy distribution network…). For this reason, it is necessary to possess a proper technical equipment, which allows this kind of measurements.

This step will be done using thermometer and thermographic imagery. Analysis performed with those two instruments will provide complex and detailed picture about the building, and will help to identify numerous issues as for example:

- Thermal bridges or other shortcomings in the building envelope hidden below plaster;
- Insufficient insulation properties of building elements;
- Insufficient insulation of heat distribution network;
- Overloading of electrical distribution network (generates heat);
- Heat losses due to damages on the boiler;
- Risk of mold creation can be identified using hygrometric module of thermometer etc.

There is currently no directive or standard on thermography in Slovakia defining minimal requirements for the equipment. In practice is therefore used VATh directive. VATh (Federation of Applied Thermography) has about 300 members of the largest thermography association in Germany. VATh released a comprehensive directive on a thermography According to which it is recommended to use sensitivity of maximum 60 mK in building thermography to provide adequate thermal images on professional level. According to our experiences, in thermographic cameras with higher sensitivity (100 mK) also so called “image noise” oftentimes appears, which prevents proper analysis as details on the picture are hard to identify. To provide high quality images of the objects in distance (roof, top floor windows etc.) it is necessary to have an option of optical zoom, otherwise the images would not have sufficient resolution and resulting in considerable measurement errors. Testo 875i thermal imager has sensitive lower than 50 mK, so all measurements and analysis will be made in line with recommendations according to VATh directive.

On occasion of the submission of the first PR1, SIEA has provided technical justification of choice of thermocamera of higher quality than other partners that were highly recommended by the Js during the negotiating phase. The justification can be find under annexes.

Laser distance meter is necessary to purchase in order to measure exact dimensions of the buildings. Integration of inclination measurement helps to measure more accurately, but is mainly used to calculate the height of the objects.

SIEA has intended to procure a calculation software, which would support energy auditing to speed up the process of calculation. However, this was planned in the preparation phase of this project, when SIEA had a proper technical worker to use this calculation program. Unfortunately, this person has left SIEA, therefore it was not necessary to purchase this software anymore.

Usage of the equipment is crucial in Energy Audits, because it has to be measured many parameters and taken into consideration many aspects to be able to evaluate energy efficiency of pilot buildings. SIEA will carry out the Energy Audits internally by their technical experts in energy auditing, therefore they do not expect any major problems using purchased thematic equipment due to their experiences in the field of energy audits.

The reports will be performed according to the existing legislation and will include the proposals for improving the energy efficiency. Many of the shortcomings in building energy use was/will be identified thanks to the equipment. The reports will contain a brief description of interventions and a rough estimation of the timing of payback of investments.

SIEA will use the equipment in all planned activities with target groups, including trainings and communication activities. SIEA sees a big opportunity to engage the end-users in the project also thanks to practical usage of the equipment, explaining its functionality and presenting the discovered building shortcomings in energy use.

10.2. Technical properties of purchased thematic equipment

Table 27: Thermohygrometer

Type of procurement	Public procurement – electronic contracting system (ECS), No PL 3316
National law for public procurement in your country	Act No 343/2015 Public procurement
Purchased thematic equipment (title)	**Thermohygrometer Testo 610**
Purchased thematic equipment (function)	The Testo 610 simultaneously measures relative air humidity and temperature. It is thus ideally suitable for fast checks on ambient conditions, e.g. in offices, production rooms or in warehouses. The accuracy of ±2.5 %RH is confirmed by a calibration protocol, which is included in delivery. Dewpoint calculation and the calculation of Wet Bulb as well as a hold-function and the display of max. and min. values are possible with the Testo 610. The clip-on protective cap, wrist strap and belt holder ensure safekeeping of the instrument. Testo 610 is very handy, small and easy to operate.
Technical data	Measuring rate: 1s, Weight 90g, Dimensions 119x45x25mm, protection class: IP20 Temperature: Operating temperature/measuring range -10/+50 °C, Permissible tolerance: +/- 0,5°C resolution: 0,1°C Humidity: Measuring range 0 to 100 %RH, Permissible tolerance: +/- 2,5%RH, Resolution: 0,1 %RH

Pictures of the thematic equipment	 
Internal inventory number	DRHM 3985
Person in charge of the thematic equipment	Zuzana Palugová, Project Manager
Place where the thematic equipment is available	Trnavská cesta 100, 821 01 Bratislava, Slovakia, Room No 6.14
Costs in Euro	124,80 € without VAT 149,76 € with VAT (20 %)

Table 28: Thermal imager

Type of procurement	Public procurement – electronic contracting system (ECS), No PL 3316
National law for public procurement in your country	Act No 343/2015 Public procurement
Purchased thematic equipment (title)	Thermal Imager with accessories Testo 875-2i SET
Purchased thematic equipment (function)	The Testo 875i thermal imager detects anomalies and weakspots in materials and components quickly and reliably. Thanks to an imaging process, energy losses and cold bridges as well as damage or overheating in systems are detected without contact. Testo SuperResolution technology increases the resolution of the testo 875i from 160 x 120 pixels in the

	Software Testo IRSoft to 320 x 240 pixels. That's four times as many readings, enabling you to spot even the smallest irregularities. Thermal imager Testo 875-2i is provided in a robust case, including professional software, soft case, carrying strap, SD card, USB cable, lens cleaning cloth, mains unit, rechargeable Li-ion battery, tripod adapter, headset, 9° x 7° telephoto lens, lens protector, spare rechargeable battery and fast battery charger
Technical data	Infrared resolution: 160x120 pixels; Image size: 640x480 pixels; Thermal sensitivity: <50mK; Spectral range: 7,5 to 14 µm; Image display: 3.5" LCD with 320 x 240 pixels; Measuring range: -30 to +100°C; exchangeable lens 9°x 7; accessories
Pictures of the thematic equipment	 

	
Internal inventory number	IM 779
Person in charge of the thematic equipment	Zuzana Palugová, Project Manager
Place where the thematic equipment is available	Trnavská cesta 100, 821 01 Bratislava, Slovakia, Room No 6.14
Costs in Euro	4.397,80 € without VAT 5.277,36 € with VAT (20 %)

Table 29: Laser distance meter

Type of procurement	Public procurement – electronic contracting system (ECS), No PL 3316
National law for public procurement in your country	Act No 343/2015 Public procurement
Purchased thematic equipment (title)	GLM 80 Professional Laser distance meter
Purchased thematic equipment (function)	This measuring instrument is designed to measure distances, Lengths, heights, spacings, inclines (sloping) and for calculation Areas and volumes. This measuring instrument is suitable for measurement Inside and outside objects.
Technical data	Distance range: 0,05-80m; Accuracy: ±1,5 mm, Resolution 0,1mm; Inclination measurement range: 0°-360°; Accuracy: ±0,2°; Resolution: 0,1°; Dimensions: 51x111x30mm; protection class: IP54;

Pictures of the thematic equipment	
Internal inventory number	DRHM 3984
Person in charge of the thematic equipment	Zuzana Palugová, Project Manager
Place where the thematic equipment is available	Trnavská cesta 100, 821 01 Bratislava, Slovakia, Room No 6.14
Costs in Euro	327,40 € without VAT 392,88 € with VAT (20 %)

11. Conclusions

Partners has procured very similar energy audit kit, even due to different budget amounts and slightly different purposes. The main differences are in technical characteristic of devices and in the way of application. According to the PPs feedback, in all cases the purchased energy audit kits will be used for guaranteeing an additional value and opportunity to engage the end-users in the project. This is meant by using it during local training activities to engage target groups and to make them interdisciplinary. This will help project target groups (building decision makers, owners, managers and users) to better understand what factors influence energy consumption and internal air quality in buildings, what's the energy situation of their particular buildings and how they can adapt their behaviours and procedures to improve this situation. Besides using it for direct involvement of target groups, equipment will be also used in all the planned activities affecting with the buildings stakeholders, including the communication activities, such as the creation of short videos and digital content to be uploaded in the project web site and social media channels. Some of PPs will made this equipment available to borrow to its target groups and this way to foster the energy efficiency awareness.

EAV, PAKS and SIEA has bought an upgraded energy audit kit including the ordinary multifunctional tools, for carrying out internal professional pilot buildings energy audits by themselves, for that reason they have allocated higher amounts for energy audit kit procurement. Paks has among others “a CAD software for creating intelligent 3D models, engineering drawings and enabling to explore the key physical, constructional features” procured, which will be also used for delivering D.T3.1.5 – “Report on modelling the energy efficiency refurbishments of selected pilot buildings owned by Paks”. For more information, please refer to chapter 4, 5, 8 and 10.

UM intends to use purchased thematic equipment also in the scope of energy audits performance, even they will perform energy audits by external services. Their purchased energy audit kit slightly differs from firstly listed in application form due to the fact that in meanwhile Um was successful in in another call for European funds, which gave them opportunity to purchase equipment before this project even started. Therefore, there choose to purchase a different set of devices and use existing one too. Usage of already existing equipment and purchasing accessories with other devices will not affect project activities, but exactly the opposite, this way UM has obtain equipment which can cover a wider spectrum than originally planned. For more information, please refer to chapter 5.

Table 30: Differences between allocated budget due to the application form and spent budget per project partner

Project Partner	Country	BL5: D.T2.1.1 thematic equipment for energy audit kit		
		According to Application form	Funds spent (with VAT)	Difference
LP_Treviso	Italy	2.200,00 €	1.587,68 €	612,32 €
PP2_EAV	Czech Republic	3.200,00 €	2.892,8 €	370,20 €
PP3_UM	Slovenia	7.000,00 €	4.215,22 €	2.784,78 €
PP4_ZAGREB	Croatia	2.200,00 €	2.190,56 €	9,44 €
PP5_PNEC	Poland	2.200,00 €	2.243,53 €	- 43,53 €
PP6_PAKS	Hungary	16.200,00 €	13.886,49 €	2.313,51 €
PP7_HEGDYVIDEK	Hungary	2.200,00 €	1.422,00 €	778,00 €
PP8_SIEA	Slovakia	10.500,00 €	5.820,00 €	4.680,00 €

Note: amounts for PP4, PP5, PP6, PP7 and PP8 are calculated to euro value according to current exchange rate. For this reason, there could be a deviation from original currency.

Table 30 presents the differences between allocated budget due to the application form and spent budget per project partner. All partners except PNEC has spent less than predicted in application form. The reason that PNEC has exceeded predicted value can be find in using different exchange rates for currency conversation as it was used for the purposes of this report. In addition, the final number can be different in Joint Report due to different exchange rate used by the system.

12. APPENDIX

12.1. LP Province Treviso datasheet list of purchased equipment

1. FLIR E4 Datasheet

FLIR

FLIR E4, E5, E6, E8 with MSX® Enhancement

- Display: 3" color LCD
- On-board 640 x 480 Digital Camera
- Easy-to-use, weighs only 1.2lbs
- 2% accuracy
- File format: Radiometric jpg
- Swappable Li-ion Battery with 4 hour life
- Spot Measurement mode
- Simultaneous storage of IR/Visual/MSX images
- Picture in Picture image (E6 and E8)
- Manual level and span thermal tuning (E6 and E8)
- Area Box Measurement mode (E5, E6 and E8)

Each includes power supply/charger with four plugs, rechargeable battery, FLIR Tools software, USB cable, and hard transport case. E8 also includes extra battery and external battery charger.

FLIR E4
- 4,800 pixels (80 x 60)

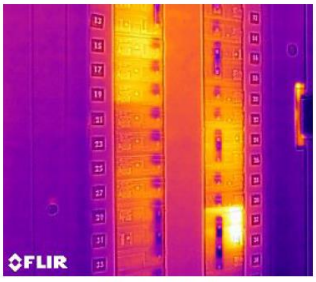
FLIR E5
- 10,800 pixels (120 x 90)

FLIR E6
- 19,200 pixels (160 x 120)

FLIR E8
- 76,800 pixels (320 x 240)

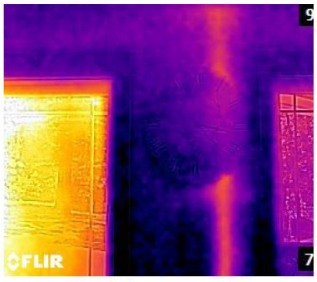
New Exclusive MSX Thermal Imaging Technology Made Affordable for Everyday Use

What is MSX?
Multi-Spectral Dynamic Imaging (MSX) for easier interpretation of an image - adds visible spectrum definition to IR images by detecting the edges of objects and including that detail in the thermal image. Text becomes clearly visible so that you can read a label or identifier within the IR image. This exclusive function provides extraordinary thermal detail that instantly highlights and orients problem locations and eliminates the need to refer back to a visual image for detail.



Breaker Panel
E8 with MSX

Missing Insulation – Summer Day
E6 with MSX



Warm Drain Pipe in Wall
E4 with MSX

Imaging Specifications

FEATURES	FLIR E4	FLIR E5	FLIR E6	FLIR E8
IR Pixel Resolution	4,800 (80 x 60)	10,800 (120 x 90)	19,200 (160 x 120)	76,800 (320 x 240)
Thermal Sensitivity	<0.15°C	<0.10°C	<0.06°C	<0.06°C
Temperature Range	-4 to 482°F (-20 to 250°C)			
Measurement modes	Centerspot	Centerspot, Area Box, Auto Hot/Cold detection	Centerspot, Area Box, Auto Hot/Cold detection	Centerspot, Area Box, Auto Hot/Cold detection
Frame Rate	9Hz			
Field of View	45° x 34°			
Focus	Focus free			
Auto Hot/Cold Detection	No	Auto min/max markers within area	Auto min/max markers within area	Auto min/max markers within area

Included in All Models

Additional Accessories Included with E8

Optional Accessories

Ordering Information

63901-0101 ..... FLIR E4 Compact Thermal Imaging Infrared Camera with MSX® Enhancement (80x60)
63901-0101-NIST..... FLIR E4 with Certificate Traceable to NIST

63905-0501..... FLIR E5 Compact Thermal Imaging Infrared Camera with MSX® Enhancement (120x90)
63905-0501-NIST ..... FLIR E5 with Certificate Traceable to NIST

63902-0202..... FLIR E6 Compact Thermal Imaging Infrared Camera with MSX® Enhancement (160x120)
63902-0202-NIST ..... FLIR E6 with Certificate Traceable to NIST

63903-0303..... FLIR E8 Compact Thermal Imaging Infrared Camera with MSX® Enhancement (320x240)
63903-0303-NIST..... FLIR E8 with Certificate Traceable to NIST

ACCESSORIES
T198529 ..... Pouch
T198530 ..... Replacement battery
T198531 ..... External battery charger
T198532..... Car Charger
T198534..... Power supply/charger with EU, UK, US and AU plugs
T198533..... USB cable
T198528..... Hard Transport Case

5-10-2 Protection

10-Year Detector Protection
5-Year Battery
2-Year Parts & Labor

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www.flir.com
NASDAQ: FLIR

PRODUCT DATASHEET

HT200 Heat Stress WBGT Meter

Extech's Heat Stress WBGT (Wet Bulb Globe Temperature) Meter accurately determines the Heat Stress level (how hot it feels outside) by factoring a combination of humidity, temperature, air movement, and direct solar radiation. These factors all affect how hot our bodies get, as well as our ability to cool down. It's perfect for monitoring the Heat Index on hot humid days to prevent heat stroke during road or building construction, outdoor activities, sporting events, or in the workplace.

Features

- Uses a capacitance sensor to accurately measure Wet Bulb Globe Temperature (WBGT), Black Globe Temperature (TG), Relative Humidity (%RH), Air Temperature (TA), Wet Bulb (WT) and Dew Point (DEW)
- Heat Stress Index measures how hot it feels when humidity is combined with temperature, air movement, and radiant heat
- Black Globe Temperature (TG) monitors the effects of direct solar radiation on an exposed surface
- In/Out function displays the WBGT value with or without direct sun exposure
- WBGT high/low alarm settings
- Memory stores up to 50 readings
- Backlit LCD
- Min/Max and Data Hold
- Low battery indicator
- Auto power off with disable
- Complete with 9V battery and hard carrying case

Specifications	Ranges	Max Resolution	Basic Accuracy
WBGT - Wet Bulb Globe Temperature (w/o sunlight)	32 to 138°F / 0 to 59°C	0.1°	±1.8°F/1°C
WBGT - Wet Bulb Globe Temperature (w/sunlight)	32 to 132°F / 0 to 56°C	0.1°	±2.7°F/1.5°C
TG - Black Globe Temperature	32 to 176°F / 0 to 80°C	0.1°	±1.1°F/0.6°C
TA - Air Temperature	32 to 122°F / 0 to 50°C	0.1°	±1.5°F/0.8°C
Relative Humidity	1 to 99%RH	0.1%RH	±3%RH
Dew Point	-31.5 to 120.1°F / -35.3 to 48.9°C	0.1°	
Wet Bulb	-6.9 to 122°F / -21.6 to 50°C	0.1°	
Dimensions	Meter: 11.8 x 2.8 x 2" (300 x 70 x 50mm) Ball: 2" (50mm) diameter		
Weight	7.8oz (220g) w/o battery		

Ordering

HT200 ..... Heat Stress WBGT Meter

CE

UPC Code: 793950112007

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Rev. 1/6/15

www.extech.com

12.2. PP2 EAV datasheet list of thematic equipment

1. BOSCH DLE 70 Professional Datasheet

Technical Data

Digital Laser Rangefinder	DLE 70 Professional
Article number	3 601 K16 60.
Measuring range	0.05–70 m[A)]
Measuring accuracy (typically)	±1.5 mm[B)]
Lowest indication unit	1 mm
Operating temperature	–10 °C...+50 °C[C)]
Storage temperature	–20 °C...+70 °C
Relative air humidity, max.	90 %
Laser class	2
Laser type	635 nm, <1 mW
Laser beam diameter (at 25 °C) approx. – at 10 m distance – at 70 m distance	 6 mm 42 mm
Batteries Rechargeable batteries	4 x 1.5 V LR03 (AAA) 4 x 1.2 V KR03 (AAA)
Battery live, approximately – Individual measurements – Continuous measurement	 30000[D)] 5 h[D)]
Automatic switch-off after approx. – Laser – Measuring tool (without measurement)	 20 s 5 min
Weight according to EPTA-Procedure 01/2003	0.18 kg
Dimensions	59 x 100 x 32 mm
Degree of protection (excluding battery compartment)	IP 54 (dust and splash water protected)

A) The working range increases depending on how well the laser light is reflected from the surface of the target (scattered, not reflective) and with increased brightness of the laser point to the ambient light intensity (interior spaces, twilight). In unfavourable conditions (e.g. when measuring outdoors at intense sunlight), it may be necessary to use the target plate.

B) In unfavourable conditions (e.g. when measuring outdoors at intense sunlight or an insufficiently reflecting surface), the maximum deviation is ±10 mm per 70 m. In favourable conditions, a deviation influence of ±0.05 mm/m must be taken into account.

C) In the continuous measurement function, the maximum operating temperature is +40 °C.

D) Fewer measurements are possible when using 1.2 V rechargeable batteries as compared with 1.5 V batteries.

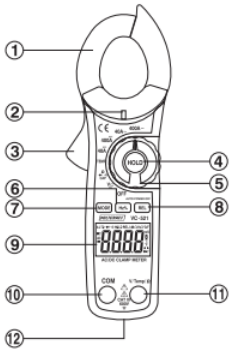
Please observe the article number on the type plate of your measuring tool. The trade names of the individual measuring tools may vary.

The measuring tool can be clearly identified with the serial number **20** on the type plate.

2. VOLTCRAFT VC 521 Datasheet

Operating elements

1 Clamp meter sensor
2 LED Display for contactless voltage measurement (NCV)
3 Opening lever for clamp meter sensor
4 Hold key
5 Rotary switch
6 Hz % - key
7 MODE key
8 REL key
9 LC Display
10 COM measuring socket (reference potential)
11 VΩ capacity measuring socket (with commensurability „+“)
12 Battery compartment (on reverse side)



Technical data

Display	4000 counts
Measuring frequency	approx. 2 measuring operations/second
Measuring impedance	>10MΩ (V range)
Operating voltage	2 x 1.5 V batteries
Working conditions	5°C to 40°C; max 80% RH
Operating altitude	max. 2,000 m
Storage conditions	-20°C to +60°C; max 80% RH
Weight	ca. 205 g
Dimensions (LxWxH)	200 x 66 x 37 (mm)
Clamp meter sensor max. opening	30 mm
Over-voltage category	CAT III 600 V

Measurement tolerances
Statement of accuracy in ± (% of reading + display error in counts (= number of smallest points)). The accuracy is valid for one year at a temperature of +23°C ± 5°C, and at a relative humidity of less than 75 %, non-condensing.

Alternating current (AC/A)

Range 50-60 Hz	Accuracy	Definition
40.00 A	±(3 % + 12)	10 mA
400.0 A	±(3,5 % + 12)	100 mA

Direct current (DC/A) VC 521 only

Range	Accuracy	Definition
40.00 A	±(3 % + 12)	10 mA
400.0 A	±(3,5 % + 12)	100 mA

Direct voltage, overload protection 600 V

Range	Accuracy	Definition
400.0 mV	±(1,2% + 5)	0.1 mV
4,000 V	±(1,8% + 5)	1 mV
40.00 V		10 mV
400.0 V		100 mV
600 V	±(2% + 5)	1 V

Alternating voltage, overload protection 600 V

Range (50-400 Hz)	Accuracy	Definition
4,000 V	±(2,5% + 8)	1 mV
40.00 V		10 mV
400.00 V		100 mV
600 V	±(3,5% + 8)	1 V

Resistance, overload protection 600 V

Range	Accuracy	Definition
400.0 Ω	±(1,3% + 8)	0.1 Ω
4.000 KΩ	±(1,8% + 8)	1 Ω
40.00 KΩ		10 Ω
400.0 KΩ		100 Ω
4.000 MΩ	±(2,5% + 5)	1 KΩ
40.00 MΩ	±(3,5% + 5)	10 KΩ

Capacity, overload protection 600 V

Range	Accuracy	Definition
40.00 nF	±(4% + 30)	0.01 nF
400.0 nF	±(3,5% + 15)	0.1 nF
4,000 µF		1 nF
40.00 µF		0.01 µF
100.0 µF	±(4% + 20)	0.1 µF

Temperature

Range	Accuracy	Definition
-20.0 to +760.0 °C	±(3% + 60)	0.1 °C

Frequency, overload protection 600 V

Range	Accuracy	Sensitivity
10 Hz - 10 kHz	±(1,5% + 5)	15 Vrms

Acoustic continuity tester <100 Ω
Diode test test voltage: 1.5V / test voltage approx. 0.3 mA
Diode overload protection/continuity tester: 600 V

3. VOLTCRAFT IR-800-20D Datasheet

Technical Data

Operating voltage:	9-V compound battery
Response time:	150 ms
Spectrum:	8 to 14 µm
Emission ratio	0.1 to 1.00 adjustable
Resolution	0.1 °C
IR-measuring spot size:	IR 650-12D 12:1 IR 800-20D 20:1
Laser:	Capacity < 1 mW, laser class 2, Wavelength 630-690 nm
Operating temperature.	0 to 50 °C
Operating humidity:	10 - 90 % RH
Storage temperature:	-10 to 60 °C
Storage humidity:	10 - 80 % RH
Weight:	175 g
Dimensions:	160 x 42 x 82 mm

Accuracy (at 23 - 25 °C ambient temperature, measuring distance in the focal point of the target laser)

IR 650-12D		
Temperature measuring range:	Accuracy	Reproducibility
- 50 to 20 °C	± 3 °C	± 1.3 °C
20 to 300 °C	± 1.5% of the measured value ± 1.5°C	± 0.5% of the measured value or ± 0.5°C
300 to 650	± 2 %	± 0.5% of the measured value or ± 0.5°C

IR 800-20D		
Temperature measuring range:	Accuracy	Reproducibility
- 50 to 20 °C	± 3 °C	± 1.3 °C
20 to 300 °C	± 1.5% of the measured value ± 1.5°C	± 0.5% of the measured value or ± 0.5°C
300 to 800	± 2 %	± 0.5% of the measured value or ± 0.5°C

Surface	Emission ratio
asphalt	0,90 - 0,98
concrete	0,94
ice	0,96 - 0.98
ferric oxide	0,78 - 0,82
soil. humus	0.92 - 0,96
hard plaster	0,80 - 0,90
glass/ceramics	0,90 - 0,95
rubber (black)	0,94
varnish	0,80 - 0,95

Surface	Emission ratio
varnish (matt)	0,97
human skin	0,98
mortar	0,89 - 0,91
paper	0,70 - 0,94
plastics	0,85 - 0,95
sand	0,90
textiles	0,90
water	0,92 - 0,96
bricks	0,93 - 0,96

4. ENERGIE 2016 Datasheet

There is no datasheet available for this software available in English language. Please refer to the table 7.

5. TESTO 871 Datasheet

Data sheet
testo 871

We measure it. testo

Thermal imager

testo 871 – smart thermography for professional demands.

- Infrared resolution 240 x 180 pixels (with testo SuperResolution technology 480 x 360 pixels)
- Thermal sensitivity 90 mK
- Integrated digital camera
- With testo Thermography App
- Wireless measurement data transfer from clamp meter testo 770-3 and humidity measuring instrument testo 605i
- With testo ScaleAssist and testo ε-Assist

The thermal imager testo 871 offers a high-quality 240 x 180-pixel detector, connectivity via the testo Thermography App, as well as the innovative functions testo ScaleAssist and testo ε-Assist, which enables objectively comparable and error-free thermal images to be recorded.

For even more meaningful thermal images, the thermal imager also wirelessly integrates the measurement values of the clamp probe testo 770-3 as well as the thermohygrometer testo 605i (both available as an option).

www.testo.com

Technical data

Infrared image output	
Infrared resolution	240 x 180 pixels
Thermal sensitivity (NETD)	90 mK
Field of view/min. focusing distance	35° x 26° / < 0.5 m
Geometric resolution (IFOV)	2.6 mrad
testo SuperResolution (Pixel/IFOV)	480 x 360 pixels 1.6 mrad
Image refresh rate	9 Hz
Focus	Fixed focus
Spectral range	7.5 to14 µm
Visual image output	
Image size / min. focusing distance	at least 3.1 MP / 0.5 m
Image presentation	
Image display	8.9 cm (3.5") TFT, QVGA (320 x 240 pixels)
Display options	IR image / real image
Colour palettes	iron, rainbow HC, cold-hot, grey
Data interfaces	
WLAN Connectivity	Communication with the testo Thermography App
Bluetooth®[1]	Measurement value transfer from thermohygrometer testo 605i, clamp meter testo 770-3 (optional)
USB 2.0 Micro B	✔
Measurement	
Measuring ranges	Measuring range 1: -30 to +100 °C Measuring range 2: 0 to +650 °C
Accuracy	±2 °C, ±2 % of measured value
Emissivity / reflected temperature compensation	0.01 to 1 / manual
testo ε-Assist	Automatic recognition of emissivity and determination of reflected temperature (RTC)
Measurement functions	
Analysis functions	Mean point measurement, hot/cold-spot recognition, Delta T,
testo ScaleAssist	✔
IFOV warner	✔
Humidity mode - manual	✔
Humidity measurement with humidity measuring instrument[1]	Automatic measurement value transfer of thermohygrometer testo 605i via Bluetooth (instrument must be ordered separately)
Solar mode - manual	Input of solar radiation value
Electrical mode - manual	Input of current, voltage or power
Electrical measurement with clamp meter[1]	Automatic measurement value transfer of clamp meter testo 770-3 via Bluetooth (instrument must be ordered separately)

Imager equipment	
Digital camera	✔
Lens	35° x 26°
Video streaming	via USB, via wireless LAN with testo Thermography App
Storage as JPG	✔
Fullscreen mode	✔
Image storage	
File format	.bmt and .jpg; export options in .bmp, .jpg, .png, .csv, .xls
Memory	Internal memory (2.8 GB)
Power supply	
Battery type	Li-ion battery can be changed on-site
Operating time	4 hours
Charging options	In instrument/in charging station (optional)
Mains operation	✔
Ambient conditions	
Operating temperature range	-15 to +50 °C
Storage temperature range	-30 to +60 °C
Air humidity	20 to 80 %RH, not condensing
Housing protection class (IEC 60529)	IP54
Vibration (IEC 60068-2-6)	2G
Physical features	
Weight	510 g
Dimensions (LxWxH)	219 x 96 x 95 mm
Housing	PC - ABS
PC software	
System requirements	Windows 10, Windows 8, Windows 7
Standards, tests, warranty	
EU directive	EMC: 2014/30/EU RED: 2014/53/EU
Warranty	2 years

[1] Wireless permit in EU, EFTA, USA, Canada, Australia, Turkey

12.3. PP3 University of Maribor datasheet list of thematic equipment

1. METREL MI 6201 MULTINORM, CO_2 & Co probes Datasheet

MI 6201 Multinorm

The MI 6201 Multinorm is a portable multifunctional handheld instrument for measuring microclimate, sound and light parameters and it is an invaluable tool for the monitoring and evaluation of indoor environmental conditions according to national and European standards. Specially designed housing enables connection of a few probes at the same time for testing of several parameters simultaneously. A large selection of measuring probes allows to measure variety of different environmental conditions. The SensorLink PRO and SoundLink LITE software come as standard accessories and enable downloading data stored in the memory, plotting and printing test results in table and graphic form, on-screen graph plotting for straightforward data comparison and export of data in text file format. The MI 6201EU set comes complete with full ISO accredited calibration certificate while the MI 6201PS set comes complete with ISO calibration certificate and an upgraded sound probe (class 1).

MEASUREMENTS:

- Air temperature;
- Air velocity;
- Air flow;
- Relative humidity;
- Dew point;
- Temperature difference (option);
- K thermocouple temperature (option);
- Illuminance;
- Luminance (option);
- Contrast (option);
- Black globe radiant temperature (option);
- CO and CO2 concentration (option);
- Sound level;
- Real time 1/1 and 1/3 octave analysis.

KEY FEATURES:

- **Adaptable:** MI 6201 Multinorm can be used as either a sound meter or environmental meter to reduce the amount of measuring equipment to move between locations.
- **Environmental:** using various standard and optional probes, the MI 6201 can be adapted to measure and calculate a combination of up to 16 different environment parameters (maximum 11 at the same time).
- **Sound:** the instrument can simultaneously measure and calculate 19 different sound parameters (displaying maximum 6 at the same time).
- **Long lasting:** record up to 160 days worth of data.
- **Accommodating:** due to optional prolongation cable or telescopic rod measurements in hard-to-rich spots are possible, while mounting on a tripod enables long-lasting recording.
- **Versatile:** can be used for spot checking of different locations or performing long investigations in a specific location.
- **Easy to use:** plug in the suitable probes and the device will automatically adjust for appropriate measurements.
- **PPD and PMV calculations:** predicted Percentage of Dissatisfied People (PPD) and Predicted Mean Vote (PMV) calculations are performed automatically.
- **Weighting:** A, C, Z frequeny weightings and fast, slow and impulse time weightings.
- **Octave frequency analysis:** instrument performs real time octave and one third octave frequency analysis in accordance with EN 61260 standard.
- **Logger:** logging memory module allows to save up to 4000 measurements with adjustable integration period.
- **Downloadable:** up to 4000 test results can be stored in a two level memory structure and then downloaded to the PC with the help of the PC software.

APPLICATION:

- Indoor air quality testing;
- Testing of factory climatic conditions;
- Testing of heating, ventilation and air conditioning systems;
- Testing of lighting conditions;
- Emergency lighting systems testing;
- Indoor or dry outdoor sound level measurement;
- Industrial sound measurement;
- Band-pass and acoustic filter testing;
- Acoustic equipment testing.

STANDARDS:

Functionality:
DIN 5032 P1; DIN 5032 P2; DIN 5032 P3; DIN 5032 P4; DIN 5032 P6; DIN 5032 P7; EN 60751; EN 60584-1; EN 12599; EN ISO 7726; ISO 10526; ISO 10527
Electromagnetic compatibility:
EN 61326
Safety:
EN 61010-1

TECHNICAL SPECIFICATION:

Function	Measuring range	Resolution	Accuracy
Microclimatic probe A 1091			
- Air temperature	-20 °C … +60 °C	0.1 °C	±0.2 °C at 25°C ±0.5 °C over working range
- Relative humidity	0 %RH … 10 %RH 10 %RH … 90 %RH 90 %RH … 100 %RH	0.1 %RH 0.1 %RH 0.1 %RH	±3 %RH ±2 %RH ±3 %RH
- Air velocity	0.10 m/s … 9.99 m/s 10.0 m/s … 20.0 m/s	0.01 m/s 0.1 m/s	±(0.05 m/s + 5 % of reading) ±(5 % of reading)
Temperature and humidity probe A 1127			
- Air temperature	-20 °C … +60 °C	0.1 °C	±0.5 °C
- Relative humidity	0 %RH … 100 %RH	0.1 %RH	±3 %RH
Black Globe temperature (A 1131)	10.0 °C … 49.9 °C 50.0 °C … 84.9 °C 85.0 °C … 120.0 °C	0.1 °C 0.1 °C 0.1 °C	±0.5 °C ±1.0 °C ±1.5 °C
Illuminance (A 1092; DIN 5032, Class B)	0.01 Lux … 19.99 Lux 20.0 Lux … 199.9 Lux 200 Lux … 1999 Lux 2000 Lux … 20000 Lux	0.01 Lux 0.1 Lux 1 Lux 10 Lux	±(0.02 Lux +8 % of reading) ±(8 % of reading) ±(8 % of reading) ±(8 % of reading)
Luminance (A 1132; DIN 5032, Class B)	0.1 cd/m²… 39.9 cd/m² 40 cd/m²… 399 cd/m² 400 cd/m² … 3999 cd/m² 4000 cd/m²… 40000 cd/m²	0.1 cd/m² 1 cd/m² 1 cd/m² 1 cd/m²	±(0.2 cd/m² + 8% of reading) ±(8 % of reading) ±(8 % of reading) ±(8 % of reading)
CO_2 concentration (A 1180)	0 ppm … 5000 ppm	1 ppm	±(3 % of reading + 40 ppm)
CO concentration (A 1181)	0 ppm … 500 ppm	1 ppm	±(5 % of reading + 5 ppm)
Sound level (A 1146)	30 dB … 140 dB	0.1 dB	Corresponds to EN 61672 Class 1
Sound level (A 1151)	30 dB … 140 dB	0.1 dB	Corresponds to EN 61672 Class 2
Sound probes A 1146 and A 1151	- Dynamic range: 80 dB - Frequency weighting: A,C, Zero - Time weighting: fast, slow, impulse		
COM port	USB		
Memory	up to 4000 values		
Display	Graphical LCD with backlight, 160 x 160 dots		
Power supply	6 x 1.2 V rechargeable batteries, type AA		
Protection degree	IP 40		
Dimensions	110 x 85 x 220 mm		
Weight	0.56 kg		

STANDARD SET:

MI 6201ST
- Instrument Multinorm
- Carrying case
- Probe adapter
- Microclimatic probe
- Illumination probe, type B
- Sound probe, class 2, with foam wind-screen
- Plastic shield for microphone
- Tripod adapter
- USB cable
- Power supply adapter
- 6 x NiMH rechargeable batteries, type AA
- PC SW SensorLink PRO
- PC SW SoundLink LITE
- Instruction manual
- Calibration certificate

MI 6201EU
- MI 6201ST
- ISO calibration certificate for complete system

MI 6201PS
- MI 6201EU
- Sound probe, class 1 (A 1146) instead of Sound probe, class 2 (A 1151)

2. TROTEC BZ30 Datasheet

BZ30 CO_2 Air quality data logger

For autonomous long-term recording of indoor air quality

This CO_2 air quality data logger is the ideal combination measuring device for architects, experts and every heating, ventilation and air conditioning engineer.

The BZ30 provides you with all functions and equipment features of the BZ25 and is further equipped with a large data memory for 50,000 measured values for the long-term recording of carbon dioxide concentrations, air temperature and humidity values in freely definable measuring intervals from 1 second to 12 hours.

The recorded data can be conveniently transferred to the connected PC via a fast USB connection and there analysed and logged using the analysis software included in the scope of delivery.

Owing to the integrated NiMH battery, the BZ30 is also suited for mobile application in addition to the stationary table installation.

The simultaneous recording of humidity and temperature values plus CO_2 concentrations offers property managers or landlords optimal possibilities to monitor the ventilation habits.

A few practical benefits

- Accurate and permanently stable NDIR measurement of carbon dioxide concentrations in the room air
- Simultaneous display of CO_2 values, room temperature, humidity, date and time
- Minimum and maximum value function for CO_2, air temperature and humidity
- Carbon dioxide alarm function with acoustic alarm signal for freely definable limit values
- Additional symbolic CO_2 indicator display
- Large backlit display with easily legible measured value indication
- Autonomous long-term recording of carbon dioxide concentration, room temperature and humidity
- Storage for 50,000 measured values
- Freely definable saving interval from 1 second to 12 hours
- USB interface for measuring data transfer
- Free standing or wall mounted
- PC analysis software

Technical data

Article number		3.510.205.015
Sensor		NDIR sensor (nondispersive infrared)
Carbon dioxide	Measuring range	0 ppm up to 9999 ppm CO_2
	Accuracy	±75 ppm or ±5 % of measured value
	Resolution	1 ppm
Temperature	Measuring range	-5 °C up to 50 °C / 23 °F up to 122 °F
	Accuracy	±1 °C
	Resolution	0.1 °C
Humidity	Measuring range	0.1 % RH up to 99.9 % RH
	Accuracy	±5 % RH
	Resolution	0.1 % RH
Measuring interval		2 s
Functions		Minimum value display, Maximum value display, Hold function, Switching function °C/°F, Backlit display, CO_2 acoustic alarm function, CO_2 sensor, Feel-good indication, Date, Time
Additional functions		Freely selectable measuring cycle from 1 second to 12 hours, Continuous or ring recording max. 50,000 measured values
PC interface		USB
Power supply		1x 3.7 V, Li-ion battery or 230 V power adapter
Dimensions		110 mm x 61 mm x 105 mm
Weight		74 g
Scope of delivery		Measuring device, Battery(-ies), Power adapter, USB connection cable, CD-ROM with Smartgraph PC software, Operating manual

12.4. PP4 ZAGREB datasheet list of thematic equipment

1. FLIR E6 Datasheet

Please see datasheet for FLIR E4 of LP Province Treviso datasheet list of purchased equipment. It is the same datasheet as for FLIR E6.

2. FLIR DTM 550 Datasheet

TECPEL CO., LTD.

DTM-550 Highly accurate Hygrometer

Features:

- Temperature: -20°C to +100°C
- Humidity: 0% ~ 100 %RH
- 3 1/2 Digit, Back light display
- Use highly accurate RTD temperature sensor
- MAX, DATA, HOLD function
- Automatic low battery indication
- Valox housing to withstand accidental drops

Specifications : With CE APPROVAL

Measurement Range:	Temp:-20°C ~ 100°C
Humidity:	0 ~ 100%RH
Temp. Accuracy:	(±0.5°C, 0°C ~50°C), (±1°C (-20°C to 0°C, 50°C to 100°C)
Humidity Accuracy:	±2.5% RH (10% to 90% RH)
	±5% RH (<10% ,>90% RH)
Operating Environment:	0°C to 50°C at <75% relative humidity
Resolution:	Temperature:0.1°C; Humidity:0.1% RH;
Sensor:	Pt385/1000Ω,RTD temperature sensor
General	
Power Requirement:	4 pieces 1.5V (AAA size) batteries
Dimensions:	6.7"x1.7"x1.6" (170x44x40mm)
Weight:	6.3 oz(180g)
Accessories:	Soft carrying case, batteries, owners manual.

12.5. PP5 PNEC datasheet list of thematic equipment

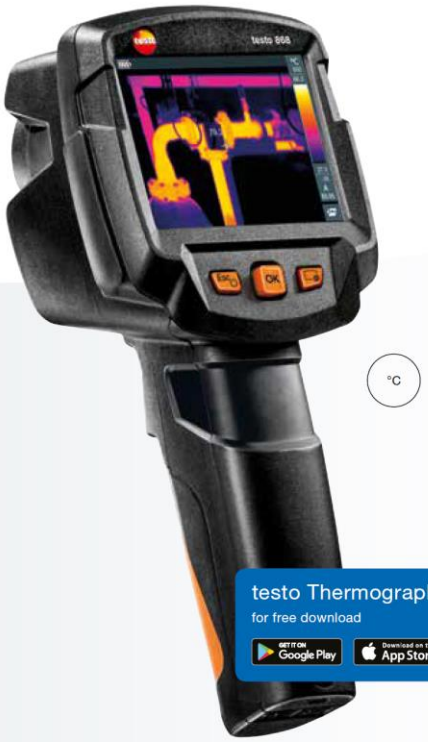
1. TESTO 868 Datasheet

Data sheet
testo 868

We measure it. testo

Thermal imager

testo 868 – smart and networked thermography.



- Infrared resolution 160 x 120 pixels (with testo SuperResolution technology 320 x 240 pixels)
- With testo Thermography App
- Integrated digital camera
- Automatic recognition of hot-cold spots
- testo ScaleAssist for comparable images in building thermography
- testo ε-Assist for the automatic determination of emissivity

Thermography connected – with the thermal imager testo 868. It has the best thermal image quality in its class, an integrated digital camera, and stands out thanks to smart new features.

The testo Thermography App wirelessly integrates measurement values, turning your smartphone or tablet into a second display. In addition to this, you can operate the imager with the App as well as creating and sending reports on site.

www.testo.com

Technical data

Infrared image output	
Infrared resolution	160 x 120 pixels
Thermal sensitivity (NETD)	100 mK
Field of view/min. focusing distance	31° x 23° / < 0.5 m
Geometric resolution (IFOV)	3.4 mrad
testo SuperResolution (Pixel/IFOV)	320 x 240 pixels 2.1 mrad
Image refresh rate	9 Hz
Focus	Fixed focus
Spectral range	7.5 to14 µm
Visual image output	
Image size / min. focusing distance	at least 3.1 MP / 0.5 m
Image presentation	
Image display	8.9 cm (3.5") TFT, QVGA (320 x 240 pixels)
Display options	IR image / real image
Colour palettes	iron, rainbow HC, cold-hot, grey
Data interfaces	
WLAN Connectivity	Communication with the testo Thermography App wireless module WLAN (EU, EFTA, USA, AUS, CDN, TR)
USB 2.0 Micro B	✔
Measurement	
Measuring ranges	Measuring range 1: -30 to +100 °C Measuring range 2: 0 to +650 °C
Accuracy	±2 °C, ±2 % of measured value
Emissivity / reflected temperature compensation	0.01 to 1 / manual
testo ε-Assist	Automatic recognition of emissivity and determination of reflected temperature (RTC)
Measurement functions	
Analysis functions	Mean point measurement, hot/cold-spot recognition, Delta T,
testo ScaleAssist	✔
IFOV warner	✔
Imager equipment	
Digital camera	✔
Lens	31° x 23°
Video streaming	via USB, via wireless LAN with testo Thermography App
Storage as JPG	✔
Fullscreen mode	✔

Image storage	
File format	.bmt and .jpg; export options in .bmp, .jpg, .png, .csv, .xls
Memory	Internal memory (2.8 GB)
Power supply	
Battery type	Li-ion battery can be changed on-site
Operating time	4 hours
Charging options	In instrument/in charging station (optional)
Mains operation	✔
Ambient conditions	
Operating temperature range	-15 to +50 °C
Storage temperature range	-30 to +60 °C
Air humidity	20 to 80 %RH, not condensing
Housing protection class (IEC 60529)	IP54
Vibration (IEC 60068-2-6)	2G
Physical features	
Weight	510 g
Dimensions (LxWxH)	219 x 96 x 95 mm
Housing	PC - ABS
PC software	
System requirements	Windows 10, Windows 8, Windows 7
Standards, tests, warranty	
EU directive	EMC: 2014/30/EU RED: 2014/53/EU
Warranty	2 years

2. EXTECH SD800 Datasheet

EXTECH INSTRUMENTS
A FLIR COMPANY

Experience the Extech Advantage

PRODUCT DATASHEET

CO_2/Humidity/Temperature Datalogger

PRELIMINARY DATASHEET

Records data on an SD card in Excel® format

For easy transfer to a PC for analysis

Features:

- Checks for Carbon Dioxide (CO_2) concentrations
- Maintenance free dual wavelength NDIR (non-dispersive infrared) CO_2 sensor
- Triple LCD simultaneously displays CO_2, Temperature and Relative Humidity
- Measurement ranges:
  CO_2: 0 to 4,000ppm
  Temperature: 32 to 122°F (0 to 50°C)
  Humidity: 10 to 95%RH
- Datalogger date/time stamps and stores readings on an SD card in Excel® format for easy transfer to a PC
- Selectable data sampling rate: 5, 10, 30, 60, 120, 300, 600 seconds
- Complete with (6) AAA batteries, 2G SD memory card, Universal AC adaptor, and mounting bracket

Applications:

- Monitor air quality in schools, office buildings, greenhouses, hospitals and anywhere that high levels of carbon dioxide are generated

Specifications	
CO_2	0 to 4,000ppm
Resolution	1ppm
Temperature	32 to 122°F (0 to 50°C)
Resolution	0.1°F/°C
Humidity	10 to 95%
Resolution	0.1%
Datalogging	2,000K data using 2G SD memory card
Dimensions	5.2 x 3.1 x 1.3" (132 x 80 x 32mm)
Weight	9.9oz (282g)

Ordering Information:

SD800.....CO_2/Humidity/Temperature Datalogger

CE

www.extech.com

Specifications subject to change without notice.
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3/25/10 - R1

12.6. PP6 PAKS datasheet list of thematic equipment

1. ArchiCAD 19 NET02 software datasheet

There is no datasheet available for this software available in English language. Please refer to the table 20.

2. TESTO 868 Datasheet

There is no datasheet available for this software available in English language. Please refer to the table 21.

3. TESTO 882 Datasheet

testo

testo 882

Committing to the future

The testo 882 Thermal Imager with a robust 320 x 240 detector

The testo 882 Thermal Imager stands out because of the **new detector with a 320 x 240 array.** It allows for even more precise infrared images.

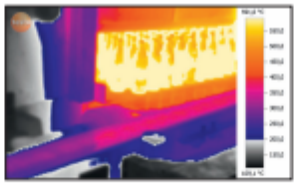
With **76,800 measurement points** you can see small temperature details of the targeted area. It makes it much easier for you to **detect anomalies and weaknesses from greater distances.**

The built-in digital camera with power LEDs simultaneously store a parallel visual image of the targeted area. **The power LEDs guarantee you optimum illumination** of dark areas when recording real images.

Testo IRSoft software package includes our **TwinPix** feature which allows you to **overlay the thermal and visual image** to better understand the targeted conditions. Easy operation with simple icons and intuitive menus.

This thermal imager can also be **equipped to measure high temperatures up to 1022°F.**

Prevent Failures. Increase Efficiency. Reduce Downtime.



Features

- 320 x 240 array for a clear, accurate image
- Large field of view with 32° lens
- High image quality: NETD < 60mk
- Voice recording with the practical headset
- Built-in digital camera with power LEDs
- Min/Max on area calculation
- Lens protection glass
- High temperature measurement up to 1022°F
- Manual and Dynamic motor focus for sharp images and true one hand operation
- Isotherm display in instrument
- Auto hot/cold spot recognition

testo, Inc. • (800) 227-0729 • e-mail: info@testo.com • www.testo.com

APPLICATIONS

Electrical Maintenance

Building Thermography

Mechanical Maintenance

testo 882

Committing to the future

The testo 882 Thermal Imager with a robust 320 x 240 detector

Technical Data

Detector type	FPA 320 x 240 pixels, a-Si
Thermal sensitivity (NETD)	<60 mK at 30°C (86°F)
Field of view / min. focus distance	32° x 23° / 7.8" (standard lens)
Geometric resolution (IFOV)	1.7 mrad
Image refresh rate	9 Hz
Focus	manual and motor focus
Spectral range	8 to 14 µm
Optical field / min. focus distance	33° x 25° / 15.7"
Image size	640 x 480 pixels
Image display	3.5" LCD with 320 x 240 pixels
Display options	only IR / only digital image / IR and digital image
Video output	USB 2.0
Color palettes	9 options (ironbow, rainbow, blue-red, greyscale, inverted grey, sepia, testo, iron)
Temperature range	-4°F to 232°F (-20°C to +100°C) +32°F to +662°F (0°C to 350°C), switchable
High temperature option	+662°F to +1022°F (350°C to +550°C)
Accuracy	± 2°C, ± 2% of rdg. (-4°F to +662°F) ± 3°C, ± 3% of rdg. (+662°F to +1022°F)
Minimum diameter measurement point	0.2" at 3 ft.
Setting emissivity	0.01 to 1 manuell
File format	.bmt; export options in .bmp, .jpg, .png, .csv, .xls
Data storage device	2 GB SD card (approx. 1000 images)
Battery type	Li-ion battery
Operating time	4 hours
Operating temperature range	5°F to +104°F
Storage temperature range	-22°F to +140°F
Protection class of housing	IP 54
Weight	approx. 2 lbs
Dimensions	6" x 4.2" x 10.3"
Tripod mounting	Yes with adapter
Housing	ABS
PC Software	
System requirements	Windows XP (Service Pack 2) Windows Vista, Windows 7, USB 2.0 interface
Warranty	2 years

Accessories

Emissivity adhesive tape Heatproof up to 572°F	0554 0051
Two-bay battery charger	0554 8801
Spare battery	0554 8802
Tripod	0554 8804
Protective lens	0554 8805

Ordering Information

882 Thermal Imager Kit
Part no. 0560 0882 70

All Imager Kits will be delivered in a hard shell case including SD card, USB cable, software power supply and tripod mounting plate.

Distributor:

testo, Inc.
(800) 227-0729
e-mail: info@testo.com
www.testo.com

Information subject to change without notice.
10TES726 1/11 2.5m

12.7. PP7 HEGYVIDEK datasheet list of thematic equipment

1. GREISINGER GFTB 200 Datasheet

GREISINGER electronic

Climate measuring device

Product information **GFTB 200**

04/2013

Precision hygro- / thermo- / barometer

Features

- Adjustable alarm function with integrated buzzer
- Very low current consumption (>6500 hours of operation)
- PC interface
- Additional display of further measuring variables, e.g. dew-point temperature and absolute humidity
- Min/max value storage

Applications

- Humidity monitoring with alarm
- Mobile or stationary weather station
- Housing space, indoor swimming pools
- Office and production space, laboratory, storage rooms
- Museums, galleries, churches
- Refrigeration and AC technology
- Construction, building physics and loss assessment, etc.

GREISINGER electronic GmbH
D - 93128 Regenstauf, Hans-Sachs-Straße 26
Tel.: 09402 / 9383-0, Fax: 09402 / 9383-33, e-mail: info@greisinger.de

The GFTB 200 is an ideal tool for achieving a comfortable room climate. It measures the relevant variables within seconds and informs you, whether the values are in the green, with or without alarm – just as desired. This allows putting the device aside and engaging in more essential things than damage due to moisture and mold formation.

The integrated interface together with the software EBS 20M (optional) allows the device to serve as mobile weather station with long-term recording. The air conditions can be displayed both precise and clear by the additional measuring variables like wet-bulb temperature, absolute humidity and humidity content of air.

Specifications	GTFB 200
Measuring range:	
Temperature:	-25.0°C ... +70.0 °C
Air humidity:	0.0 ... 100.0 % RH (recommended range: 11 ... 90 % RH)
Air pressure:	10.0 ... 1100.0 mbar
Dew-point temperature Td:	-40.0 ... 70.0 °C
Wet-bulb temperature Twb:	-27.0 ... 70.0 °C
Humidity content x:	0.0 ... 280.0 g/kg
Absolute humidity d:	0.0 ... 200.0 g/m³
Resolution:	0.1 % RH; 0.1°C or 0.1°F; 0.1mbar
Accuracy: (±1 digit)	(at nominal temperature = 25°C)
Temperature:	±0.5 % of m.v. ±0.1°C (Pt1000 1/3 DIN B)
Air humidity:	±2.5 % RH (in range 11 ... 90%)
Air pressure:	±1.5 mbar (750...1100 mbar)
Sensor:	
Temperature:	Pt1000
Air humidity:	Capacitive polymer humidity sensor
Air pressure:	Piezoresistive sensor hybrid
Response time:	T_{90} = 10 sec.
Nominal temperature:	25°C
Power supply:	9V-battery type IEC 6F22
Auto-off function:	If auto-off is activated, the device switches automatically off, if no button is pressed within a longer period (selectable 1..120min).
Interface:	Serial interface, directly connectable to USB socket of PC via electrically isolated interface converter USB 3100 N (accessories).
Sea level correction:	The displayed barometer value can be converted to air pressure at sea level. (therefore the altitude has to be entered)

GREISINGER electronic GmbH
D - 93128 Regenstauf, Hans-Sachs-Straße 26
Tel.: 09402 / 9383-0, Fax: 09402 / 9383-33, e-mail: info@greisinger.de

2013-04

Technical Data

Display (indication)	3 1/2 -digit LC display up to 1999 (LCD = liquid crystal display)
Max. measuring rate	1.5 measurements per second
Operating temperature	0°C up to 50°C (32°F up to 122°F)
Temperature for guaranteed accuracy	+23°C +/- 5°C
Storage temperature	-10°C up to 60°C (14°F up to 140°F) <80% Rel. air humidity
Rel. Air humidity	<70% not condensing (with multi-meter)
Voltage supply	9V DC Alkaline Block battery type 006P or 6F22 or 6LR61
Current consumption	approx. 6 mA
Dimensions (LxWxD)	251 x 85 x 40 (mm) incl. sensor support
Weight with battery	approx. 360 g without external sensors

Measuring Tolerances

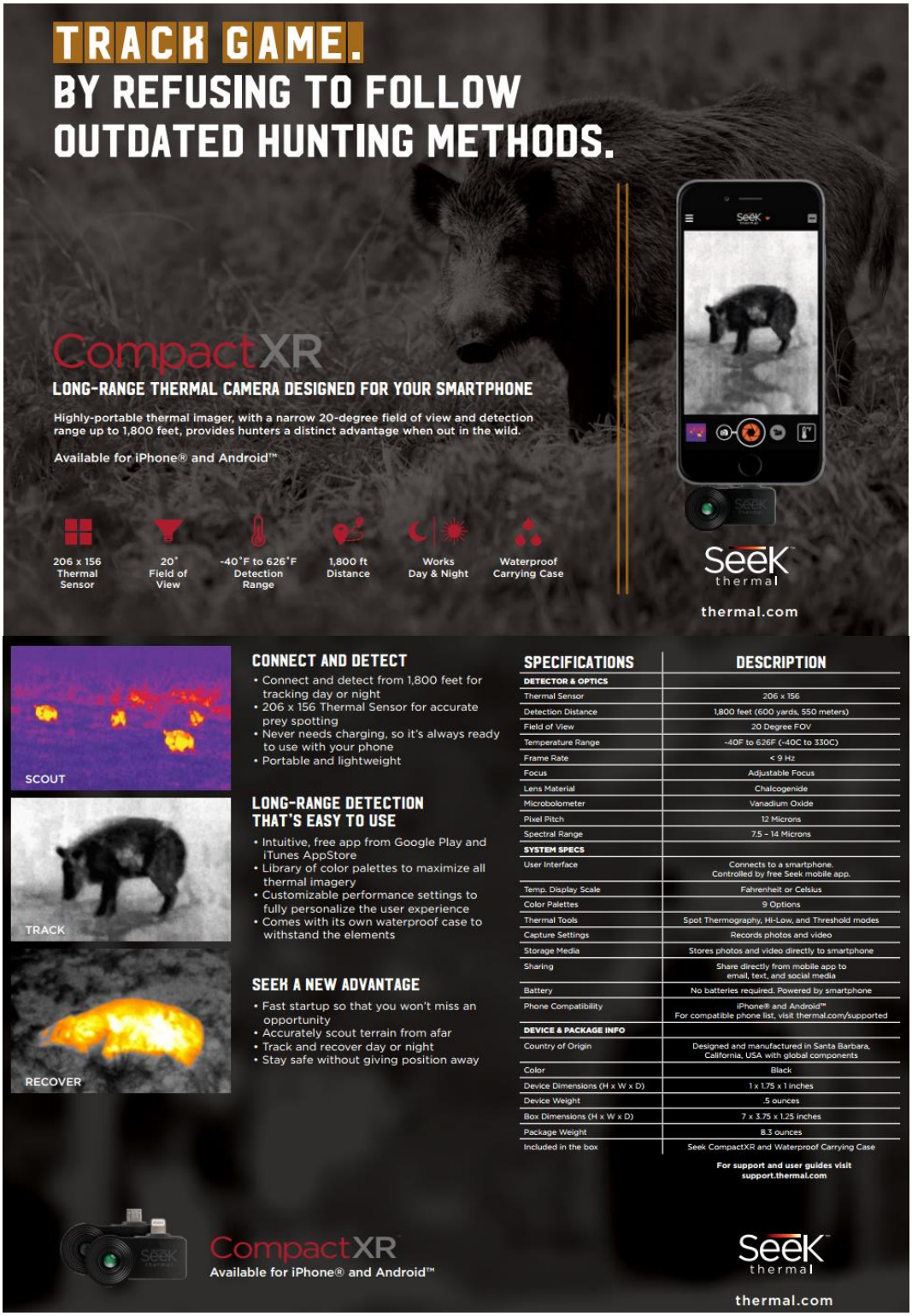
Indication of the accuracy in ± (% of the reading (= rdg) + indication errors in digits (= dgt = number of the smallest digits)). The accuracy is valid for one (1) year at a temperature of +23°C ± 5°C, at a relative air humidity of less than 70 %, not condensing (with the multimeter part).

Function		Measuring data
DB	Measuring range Resolution Frequency range Valuation curve Accuracy Mikrophone	A/C LO 35 up to 100 dB A/C HI 65 up to 130 dB 0.1 dB 30 Hz up to 10 kHz A (hearing), C (linear) ± 3.5 dB at 94 dB, 1 kHz capacitor microphone
%RH	Measuring range Resolution Accuracy Measuring time	25% up to 95% rel. Air humidity 0.1% ± 5% (25°C, 35%~95% RH) approx. 6 min.

Function		Measuring data
°C	Measuring range K-type probe Accuracy Input protection (!)	0°C ~50°C (without probe) -20°C ~ 200°C (0,1° resolution) 200°C ~ 750°C (1° resolution) ± (3% rdg + 2°C); at "0,1°C resolution ± (3.5% rdg + 2°C); at "1°C resolution" max. 60 VDC/ 24 V AC
Lux	Measuring range Resolution Accuracy Repeating accuracy Temperature deviation Light sensor	20, 200, 2000 lux, 20 000 lux (value x10) 1 lux / 10 lux ± (5% rdg + 10dgt) related to a light bulb with a colour temperature of 2856 K +/- 2% ± 0.1% / °C silicon photodiode with filter

Do not exceed the maximum admissible input quantities. Do not touch circuits or circuit parts if voltages higher than 25 V Acrms or 35 V DC might be applied to them! Lethal danger!

3. SEEK THERMAL COMPACT XR SK1002AN Datasheet



FLUKE

VT04, VT04A and VT02 Visual IR Thermometers

Technical Data

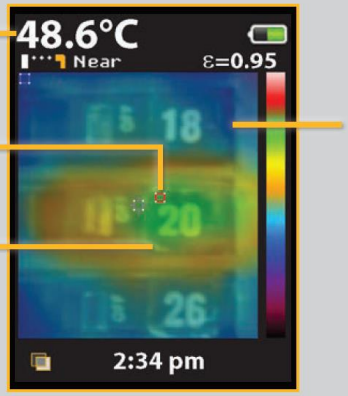
Detect issues instantly!

Eliminate the need for multiple temperature measurements. Fluke Visual IR Thermometers combine the convenience of a spot thermometer with the visual advantage of an infrared heat map.

- See temperature patterns in a blended heat map image
- Intuitive enough to use right out of the box
- Pocket-size design
- Breakthrough affordability

Designed to see it all

Every Fluke Visual IR Thermometer has a built-in digital camera with an infrared heat map overlay to instantly identify the exact location of the problem.

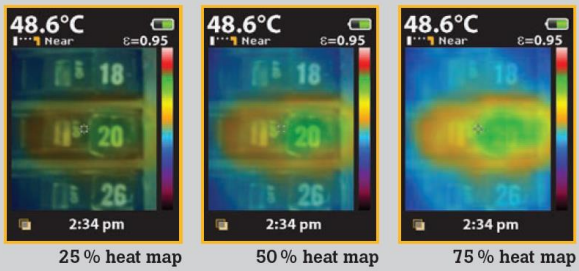


Center-point temperature (°C/°F)

Hot and cold markers

Digital image for context
Clearly see that breaker 20 is overloaded and communicate your findings.

Infrared heat map overlay



25 % heat map | 50 % heat map | 75 % heat map

Key features of a visual IR thermometer:

Fits your budget
Fluke VT02, VT04 and VT04A Visual IR Thermometers give you bold temperature features at a price that allows you to outfit your entire team.

Intuitive interface
Get to work as soon as you take it out of the box.

Pocket-size design
Handy when you need it—easily fits in your tool bag or pocket.

Infrared heat map blending
Blend digital image with heat map overlay at 0 %, 25 %, 50 %, 75 %, and full infrared with one button.

Center-point temperature and hot and cold markers
Hot and cold markers automatically identify hottest and coldest spots within field of view.

SmartView® reporting software
Store up to 10,000 images per GB on included SD card and make reports with Fluke's professional reporting software.

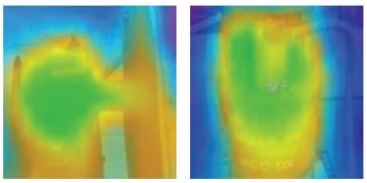
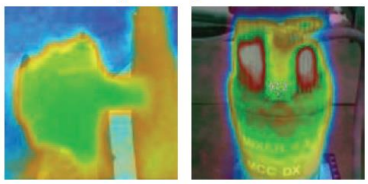
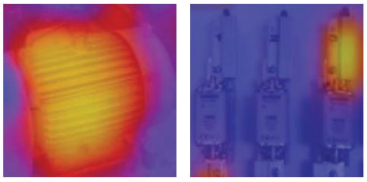
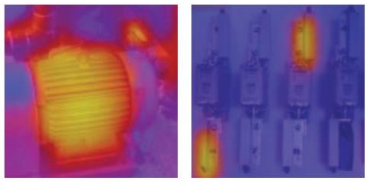
Batteries that work as long as you
Choose between a rechargeable Lithium-ion battery (VT04) and 4 AA batteries (VT04A and VT02). Both options last 8 hours.

Additional benefits of VT04/VT04A

See more with PyroBlend® Plus optics
- **Excellent field of view for tight spaces:** 28° x 28°
- **Four times sharper images than VT02**

Alarm and time lapse features
- **High/low temperature alarms**—high and low temperature alarms flash whenever the temperature threshold is exceeded
- **Time-lapse image capture**—automatically capture images at set intervals of time without being there
- **Auto-monitor alarm**—automatically capture images after a user-selected temperature threshold has been exceeded

Specifications

Key features	VT02	VT04/VT04A
Built-in digital camera	Yes	
Infrared heat map overlay	Yes, five blending modes	
Image optics system	PyroBlend® optic 	PyroBlend® Plus optic 4x sharper image than VT02 
Field of view	20° x 20° 	28° x 28° 
High/low temperature alarms	–	Yes
Time-lapse image capture	–	Yes
Auto-monitor alarm	–	Yes
Battery type	Four (4) AA batteries	VT04: Li-ion rechargeable; VT04A: Four (4) AA batteries
Ergonomics	Slim pocket-sized design	
Hot and cold markers	Yes	
General specifications		
Battery life	Eight (8) hours	
Temperature measurement range	-10 °C to +250 °C (14 °F to 482 °F)	
Temperature measurement accuracy	± 2 °C or ± 2 %	
Temperature measurement	Yes, center-point	
Storage medium (micro SD card)	Stores up to 10,000 images per GB (4 GB card included)	
Infrared spectral band	6.5 µm to 14 µm	
Level and span	Auto	
Focus mechanism	Focus free	
Alignment of blended visual image and infrared heat map	NEAR: <23 cm (9 in) from target FAR: >23 cm (9 in) from target	
Dimensions	21 cm x 7.5 cm x 5.5 cm (8.3 in x 3 in x 2.2 in)	
Weight	385 g (13.5 oz)	VT04: 350 g (12.5 oz); VT04A: 385 g (13.5 oz)
File format	.is2 format saved to SD card. User can create professional reports or export images in SmartView® (BMP, DIB, GIF, JPE, JFIF, JPEG, JPG, PNG, TIF and TIFF); go to Fluke website to download software free	
Safety and compliance	CFR47: 2009 Class A. Part 15 subpart B; CE: EN 61326:2006; IEC/EN 61010-1:2010	
Warranty	Two-years	

12.8. PP6 SIEA datasheet list of thematic equipment

1. Justification of choice of thermocamera of higher quality than other partners

Directive of Ministry of Economy 179/2015 about energy audit prepared in accordance with Directive 2012/27/EU on energy efficiency describes and states requirements for energy audits in Slovakia. According to the directive (179/2015) it is among others necessary to evaluate the state of the energy production and distribution in the building (grounds) as well as the thermal performance of the building. In order to do this crucial step properly, it is necessary to create analyze the surface temperatures of various elements (walls, thermal bridges, energy distribution network…). This will be done using thermometer and thermographic imagery. Analysis performed with those two instruments will provide complex and detailed picture about the building and will help to identify numerous issues as for example:

- Thermal bridges or other shortcomings in the building envelope hidden below plaster
- Insufficient insulation properties of building elements
- Insufficient insulation of heat distribution network
- Overloading of electrical distribution network (generates heat)
- Heat losses due to damages on the boiler
- Risk of mold creation can be identified using hygrometric module of thermometer

There is currently no directive or standard on thermography in Slovakia defining minimal requirements for the equipment. In Slovak practice is therefore commonly used VATh guideline. VATh is German Federation of Applied Thermography which has about 300 members and is the largest thermographer Association in German-speaking countries. VATh released a comprehensive directive/guideline on a thermography, according to which it is recommended to use sensitivity of maximum 60mK in thermography to provide adequate thermal images on professional level. The sensitivity of max 60mK is standardly used in Slovakia.

7. Infrared Camera Equipment

The infrared imaging system beeing used has to meet the following requirements:

Spectral Range:	Cameras working in the MW (Mid-Wave: 3-5 µm) or LW (Long-Wave: 8-12 µm) spectral band can be used.
Measurement Temperature Range	-20° to +500°C (or higher)
OperatingTemperature Range	-10° to +40°C (or higher)
Basic Type:	A split camera/controller concept (monitor and remote control unit separated or alternatively a turnable monitor) is necessary in order to run the inspection also in areas with difficult access
Lenses:	Usually a lens out of the available standard lens set must be used - Wide angle lens - Standard angle lens - Tele lens depending on the particular scope
Thermal resolution:	≤ 100 mK recommended: ≤ 60 mK
Geometrical resolution:	≤ 1,5 mrad (= IFOV of Standard lens)

Figure 3: Screenshot from VATh guideline

According to our experiences, in thermocameras with higher sensitivity (100mK) so called “image noise” oftentimes appears which prevents proper analysis as details on the picture are hard to identify.

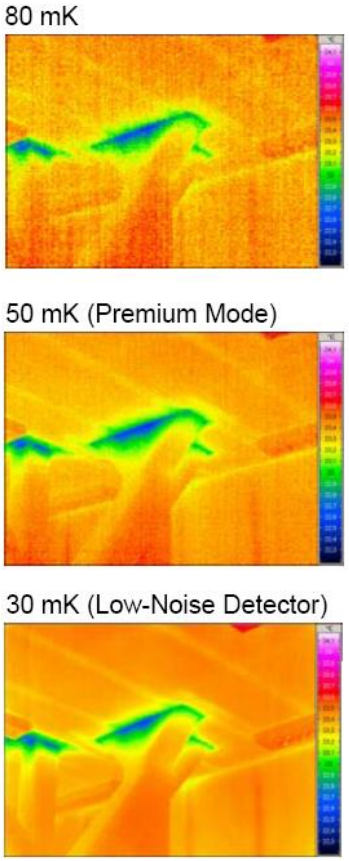


Figure 4: Comparison of thermocameras with different sensitivity

To provide high quality images of the objects in distance (roof, top floor windows…) it is necessary to have an option of optical zoom or high resolution (HD) camera, otherwise the images will not have sufficient resolution resulting in considerable measurement errors as illustrated on following figure. However, it is much cheaper to equip the camera with the optical zoom than to buy a camera with much higher resolution.

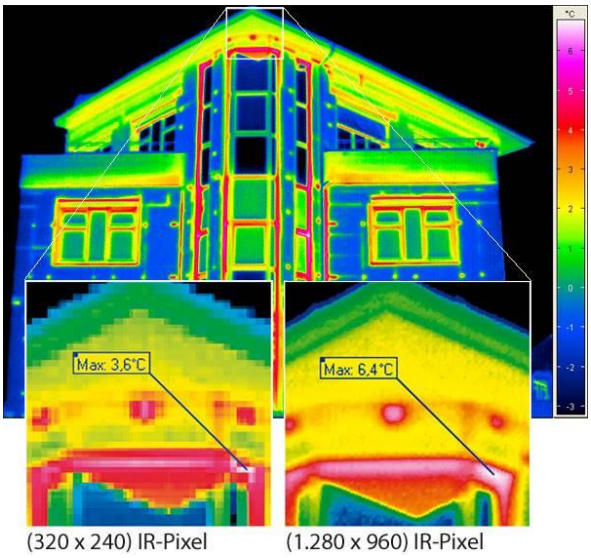


Figure 5: Comparison of thermocameras with different resolution

In conclusion: According to our experiences, in order to provide results, which can be used for thorough analysis of the buildings and results which cannot be doubted by other auditors it is necessary to purchase a thermocamera with described parameters (thermal sensitivity <60mK, with optical zoom). Unfortunately, according to our research, it is not possible to purchase such camera for less than 5 000 EUR.

2. TESTO 610 Datasheet

We measure it. testo

Humidity/temperature measuring instrument

testo 610 – Pocket-sized air humidity measurements

Illustration 1:1

- Measurement of air humidity and temperature
- Incl. dewpoint calculation and Wet Bulb
- Long-term stable Testo humidity sensor
- Hold-function and max./min. values
- Display illumination

The testo 610 simultaneously measures relative air humidity and temperature. It is thus ideally suitable for fast checks on ambient conditions, e.g. in offices, production rooms or in warehouses.
The patented humidity sensor developed by Testo guarantees reliable measurement resulty. The accuracy of ±2.5 %RH is confirmed by a calibration protocol which is included in delivery. Dewpoint calculation and the calculation of Wet Bulb as well as a hold-function and the display of max. and min. values are possible with the testo 610.
The clip-on protective cap, wrist strap and belt holder ensure safekeeping of the instrument. testo 610 is very handy, small and easy to operate.

www.testo.com

Technical data / Accessories

testo 610

testo 610 handy humidity/temperature meter incl. protection cap, batteries, belt holder and calibration protocol

Part no. 0560 0610

General technical data

Measuring rate	1 s
Weight	90 g (batteries and protective cap included)
Operating temperature	-10 to +50 °C
Storage temperature	-40 to +70 °C
Battery type	2 AAA micro batteries
Battery life	200 h (average, without display illumination)
Dimensions	119 x 46 x 25 mm (incl. protective cap)
Protection class	IP20

0981 9734/msp/A/10.2013

Sensor types

	NTC	Testo humid. sensor, cap.
Measuring range	-10 to +50 °C	0 to 100 %RH
Accuracy ±1 digit	±0.5 °C	±2.5 %RH (5 to 95 %RH)
Resolution	0.1 °C	0.1 %RH

Accessories

	Part no.	
Accessories for measuring instrument		
Belt holder	0516 4007	
ISO calibration certificate humidity calibration points 11.3 %RH and 75.3 %RH at +25 °C/+77 °F; per channel/instrument	0520 0076	
ISO calibration certificate/temperature temp. data logger; calibration points -8°C; 0°C; +40°C per channel/instrument	0520 0171	

Subject to change without notice.

3. TESTO 875-2i SET Datasheet

We measure it. testo

Datasheet
Thermal imager

testo 875i – versatile professional-level thermography

- Infrared resolution 160 x 120 pixels
- SuperResolution technology to 320 x 240 pixels
- Thermal sensitivity < 50 mK
- Built-in digital camera with power LEDs
- Exchangeable lenses
- Measurement mode for detecting mould-risk areas
- High temperature measurement up to 550 °C

°C

%RH

The testo 875i thermal imager detects anomalies and weak spots in materials and components quickly and reliably. Thanks to an imaging process, energy losses and cold bridges as well as damage or overheating in industrial systems are detected without contact. Whereas with other methods, cable or pipeline systems must be exposed over a large area, with the thermal imager testo 875i, a single glance is enough. testo SuperResolution technology also increases the resolution of the testo 875i from 160 x 120 pixels in the Software testo IRSoft to 320 x 240 pixels. That's four times as many readings, enabling you to spot even the smallest irregularities.

www.testo.com

Technical data

	testo 875-1i	testo 875-2i
Infrared image output		
Infrared resolution	160 x 120 pixels	
Thermal sensitivity (NETD)	< 50 mK at +30 °C	
Field of view/min. focus distance	32° x 23° / 0.1 m (Standard lens)	32° x 23° / 0.1 m (Tele: 9° x 7° / 0.5 m)
Geometric resolution (IFOV)	3.3 mrad (Standard lens)	3.3 mrad (Tele: 1.0 mrad)
SuperResolution (pixel / IFOV)	320 x 240 pixels / 2.1 mrad (Standard lens)	320 x 240 pixels / 2.1 mrad (Tele: 0.6 mrad)
Image refresh rate	33 Hz*	
Focus	manual	
Spectral range	7.5 to 14 µm	
Image output visual		
Image size / min. focus distance	640 x 480 pixels / 0.4 m	
Image presentation		
Image display	3.5" LCD with 320 x 240 pixels	
Display options	IR image only / real image only/ IR and real image	
Video output	USB 2.0	
Colour palettes	10 (iron, rainbow, rainbow HC, cold-hot, blue-red, grey, inverted grey, sepia, Testo, iron HT)	
Image presentation		
Measuring range	-30 to +100°C / 0 to +350 °C (switchable)	
Accuracy	±2 °C, ±2 % of m.v. (±3 °C of m.v. at -30 to -22 °C)	
High temperature measurement – optional	–	+350 to +550 °C
Accuracy		±3 % of m.v. at +350 to +550 °C
Emissivity / reflected temperature	0.01 to 1 / manual	
Measuring functions		
Display of surface moisture distribution (using manual input)	–	✓
Humidity measurement with radio humidity probe (automatic measurement value transfer in real time)**	–	(✓)
Solar mode	✓	
Analysis function	up to 2 measurement points, Hot/Cold Spot Recognition	up to 2 measurement points, Hot/Cold Spot Recognition, Isotherms, Area measurement (Min-/Max on Area)

* inside the EU, outside 9 Hz
** Wireless humidity probes only in the EU, Norway, Switzerland, USA, Canada, Colombia, Turkey, Brazil, Chile, Mexico, New Zealand, Indonesia
*** excepting USA, China and Japan

	testo 875-1i	testo 875-2i
Imager equipment		
Digital camera	✓	
Power LEDs	–	✓
Standard lens	32° x 23°	
Exchangeable lenses - optional	–	9° x 7°
Laser (laser classification 635 nm, Class 2)***	✓	
Voice recording	–	wired headset
Video streaming (via USB)	✓	
Image storage		
File format	.bmt; export option in .bmp, .jpg, .png, .csv, .xls	
Storage device	SD card 2GB (approx. 2.000 images)	
Power supply		
Battery type	Fast-charging, Li-ion battery can be changed on-site	
Operating time	4 hours	
Charging options	In instrument/in charging station (optional)	
Mains operation	yes	
Ambient conditions		
Operating temperature range	-15 to +40 °C	
Storage temperature range	-30 to +60 °C	
Air humidity	20 to 80 % RH non-condensing	
Housing protection class (IEC 60529)	IP54	
Vibration (IEC 60068-2-6)	2G	
Physical specifications		
Weight	Approx. 900 g	
Dimensions (L x W x H) in mm	152 x 108 x 262	
Tripod mounting	M6	
Housing	ABS	
PC software		
System requirements	Windows XP (Service Pack 3), Windows Vista, Windows 7 (Service Pack 1), Windows 8, interface USB 2.0	
Standards, tests, warranty		
EU Directive	2004 / 108 / EC	
Warranty	2 years	

✓ included in delivery
(✓) optional
– not available

Overview of variants

Features	testo 875-1i	testo 875-2i	testo 875-2i Set
Infrared resolution	160 x 120 pixels		
Thermal sensitivity (NETD)	< 50 mK		
Measuring range	-30 to +350 °C		
Image refresh rate	33 Hz*		
Lens 32° x 23°	✓	✓	✓
Exchangeable telephoto lens 9° x 7°	–	(✓)	✓
SuperResolution	✓	✓	✓
High temperature measurement up to 550 °C	–	(✓)	(✓)
Integrated digital camera	✓	✓	✓
Integrated power LEDs	–	✓	✓
Voice recording using the headset	–	✓	✓
Laser pointer**	✓	✓	✓
Display of surface moisture distribution (by manual input)	–	✓	✓
Humidity measurement with wireless humidity probe*** (automatic measurement value transfer in real time)	–	(✓)	(✓)
Isotherm display in instrument	–	✓	✓
Min/Max on Area calculation	–	✓	✓
Auto Hot/Cold Spot Recognition	✓	✓	✓
Solar mode	✓	✓	✓
Lens protection glass	(✓)	(✓)	✓
Additional battery	(✓)	(✓)	✓
Fast battery charger	(✓)	(✓)	✓

✓ included in delivery
(✓) optional
– not available

* inside the EU, outside 9 Hz
** excepting USA, China and Japan
*** Wireless humidity probes only in the EU, Norway, Switzerland, USA, Canada, Colombia, Turkey, Brazil, Chile, Mexico, New Zealand, Indonesia

0981 8814/msp/A/01.2016

Subject to change without notice.

4. BOSCH GLM 80 Professional Datasheet

BOSCH
Invented for life

Laser Distance and Angle Measurer
GLM 80

Benefits: GLM 80 Laser Distance and Angle Measurer

- Precision Distance and Angle Measuring Technology
- Indirect Length Measurement Mode Backlit Display with Tilt Screen Technology Integrated Li-ion Battery Min./Max. Measurement Mode Multi-Surface Area Mode
- Backlit Display with Tilt Screen Technology
- Integrated Li-ion Battery
- Min./Max. Measurement Mode
- Multi-Surface Area Mode

Specifications: GLM 80 Laser Distance and Angle Measurer

Battery	3.7 Li-ion Battery
Laser Diode	Class II 630 - 670 nm
Leveling Accuracy (Vial)	+/- 0.2°
Measuring Accuracy	Typ. +/-1/16-in (1.5 mm)
Range	2-in (50 mm) to 265-ft (80 m)
Weight (oz.)	5 oz. (0.14 kg)

Includes

Li-ion Battery
Charger
Belt Pouch