



## Center for Cooperative Aquaculture Research

### Containerized 250 kW Hamont Boiler System Manual



# Table of Contents

<b>SECTION 1 GENERAL INFORMATION .....</b>	<b>3</b>
CONTACT INFORMATION .....	4
<b>SECTION 2 SITE INFORMATION.....</b>	<b>5</b>
SITE PLAN .....	6
<b>SECTION 3 DESIGN .....</b>	<b>7</b>
CONTAINER DRAWING.....	8
<b>SECTION 4 ENGINEERING .....</b>	<b>9</b>
ENGINEERING AS BUILTS .....	10
ALFA LAVAL PLATE HEAT EXCHANGER DRAWING .....	12
ALFA LAVAL SPECIFICATION SHEET .....	13
<b>SECTION 5 HAMONT .....</b>	<b>14</b>
OWNER'S MANUAL .....	15
SPARE PARTS LIST .....	104
MOTOR AND DEVICES LIST .....	105
ALARM LIST .....	106
OPERATOR'S CHECKLIST .....	108
SECTION LEVEL DESCRIPTIONS .....	108
LEVEL 1 SITE SUPERVISION .....	109
LEVEL 2 REGULAR MAINTENANCE .....	110
LEVEL 3 FULL BOILER SERVICE .....	111
FUEL INPUT CALCULATOR .....	112
COMMISSIONING SHEET.....	113
COMBUSTION SETTINGS .....	114
<b>SECTION 6 VACUUM SYSTEM.....</b>	<b>117</b>
FROLING UNIVERSAL SUCTION PICK-UP .....	118
COMFORT PELLET BOX PAGE 1 .....	118
COMFORT PELLET BOX PAGE 2 .....	119
ECO PELLET BOX.....	120
SUCTION PROBES AND LINES .....	121
GRUNER MOTOR DATA SHEET .....	122
TECHNICAL DATA SHEET .....	122
TECHNICAL DATA SHEET PAGE 2 .....	123
CONNECTION AND SAFETY REMARKS.....	124
TECHNICAL DRAWING .....	125
FROLING PICK UP .....	126
<b>SECTION 7 HEAT METER.....</b>	<b>127</b>
KAMSTRUP MULTICAL 602 LEAFLET .....	128
KAMSTRUP MULTICAL 602 PAGE 1 .....	128
KAMSTRUP MULTICAL 602 PAGE 2 .....	129
KAMSTRUP MULTICAL 602 PAGE 3 .....	130
KAMSTRUP MULTICAL 602 TECHNICAL DESCRIPTION .....	131
KAMSTRUP ULTRAFLW 54 DATASHEET .....	259

**Section 1 General Information**

## Contact Information

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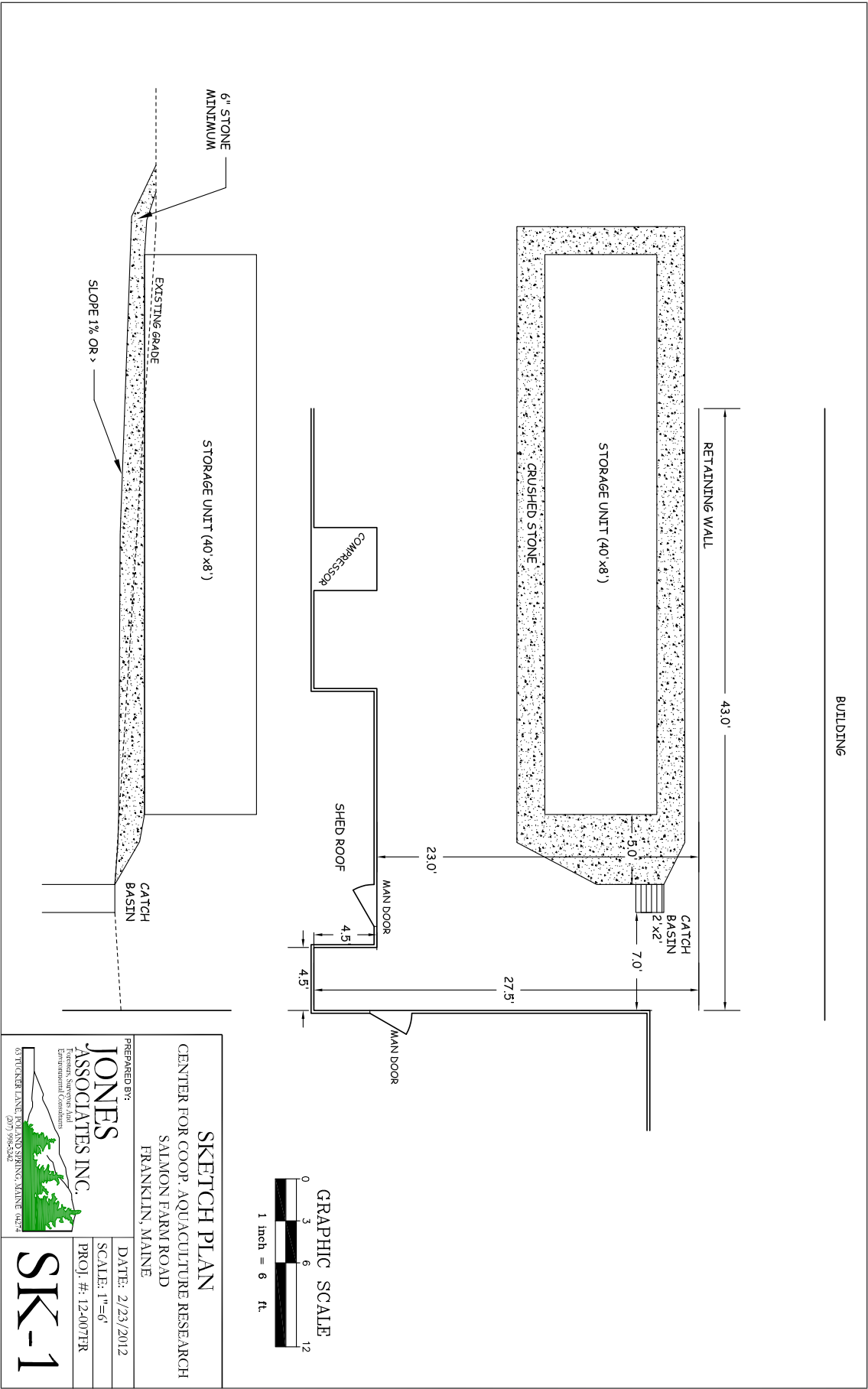
### Center for Cooperative Aquaculture Research

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**Section 2 Site Information**

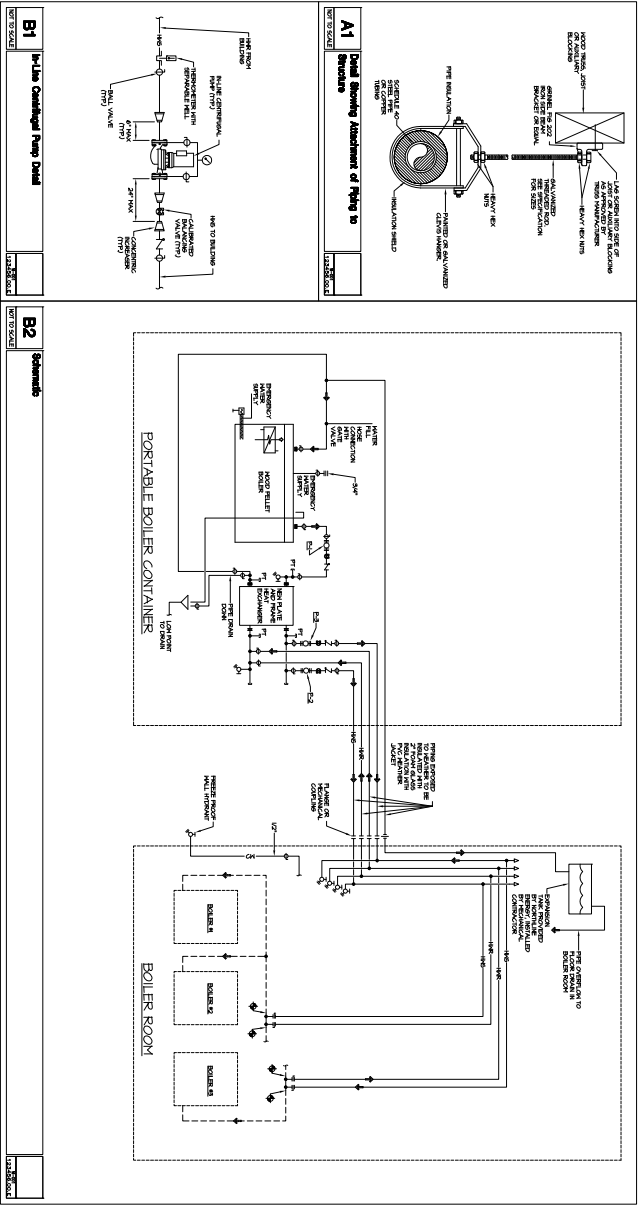
Site Plan



# Section 3 Design



## Section 4 Engineering





CONSULTANT-

**KEY PLAN:**

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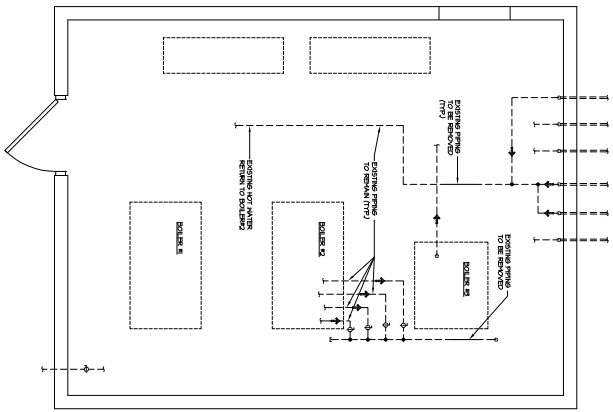
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**FIRST FLOOR PIPING &  
DEMOLITION**

SEAL

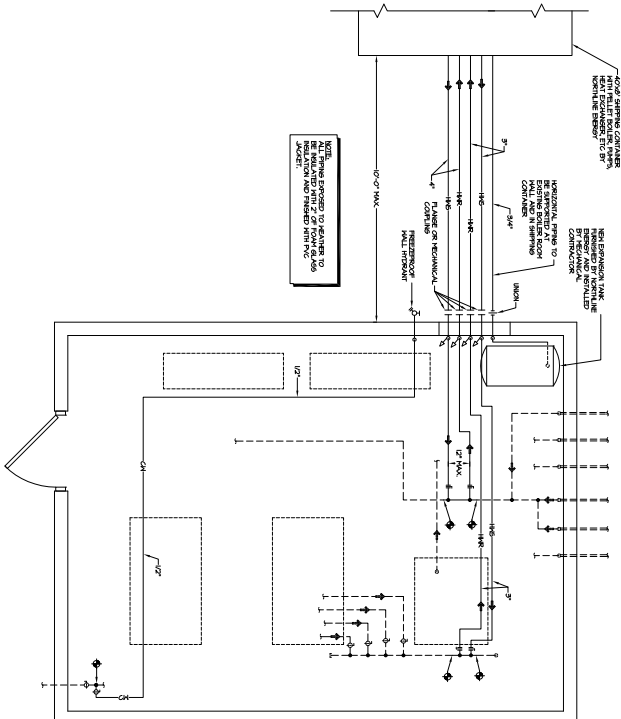
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**FIRST FLOOR - PIPING - DEMOLITION**  
SCALE: 1/2"=1'-0"



FIRST FLOOR - PIPING  
SCALE: 1/2"=1'-0"

## SYMBOLS & ABBREVIATIONS

	DRILLING PIPE INTO STEEL
	DRILLING PIPE INTO CAST IRON
	DRILLING PIPE INTO CONCRETE
	DRILLING PIPE INTO BRICK
	DRILLING PIPE INTO MASONRY
	DRILLING PIPE INTO ASPHALT
	DRILLING PIPE INTO GRAVEL
	DRILLING PIPE INTO SAND
	DRILLING PIPE INTO CLAY
	DRILLING PIPE INTO SILT
	DRILLING PIPE INTO MUD
	DRILLING PIPE INTO WATER
	DRILLING PIPE INTO AIR
	DRILLING PIPE INTO GAS
	DRILLING PIPE INTO OIL
	DRILLING PIPE INTO FUEL
	DRILLING PIPE INTO ACID
	DRILLING PIPE INTO BASE
	DRILLING PIPE INTO SALT
	DRILLING PIPE INTO SUGAR
	DRILLING PIPE INTO GUM
	DRILLING PIPE INTO RESIN
	DRILLING PIPE INTO WAX
	DRILLING PIPE INTO GREASE
	DRILLING PIPE INTO LUBRICANT
	DRILLING PIPE INTO COOLANT
	DRILLING PIPE INTO HYDRAULIC FLUID
	DRILLING PIPE INTO AIR LINE
	DRILLING PIPE INTO WATER LINE
	DRILLING PIPE INTO GAS LINE
	DRILLING PIPE INTO OIL LINE
	DRILLING PIPE INTO FUEL LINE
	DRILLING PIPE INTO ACID LINE
	DRILLING PIPE INTO BASE LINE
	DRILLING PIPE INTO SALT LINE
	DRILLING PIPE INTO SUGAR LINE
	DRILLING PIPE INTO GUM LINE
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	DRILLING PIPE INTO G

DEMOLITION  
DRAWING NOTE

- A. PRELIMINARY PART FIVE IS COMPARATIVE AND NOT PLANNED TO AFFECT CONSTRUCTION IN ANY WAY. CHANGES TO THE PRELIMINARY REGULATIONS MAY HAVE OCCURRED THAT ARE NOT INDICATED HEREIN. THE PRELIMINARY REGULATIONS ARE SUBJECT TO REVISION, AND THE PRELIMINARY REGULATIONS WILL BE REVISITED. THE PRELIMINARY REGULATIONS WILL BE REVISITED. THE PRELIMINARY REGULATIONS WILL BE REVISITED.
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**NOTE:**  
ALL NEW HYDRONIC HOT WATER PIPING TO BE  
INSULATED WITH 2" FIBERGLASS INSULATION

**ISSUE:**

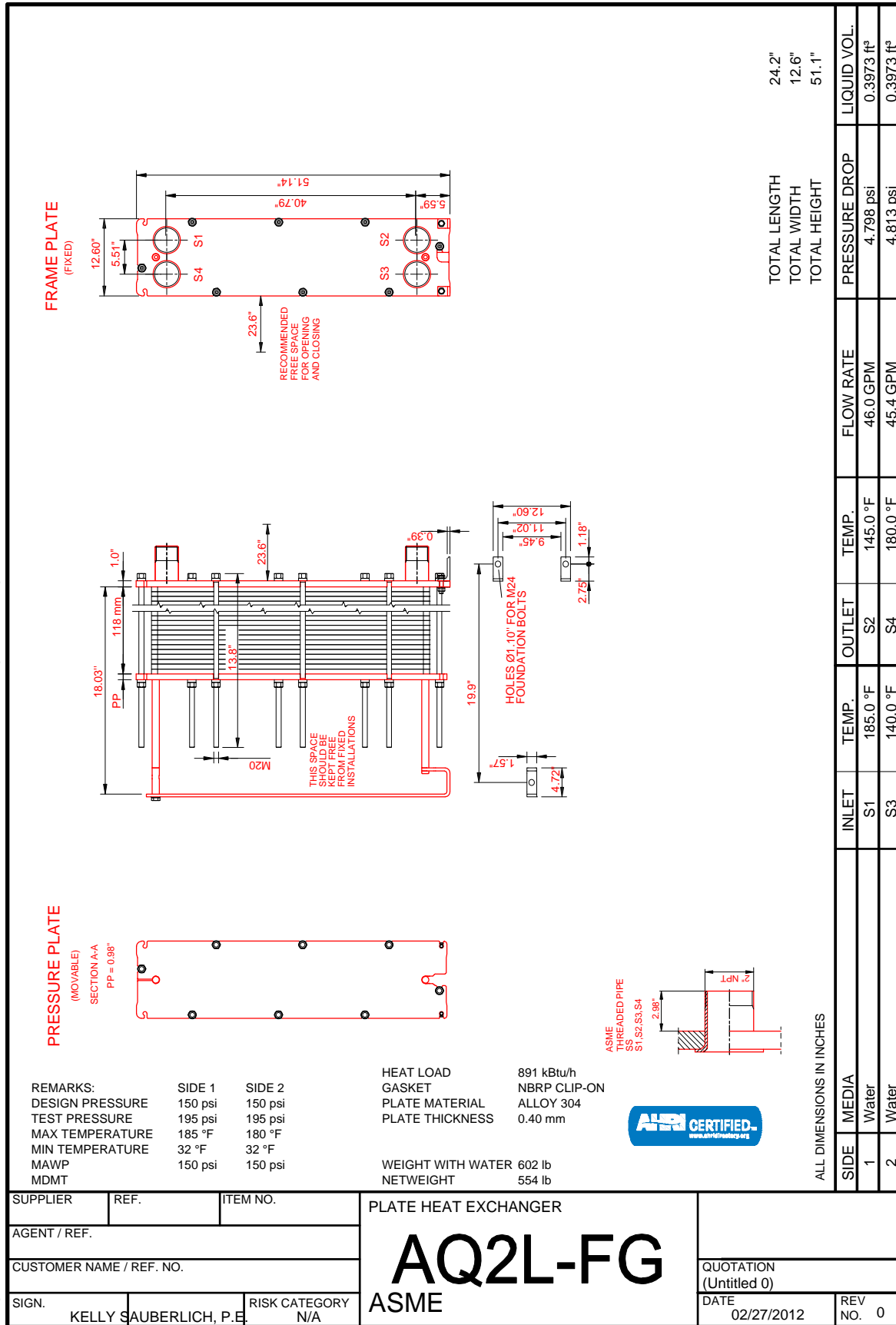
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**DRAWING TITLE:**  
**FIRST FLOOR PIPING &  
DEMOLITION**

# Alfa Laval Plate Heat Exchanger Drawing

This is a general drawing. Additional parts, if required, like protection sheets, inspection covers, etc. are not displayed.

Designed constructed and stamped in accordance with 2010 ASME Code and latest Addendum.





# Alfa Laval Specification Sheet



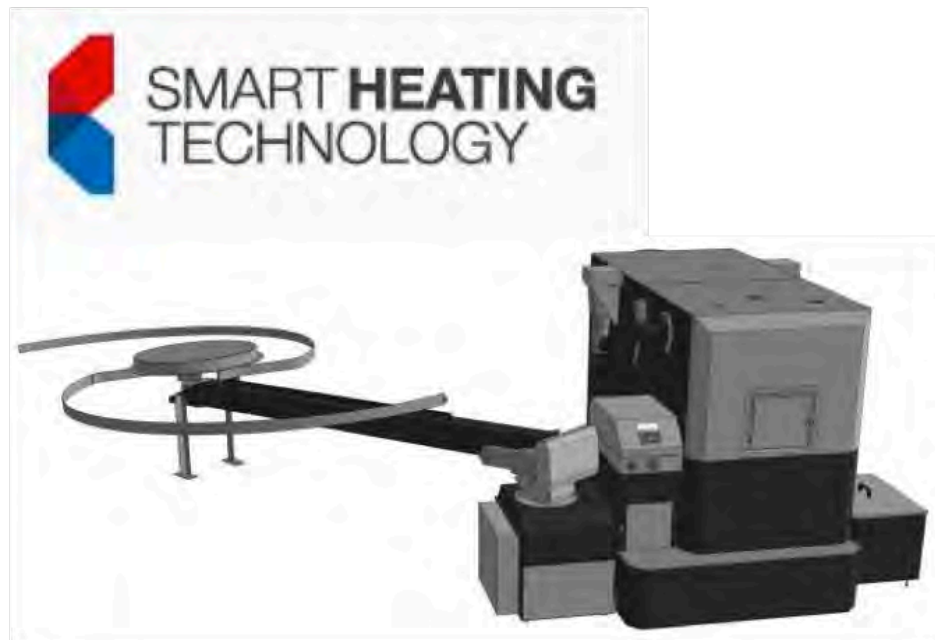
## Alfa Laval Plate Heat Exchanger Specification

Customer: DiGiorgio  
Model: AQ2L-FG  
Project: (Untitled 0)  
Item:

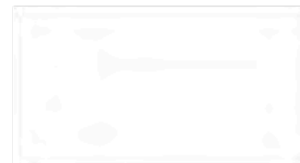
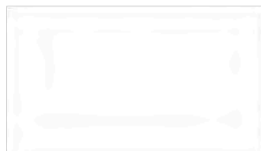
Date: 2/27/2012

		Hot Side	Cold Side
Fluid		Water	Water
Density	lb/ft³	60.87	60.96
Specific heat capacity	Btu/lb, °F	1.00	1.00
Thermal conductivity	Btu/ft,h, °F	0.384	0.383
Viscosity.inlet	cP	0.333	0.465
Viscosity.outlet	cP	0.446	0.344
Volume flow rate	GPM	46.0	45.4
Inlet temperature	°F	185.0	140.0
Outlet temperature	°F	145.0	180.0
Pressure drop	psi	4.80	4.81
Heat exchanged	kBtu/h	891.0	
L.M.T.D.	°F	5.0	
Heat transfer area	ft²	140.0	
Rel. directions of fluids		Countercurrent	
Number of plates		53	
Number of passes		1	1
Additional plate capacity		4	
Plate material / Thickness		ALLOY 304 / 0.40 mm	
Gasket material		NBRP CLIP-ON	NBRP CLIP-ON
Connection material		Stainless steel	Stainless steel
Connection diameter	in	2	2
Nozzle orientation		S1 -> S2	S4 <- S3
Pressure vessel code		ASME	
Design Pressure	psi	150.0	150.0
Test pressure	psi	195.0	195.0
Design temperature	°F	185.0	180.0
Overall length x width x height	in	24 x 13 x 51	
Liquid volume	ft³	0.4	0.4
Net weight, empty / operating	lb	554 / 602	

**Section 5 Hamont**



## **Operating Manual for Boilers**



## Legend

<b>1</b>	<b>Brief information</b>	<b>6</b>
1.1	Advantages of our biomass boilers	6
<b>2</b>	<b>Safety instructions</b>	<b>7</b>
<b>3</b>	<b>Description of types</b>	<b>8</b>
<b>4</b>	<b>Parts of the equipment</b>	<b>9</b>
<b>5</b>	<b>Delivery, installation, assembly</b>	<b>12</b>
5.1	Readiness of the boiler room	12
5.2	Directions for the installation	13
5.3	Safe distances	13
5.3.1	Subject to Approval from the side of the Building Authority	14
5.3.2	Characteristics of the Boiler Room	14
5.3.3	Chimney	14
5.3.4	Fuel storage	14
5.3.5	Standards for design and assembly of the boilers	15
5.4	Assembly of the equipment	15
5.4.1	Electrical connection	26
5.4.2	Connection to the smoke flue and the exhaust fan	29
5.4.3	Water connection	29
5.4.4	Quality of the feed-water and boiler-water	30
5.4.5	Refilling of the water	30
5.4.6	Adjusting device and measuring equipment	30
5.4.7	Safety device of the water heating systems	31
5.4.8	Protection against exceeding the highest working excess pressure	32
5.5	Connection diagram	33
5.5.1	Hydraulic diagram	33
5.5.2	Diagram of electroconnections	36
<b>6</b>	<b>Operation of the SMART Control unit</b>	<b>46</b>
6.1	Safety instructions	46
6.2	Attendance and display elements	47
6.3	Control unit functionality	48
6.3.1	Main menu	48
6.3.1.1	Menu 1.13 User setting	49
6.3.1.1.1	Menu 1.13.1 Temperatures	49
6.3.1.1.1.1	Menu 1.13.1.1 Setting value	49
6.3.1.1.1.2	Menu 1.13.1.2 Setting return Temp.	49
6.3.1.1.2	Menu 1.13.2 Status binary inputs	50
6.3.1.1.2.1	Menu 1.13.2.1 External (On/off)	50
6.3.1.1.2.2	Menu 1.13.2.2 Safety limit term	50
6.3.1.1.2.3	Menu 1.13.2.3 KM1 Fault	50
6.3.1.1.2.4	Menu 1.13.2.4 KM2 Fault	50
6.3.1.1.2.5	Menu 1.13.2.5 Safe canystr	51
6.3.1.1.2.6	Menu 1.13.2.6 TK M1 Conveyor 2	51
6.3.1.1.2.7	Menu 1.13.2.7 TK M2 feeder 1	51
6.3.1.1.2.8	Menu 1.13.2.8 TK M3 deashing	51

6.3.1.1.2.9	Menu 1.13.2.9 TK M6 Burner cleaning	51
6.3.1.1.2.10	Menu 1.13.2.10 TK M4/5 Exchanger cleaning	51
6.3.1.1.2.11	Menu 1.13.2.11 TK M7 Exch. deashing	51
6.3.1.1.2.12	Menu 1.13.2.12 Level M2 Conveyor	51
6.3.1.1.2.13	Menu 1.13.2.13 On damper M1Conveyor	51
6.3.1.1.2.14	Menu 1.13.2.14 Off damper M1Conveyor	51
6.3.1.1.2.15	Menu 1.13.2.15 Exchanger damper	51
6.3.1.1.3	Menu 1.13.3 Status binary outputs	52
6.3.1.1.3.1	Menu 1.13.3.1 M1 Conveyor 2	52
6.3.1.1.3.2	Menu 1.13.3.2 M2 Feeder 1	52
6.3.1.1.3.3	Menu 1.13.3.3 M3 Deashing	52
6.3.1.1.3.4	Menu 1.13.3.4 M6 Burner cleaning	52
6.3.1.1.3.5	Menu 1.13.3.5 M4/5 Exchanger cleaning	52
6.3.1.1.3.6	Menu 1.13.3.6 M7 Exchanger deashing	52
6.3.1.1.3.7	Menu 1.13.3.7 MIX opening	52
6.3.1.1.3.8	Menu 1.13.3.8 MIX closing	53
6.3.1.1.3.9	Menu 1.13.3.9 M9 Boiler pump	53
6.3.1.1.3.10	Menu 1.13.3.10 Exhaust dumper	53
6.3.1.1.3.11	Menu 1.13.3.11 Conveyor Damper	53
6.3.1.1.3.12	Menu 1.13.3.12 Ignitb n	53
6.3.1.1.4	Menu 1.13.4 Status analog inputs	53
6.3.1.1.4.1	Menu 1.13.4.1 Boiler Temperature	53
6.3.1.1.4.2	Menu 1.13.4.2 Boiler return Tepm.	53
6.3.1.1.4.3	Menu 1.13.4.3 MIX Temperature	54
6.3.1.1.4.4	Menu 1.13.4.4 Exhaust gas Temperature	54
6.3.1.1.4.5	Menu 1.13.4.5 Backfie Temperature	54
6.3.1.1.4.6	Menu 1.13.4.6 Undrepressure	54
6.3.1.1.4.7	Menu 1.13.4.7 O2 concentration	54
6.3.1.1.5	Menu 1.13.5 Status analog outputs	54
6.3.1.1.5.1	Menu 1.13.5.1 Exhaust fan	54
6.3.1.1.5.2	Menu 1.13.5.2 Primary Fan	54
6.3.1.1.5.3	Menu 1.13.5.3 Secondary Fan 1	54
6.3.1.1.5.4	Menu 1.13.5.4 Secondary Fan 2	54
6.3.1.2	Menu 1.15 Language selectb n	55
6.3.1.3	Menu 1.16 Password enter	55
6.3.1.4	Menu 1.14 Service	56
6.3.1.4.1	Menu 1.14.1 Manual control	57
6.3.1.4.1.1	Menu 1.14.1.1 Fans	57
6.3.1.4.1.1.1	Menu 1.14.1.1.1 Primary fans	57
6.3.1.4.1.1.2	Menu 1.14.1.1.2 Secondary Fan 1	58
6.3.1.4.1.1.3	Menu 1.14.1.1.3 Secondary Fan 2	58
6.3.1.4.1.1.4	Menu 1.14.1.1.4 Exhaust Fan	58
6.3.1.4.1.2	Menu 1.14.1.2 Engines	58
6.3.1.4.1.2.1	Menu 1.14.1.2.1 M1 Conveyor 2	58
6.3.1.4.1.2.2	Menu 1.14.1.2.2 M2 Feeder 1	58
6.3.1.4.1.2.3	Menu 1.14.1.2.3 M3 Deashing	58
6.3.1.4.1.2.4	Menu 1.14.1.2.4 M4/5 Exchanger cleaning	59
6.3.1.4.1.2.5	Menu 1.14.1.2.5 M6 Burner cleaning	59
6.3.1.4.1.2.6	Menu 1.14.1.2.6 M7 Exchanger deashing	59
6.3.1.4.1.3	Menu 1.14.1.3 Damper	59
6.3.1.4.1.3.1	Menu 1.14.1.3.1 Exhaust Damper	59
6.3.1.4.1.3.2	Menu 1.14.1.3.2 Conveyor Damper	59
6.3.1.4.1.4	Menu 1.14.1.4 Pumps	60
6.3.1.4.1.4.1	Menu 1.14.1.4.1 M9 Boiler pump	60
6.3.1.4.1.5	Menu 1.14.1.5 Valves	60
6.3.1.4.1.5.1	Menu 1.14.1.5.1 MIX opening	61
6.3.1.4.1.5.2	Menu 1.14.1.5.2 MIX closing	61
6.3.1.4.1.6	Menu 1.14.1.6 Ignitb n	61
6.3.1.4.1.6.1	Menu 1.14.1.6.1 Ignitb n	61

6.3.1.4.2	Menu 1.14.2 Underpressure	62
6.3.1.4.2.1	Menu 1.14.2.1 Underpressure setth g	62
6.3.1.4.2.2	Menu 1.14.2.2 Reduce underpressure	62
6.3.1.4.3	Menu 1.14.3 Oxygen sensor	63
6.3.1.4.3.1	Menu 1.14.3.1 Setth g O2 concentratb n	63
6.3.1.4.3.2	Menu 1.14.3.2 O2 calibratb n	64
6.3.1.4.3.3	Menu 1.14.3.3 Decreasing power	64
6.3.1.4.3.4	Menu 1.14.3.4 Increasing power	64
6.3.1.4.3.5	Menu 1.14.3.5 Clear err fba gs	64
6.3.1.4.3.6	Menu 1.14.3.6 O2sensor status	64
6.3.1.4.3.7	Menu 1.14.3.7 Time to start Calibratb n	64
6.3.1.4.3.8	Menu 1.14.3.8 Time to finish calibratb n	64
6.3.1.4.4	1.14.4 Fans	65
6.3.1.4.4.1	Menu 1.14.4.1 Power primary fan	65
6.3.1.4.4.2	Menu 1.14.4.2 Power secondary 1 fan	65
6.3.1.4.4.3	Menu 1.14.4.3 Power secondary 2 fan	66
6.3.1.4.4.4	Menu 1.14.4.5 Exhaust Fan	66
6.3.1.4.4.5	Menu 1.14.4.6 Underpressure hysteresis	66
6.3.1.4.5	Menu 1.14.5 Engines	66
6.3.1.4.5.1	Menu 1.14.5.1 M3 Deash.number of ...	67
6.3.1.4.5.2	Menu 1.14.5.2 M3 Deashing Time	67
6.3.1.4.5.3	Menu 1.14.5.3 M4/5 Exch.number of achrg.	68
6.3.1.4.5.4	Menu 1.14.5.4 M4/5 Time Exchanger cleaning	68
6.3.1.4.5.5	Menu 1.14.5.5 M6 Burner number of ...	68
6.3.1.4.5.6	Menu 1.14.5.6 M6 Burner cl. time ...	69
6.3.1.4.5.7	Menu 1.14.5.7 M7 Deash.exh.number ...	69
6.3.1.4.5.8	Menu 1.14.5.8 M7 Exch.Deashing Time	70
6.3.1.4.5.9	Menu 1.14.5.9 M1 Max. time feeding	70
6.3.1.4.6	Menu 1.14.6 Damper	70
6.3.1.4.6.1	Menu 1.14.6.1 Exh.Temp.close damper	71
6.3.1.4.6.2	Menu 1.14.6.2 Exh.Temp.open damper	71
6.3.1.4.6.3	Menu 1.14.6.3 Damper delay	71
6.3.1.4.6.4	Menu 1.14.6.4 Boiler Temp.open damper	72
6.3.1.4.7	Menu 1.14.7 Pumps	72
6.3.1.4.7.1	Menu 1.14.7.2 Min.boiler Temp.	72
6.3.1.4.7.2	Menu 1.14.7.3 Max.boiler temp.	73
6.3.1.4.8	Menu 1.14.8 Ignitb n	73
6.3.1.4.8.1	Menu 1.14.8.1 Ignitb n Time	73
6.3.1.4.8.2	Menu 1.14.8.2 Exch.temp. Ignitb n	74
6.3.1.4.8.3	Menu 1.14.8.3 Space between Ignitb ns	74
6.3.1.4.8.4	1.14.8.4 Ignitb n repetit ion	74
6.3.1.4.8.5	Menu 1.14.8.5 Exh.Gas Difference	75
6.3.1.4.8.6	Menu 1.14.8.6 Feeding between Ignitb n	75
6.3.1.4.9	Menu 1.14.9 Valves	75
6.3.1.4.9.1	Menu 1.14.9.1 Open Time	76
6.3.1.4.9.2	Menu 1.14.9.2 Close Time	76
6.3.1.4.10	Menu 1.14.10 Power setth g	76
6.3.1.4.10.1	Menu 1.14.10.1 Max. Power Pause	77
6.3.1.4.10.2	Menu 1.14.10.2 Min. Power Pause	77
6.3.1.4.10.3	Menu 1.14.10.3 First feeding	77
6.3.1.4.10.4	Menu 1.14.10.4 Feeder on time	78

## 7 Operation 79

7.1.1	Light up the boiler	79
7.1.2	Normal operatb n	79
7.1.3	Manual operatb n	79
7.1.4	Return run	80
7.1.5	Boiler shutdown	80



7.2	<i>Failures</i> .....	81
7.2.1	Restart of the controlling unit.....	81
<b>8</b>	<b>Maintenance</b> .....	<b>81</b>
8.1	<i>Checking book</i> .....	81
8.2	<i>Regular maintenance</i> .....	81
8.2.1	Weekly checks.....	81
8.2.2	Monthly checks.....	81
8.2.3	Half-year checks.....	82
8.2.4	Sequence of works.....	82
8.3	<i>Diagram of the chain gear of the turbulators</i> .....	84

# 1 Brief information

Dear Ladies and Gentlemen Customers!

We congratulate you on the acquisition of the heating biomass appliance from the company Smart Heating Technology Ltd. By buying such appliance you will contribute to the protection of our environment and sources, and moreover you will dispose of an extraordinary comfortable and efficient heating appliance.

Please, read this Operating Manual carefully prior to place the boiler in operation. It contains all the data and information you require for the perfect operation of the equipment. However, if some questions remain unanswered, then simply contact by telephone the Customer Service of our company. They will immediately assist you, possibly come to you as soon as possible. As for the damage caused by non-observance of the safety and operation instructions mentioned hereinafter, no possibility of claim exists. Therefore we also recommend observing the prescribed professional technical checks performed by our Service Department. The forms of the contractual guarantee are stipulated in the "Contract of purchase" and in the "Certificate of warranty".

Several renowned research institutes and universities participated in the development of our equipment. The appliance bought by you ranks among the natural cycle of energy thanks to the perfect biomass combustion.

The boilers SMART 150-500 kW have been awarded a registered trademark of Minister of the Czech Republic "Ecologically desirable product".

## 1.1 Advantages of our biomass boilers

More and more plants, as well as the heating stations, use the biomass as the energy medium considerate to the environment. We have achieved this especially due to managing many various tasks.

Advantages:

1. Combustion of wood shavings, sawdust, other crushed waste, wood bark, wood briquettes, as well as of the pellets to an increasing extent.
2. Proven quality: with regard to the globally existing problems of the environment the following company's philosophy has been developed:
  - a dynamic team under the experienced leadership
  - we offer the highest quality instead of cheap products
  - a variability of sets according to the special requirements of the Ordering Customer
3. The computer controlled combustion equipments breed a high degree of efficiency. During the complete combustion (long time periods of burning) with exactly batched air quantity we achieve a very high degree of efficiency in comparison with the usual equipments. It is very important to prevent from the inefficient and undesirable losses caused by the emission of heat. We have achieved this thanks to the double insulation of the boiler.
4. A special construction of the combustion chamber. The construction with the post-combustion by means of the secondary supply air. Thanks to this newly developed combustion chamber we have extended in a crucial way the dwell time (the time of the burnup in the hot zone). Due to this method we have achieved the revolutionary values of emissions.
5. We can offer special experiences in the area of automated discharge of the material from the silos by means of the worm-conveyers (inclined worm up to 7 m, horizontal worms up to 10 m and 12 m).





## 2 Safety instructions

When designing the Smart Heating Technology Ltd. equipment we have placed great emphasis especially on the safety. As it concerns combustion equipment, it is a prerequisite to observe some simple, but important rules during the attendance.

### **Safety directions of the company Smart Heating Technology Ltd.!**

#### **"Do not play with fire!"**

- Please, read this Operating Manual carefully prior to place the boiler in operation and observe especially the safety instructions. When uncertain, please, refer to the relevant chapters in this Manual.
- Always close carefully all the covers. In the equipment the flap valve of the protection against the fire must be always released (unlocked).
- When opening the boiler door, please, pay attention to that neither the smoke nor the sparks would get outside the boiler space. Never leave the boiler door open unattended.
- Take care of a sufficient fresh air supply to the boiler room and avoid the low temperatures in the boiler room.
- To improve the burning, never use any liquid combustibles, for example petrol, etc., close to the warm boiler.
- Perform regularly the service works or use our Customer Service.
- It is necessary to disconnect the current supply during the maintenance works on the boiler or when opening the control.
- Except the equipment itself no combustibles can be stored in the boiler room.
- It is necessary to have a ready hand fire extinguisher in front of the boiler room.
- It is possible to operate the equipment only with the fuels specified by the company (no waste or wood logs).
- Don't perform any unplanned changes in the set-up or shutdown of the equipment.
- If the emergency extinguisher was in the operation, it is necessary to connect it with the defect of the device in any case. Please, contact immediately in your own interest our Customer Service.
- If you have any problems, we are continuously please contact our Sales representative.

As for the automatic biomass combustion, there are prescribed under the law the devices, which will prevent from the backward burning along the conveyer channel into the fuel storage. In our device the following safety measures are available:

1. The channel of the worm feeding and the intermediate storage bin are performed absolutely tightly up to the backward burning flap valve. Thanks to this measure the backward burning will be smothered due to the lack of the air. The backward burning flap valve is verified as a protective equipment of the backward burning. A positional engine opens and closes the flap valve. The transport of the fuel doesn't begin before the full opening of the flap valve. At any failure or during the failure of current the flap valve shall be self-closed. When performing the maintenance works, the flap valve may be closed.
2. The under-walking of the bottom level of the furnace level prevents from the control by means of the fuel feeding. The hot fuel is continuously moved forward from the worm conveyer channel. This protection against the backward burning functions continually (the function of the up-keeping fire).
3. The emergency extinguisher close to the worm channel serves as the last reserve in emergency situations. It consists of the temperature sensor, which opens the valve at the temperature of 95°C. The temperature sensor is placed in a pipe, which is double-sided welded together with the channel of the worm conveyer. The valve is connected to one outlet valve of the boiler (it should always be in the open position) and in the event of activation of the quenching device it will bleed the water from the heating system. During the backward burning the channel is overflowed by water through two openings and the hot fuel is extinguished.
4. The device is protected by a safety non-returnable thermostat. When the boiler temperature exceeds the temperature of 100°C, the equipment is switched off.



### 3 Description of types

The boilers of output range SMART 150 - 500 kW are produced in the types (designs) USZI and USV

- U combustion with the bottom feeding, it describes the method of the combustion system
- S self-cleaning, it refers to the automatic cleaning of the heat exchanger
- V device with a storage bin. The fuel comes into the boiler from the storage bin, the volume of which is sufficient for several days
- ZI device with the intermediate storage bin with the indirect conveyance. The fuel comes from the storage bin in the intermediate storage bin, from which it comes to the boiler

#### Boiler output:

SMART 150 - with power output from 40 to 150 kW

SMART 180 - with power output from 45 to 180 kW

SMART 220 - with power output from 55 to 220 kW

SMART 250 - with power output from 65 to 250 kW

SMART 300 - with power output from 75 to 300 kW

SMART 350 - with power output from 90 to 350 kW

SMART 400 - with power output from 100 to 400 kW

SMART 450 - with power output from 115 to 450 kW

SMART 500 - with power output from 140 to 500 kW



## 4 Parts of the equipment

In order to orientate yourself easier you will find on the following page a diagrammatic representation of your equipment.

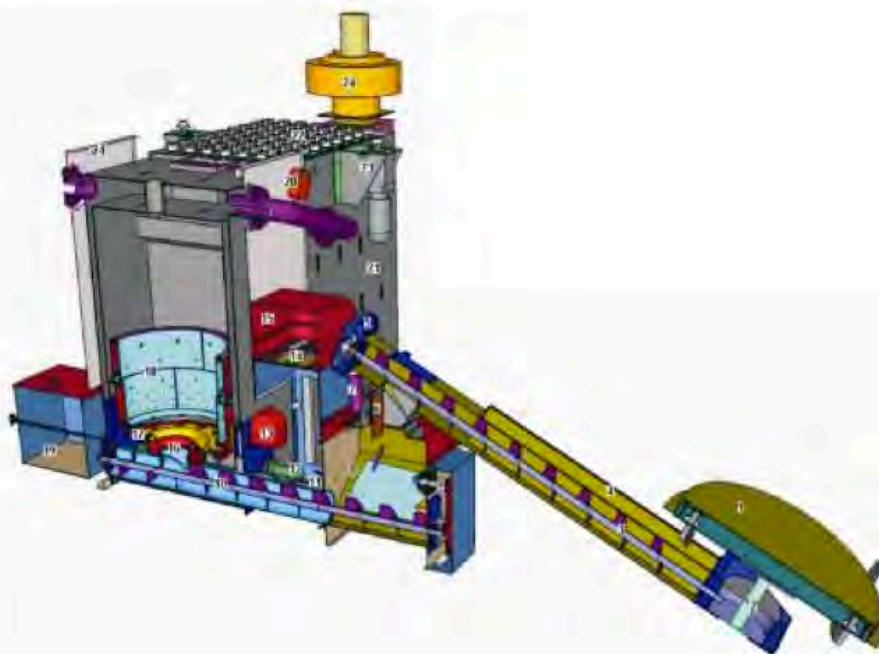
The boiler consists of the boiler combustion chamber (I), exchanger of the boiler (II), middle part (III), intermediate storage bin and spatial conveyer, possibly of the storage bin (IV).

In the front part of the boiler (I, II) there is “the heart” of the device – the combustion chamber. It consists of the round burner plate (16), two-part collar of the post-combustion (18) and ash-removing disk (17), which is driven by the grating mechanism (25). Due to high temperatures all the parts are made of the high-grade (refined) steel. They can be removed through the door of the combustion chamber (32). The fuel is conveyed from the bottom to the burner plate (hence the designation of *the combustion system with the bottom feeding*). On the burner plate there is the furnace. The primary air is supplied here supporting the combustion. In the collar of the post-combustion the secondary air is being supplied for the purpose of combustion of wood gas. The ash falls from the edge of the ash-removing disk on two ashes worms (26), which conduct the conveyance into the ashes storage bin (19). In the back part there is a by-pass valve (28) of flue gases with a slave drive (20), which ensures the flowing of flue gases directly into the smoke-flue or through the tubes of the exchanger. The back part of the boiler is formed by a tubular heat exchanger (21). In the tubes there are installed the rotary turbulators (22, 29), which take care of good heat transmission and of the cleaning of heat exchanger. On the lateral side of the boiler there is the turbulators’ drive (23) consisting of the chain transmission (drive) and cleaning engine. On the top part of the boiler there is a safety thermostat. The heat losses are minimized by double insulation by means of the mineral wool, covered by a sheathing (34). Furthermore there is a smoke collector (31) and an exhaust fan (24). In the bottom part of the exchanger there is a door (30) for the cleaning of space under the turbulators.

The middle part (III) contains the radial ventilators (13) with the air flaps, the under-pressure sensor, which senses the under-pressure in the combustion chamber and the frequency changer continuously regulating the revolutions of the exhaust fan depending on the under-pressure. In addition there is the hot-air pistol (12), which functions as an automatic lighting-up, and the equipment of emergency fire extinguishing (11). The ashes worm drive is also placed here. On the upper side of the middle part there is built-in the control unit (14, 15).

The spatial conveyer (IV) conveys the fuel from the storage bin to the boiler room. The conveyer consists of the container (1) and the worm conveyer channel (4) with the conveying worm (3) and the conveying worm engine (5). At the end of the channel close to the boiler there is mounted on a flap valve with the terminal switch, which will be opened at the accumulation of material and will disconnect the equipment. The container consists of a covering wheel with removable bundles of the leaf springs. The fuel falls from the spatial conveyer through the falling step into the intermediate storage bin (8). On the intermediate storage bin there is placed an ultrasonic probe (7), which senses the minimal and maximal level of material in the storage bin. If the minimal level is reached, the airproof flap valve of the protection against fire is opened. The engine of the conveyer is switched on and the quantity of material is supplied up to the maximal level. After refuelling the flap valve is closed, the material starts supplying again until the level drops below the minimum. The fuel is transported from here by the screw conveyer feeder (10) to the burner plate (16). The airproof flap valve of the fire protection with engine (6) closes the falling step during the idleness of the boiler or at the power failure. In the bottom part there are the main drive engine, the drive engine of ashes worms and the gear-case with drive of the breaking blades in the intermediate storage bin (8).

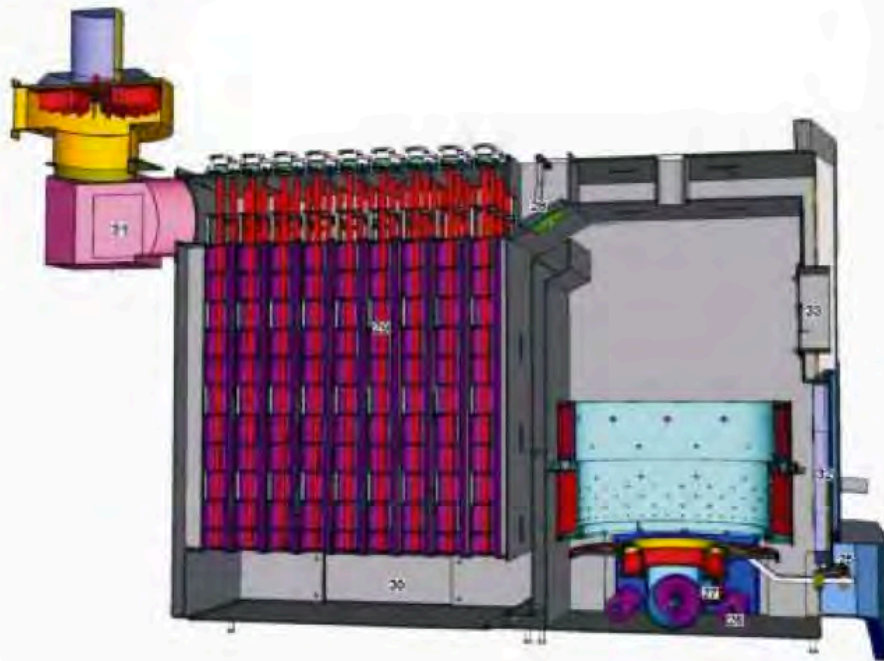




1 Picture of Burning chamber

**Boiler SMART 150-500 kW with the discharging device**

1. Mixer of the spatial discharging
2. Gear – case
3. Worm of the discharging device
4. Chammel of the discharging device
5. Box with the drive engine and gearing
6. Separating flap valve of the channel and intermediate storage bin
7. Ultrasonic probe
8. Intermediate storage bin
9. Beaker of the arch
10. Feeding worm
11. Equipment of emergency fire extinguishing
12. Lighters
13. Air blower
14. Box of the switchboard
15. Cover of the switchboard with the control



2 Picture of Exchanger

**Boiler SMART 150-500 kW**

- 25. Grating mechanism
- 26. Ashes worms
- 27. Primary air channel
- 28. Exchanger flap valve
- 29. Turbulators
- 30. Cover for the exchanger cleaning
- 31. Chimney super structure
- 32. Service door of the combustions chamber
- 33. Checking door of the combustion chamber



## 5 Delivery, installation, assembly

### 5.1 Readiness of the boiler room

#### Readiness of the boiler room before starting the boiler installation:

- Completion of the constructional adaptations of the boiler room and fuel storage room. If the boiler is fitted with an automatic refuelling from the fuel storage, an opening should be prepared for the passage of the conveyer through the partition wall. Ensure the boiler room ventilation for the fresh air supply.
- All the openings required for the transport and installation of the boiler in the boiler room should match the minimal dimensions for the particular type of boiler. As for the boilers of the 500kW type, the whole opening for the boiler transport into the boiler room should match at least the dimensions: 1400x2000mm; as for the boilers of the 150-450kW type the opening must have the following dimensions: 1200x 2000mm.
- Ensure a hand pallet truck with a minimal load capacity of 1500kg. If the floors in the whole handling space (route) are of different levels, it is necessary to ensure such a handling equipment, which will allow to transport the boiler (or any part thereof) to the installation place.
- Each boiler room should be furnished with the installed electric lighting and with at least one 16A socket to the network of 230V, placed close to the boiler (see "The connecting place of the boiler").
- Ensure the cleaning of the operational area to be ready for the installation (boiler room and fuel storage room).

#### Readiness before setting in operation:

- Ensure the "Main power supply" and its revision (see "The connecting place of the boiler"), which should be secured with an over-voltage protection and a three-phase protection.
- Close to the connecting place to determine and mark the terminal (connector) for the boiler connection to the protective bonding of the boiler room.
- Ensure the "Main (circulation) pump", the "Mixing (short-circuit) pump" ( for example UPS 50-30) and the power wiring for the switching signal from the boiler automatics, if the abovementioned pumps are at a distance of more than **0.7 m** of the boiler (see the "Hydraulic diagram"). It is possible to control the remaining boiler equipments (see the "Hydraulic diagram") by means of the boiler automatics. If you require its regulation, it is necessary to place in the connecting place of the boiler a switchboard with labelled inputs and our engineer shall connect-up the control signals.
- Ensure the treatment of the boiler-water.
- Ensure the interconnection of the smoke flue between the boiler and the separator (if the boiler is fitted with a separator), and between the separator and the chimney flue.
- If the boiler is fitted with an automatic refuelling from the fuel storage, the opening for the passage of the conveyer through the partition wall should be later bricked up.
- Ensure the filling of the heating system with water, if this is made impossible due to the climate conditions, it is necessary to inform about this state before the initialization of the boiler.
- Ensure at least two persons responsible for the maintenance and operation of the boiler, who will be trained and informed about the boiler operation and maintenance during the heating test.
- If the boiler operator requires the failure states reporting by means of a visual (light) signalling device or audio signalling device, it is necessary to provide a labelled lead (inlet) in "The connecting place of the boiler" and our engineer shall connect-up the control signal.



12 z 87

- If the boiler operator requires the failure states reporting and the boiler state check by means of a GSM modem, it is necessary to ensure a SIM card (and verify the signal quality of the mobile operator chosen by you).

## 5.2 Directions for the installation

The following overview contains the most important references to the proposition of building activities. Our external co-workers shall be willingly available to you at your planning. Please, contact us as soon as possible to find the best solution.

The boilers can be operated in the basic surroundings according to the ČSN 332000-3/1995 (Czech Standard); must be placed in a boiler room, in which a sufficient air supply is ensured that is required for the combustion.

**The placing of boilers in the dwelling space (including the halls and corridors) is inadmissible.**

### WARNING!!!

The boilers must be put out of operation in time before the danger occurrence, under circumstances leading to the danger of temporary penetration of combustible gases or vapours and during the works, at which a temporary danger of fire or explosion may occur (for example gluing of the linoleum, PVC, etc.). The objects and things made of the combustible materials mustn't be placed on the boilers and at a distance, which is less than the safe distance of the boiler.

## 5.3 Safe distances

The equipment must be installed so that the safe distance of the building materials should be observed, minimally 200mm. This distance applies to the boilers and smoke-flues placed close to the combustible materials of the combustibility grade B, C and C2 (see the Table No. 1). It is necessary to double the safe distance (200mm), if the boilers and the smoke-flues are placed close to the combustible materials of the combustibility grade C3 (see the Table No. 1). It is necessary to double the safe distance even if the combustibility grade of the material is not proven. It is possible to reduce the safe distance to its half (100mm) when using a heat insulating non-combustible plate of the thickness of min. 5mm, which would be placed at the distance of 25mm of the protected combustible material (air-space insulation). The shielding plate or the protective screen (on the protected object) must exceed the outline of the boilers, including the smoke-flues, on each side by 150mm at least, and above the upper surface of the boilers by 300mm at least. The room furniture and equipment made of combustible materials must be also protected by the shielding plate, if it is impossible to keep the safe distance (for example in the mobile equipments and cottages, etc. – more details in the Czech Standard ČSN 061008). It is necessary to keep the safe distance even when placing any things and objects close to the boilers.

Table of Combustibility grade

Combustibility grade of the building materials and products	The structural (building) elements and products included in the combustibility grade (selected from the Czech Standard ČSN 730823)
A – non-combustible	Granite, sandstone, concretes, bricks, ceramic tiles, mortars, fire-resistant plasters, etc.
B – hardly combustible	Akumin, izoklin, heraklit, lignose, slabs made of the basalt felt, slabs made of the glass fibre, novodur
C1 – combustible with difficulty	Leaf wood (oak, beech), hardboards, plywood, sirkolit, werzalit, hardened paper (formica, ecrona)
C2 – moderately combustible	Coniferous wood (pine wood, larch, and spruce), chip boards and cork slabs, rubber floorings (industrial, Super)
C3 – easily combustible	Chipboards (hardboard, sololak, sololit), cellulose substances, polyurethane, polystyrene, polyethylene, foamed PVC



### 5.3.1 Subject to Approval from the side of the Building Authority

All changes or enlargements of the wood fuel heating unit must be communicated in writing to the appropriate Building Authority. Should a change of the house rooms determination occur as a result of the heating unit construction (for example the closet or the dressing room will be used as the fuel storage, etc.), it is necessary to file an application for the permission. You will receive the technical data and details required for the application filing (the design, the technical specification) from our representatives for a fee connected with the expenses of delivery. As for the drawings of layouts and plans, all accurate dimensions of the boiler room and storage room are required. You will obtain any further answers to your questions regarding the procedure from your Building Authority (either the Municipal Council or the municipal office).

### 5.3.2 Characteristics of the Boiler Room

The walls and ceilings must be built of the fire-resistant material (two-sided plastered brick - dimension of 12 cm, concrete of 10 cm, two-sided sealed (coated) plaster slabs - dimension of 10 cm. The floor covering mustn't be constructed of the combustible material. The accesses to the boiler room must be closed by doors openable in the direction of escape. In the following table there are mentioned the minimal possible clear widths of doors depending on the type of the boiler. The minimal width applies to the installation of disassembled boiler. The second value applies to the installation of an assembled boiler.

The subbasement of the boiler must be constructed either of the concrete floor or the floor for the purpose of the boiler installation. Small unevenness is levelled (straightened) by means of the height adjustment of the boiler legs. A continuously opened air hole outside the building must be always available for the purpose of air supply; the cross-section of the hole must be  $5\text{ cm}^2/\text{kW}$  (at least  $400\text{ cm}^2$ ). The hole should be secured by a grate of the following dimensions: the width of the netting meshes must be  $<5\text{ mm}$ . It is also necessary to carefully prevent the frost penetration into the fire chamber. No combustible materials and substances can be stored in the heating room except for the fuel storage bin. It is necessary to have available a ready hand fire extinguisher (the weight of the filling must be 12 kg) outside the boiler room, namely close to the boiler room doors. Each boiler room should be furnished with the fixedly installed electric lighting. An emergency switch must be placed on a safe, easily accessible place for the purpose of putting the boiler out of operation. In order to ease the installation, assembly and maintenance of the equipment it is necessary to keep the minimal distances between the boiler and the walls of the room, as specified in the "Enclosure".

### 5.3.3 Chimney

The chimney draught must be inspected at too small or low chimneys. The high efficiency of the boiler results in a low temperature of the boiler waste gases, therefore the chimney must be moisture-resistant. If you have any serious problems, please, contact our representatives or your chimneysweep. You will find any necessary data for the calculation of the chimney ratings in the Chapter 9.

### 5.3.4 Fuel storage

The following rough rules are valid for the size of the storage under average circumstances:

Table of Fuel storage

Fuel	Chips - 25% water content, 30mm, soft wood	Pellets - 10% water content, 6 mm diameter
Storage for the period of 1 year	$\approx 3.7\text{ m}^3 \times \text{heat output}$	$\approx 0.9\text{ m}^3 \times \text{heat output}$
Consumption for 1 year	$\approx 2.6\text{ m}^3 \times \text{heat output}$	$\approx 360\text{ kg} \times \text{heat output}$

As for the data for the storage, the so called "dead storages" are included (the inclined walls, incomplete filling-in and discharging). As for the equipment with the spatial conveyer, the storage should be directly connected with the boiler room and the storage should be quadratically as far as possible.





The same structural and technical fire-prevention requirements are valid for the storage as for the boiler room. In the middle of the storage room there is built the discharging device. The channel of the worm conveyer comes to the room from above at an angle, in most cases. The floor of the storage room should be concreted evenly. It is recommended to place on this concrete floor an inclined floor made of wood laths, in which the worm channel and the drive would be embedded. Thanks to this measure an air cushion is formed under the fuel, which subsequently dries the fuel. The opening for the flow of uncontaminated air should be placed under the wood flooring. The storage room must have the door (the cross-section at least 1,8 m<sup>2</sup>, in the space) so that the shovelling device could be built-in. It is a REGULATION for the aboveground storages! In order to open these doors even if the storage is full, it is advantageous to latch them from the inner side of the room. An opening into the boiler room (50 x 50 cm) must be taken into consideration for the purpose of assembly of the worm conveyer channel. After the installation of the equipment this opening shall be bricked up. As for the chips, the fuel charging is most suitable from above by a transport.

Biomass fuel indicators													
Water content [%]	0	8	10	20	30	35	0	8	10	20	30	35	
Moisture [%]	0	9	11	25	43	54	0	9	11	25	43	54	
							5.1	4.7	4.5	4.0	3.4	3.1	
Fuel	Storage density in kg/m3						Calorific value in kWh/m3					Ash percentage [%]	
Chopped hardwood	200	216	220	240	260	270	1024	1006	999	950	878	833	1
Chopped soft wood	140	151	154	168	182	189	717	704	699	665	614	583	1
Chopped bark	150	167	165	180	195	203	768	754	749	712	658	625	5.10
Wood sawdust	300	308	310	320	330	335	512	503	499	475	439	416	1
Wood shavings	30	32	33	36	39	41	154	151	150	142	132	125	0.2-0.5
Wood pellets	600	648	660				3073	3017	2996				0.2-0.5

### 5.3.5 Standards for design and assembly of the boilers

ČSN 060310 (Czech Standard)	Central heating, designing and installation
ČSN 060830 (Czech Standard)	Safety devices for the central heating and for the hot service water system
ČSN 734210 (Czech Standard)	Designing of chimneys and smoke flues
ČSN 061008 (Czech Standard)	Fire safety of the local consumers and heat sources
ČSN 070240 (Czech Standard)	Warm-water and low-pressure steam boilers
ČSN 070245 (Czech Standard)	Warm-water boilers up to the output of 50 kW
ČSN 730823 (Czech Standard)	Combustibility grades of the building materials
ČSN EN 303-5/2000 (Czech Standard)	
Public Notice No. 48/82 of Collection of laws and Public Notice No. 91/93 of Collection of laws	

### 5.4 Assembly of the equipment

It is recommended to execute the installation of the equipment solely by our technicians. If the equipment can be delivered in the boiler room as the complete unit, then it is delivered assembled. Under bad spatial conditions the equipment is disassembled into parts and again assembled in the boiler room. The connections (chimney pipe, water connection, electric service line) must be performed by a professional installer with a certificate. After fulfilment of all these requirements the equipment shall be put into operation and set-up by our employees.

1. Combustion chamber has to be placed in to a boiler room either by crane using four loops (picture 1) on the top of the boiler or a forklift (which can be done always from front or back of the Burning chamber).

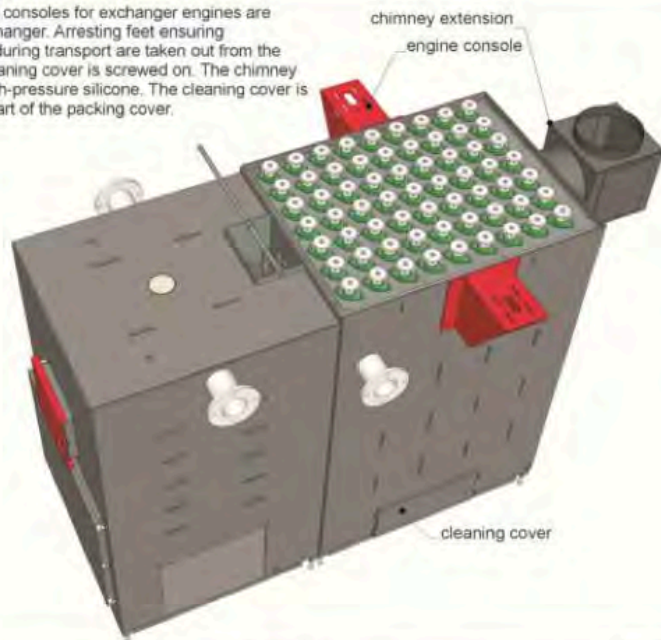


Picture 1



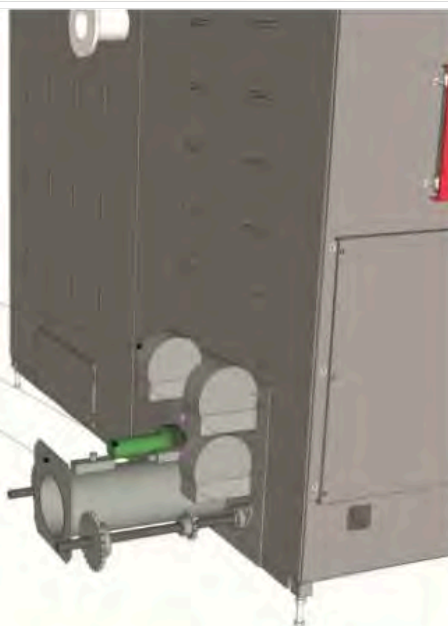
- A) After the Combustion chamber is placed in correct position firmly attach a Teflon tape as you can see on the picture.

3. The chimney extension and consoles for exchanger engines are screwed on to the heat exchanger. Arresting feet ensuring immovability of turbulators during transport are taken out from the heat exchanger and the cleaning cover is screwed on. The chimney extension is sealed with high-pressure silicone. The cleaning cover is sealed with packing cord, part of the packing cover.

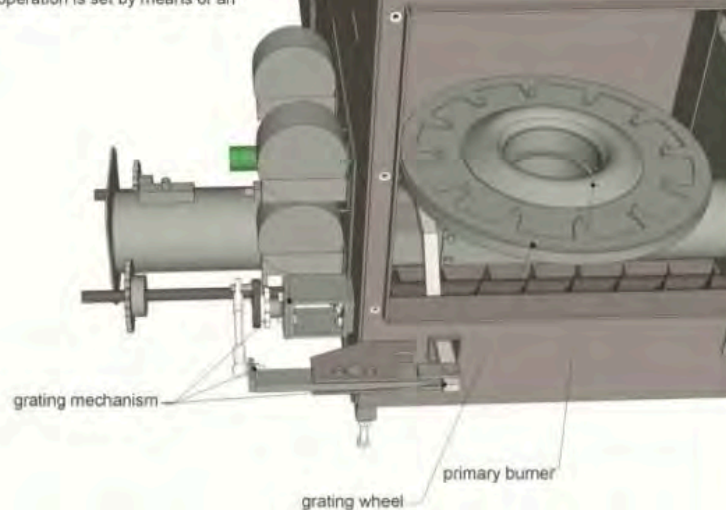


4. The fuel feeder is placed in the combustion chamber. High-pressure silicone is used to seal contact surfaces between the fuel feeder and the combustion chamber. Ventilators are sealed in the same manner. The flame lighter is sealed in its pipe with packing cord.

input ventilators  
flame lighter  
fuel feeder

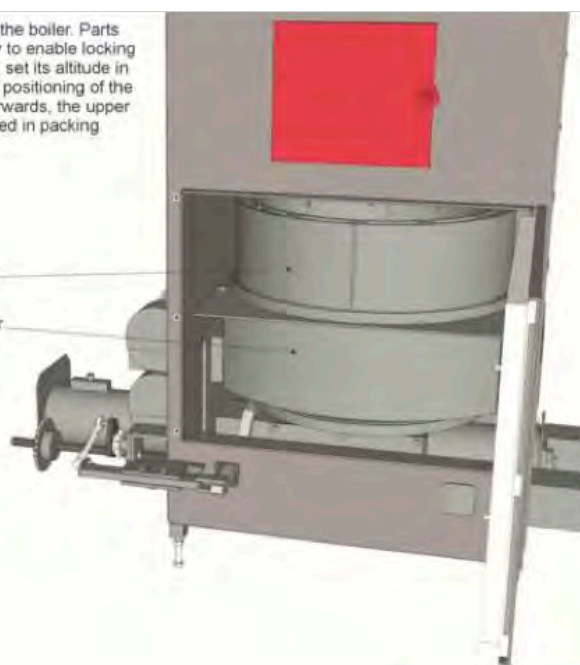


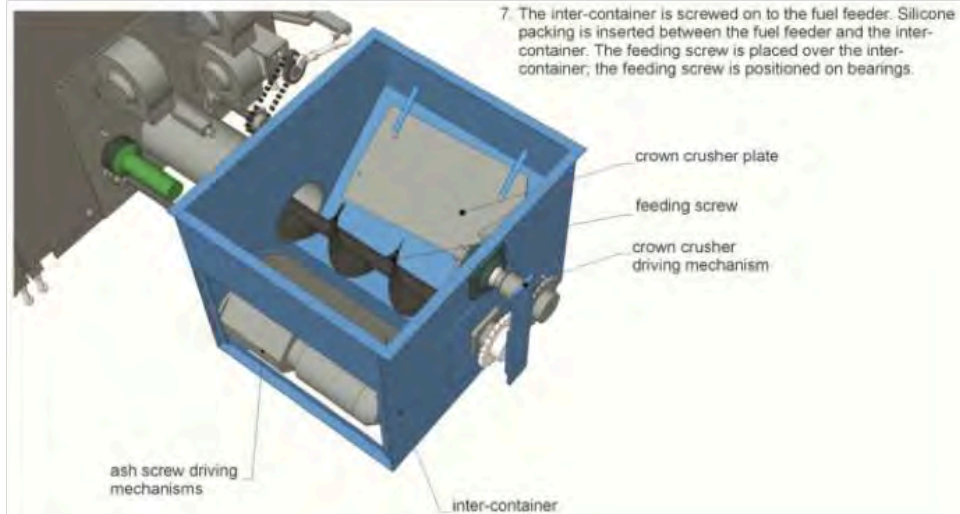
5. On the exhaust branch of the fuel feeder, a grating wheel and primary burner are placed; the burner is secured against release by three pivots. Further, the grating mechanism is mounted on to the combustion chamber. Its accurate operation is set by means of an adjustable ball joint.



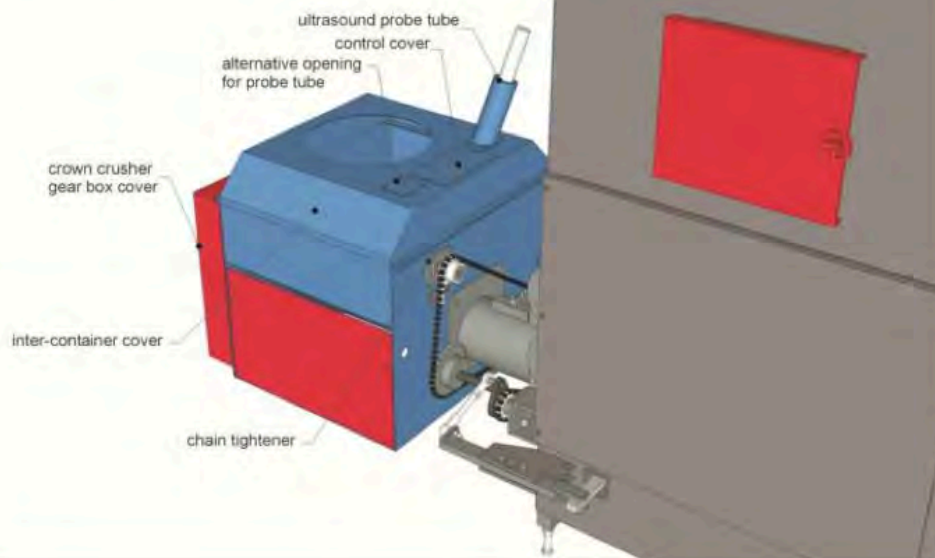
6. The secondary burner is fitted into the boiler. Parts of the burner are placed separately to enable locking the bottom part against movement, set its altitude in the heating chamber and sufficient positioning of the burner to secondary air inlets. Afterwards, the upper part of the burner is fitted; it is placed in packing cords to prevent false air streams.

part of the secondary burner  
bottom part of the secondary burner



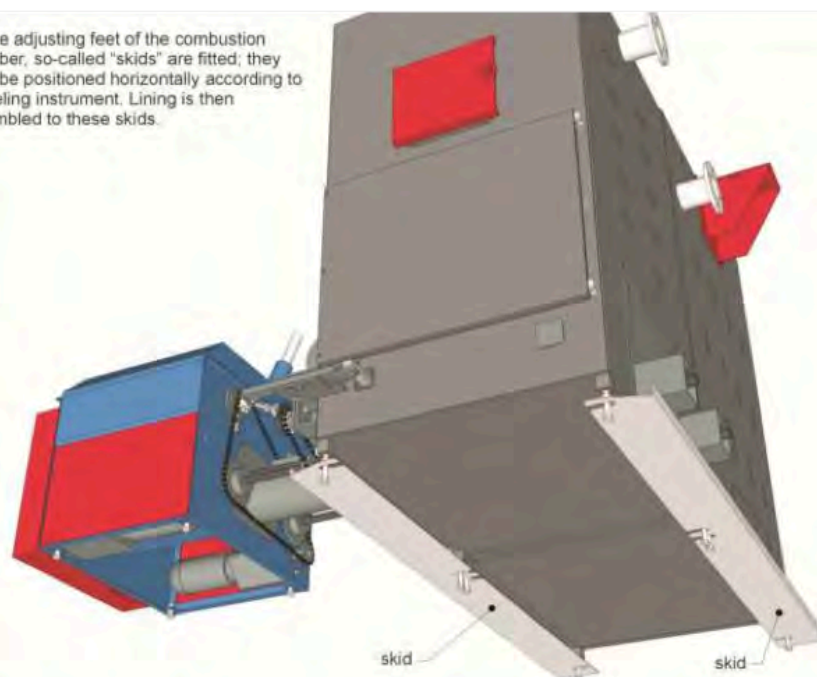


8. The inter-container is putted and the inter-container cover is screwed on. Flexible packing is glued between the cover and the inter-changer. An ultrasound probe tube and control cover can be placed on the cover. All is sealed with silicone packing.

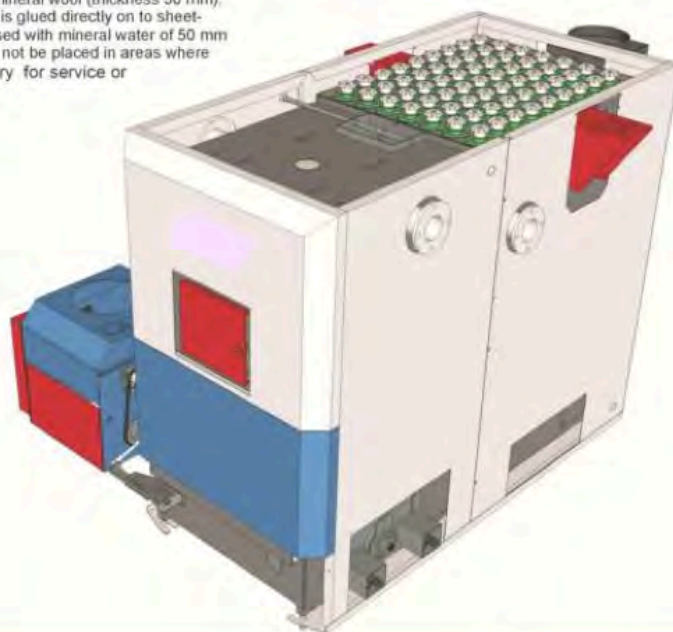




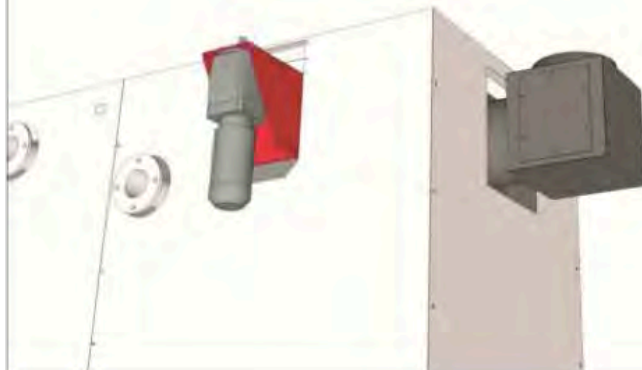
9. On the adjusting feet of the combustion chamber, so-called "skids" are fitted; they must be positioned horizontally according to a leveling instrument. Lining is then assembled to these skids.



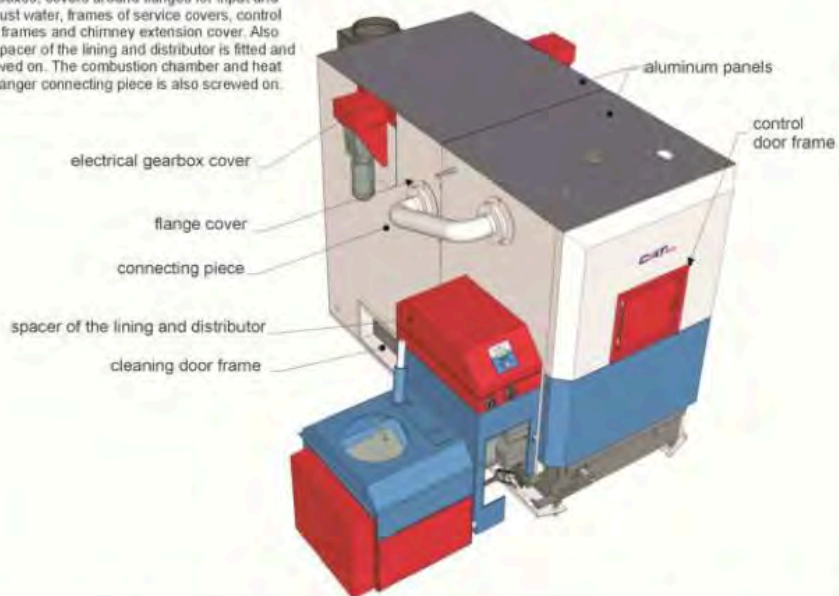
10. The entire boiler is gradually lined. Prior to placement of sheet-metal panels, the combustion chamber with the exchanger is covered with mineral wool (thickness 50 mm). The second insulation layer is glued directly on to sheet-metal panels. It will be pressed with mineral wool of 50 mm thickness. Insulation should not be placed in areas where access to boiler is necessary for service or maintenance purposes.

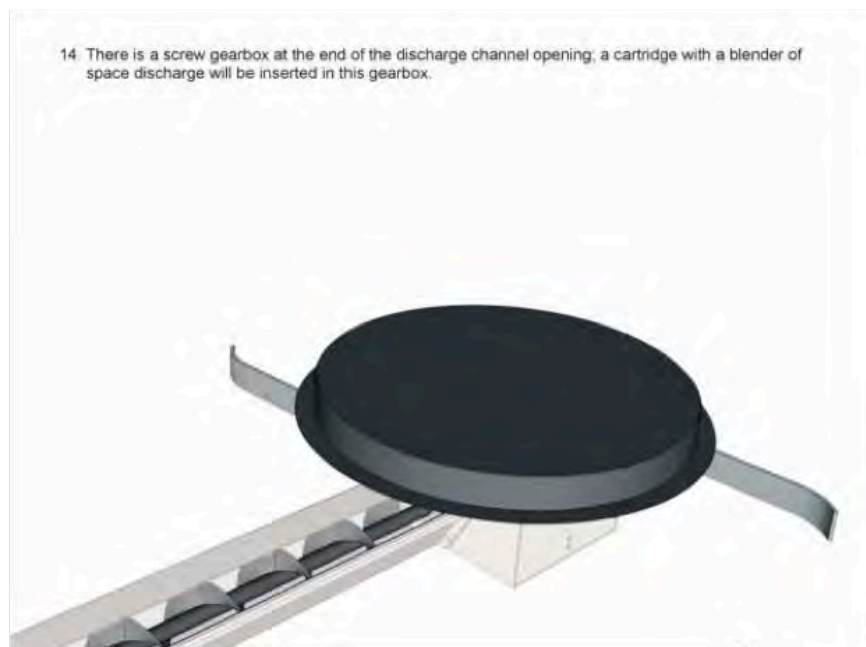
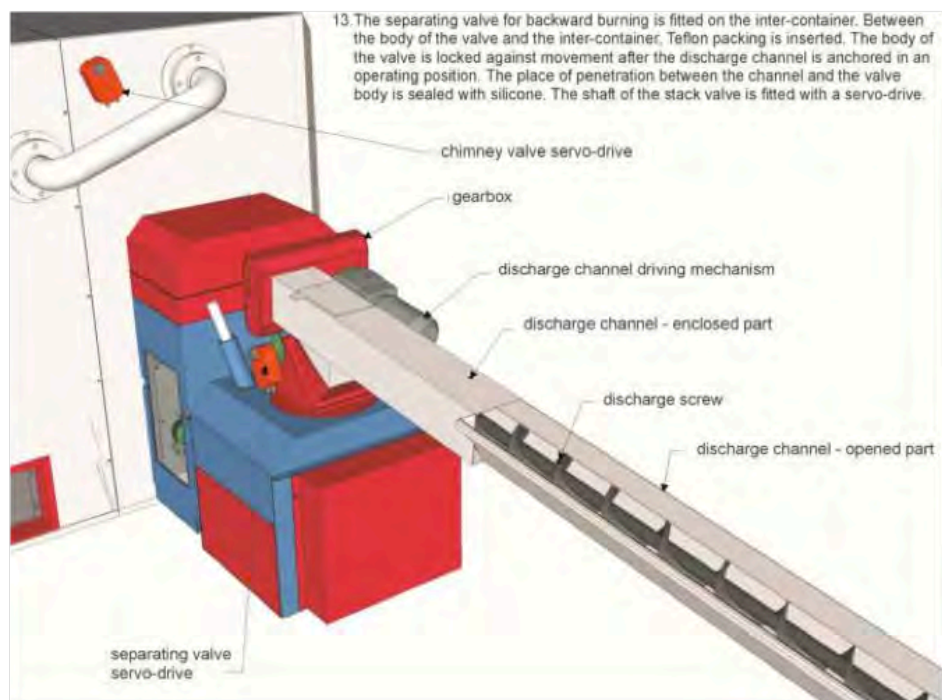


11. Engines will be mounted on engine consoles; the prepared chain will be stretched.



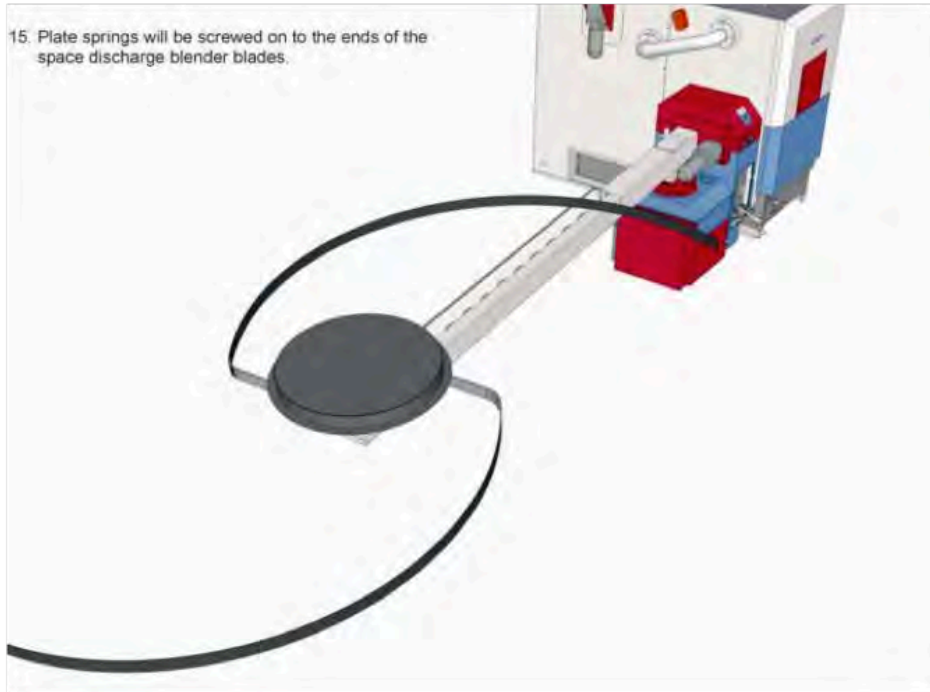
12. Remaining parts of the lining are assembled. Upped aluminum panels, covers around electrical gearboxes, covers around flanges for input and exhaust water, frames of service covers, control door frames and chimney extension cover. Also the spacer of the lining and distributor is fitted and screwed on. The combustion chamber and heat exchanger connecting piece is also screwed on.



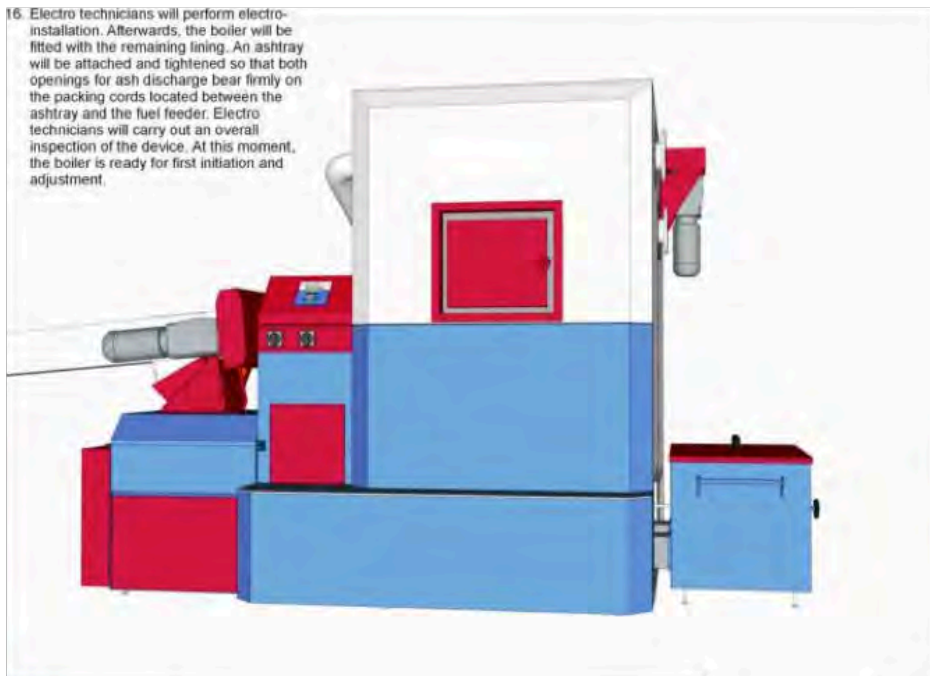




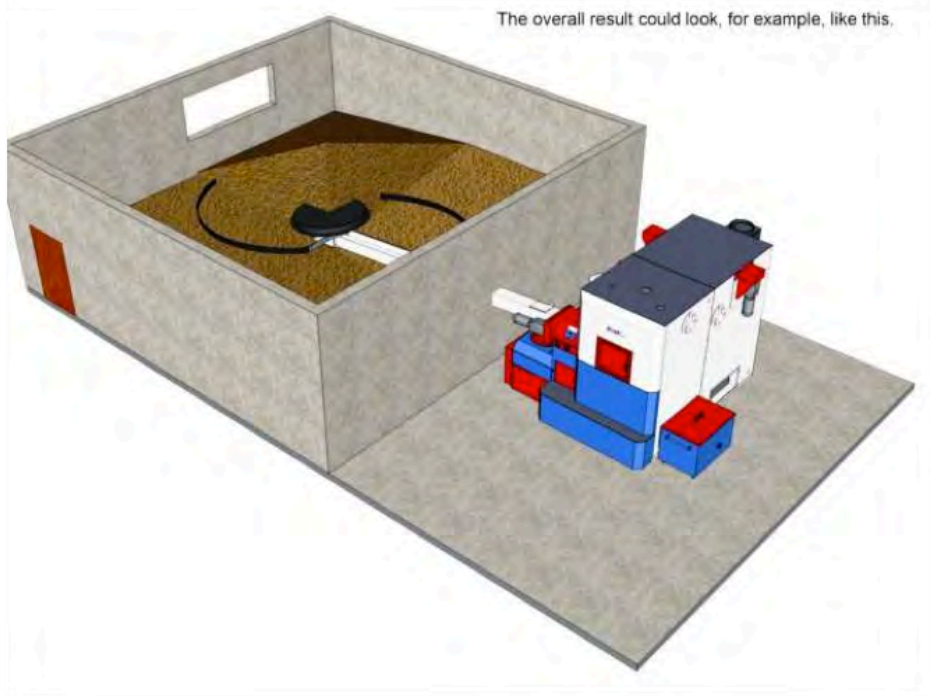
15. Plate springs will be screwed on to the ends of the space discharge blender blades.



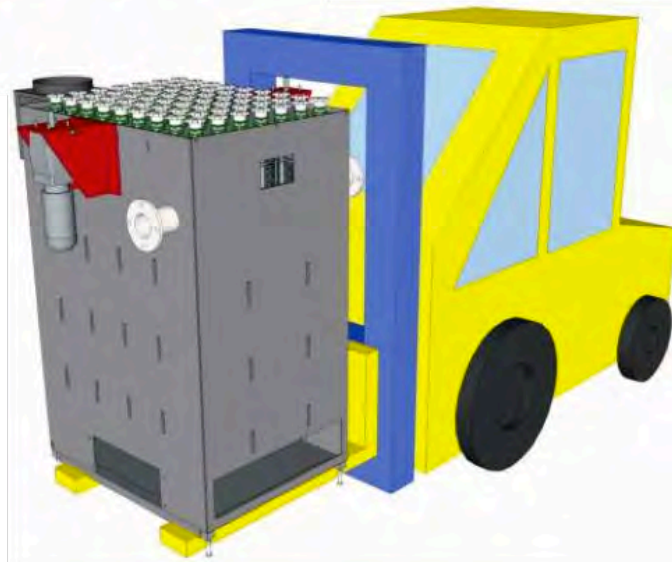
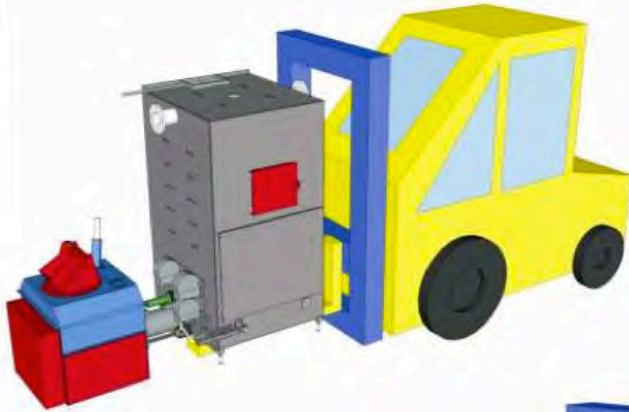
16. Electro technicians will perform electro-installation. Afterwards, the boiler will be fitted with the remaining lining. An ashtray will be attached and tightened so that both openings for ash discharge bear firmly on the packing cords located between the ashtray and the fuel feeder. Electro technicians will carry out an overall inspection of the device. At this moment, the boiler is ready for first initiation and adjustment.



The overall result could look, for example, like this.

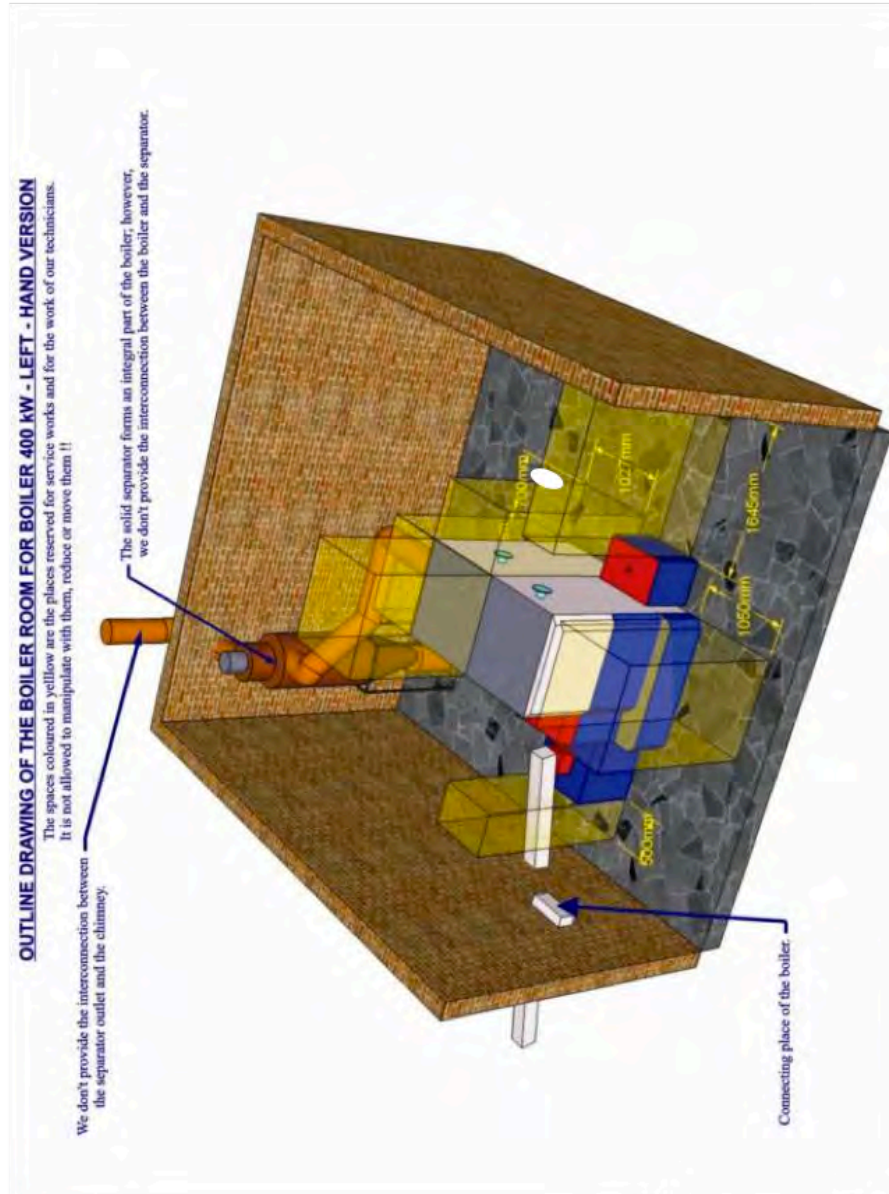


Handling the boiler with a forklift or packing truck with min. bearing capacity 2,000 kg is allowed.



### 5.4.1 Electrical connection

When projecting the electrical installation and control system of the boiler room it is suitable to proceed from the below mentioned recommendations, conditions and requirements for the connection of the particular input or output elements.



#### The connecting place of the boiler:

Determine and appropriately locate the connecting place of the boiler. However, the most suitable position is on the wall adjacent to the lateral face of the control box from the direction of location of the intermediate fuel storage bin, accessible for easy attendance.

#### The main power supply:

In the connecting place to terminate the electric supply conduit by an appropriate **main switch of the boiler** (cam switch, press-button switch, etc.). This switch should be appropriately marked by a label (for example "BOILER" or in another appropriate way). The switch must be for the rated current of at least  $I_n = 16A$ , three-polar or four-polar.

It is also possible to replace the switch by a three-phase five-pin **socket with the plug** with the rated current of at least  $I_n = 16A$  (for example IZS 1653).

The boiler equipment is ready for the connection to the network 3 x 400/230V 50Hz, in the design of **TNC-S (the drop line to the boiler is 5x2, 5C)**. The protection of the boiler supply should be performed by a three- or four-pole circuit-breaker with the rated current of  $I_n = 16A$ , the time-current characteristic B. The main power supply must be protected by circuit-breaker and secured by excess voltage protection and three phase monitoring.

Close to the connecting place to determine and mark the terminal (connector) for the boiler connection to the protective bonding of the boiler room.

#### The main (circulation) pump:

In the connecting place terminate the electric supply conduit by an appropriate conduit box (plug) with an expressive marking (for example "MAIN PUMP" or in another appropriate way).

The output is a one-phase output and is determined for the control of contactor. If the maximal permitted current is not exceeded (2.5A), it is possible to execute the connection of the pump directly from the controlling part of the boiler (after an agreement).

#### Mixing (short-circuit) pump:

In the connecting place terminate the electric supply conduit by an appropriate conduit box (plug) with an expressive marking (for example "MIXING PUMP" or in another appropriate way).

The output is a one-phase output and is determined for the control of contactor. If the maximal permitted current is not exceeded (2A), it is possible to execute the connection of the pump directly from the controlling part of the boiler (after an agreement).

#### Mixing (shorting) three-port valve:

In the connecting place terminate the electric supply conduit by an appropriate conduit box (plug) with an expressive marking (for example "MIXING THREE-PORT VALVE" or in another appropriate way).

The output is a one-phase output and is determined for the control of contactor. If the maximal permitted current is not exceeded (0.5A), it is possible to execute the connection of the three-port valve directly from the controlling part of the boiler (after an agreement).



#### **Three-port valve of the output circuit 1 (VO1):**

In the connecting place terminate the electric supply conduit by an appropriate conduit box (plug) with an expressive marking (for example "MIXING THREE-PORT VALVE" or in another appropriate way).

The output is a one-phase output and is determined for the control of contactor. If the maximal permitted current is not exceeded (0.5A), it is possible to execute the connection of the three-port valve directly from the controlling part of the boiler (after an agreement).

#### **Failure states of the boiler:**

It is also possible to connect from the controlling unit of the boiler the FAILURE STATE REPORT of the boiler. In the connecting place terminate the electric supply conduit by an appropriate conduit box (plug) with an expressive marking (for example "FAILURE REPORT" or in another appropriate way). This report is performed by one potential-free change-over contact with the allowed burden of 230 V/6 A.

##### **The failure report occurs in two cases:**

- Internal fault of the boiler engineering (the boiler stops its operation), it is necessary to cancel the state by the operating personnel on the boiler control panel.
- The water temperature drops below the pre-set limit of the releasing into the heating system (for example during the fire-up of the boiler, cooling of the medium, etc.); this state shall be cancelled automatically after reaching the pre-set temperature.

#### **External shut-down of the boiler:**

At the external requirement for the forced shut-down of the boiler, it is necessary to put it out of the operation by disconnecting the main network supply of the boiler, preferably by the contactor in the distribution board in the boiler protection. After restoration of the power supply voltage of the control unit the boiler puts itself into operation automatically according to its own set-up programme. However, it is necessary to take into account that the control voltage required for the pumps' operation also falls off and an overheating of the boiler may occur! If the pumps must be in the operation, it is necessary to resolve this problem in the controlling system of the heating circuit. If the pumps are connected directly from the control unit of the boiler, it is necessary to discuss this problem with the company delivering the electrical wiring system of the boiler.

#### **Other recommendations, conditions and requirements:**

- It is necessary to consult with the company delivering the boiler controlling unit any connections of the controlling elements to the boiler, which are different from the above specified connections! All requirements for any atypical connections or changes must be made in writing and delivered to the company Smart Heating Technology Ltd. and to the company supplying the boiler electrical wiring system!
- The type, covering, location and performance of the particular elements or distributors in the connecting place are not specified precisely, they are mostly based on the Project Documentation, and however it is necessary to comply with all applicable standards and norms!
- The electric line between the connecting place and the control unit is mostly executed by the company delivering the boiler electrical wiring system, nevertheless it is possible to have the line prepared by the company delivering the electrical wiring system of the boiler room (after an agreement). It is also possible to omit the mounting boxes in the connecting place and to lead the particular lines up to the control unit (again after an agreement). In both cases it is necessary to obtain from the company delivering the control unit all





the information concerning the way of performance, types of the particular cables and the reserves of cables' length required for the connection to the boiler system!

- Any actions concerning the boiler system (connecting of the cables, set-up of the programmes) may be performed solely by a worker authorized by the company Smart Heating Technology Ltd. ; any changes and modifications in the internal connection of the control unit are NOT ALLOWED!
- Because of the service works it is recommended to install (close to the connecting place) a single socket-outlet or a double receptacle 230V 50Hz with the current strength of the protecting element of 16A.

It is possible to consult with our Service Department all questions, details or requirements from your side regarding the connection of the boiler to the electrical wiring system.

#### 5.4.2 Connection to the smoke flue and the exhaust fan

The size of interconnection of the smoke flue between the boiler and the chimney is usually chosen in accordance with the boiler connection. We offer (as preferred) the smoke flue connection either to the back or upwards (from the point of view of the front side of the boiler). The exhaust fan delivered together is inbuilt in the smoke pipe. The performance of the smoke flue should be as short as possible and it should be raised towards the chimney. Therefore the connection to the chimney must be at least as high as the connection of the smoke flue to the fan. The dimensions of the connections are attached. Easily accessible holes for the cleaning must be available for the purpose of the smoke flue cleaning. The smoke flue must be performed tightly so that no undesirable air inlet would occur (cooling of the flue gases, condensation, and loss of the draught). The detonation door must be performed in a safety manner to prevent the persons' health hazard. It is suitable to insulate the smoke flue in order to improve the draught. The smoke flues mustn't lead through the flats and apartments of any other people or through the non-residential rooms. The internal cross-section of the smoke flue should not exceed the internal cross-section of the chimney flue and should not be tapered towards the chimney. The use of pipe bends is not appropriate. The ways of execution of the smoke flue passage through the constructions made of combustible materials are described in the Czech Standard – ČSN 061008/97.

#### 5.4.3 Water connection

In order to prevent any damage of the boiler caused by the corrosion, it is necessary to keep the lowest limit 55 °C of temperature of the water brought back at all types of SMART 150-500 kW boilers. Therefore it is absolutely necessary to increase the temperature of the back flow at all boilers. The increase of temperature of the back flow is realized by means of the shorting pump. The heating equipment must be equipped with the pressure-less distributor and with the boiler and shorting pumps. Other methods of connection should be consulted with our engineers already in the project preparation phase (due to the links to the boiler regulation, etc.).

The water connection to the boiler is realized by means of flanges. The boilers of the 150 – 250 kW output are connected by means of 2 pieces of flanges DN 80/PN6 and the boilers of the 300 – 500 kW output are connected by 2 pieces of flanges DN 100/PN6.



Boiler output (kw)	Minimal size Forwards flow and back flow	The pump of the boiler circuit - discharge flow (m <sup>3</sup> /h)	
		$\Delta t=10K$	$\Delta t=20K$
150	DN 80 PN6	13.4	6.7
180	DN 80 PN6	16.1	8.0
220	DN 80 PN6	19.6	9.8
250	DN 80 PN6	22.3	11.2
300	DN 100 PN6	26.8	13.4
350	DN 100 PN6	31.3	15.6
400	DN 100 PN6	35.7	17.9
450	DN 100 PN6	40.2	20.1
500	DN 100 PN6	44.6	22.3

#### 5.4.4 Quality of the feed-water and boiler-water

The quality of the feed-water and boiler-water is prescribed by the Czech Standard ČSN 07 7401. It is necessary to execute the analyses and batching of the chemicals for the system so that any requirements of this standard would be reliably met during the whole time period of the heating system operation. The deposition of sediments on the heat-exchanging surfaces of the boiler and the corrosion of the system can be prevented by keeping the prescribed values. If the quality of feed-water and boiler-water doesn't meet the requirements of the Czech Standard ČSN 07 7401, it would be necessary to furnish the heating system with equipment for the treatment of feed-water (for example a cation exchanger softener of water of the KZV 100 type for the treatment of the refilled water; in order to keep the required quality, all water delivered in the heating system should go through this equipment).

#### 5.4.5 Refilling of the water

Water treated according to the Czech Standards ČSN 07 7401 or ČSN 38 3350 is being used for the feeding and refilling of the heating systems. It is allowed to use the water from the water (main) piping, if the quality of the water meets the requirements of the abovementioned standards. However, the water piping must be protected against the penetration of the heating system water into the water piping, even if the water overpressure in the water main pipeline falls below the overpressure in the heating system. As for the systems up to 100 kW, it is recommended to use for the feeding a removable water hose connected only during the time period of the system water refilling, under continuous surveillance from the side of the operating personnel. In the place of connection to the heating system it is necessary to furnish the water main pipe with cutting-off, backward (return) and aerating fittings. The automatic refilling should be limited for a certain period of time and its range must be controllable.

#### 5.4.6 Adjusting device and measuring equipment

The heat sources and the treatment rooms of parameters must be equipped with a device, which signals any failure and puts the equipment out of operation, if:

- The „black out“ ;
- The values of the highest or lowest operational overpressure in the system are exceeded;
- The highest working temperature of the heat-carrying medium or of the heated medium is exceeded;
- Any harmful substances exceed the permissible concentrations;
- The flooding of the room occurs [it concerns especially the subterraneous (underground) rooms];
- The temperature in the space exceeds 40 °C;
- The time limit for the system water refilling is exceeded.





After disappearing of the states ad a) the equipment can be put into operation automatically and only after a repeated subsequent failure the equipment shall be shut-down and may be put again into the operation only by an action of the authorized operating personnel.

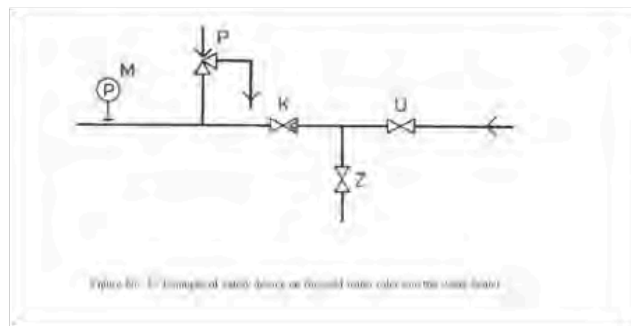
The states ad b) to g) shall put the equipment out of operation, and it can be put again into the operation only by an action of the authorized operating personnel.

The signalling of failure states shall be interconnected with the place of permanent residence or with a dispatcher working site.

#### 5.4.7 Safety device of the water heating systems

The safety device must be connected in the safety place. Furthermore a thermometer and pressure gauge, pressure sensor and temperature gauge, possibly a sensor of water shortage must be placed in the safety place.

Each self-lockable service water heater must be fitted with a closure (U), proving cock (Z), check valve or non-return flap valve (K), safety valve (P) and manometer (M) on the cold pressure water inlet. The safety valve and the manometer can be placed anywhere on the safety section. It is also allowed to use the combined fittings consisting of the safety and check valve. An example of the solution – see the Figure No. 3



#### 5.4.8 Protection against exceeding the highest working excess pressure

It can be executed either hydrostatically, i.e. by the column of water in the safety piping and container, or by the safety valve.

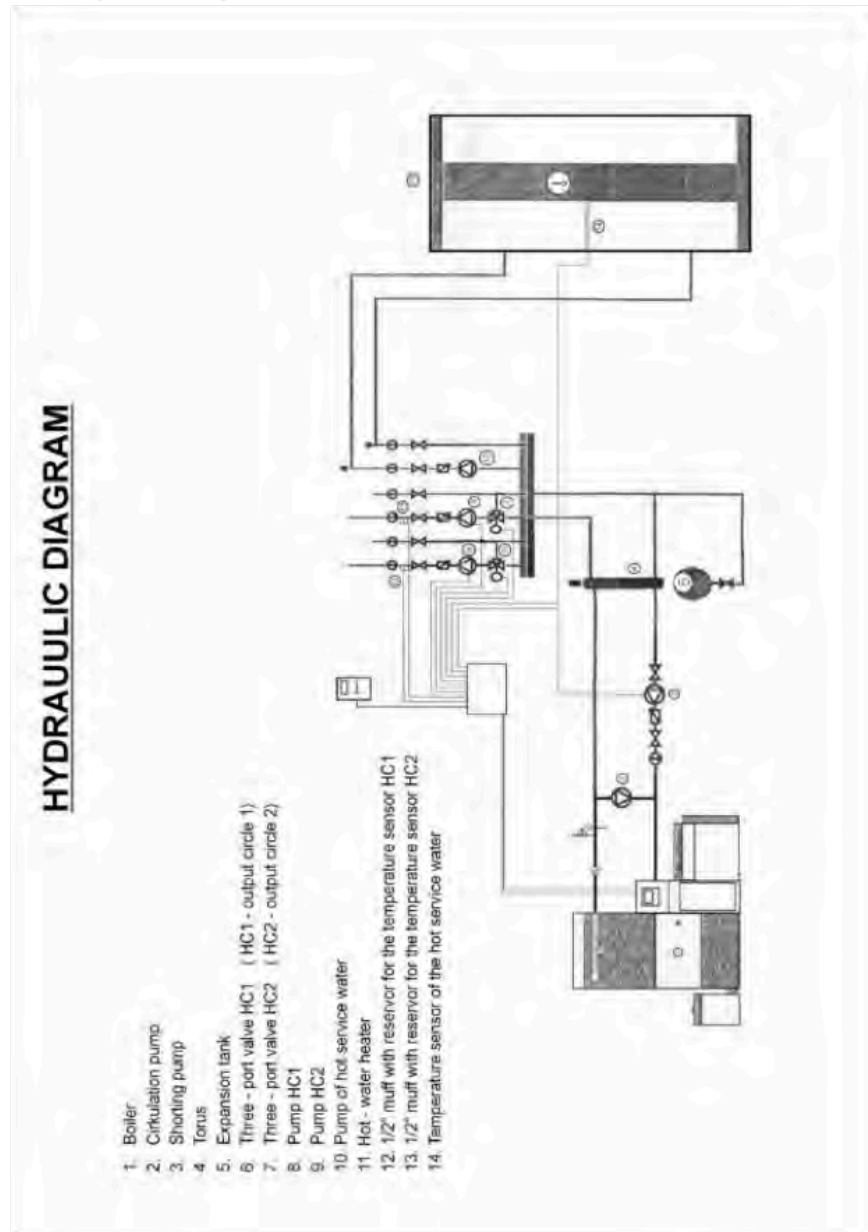
Boiler type	Pot	Q <sub>n</sub>	S <sub>o</sub> min	Valve type (DUCC MBBES)	S <sub>o</sub>	d1	d2		
Smart 150 US	250	150	196	1" x 1.1/4" KD		380	32	32	
Smart 150 US	350	150	156	1" x 1.1/4" KD		380	32	32	
Smart 150 US	250	180	235	1" x 1.1/4" KD		380	34	34	
Smart 150 US	350	180	187	1" x 1.1/4" KD		380	34	34	
Smart 150 US	250	220	287	1" x 1.1/4" KD		380	36	36	
Smart 150 US	350	220	228	1" x 1.1/4" KD		380	36	36	
Smart 150 US	250	250	326	1" x 1.1/4" KD		380	37	37	
Smart 150 US	350	250	259	1" x 1.1/4" KD		380	37	37	
Smart 150 US	250	300	387	1.1/4" x 1.1/2" KD		804	39	39	
Smart 150 US	350	300	311	1" x 1.1/4" KD		380	39	39	
Smart 150 US	250	350	451	1.1/4" x 1.1/2" KD		804	41	41	
Smart 150 US	350	350	363	1" x 1.1/4" KD		380	41	41	
Smart 150 US	250	400	451	1.1/4" x 1.1/2" KD		804	43	43	
Smart 150 US	350	450	409	1.1/4" x 1.1/2" KD		804	43	43	
Smart 150 US	250	450	580	1.1/4" x 1.1/2" KD		804	45	45	
Smart 150 US	350	450	461	1.1/4" x 1.1/2" KD		804	45	45	
Smart 150 US	250	500	644	1.1/4" x 1.1/2" KD		804	46	46	
Smart 150 US	350	500	512	1.1/4" x 1.1/2" KD		804	46	46	

<b>p<sub>set</sub> = kPa ... opening overpressure of the safety valve</b>
<b>Q<sub>n</sub> = kW ... nominal output of the heat source</b>
<b>S<sub>o min</sub> = mm<sup>2</sup> ... calculated minimal cross-section of the safety valve seating</b>
<b>S<sub>o</sub> = mm<sup>2</sup> ... real cross-section of the seating of the designed safety valve</b>
<b>d<sub>1</sub> = mm ... minimal inside diameter of the inlet safety piping</b>
<b>d<sub>2</sub> = mm ... minimal inside diameter of the outlet safety piping</b>

**NOTE:** The calculated inside diameter of the safety piping is taken into consideration only as an orientation value in the event of the connection. The piping dimensions must meet the condition that the pressure loss of the safety piping before the safety valve should not exceed the value of 0.03.pot and the total loss of the safety piping should not exceed the value of 0.10.pot

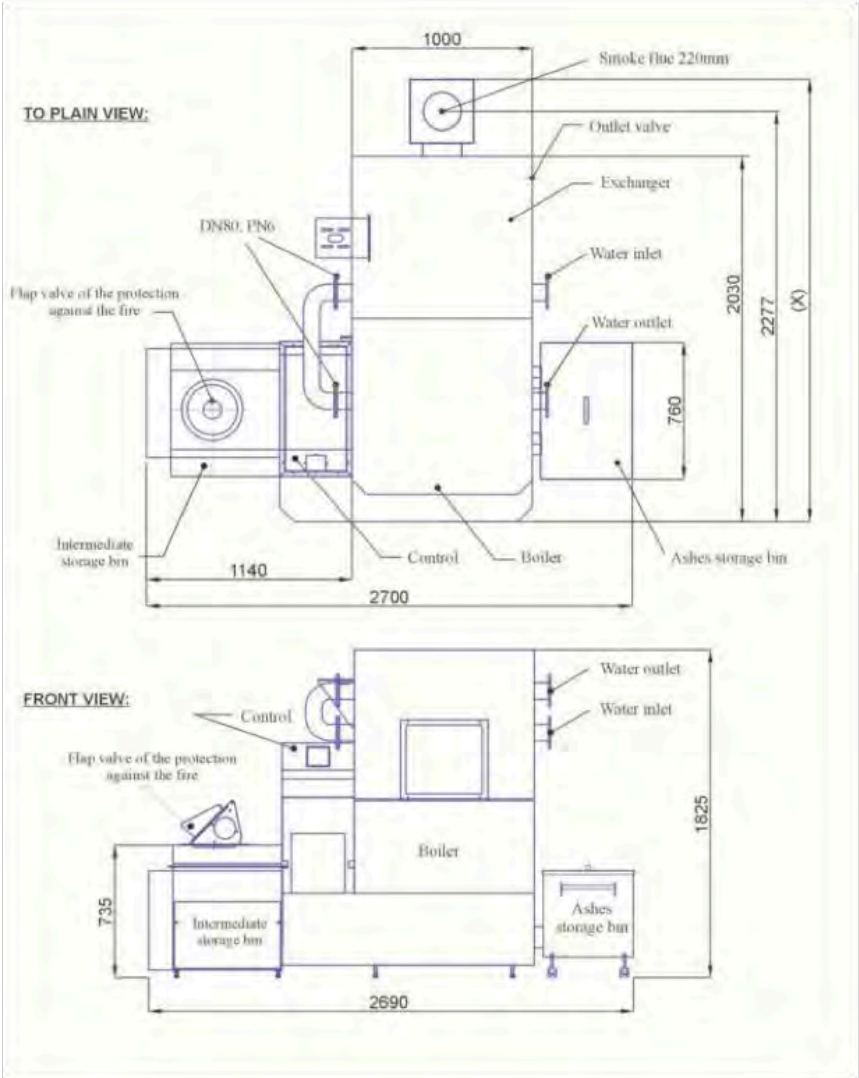
## 5.5 Connection diagram

### 5.5.1 Hydraulic diagram



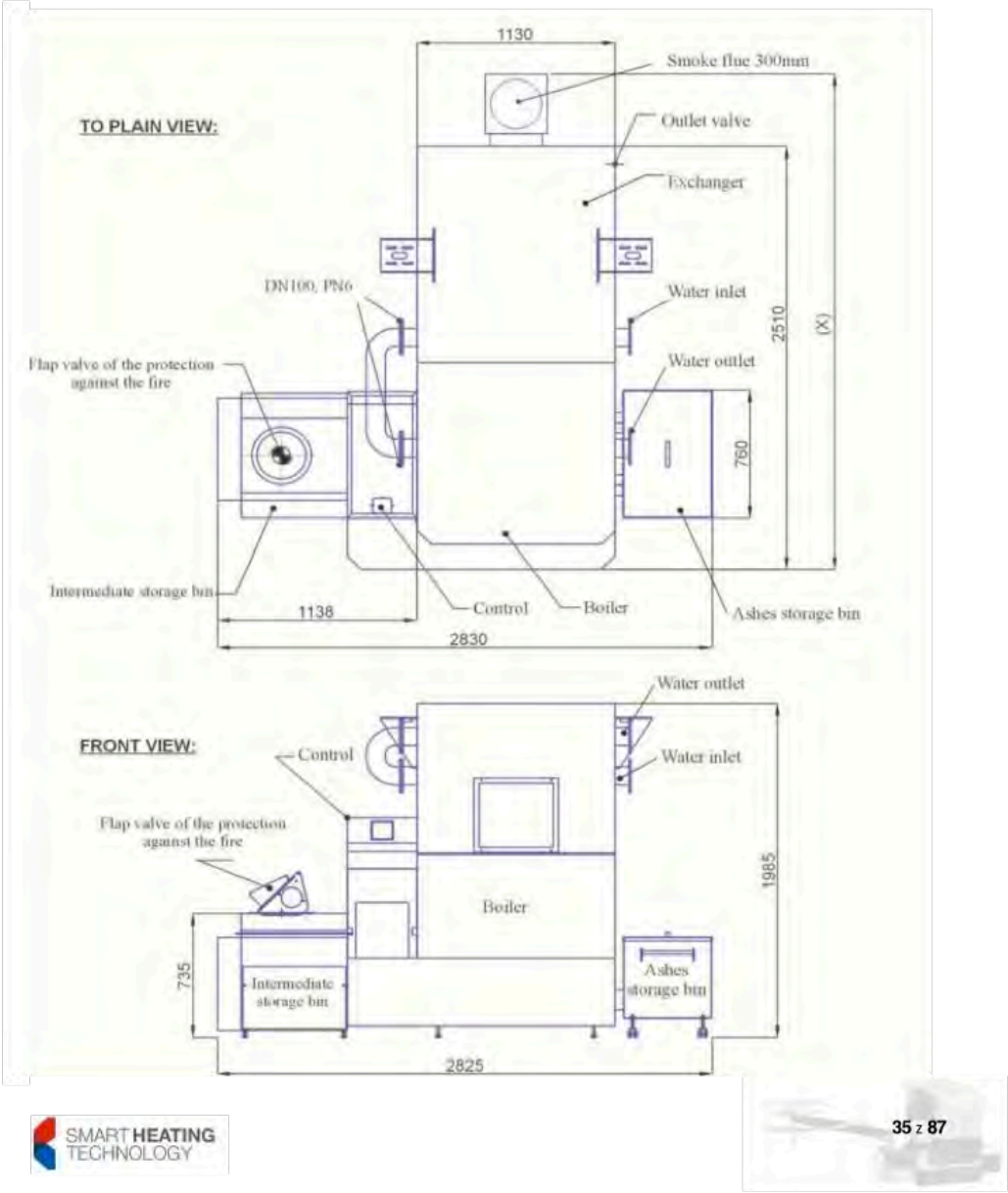
**Boilers' engineering characteristic SMART 125-250 kW – US2**

Type SMART:	125 kW	150kW	180kW	220kW	250kW
Lenght (X):	1980	2100	2220	2340	2640
Hight:	1825	1825	1825	1825	1825



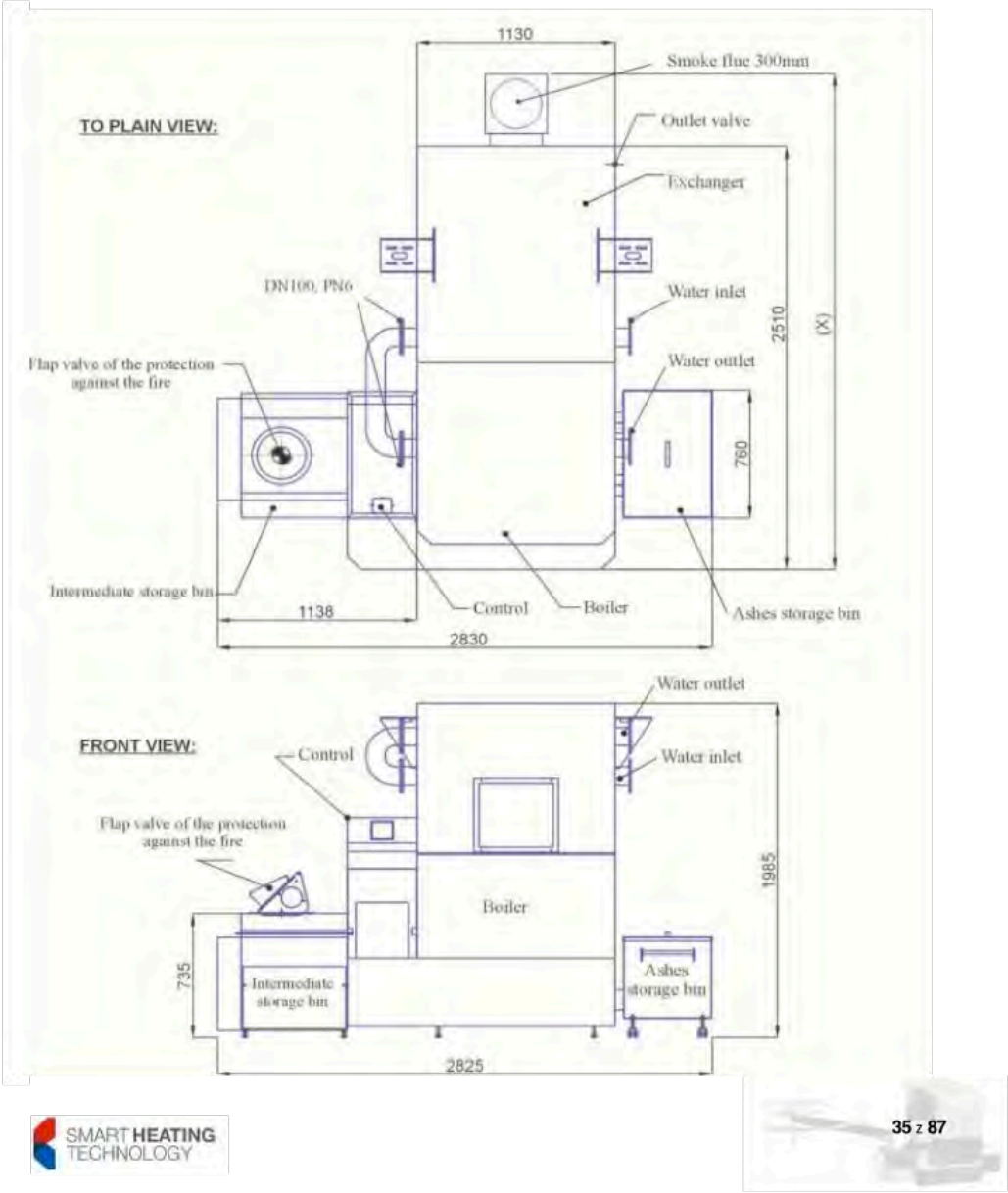
Boilers' engineering characteristic SMART 300-500 kW – US2

Type SMART:	300 kW	350kW	400kW	450kW	5000kW
Lenght (X):	2460	2580	2700	2820	2940
Hight:	1985	1985	1985	1985	1985

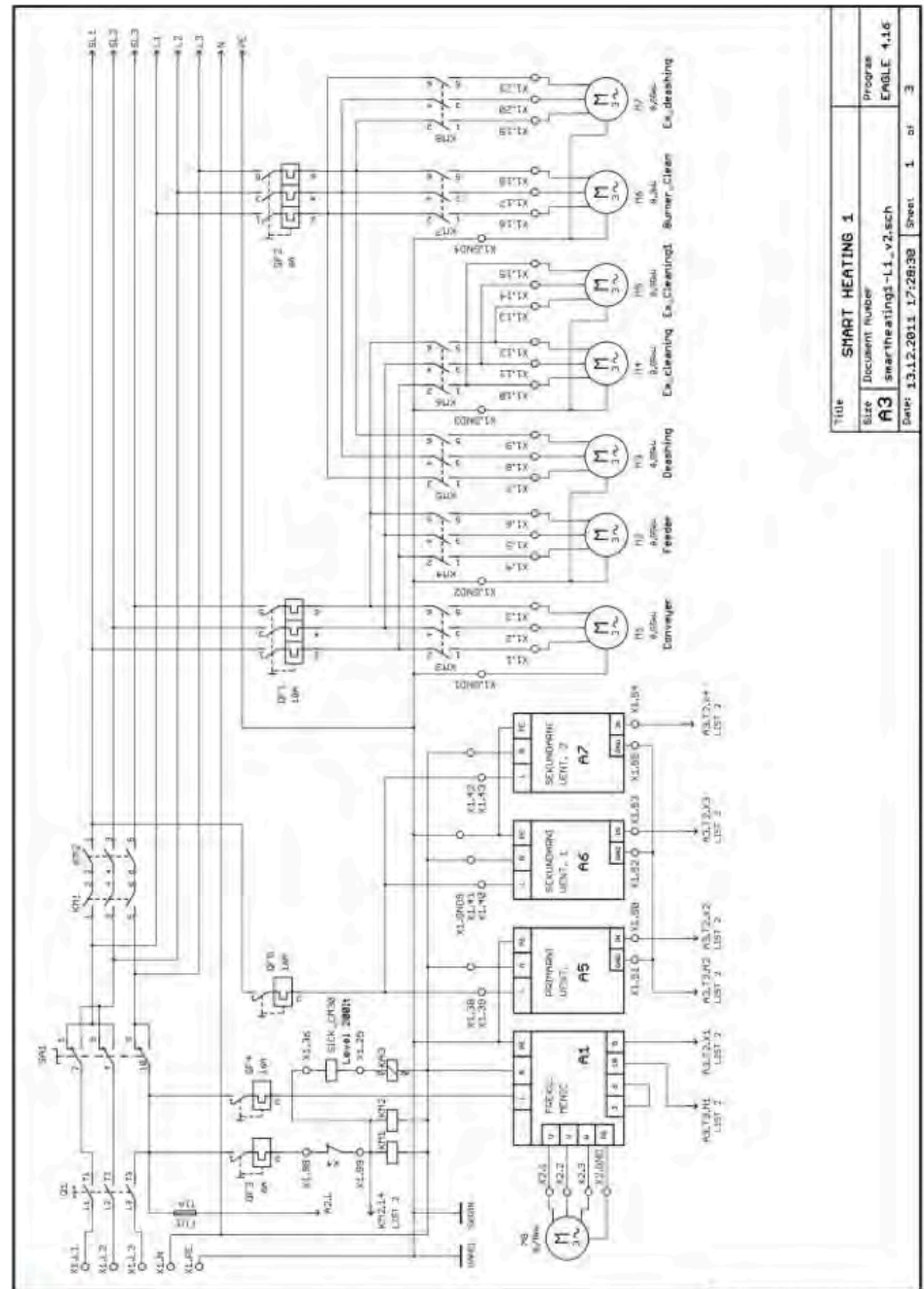


Boilers' engineering characteristic SMART 300-500 kW – US2

Type SMART:	300 kW	350kW	400kW	450kW	5000kW
Lenght (X):	2460	2580	2700	2820	2940
Hight:	1985	1985	1985	1985	1985



### 5.5.2 Diagram of electroconnections



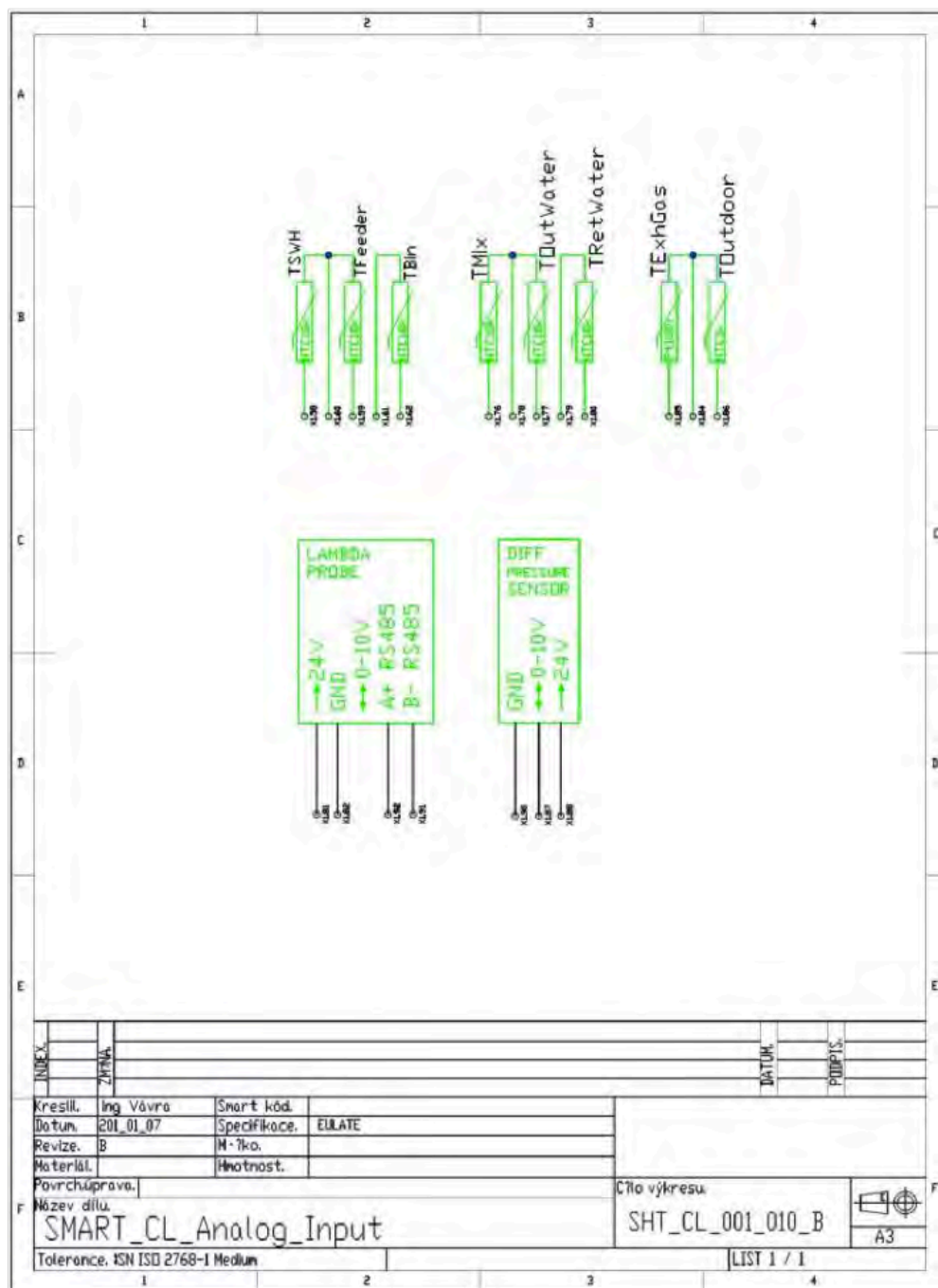
Title		SMART HEATING 1
Size	Document Number	Program
A3	Smartheating1-L1_v2.sch	EWBLE 4.1.6
Sheet	13.12.2011 17:28:30	Sheet 1 of 3



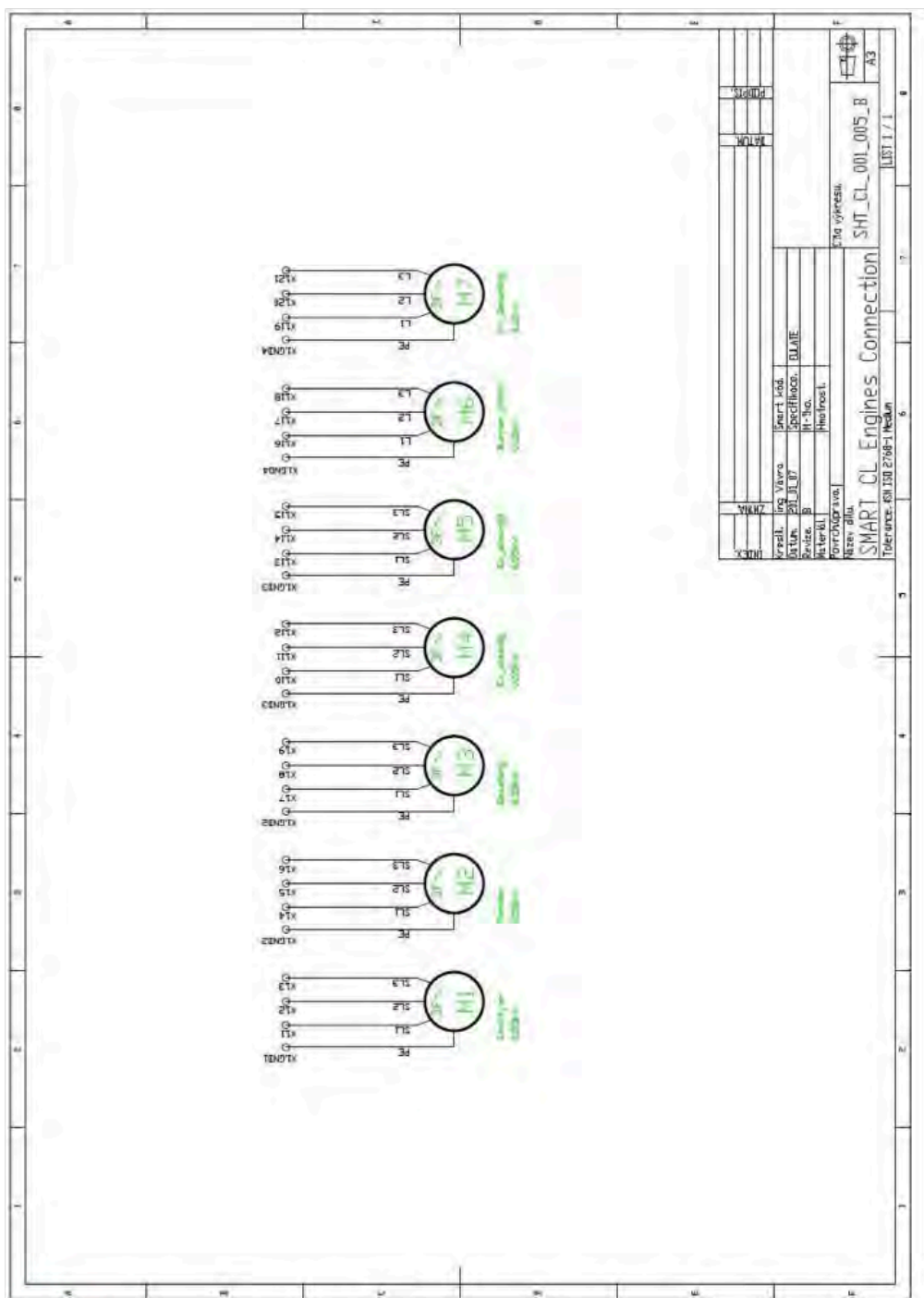


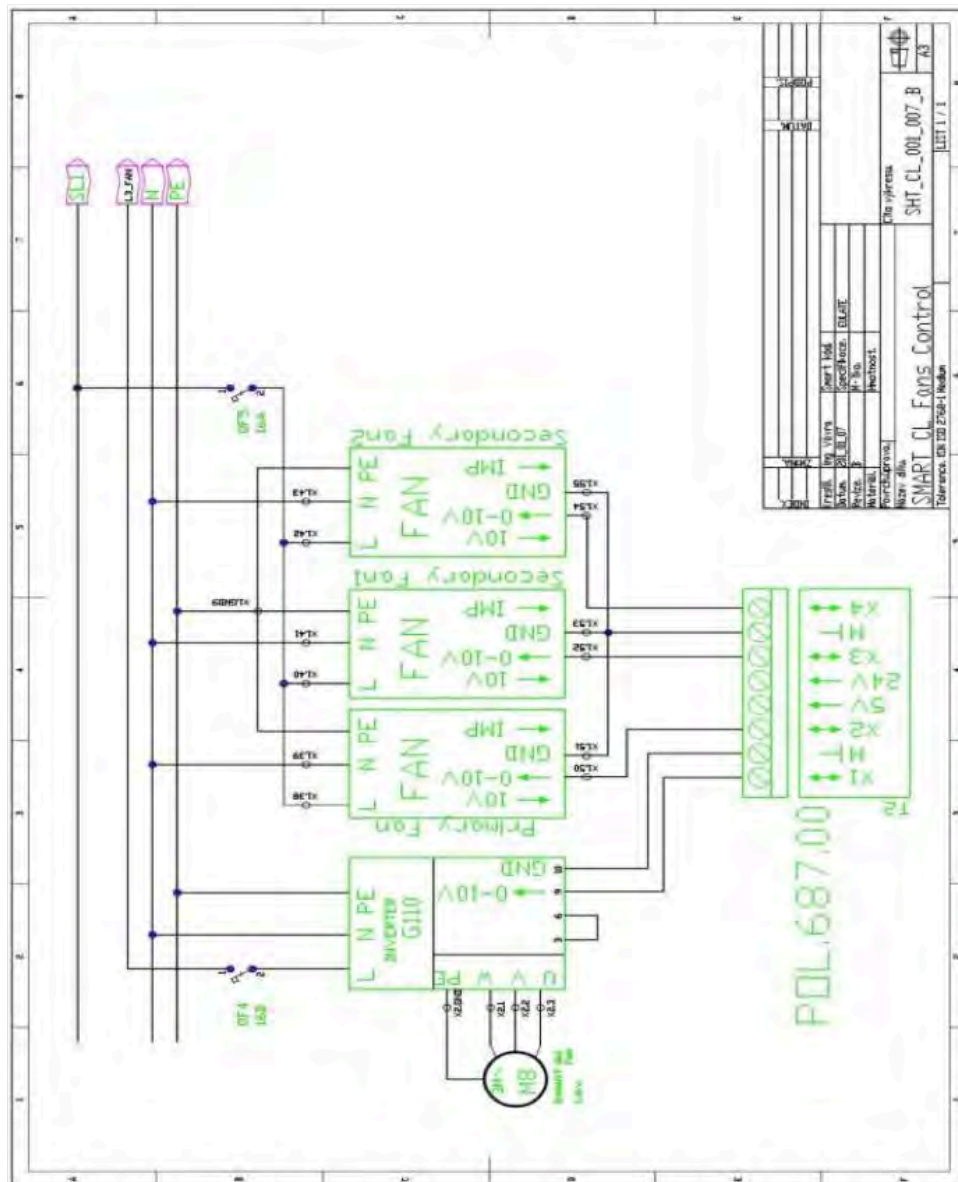


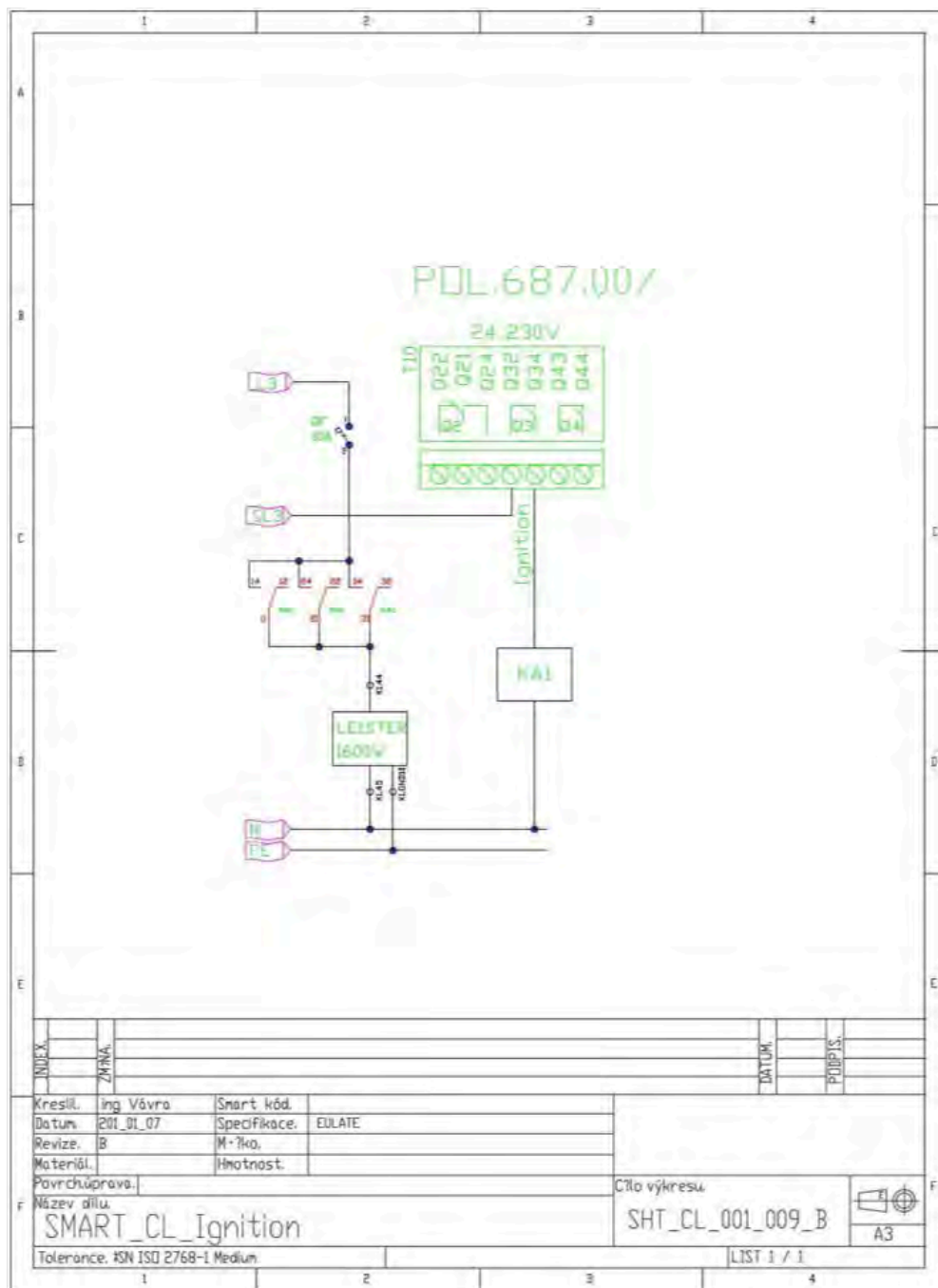


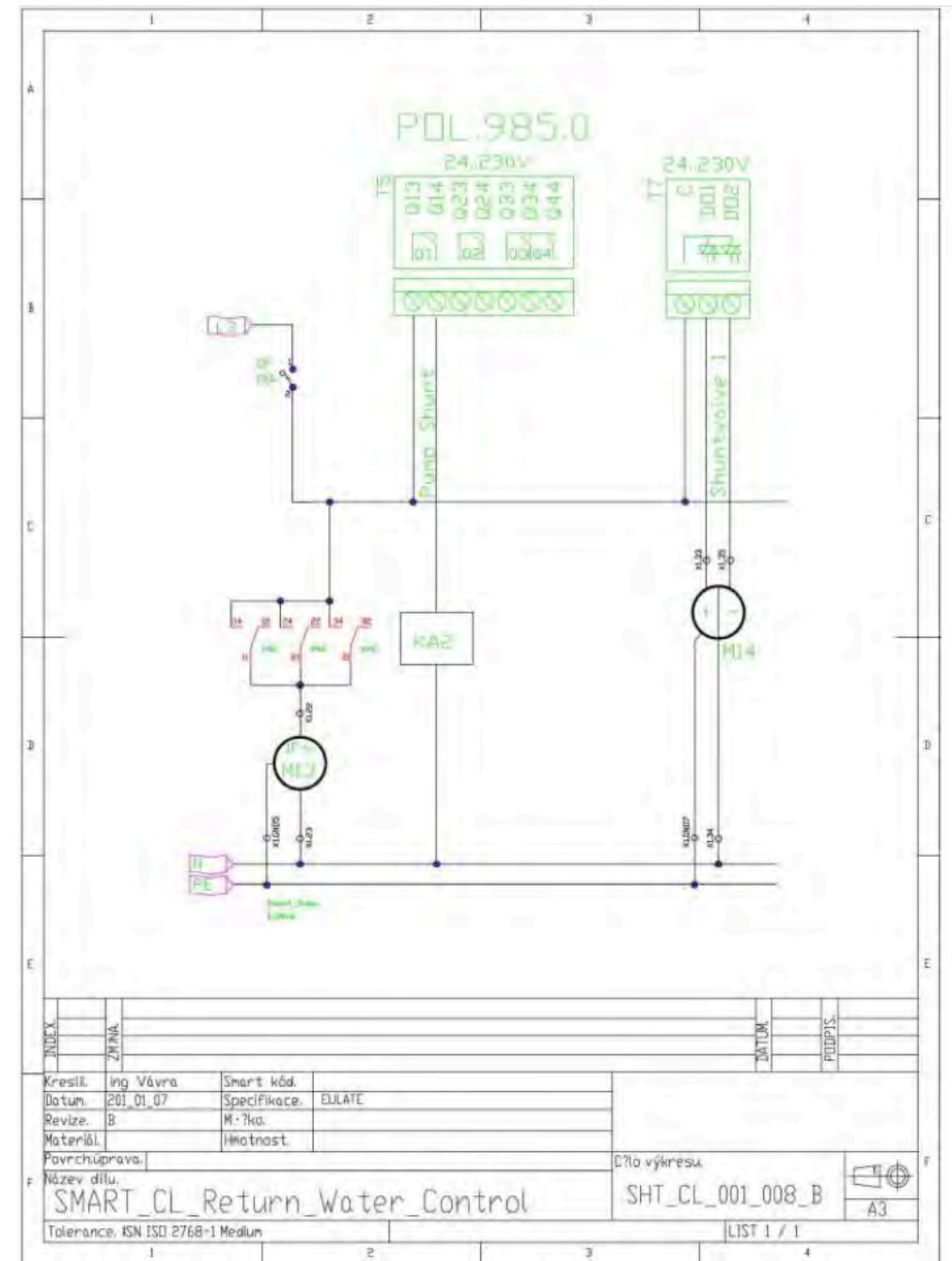
















## 6 Operation of the SMART Control unit

### 6.1 Safety instructions

It is necessary to disconnect the equipment by means of the main switch before opening the control box, the connection boxes of the engine, fan or other connection boxes.

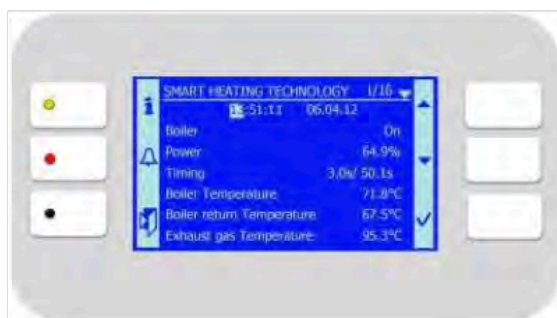
The construction of the boiler allows the boiler operation without usual actions of the operating personnel, namely within the scope of the volumes of fuel storage and ash pans. The boilers are fitted with the automatics enabling the operation under occasional attendance and the control of the boiler heat output by a programmable control unit. The operational states of the boiler are being evaluated and clearly displayed on the display. The concrete time intervals of the supervision of the boiler operation depend on the method of signalling and scope of automation of the used regulation. It is recommended to carry out the inspection of the boiler state at least once a week.

The actions of the operating personnel are required at:

- any change of the combustible material [the volume weight (kg/m<sup>3</sup>) of the wood chips and sawdust is different; therefore it is necessary to change the combustion programme due to another type of combustion].
- the maintenance of the boilers, when the weekly, monthly and half-year checks are specified
- the failure state caused by the boiler engineering, when the failure state is displayed on the display of the control unit, which is fitted with a voltage-less contact of failure state. The boiler is equipped with a GSM modem; when a failure state occurs, an SMS message is sent reporting about the failure state. In the GSM modem there is placed a SIM card telephone number, to which it is possible to send an SMS in the form STATE (STAV - in Czech language = it is necessary to keep the diacritics). By sending this SMS it is possible to find out the actual state of the boiler. The boiler shall respond by sending back an SMS message containing information about the temperatures of flue gases, input and output temperatures.

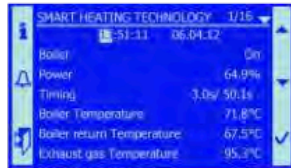
## 6.2 Attendance and display elements

- Main switch of the boiler. The main switch discontinues the current supply to the distributor, by which the whole boiler is disconnected. This switch also switches on and switches off the boiler.
- Reverser of the boiler. By the reverser we can change the direction of rotation of the three-phase drives. There are three positions:
  - Position 0 – the drives are switched off.
  - Position 1 – the direction of rotation of the drives is in the basic position, when the correct function of the boiler is secured.
  - Position 2 - the direction of rotation of the drives is in the position of reverse movement. The reverse movement can be used only in the "Manual mode", when we switch just the engine, with which we need to manipulate (for example when a large piece of material gets jammed) in the reverse movement. When manipulating with the "Engine of discharging (carrier)", which ensures the transport of the material into the intermediate storage bin, the maximal length of the reverse movement is 5 seconds. Should the reverse movement function longer, a threat of a permanent deformation exists to the mixer, which ensures the pushing-up of the material to the conveyor of discharging device. Switch the reverser back into the position 1 and switch the relevant engine. If you fail to remedy the defect after several repetitions, please, contact the Service Department. We can use the reverse movement repeatedly only if we switch the engine in the position 1.
- Industrial terminal with HMI parallel interface, the picture of which is below. Only the particular places actually pictured on the industrial terminal are active. All the set-ups of the boiler and changes of the set values are performed by slight touches of the finger on the places illustrated below on the picture of the industrial terminal.



## 6.3 Control unit functionality

### 6.3.1 Main menu



#### 1.1 Boiler (on/off)

- current status of the boiler activation requirement
- boiler is ON if the temperature is lower than its set-point 1.13.1.1.
- the ExtON requirement is simultaneously active at the terminals X1.96 –X1.97
- or - KNX requirement is simultaneously active on the process bus
- or -temperature in the storage tank is simultaneously lower than its setpoint

#### 1.2 Power (%)

- current boiler capacity within the range of 30 – 100% of the nominal boiler capacity

#### 1.3 Timing (s/s)

- current timing of the fuel feeding conveyor screw

#### 1.4 Boiler Temperature (°C)

- current temperature of the boiler outlet water

#### 1.5 Boiler return Temperature (°C)

- current temperature of the boiler outlet water

#### 1.6 Exhaust gas Temperature (°C)

- current temperature of exhaust fumes downstream the boiler

#### 1.7 O<sub>2</sub> concentration (%)

- current temperature of residual oxygen in exhaust fumes

#### 1.8 Underpressure (Pa)

- current underpressure value in the fume chamber



#### 1.9 MIX Temperature(°C)

- current temperature downstream the primary circuit's mixing valve

#### 1.10 Backfire Temperature(°C)

- current temperature on fuel channel between the burner and bin

#### 1.13 User setting

- Entry into user accessible information MENU

#### 1.14 Servis

- Entry into service MENU – enabled once the password 1.16 has been entered

#### 1.15 Language selection

- Entry into the language version selecting MENU

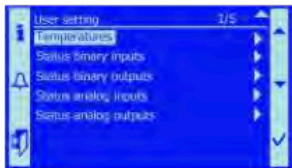


- 1.16 Password enter
- Entering the password for access to service MENU 1.14

6.3.1.1 Menu 1.13 User setting

6.3.1.1.1 Menu 1.13.1 Temperatures

The temperature setpoints for boiler operation can be set in the menu

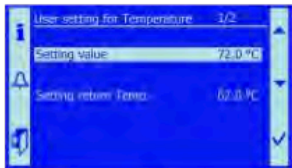


1. select row

2. press enter

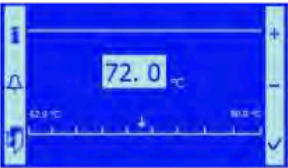
6.3.1.1.1.1 Menu 1.13.1.1 Setting value

Setting the boiler operating temperature. Range of user settings as allowed by the manufacturer



1. select row

2. press enter




3. set temperature by pressing

4. confirm the setting by pressing enter

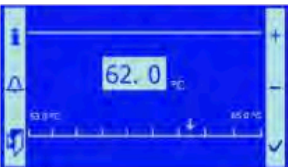
6.3.1.1.1.2 Menu 1.13.1.2 Setting return Temp.

Setting of the boiler operating temperature. Range of user settings as allowed by the manufacturer.



1. select row

2. press enter



3. set temperature by pressing

4. confirm the setting by pressing enter

### 6.3.1.1.2 Menu 1.13.2 Status binary inputs

Provides information on status of the boiler peripherals. Status of these devices is only binary, mostly reflecting an open or closed contact



### 6.3.1.1.2.1 Menu 1.13.2.1 External (On/off)

Provides information regarding the activity/inactivity of the heat supply requirement Status ON – heat required, OFF – heat is not required (Boiler is OFF)

### 6.3.1.1.2.2 Menu 1.13.2.2 Safety limit thermo .....

Information on the Safety Thermostat status OK – emergency thermostat is in inactive condition, Error – when boiler's temperature exceeds 95°C.

### 6.3.1.1.2.3 Menu 1.13.2.3 KM1 Fault

KM1 and KM2 are the contactors that ensure safe disconnection of equipment should the boiler get overheated.

If the thermostat is in its initial position (1.13.2.2 is OK), both contactors MUST be OK.

If the thermostat is in its active position (1.13.2.2 is Error), both contactors MUST be in Error status

KM1 Status – OK and KM2 at the same time – Error is unacceptable, equipment repair necessary

KM1 Status – Error and KM2 at the same time – OK is unacceptable, equipment repair necessary

### 6.3.1.1.2.4 Menu 1.13.2.4 KM2 Fault

Provision under 1.13.2.3 shall apply

#### **6.3.1.1.2.5 Menu 1.13.2.5 Safe canystr**

there is a level sensor inside of the canystr.

Full – initial condition, boiler is operating normally

Empty – faulty condition. The safety flapping system must be checked and the can refilled thereafter

#### **6.3.1.1.2.6 Menu 1.13.2.6 TKM1 Conveyor 2**

thermo contact of the motor used to feed fuel from silo

#### **6.3.1.1.2.7 Menu 1.13.2.7 TKM2 feeder 1**

Thermo contact of the motor used to drive the conveyor screw that feeds fuel to burner

#### **6.3.1.1.2.8 Menu 1.13.2.8 TKM3 deashing**

Thermo contact of the motor used to drive the ash removing conveyor screws

#### **6.3.1.1.2.9 Menu 1.13.2.9 TKM6 Burner cleaning**

Thermo contact of the grating motor

#### **6.3.1.1.2.10 Menu 1.13.2.10 TKM4/5 Exchanger cleaning**

Thermo contact of the exchanger cleaning motor. The thermo contacts are arranged in series if the boiler uses two of them

#### **6.3.1.1.2.11 Menu 1.13.2.11 TKM7 Exch. deashing**

Thermo contact of the motor used to remove ash underneath the exchanger

#### **6.3.1.1.2.12 Menu 1.13.2.12 Level M2 Conveyor**

status of the fuel level sensor in the intermediate fuel tank

Off – initial condition, fuel level is high

On – level sensor is active, level is low, the boiler will automatically refill the fuel

#### **6.3.1.1.2.13 Menu 1.13.2.13 On damper M1Conveyor**

limit switch for the flap inactive position

On – Flap is fully closed. Initial position of the flap

Off – Flap is not closed. Getting open or being fully open

#### **6.3.1.1.2.14 Menu 1.13.2.14 Off damper M1Conveyor**

limit switch for open position of the flap

On – flap is fully open. The flap position allowing automatic refilling with fuel

Off – flap is in its intermediate position or fully closed

#### **6.3.1.1.2.15 Menu 1.13.2.15 Exchanger damper**

limit switch for the exhaust fumes safety flap

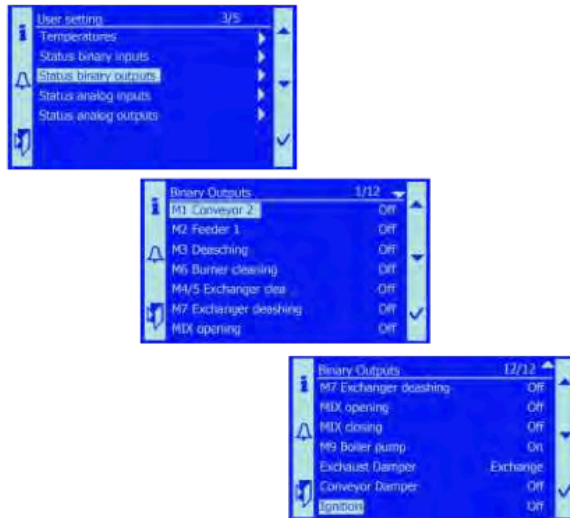
On – flap is in its open position, the exhaust fumes proceed to stack, bypassing the exchanger

Off – flap is getting closed or being closed. the exhaust fumes proceed to exchanger



### 6.3.1.1.3 Menu 1.13.3 Status binary outputs

Provides information on status of the binary control signals



#### 6.3.1.1.3.1 Menu 1.13.3.1 M1 Conveyor 2

control of the conveyor screw motor used to feed fuel from silo

Off – motor is off

On – motor is running

#### 6.3.1.1.3.2 Menu 1.13.3.2 M2 Feeder 1

control of the conveyor screw motor used to feed fuel to burner

#### 6.3.1.1.3.3 Menu 1.13.3.3 M3 Deashing

control of the ash removing conveyor screws motor

#### 6.3.1.1.3.4 Menu 1.13.3.4 M6 Burner cleaning

control of the grating motor (burner cleaning)

#### 6.3.1.1.3.5 Menu 1.13.3.5 M4/5 Exchanger cleaning

control of the exchanger cleaning motor. The motors are arranged in parallel if a boiler uses two of them

#### 6.3.1.1.3.6 Menu 1.13.3.6 M7 Exchanger deashing

control of the motor used to remove ash from underneath the exchanger

#### 6.3.1.1.3.7 Menu 1.13.3.7 MIX opening

control of the three-way valve servo used to control the return branch temperature – valve opening

#### 6.3.1.1.3.8 Menu 1.13.3.8 MIX dosing

control of the three-way valve servo used to control the return branch temperature – valve closing

#### 6.3.1.1.3.9 Menu 1.13.3.9 M9 Boiler pump

control of the boiler primary circuit's circulation pump. Along with the three-way valve, this pump is involved in the return temperature control

#### 6.3.1.1.3.10 Menu 1.13.3.10 Exhaust dumper

control of the safety flap to control the fumes flow rate

Exchanger – exhaust fumes are channeled through the boiler exchanger. The flap is closed in this position when the fumes temperature is sufficiently high and when the boiler is not overheated

Exhaust stack – the flap is open and the fumes proceed directly to the stack, bypassing the exchanger. The flap takes this position during the boiler ignition, when the boiler gets overheated or in response to power failure

#### 6.3.1.1.3.11 Menu 1.13.3.11 Conveyor Damper

control of the fire safety flap on the boiler intermediate bin

Off – flap is closed in its initial secured position. It will take this position in response to power failure

On – flap is open, fuel can be refilled

#### 6.3.1.1.3.12 Menu 1.13.3.12 Ignition

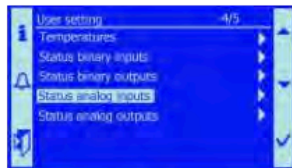
control of the hot-air gun ignition system

On – ignition is active, the gun is driving hot air into fuel

Off – ignition gun is off

#### 6.3.1.1.4 Menu 1.13.4 Status analog inputs

Current status is displayed, as measured by the control unit



Analog Inputs		-4/7
Boiler Temperature	70.8°C	
Boiler return Temp.	66.7°C	
MIX Temperature	67.9°C	
Exhaust gas Tempera.	93.1°C	
Backfire Temperature	25.7°C	
Underpressure	75.3Pa	
O2 concentration	18.6%	✓

#### 6.3.1.1.4.1 Menu 1.13.4.1 Boiler Temperature

current condition of outlet water temperature

#### 6.3.1.1.4.2 Menu 1.13.4.2 Boiler return Temp.

current condition of return water temperature



#### 6.3.1.1.4.3 Menu 1.13.4.3 MIX Temperature

current condition of water temperature downstream the mixing valve (temperature of water leaving for the system)

#### 6.3.1.1.4.4 Menu 1.13.4.4 Exhaust gas Temperature

current temperature of fumes downstream the boiler

#### 6.3.1.1.4.5 Menu 1.13.4.5 Backfire Temperature

current temperature downstream the fuel channel between the burner and intermediate fuel bin.

#### 6.3.1.1.4.6 Menu 1.13.4.6 Undrepressure

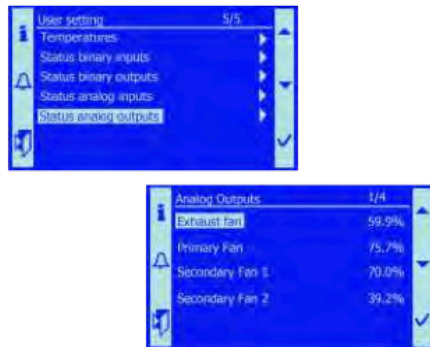
current value of vacuum in the fume chamber

#### 6.3.1.1.4.7 Menu 1.13.4.7 O<sub>2</sub> concentration

current value of O<sub>2</sub> in exhaust fumes. The value is taken from the Lambda Probe, used to control the fan capacity

### 6.3.1.1.5 Menu 1.13.5 Status analog outputs

Current status of the individual fans' capacities is displayed



#### 6.3.1.1.5.1 Menu 1.13.5.1 Exhaust fan

current status of the fumes extracting fan capacity

#### 6.3.1.1.5.2 Menu 1.13.5.2 Primary Fan

current status of the combustion primary fan capacity

#### 6.3.1.1.5.3 Menu 1.13.5.3 Secondary Fan 1

current status of the combustion secondary fan 1 capacity

#### 6.3.1.1.5.4 Menu 1.13.5.4 Secondary Fan 2

current status of the combustion secondary fan 2 capacity

6.3.1.2 Menu 1.15 Language selection

This manu allows selectn g the language versions of the text strings displayed on the HMI terminal



SMART HEATING TECHNOLOGY 15/16  
MDX Temperature 67.9°C  
Backfire Temperature 25.7°C  
User setting  
Servis  
Language selection  
Password enter

1. select row

2. press enter



Language selection 1/1  
HMI language English

3. Current language is displayed

4. press enter



English  
Czech  
Spanish  
German  
Langs

5. select language


6. press enter



SMART HEATING TECHNOLOGY 17/16  
51.11 06.04.12  
Boiler On  
Power 64.9%  
Timing 3.0s/ 50.1%  
Boiler Temperature 71.8°C  
Boiler return Temperature 67.5°C  
Exhaust gas Temperature 95.3°C

Terminal operates in the language version as selected


6.3.1.3 Menu 1.16 Password enter



SMART HEATING TECHNOLOGY 16/16  
MDX Temperature 67.9°C  
Backfire Temperature 25.7°C  
User setting  
Servis  
Language selection  
Password enter

1. select menu

2. press enter



Password  
1 - - -

3. set the fr st digit

4. press enter



5. set the second digit



6. press enter



7. set the third digit



8. press enter



9. set the third digit



10. press enter



11. select Service menu

The ► symbol will appear in response to the prior entered correct password, indicating that the service menu can be entered.

Should the operators not use the service menu for a prolonged period of time, the entry symbol will disappear. The password has to be re-entered for another access to this menu

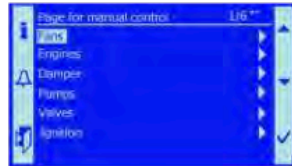
#### 6.3.1.4 Menu 1.14 Service

When in the Service Menu, the authorized persons can exert control of boiler peripheries, test functions, and set parameters

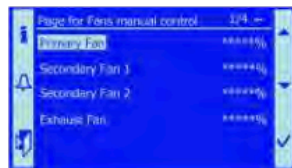
#### 6.3.1.4.1 Menu 1.14.1 Manual control

Allows manual control of the boiler's electrical and electronic devices. Used for boiler testing, starting, and inspection.

##### 6.3.1.4.1.1 Menu 1.14.1.1 Fans



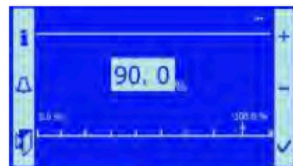
##### 6.3.1.4.1.1.1 Menu 1.14.1.1.1 Primary fans



1. select menu



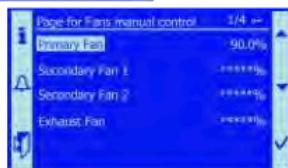
2. press enter



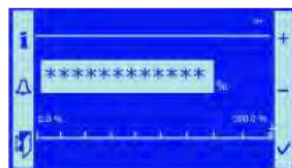
3. set the power output of the fan



4. press enter



The fan will work permanently in set value and yellow led light will turn on.



1. to have the fan work automatically set it over 100 when \*\*\*\* will appear.



2. press enter



The fan will work in automatic mode.

#### 6.3.1.4.1.2 Menu 1.14.1.1.2 Secondary Fan 1

to see the output value follow the steps as are in the menu 1.14.1.1.1

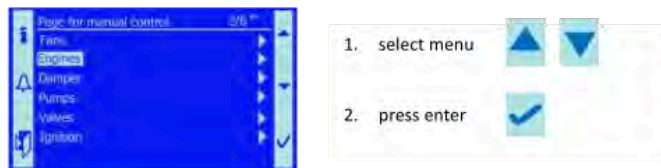
#### 6.3.1.4.1.3 Menu 1.14.1.1.3 Secondary Fan 2

to see the output value follow the steps as are in the menu 1.14.1.1.1

#### 6.3.1.4.1.4 Menu 1.14.1.1.4 Exhaust Fan

to see the output value follow the steps as are in the menu 1.14.1.1.1

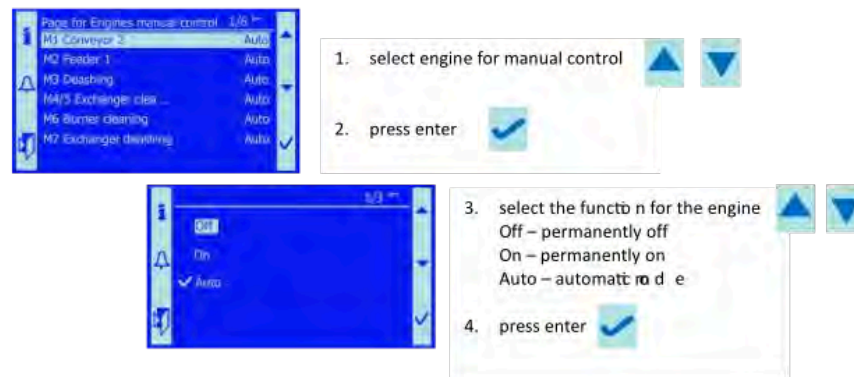
### 6.3.1.4.1.2 Menu 1.14.1.2 Engines



**Note:** Engine M2 Feeder 2 – after you turning in to a mode ON, the motor is running only for short period of time (5x of the feeding time which is set in menu 1.14.10.4)

#### 6.3.1.4.1.2.1 Menu 1.14.1.2.1 M1 Conveyor 2

it controls engine of the feeder – from seasonal silo in to fuel bin



#### 6.3.1.4.1.2.2 Menu 1.14.1.2.2 M2 Feeder 1

in this menu you can control of the fuel feeder

**Note:** Engine M2 Feeder 2 – after you turning in to a mode ON, the motor is running only for short period of time (5x of the feeding time which is set in menu 1.14.10.4)

#### 6.3.1.4.1.2.3 Menu 1.14.1.2.3 M3 Deashing

in this menu you can control of the ash removing engine





#### 6.3.1.4.1.2.4 Menu 1.14.1.2.4 M4/5 Exchanger cleaning

in this menu you can control of the exchanger cleaning engine(s)

#### 6.3.1.4.1.2.5 Menu 1.14.1.2.5 M6 Burner cleaning

in this menu you can control of the grading engine

#### 6.3.1.4.1.2.6 Menu 1.14.1.2.6 M7 Exchanger deashing

in this menu you can control of the heat exchanger ash removing engine

**Note:** it is not a part of standart boiler configuration.

### 6.3.1.4.1.3 Menu 1.14.1.3 Damper



1. select menu



2. press enter



#### 6.3.1.4.1.3.1 Menu 1.14.1.3.1 Exhaust Damper

in this menu you can open or close damper between combustion chamber and fuel bin



1. select damper



2. press enter



3. select position or Auto mode



4. press enter



#### 6.3.1.4.1.3.2 Menu 1.14.1.3.2 Conveyor Damper





1. select damper



2. press enter





3. select position or Auto mode 
4. press enter 

#### 6.3.1.4.1.4 Menu 1.14.1.4 Pumps

in this menu you can control the pump(s) connected to Control unit



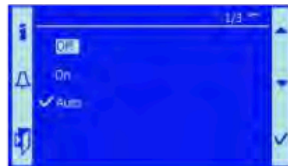
1. select menu 
2. press enter 



#### 6.3.1.4.1.4.1 Menu 1.14.1.4.1 M9 Boiler pump



3. select Pump 
4. press enter 

Note: M9 is a primary cycle pump for return water. If there are other pumps in the system it can be configured in the control unit on the side.



5. select position or Auto mode 
6. press enter 

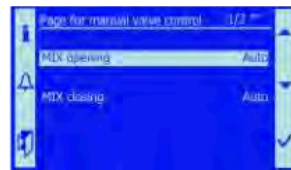
#### 6.3.1.4.1.5 Menu 1.14.1.5 Valves




in this menu you can control three-way valve servo motor






1. select menu 
2. press enter 

#### 6.3.1.4.1.5.1 Menu 1.14.1.4.1 MIX opening

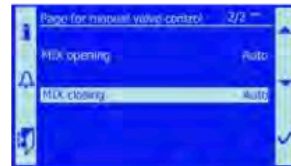





3. select MIX opening  
4. press enter 






5. select position or Auto mode    
 Off – permanently off  
 On – permanently on  
 Auto – automatic mode
6. press enter 

#### 6.3.1.4.1.5.2 Menu 1.14.1.4.1 MIX closing



3. select MIX closing  
4. press enter 



5. select position or Auto mode    
 Off – permanently off  
 On – permanently on  
 Auto – automatic mode
6. press enter 

#### 6.3.1.4.1.6 Menu 1.14.1.6 Ignition



1. select menu  
2. press enter 

#### 6.3.1.4.1.6.1 Menu 1.14.1.6.1 Ignition



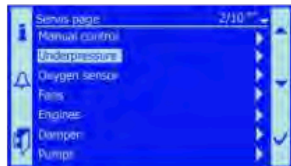
3. press enter 



4. select position or Auto mode  
Off – permanently off  
On – permanently on  
Auto – automatic mode
5. press enter

#### 6.3.1.4.2 Menu 1.14.2 Underpressure

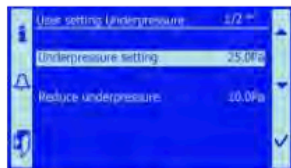
Service technician can set needed underpressure, which needs to be in combustion chamber while in different stages of the operation mode.



1. select menu
2. press enter

##### 6.3.1.4.2.1 Menu 1.14.2.1 Underpressure setting

underpressure setting while the boiler is running



3. select Underpressure setting
4. press enter



5. set underpressure by pressing + -
6. confirm by pressing enter

After the value is set CU will regulate the speed of the flue gas fan to fulfill it.




##### 6.3.1.4.2.2 Menu 1.14.2.2 Reduce underpressure

underpressure setting while the boiler is in stand by



3. select Underpressure setting
4. press enter



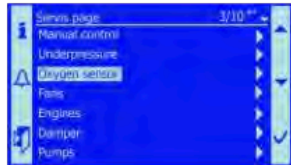
5. set underpressure by pressing  
6. confirm by pressing enter 

After the value is set CU will control the underpressure inside of the burning chamber while the boiler is in stand by mode.

**Note:** After about 35min of the boiler being in stand by the flue gas fan will stop completely.

#### 6.3.1.4.3 Menu 1.14.3 Oxygen sensor

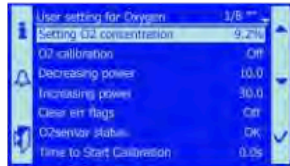
In the case when the sensor needs to be calibrated you can set it by using this menu






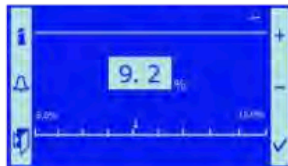
1. select menu  
2. press enter 

##### 6.3.1.4.3.1 Menu 1.14.3.1 Setting O2 concentration

to set requested value of leftover O2 in flue gas



3. select Setting O2 concentration  
4. press enter 



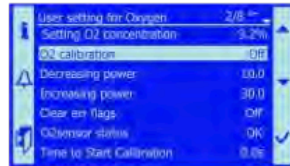
5. set by pressing  
6. press enter to confirm 

CU will regulate the speed of the Secondary 1 and 2 fan according to your setting. So it is in the level of set value.

#### 6.3.1.4.3.2 Menu 1.14.3.2 O2 calibration

it allows you to calibrate the Lambda probe.

**!! Important notice:** Calibration can be done only when the boiler is not running, or if the boiler is in operation take out the probe and then start the calibration.



3. select O2 calibration
4. press enter



5. select On to start calibration
6. press enter to confirm

After the confirmation by pressing enter you have to wait for the probe to get stability which you can see in menu 1.14.3.7 Time to start Calibration.

#### 6.3.1.4.3.3 Menu 1.14.3.3 Decreasing power

it is a % value set by a technician, which is decreasing the curve of Secondary fans set in menu 1.14.4.2 and 1.14.4.3.

#### 6.3.1.4.3.4 Menu 1.14.3.4 Increasing power

it is a % value set by a technician, which is increasing the curve of Secondary fans set in menu 1.14.4.2 and 1.14.4.3.

#### 6.3.1.4.3.5 Menu 1.14.3.5 Clear err flags

it allows you to clear all error messages of the sensor. If the occurred error disappears by itself the record will do so as well.

#### 6.3.1.4.3.6 Menu 1.14.3.6 O2sensor status

current status of the oxygen sensor

OK – probe is working properly

Run – up – warming process

Vyp – probe has turned off automatically (boiler is in stand by)

#### 6.3.1.4.3.7 Menu 1.14.3.7 Time to start Calibration

count down of the time before the calibration start

#### 6.3.1.4.3.8 Menu 1.14.3.8 Time to finish calibration

calibration process count down

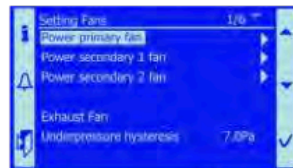
#### 6.3.1.4.4 1.14.4 Fans

menu were you set the basic fan curves for burning proces. It is based on the power output of the boiler there for the amount of the fuel, which is given by the power out of individual fans. From the set values a lamda probe can coordinate the operatb n of fans according to seeth g made in menu 1.14.3.3 and 1.14.3.4.

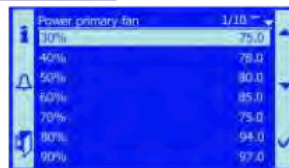


1. select menu
2. press enter

##### 6.3.1.4.4.1 Menu 1.14.4.1 Power primary fan



3. select menu
4. press enter

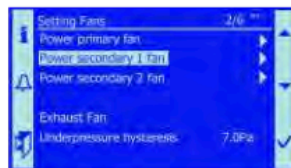


5. select power output from 30% to 100%
6. press enter

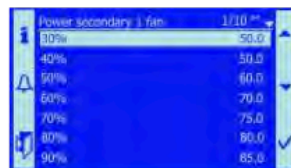
After the values are set or correcteed you have set the base for operatb g curve of theprimary fan

**Note:** The basic curve is set by manufacturer

##### 6.3.1.4.4.2 Menu 1.14.4.2 Power secondary 1 fan



3. select menu
4. press enter

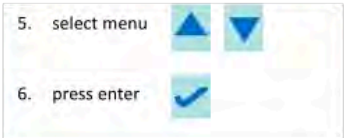




After the values are set or correcteed you have set the base for operatb g curve of the secondary 1 fan



**Note:** The basic curve is set by manufacturer

**6.3.1.4.4.3 Menu 1.14.4.3 Power secondary 2 fan**





After the values are set or corrected you have set the base for operating curve of the secondary 2 fan

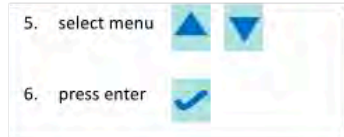
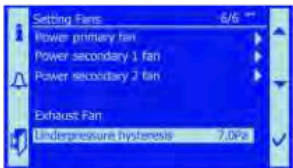
**Note:** The basic curve is set by manufacturer


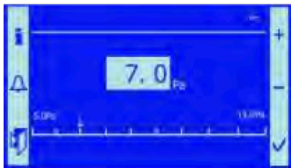
**6.3.1.4.4.4 Menu 1.14.4.5 Exhaust Fan**

to set outer condition for the boiler operation

**6.3.1.4.4.5 Menu 1.14.4.6 Underpressure hysteresis**

to set the lever of the underpressure drop which is set in menu 1.14.2.1. If the drop of underpressure last for more than 2 minutes, the boiler will stop. And the error message "low underpressure" will appear.

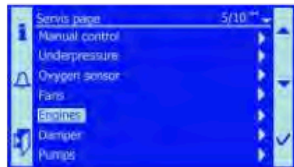




**6.3.1.4.5 Menu 1.14.5 Engines**

to set working parameters of the engines which are on the boiler. When actual motor operation is based on boiler power output and its feeding cycles

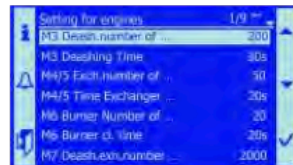




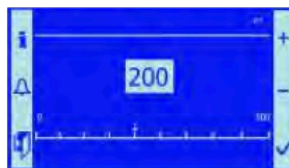
1. select menu
2. press enter

#### 6.3.1.4.5.1 Menu 1.14.5.1 M3 Deashing.number of ...

setting of the ash removing drive operating conditions.



3. select menu
4. press enter

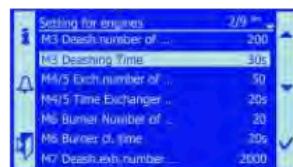


5. set by pressing
6. press enter to confirm

200 means that the motor will turn on after every 200 feeding cycle. The length of cleaning time is set in menu 1.14.5.2.

#### 6.3.1.4.5.2 Menu 1.14.5.2 M3 Deashing Time

Time of how long will the ash removing drive removing the ash from burning chamber.



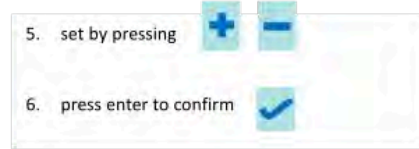
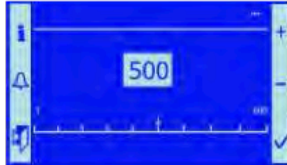
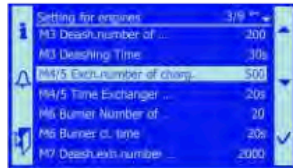
3. select menu
4. press enter



5. set by pressing
6. press enter to confirm

#### 6.3.1.4.5.3 Menu 1.14.5.3 M4/5 Exch.number of adhrq

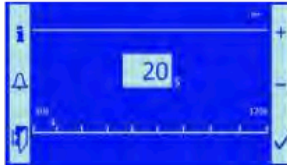
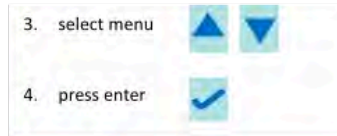
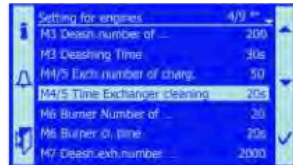
setth g of the exchanger heating drive operating conditb ns.



500 means that the motor will turn on after every 500 feeding cycle. The lenght of cleaning time is set in menu 1.14.5.4.

#### 6.3.1.4.5.4 Menu 1.14.5.4 M4/5 Time Exchanger cleaning

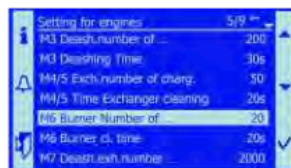
Time of how long will the heat exchanger drive be working.

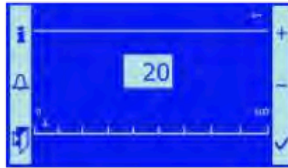





20 means that the motor will turn on after every 20 feeding cycle. The lenght of cleaning time is set in menu 1.14.5.6.

#### 6.3.1.4.5.5 Menu 1.14.5.5 M6 Burner number of ...

setth g of burner grath g drive operath g conditb ns.

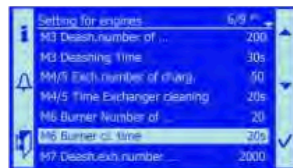




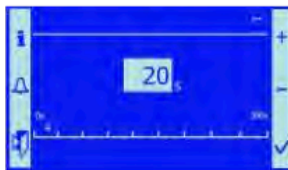
5. set by pressing  
6. press enter to confirm 




#### 6.3.1.4.5.6 Menu 1.14.5. 6 M6 Burner d. time ...

Time of how long will the grating drive be working.



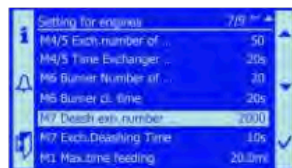
3. select menu  
4. press enter 



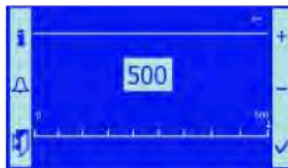
5. set by pressing  
6. press enter to confirm 




#### 6.3.1.4.5.7 Menu 1.14.5.7 M7 Deash.exh.number ...

setth g of heat exchanger sh removing drive operath g conditb ns.



3. select menu  
4. press enter 

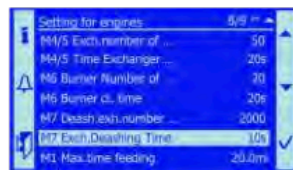


5. set by pressing  
6. press enter to confirm 

500 means that the motor will turn on after every 500 feeding cycle. The lenght of cleaning time is set in menu 1.14.5.8.

#### 6.3.1.4.5.8 Menu 1.14.5.8 M7 Exch.Deashing Time

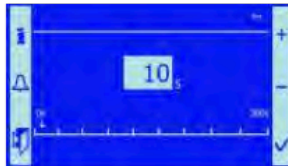
Time of how long will be the heat exchanger drive removing the ash from bottom part of the heat exchanger.



3. select menu



4. press enter



5. set by pressing

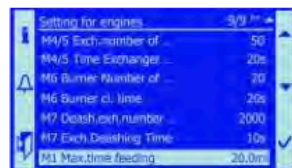


6. press enter to confirm



#### 6.3.1.4.5.9 Menu 1.14.5.9 M1 Max. time feeding

setting of the maximum feeding time for the 200l fuel bin.



3. select menu



4. press enter



5. set by pressing



6. press enter to confirm



If the 200l fuel bin fill up within set time, the error message „exceeded filling time“ will appear. The cause of this message could be empty seasonal silo.

#### 6.3.1.4.6 Menu 1.14.6 Damper

setting of damper operating conditions.



1. select menu

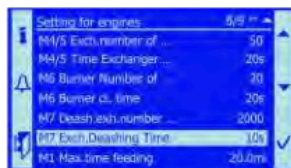


2. press enter



#### 6.3.1.4.5.8 Menu 1.14.5.8 M7 Exch.Deashing Time

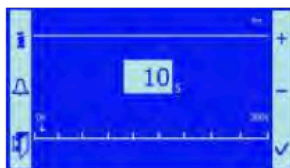
Time of how long will be the heat exchanger drive removing the ash from bottom part of the heat exchanger.



3. select menu



4. press enter



5. set by pressing

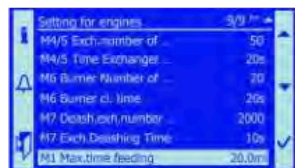


6. press enter to confirm



#### 6.3.1.4.5.9 Menu 1.14.5.9 M1 Max. time feeding

setth g of the maximum feeding time for the 200l fuel bin.



3. select menu



4. press enter



5. set by pressing



6. press enter to confirm



If the 200l fuel bin fill up within se set time, the error message „exceeded filling time“ will appear. The cause of this messase could be empty seasonal silo.

#### 6.3.1.4.6 Menu 1.14.6 Damper

setth g of damper operath g conditb ns.



1. select menu



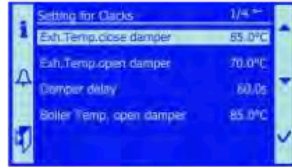
2. press enter



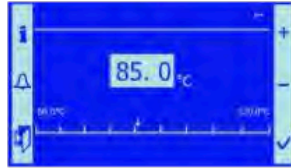


#### 6.3.1.4.6.1 Menu 1.14.6.1 Exh.Temp.close damper

setting of the flue gas duct safety damper temperature – when the damper will close.  
When start of the boiler is when damper is open directly into chimney bypassing the exchanger



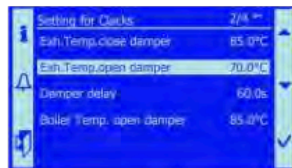
3. select menu
4. press enter



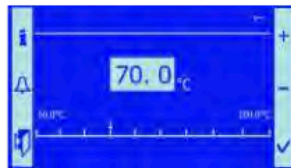
5. set by pressing
6. press enter to confirm

#### 6.3.1.4.6.2 Menu 1.14.6.2 Exh.Temp.open damper

If there is a drop of the flue gas temperature more than set value, the safety flue gas damper has to open. This function is to protect the heat exchanger against a condensation.



3. select menu
4. press enter



5. set by pressing
6. press enter to confirm

#### 6.3.1.4.6.3 Menu 1.14.6.3 Damper delay

To prevent the damper close and open only because of temperature fluctuation you set a damper delay, which will prevent it if the drop is for short period of time.



3. select menu
4. press enter



#### 6.3.1.4.6.4 Menu 1.14.6.4 Boiler Temp.open damper

setting of the temperature for the safety damper, when once the temperature is reached the damper will open directly into a chimney to bypass exchanger. It is to protect exchanger against overheating.



3. select menu
4. press enter



5. set by pressing
6. press enter to confirm

#### 6.3.1.4.7 Menu 1.14.7 Pumps

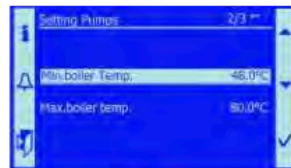
setting of pumps operating conditions.



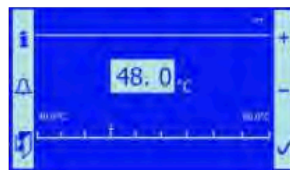
1. select menu
2. press enter

##### 6.3.1.4.7.1 Menu 1.14.7.2 Min.boiler Temp.

setting of the boiler temperature, when the pump of the three way valve will start to work together with three way Mixing valve to optimize return water temperature.



3. select menu
4. press enter

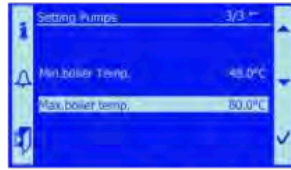


5. set by pressing
6. press enter to confirm

Pumps will turn on when the set temperature is set and the request for hot water is not on the output ExON/OFF.

#### 6.3.1.4.7.2 Menu 1.14.7.3 Max.boiler temp.

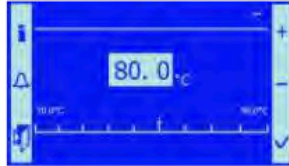
by setting this value you are protecting your boiler against overheating, when the set temperature is reached the pumps will turn and cool down the boiler.



3. select menu



4. press enter



5. set by pressing

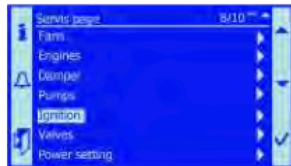


6. press enter to confirm



#### 6.3.1.4.8 Menu 1.14.8 Ignition

Setting of parameters for ignition parts. Requirement for optimal setting could be different according to fuel used in the boiler.



1. select menu

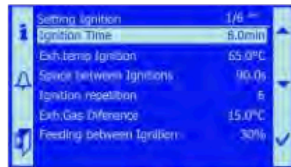


2. press enter



#### 6.3.1.4.8.1 Menu 1.14.8.1 Ignition Time

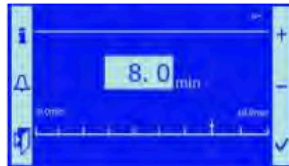
maximum firing time of heating gun.



3. select menu



4. press enter



5. set by pressing



6. press enter to confirm



Should it not be found out for the entire operation of the ignition gun that the boiler has already been fired, the ignition routine will be carried out repeatedly as per 1.14.8.4

#### 6.3.1.4.8.2 Menu 1.14.8.2 Exch.temp. Ignition

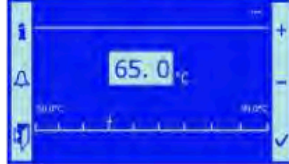
Achievement of this fumes temperature setting is one of the preconditions for finding out that the boiler has been fired properly. The other of the preconditions is to be set as per 1.14.8.5.



4. select menu



5. press enter



6. set by pressing

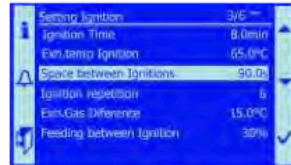


7. press enter to confirm



#### 6.3.1.4.8.3 Menu 1.14.8.3 Space between Ignitions

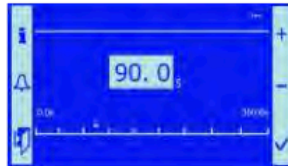
Upon unsuccessful ignition attempts, the process can be repeated several times. Number of such automatically repeated attempts can be set as per 1.14.8.5. It is advisable to insert a space between the individual repeated attempts



4. select menu



5. press enter



6. set by pressing



7. press enter to confirm



#### 6.3.1.4.8.4 1.14.8.4 Ignition repetition

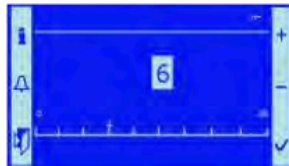
Setting of the number of repeated ignition attempts



4. select menu



5. press enter



6. set by pressing





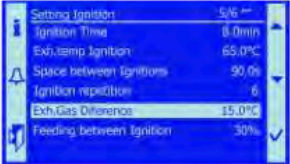
7. press enter to confirm



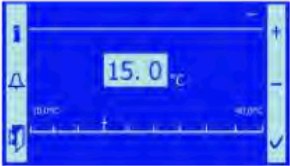


Should the boiler not catch fire even after the set number of attempts, it will be shut down with the "Ignition Error" alarm activated

6.3.1.4.8.5 Menu 1.14.8.5 Exh.Gas Difference




Setting of the other necessary condition to find out whether the boiler has or has not been properly fired. The first precondition is set as per 1.14.8.2. This condition will determine the amount by which the fumes temperature MUST exceed the boiler water temperature for the boiler ignition to be deemed correct



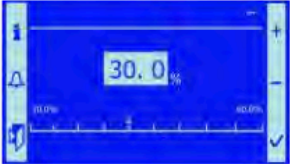







6.3.1.4.8.6 Menu 1.14.8.6 Feeding between Ignition

Setting of the supplementary dose of fuel between the repeated ignition attempts. Upon the ignition routine the fuel is being ignited in the amount supplied as per 1.14.10.3. Supplementary dose for repeated ignition attempts is only x% of the first dose. Size of this dose is to be set in this menu





6.3.1.4.9 Menu 1.14.9 Valves

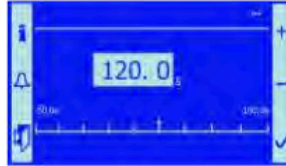


#### 6.3.1.4.9.1 Menu 1.14.9.1 Open Time

Setting of the opening servo running time



3. select menu
4. press enter

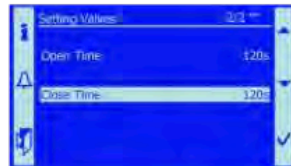


5. set by pressing
6. press enter to confirm

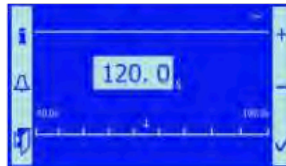
**Note:** Servo running time is set by the servo manufacturer, depending on a particular type

#### 6.3.1.4.9.2 Menu 1.14.9.2 Close Time

Setting of the closing servo running time



3. select menu
4. press enter

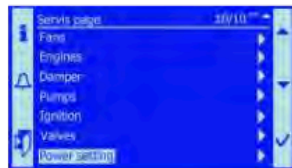


5. set by pressing
6. press enter to confirm

**Note:** Servo running time is set by the servo manufacturer, depending on a particular type

#### 6.3.1.4.10 Menu 1.14.10 Power setting

Setting of the boiler control and capacity modulation parameters between the nominal and minimum values. Setting of the values is specific for each type of boiler, varying also with the type of fuel used

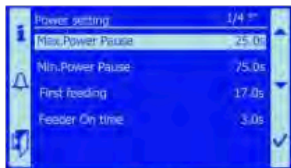




1. select menu
2. press enter




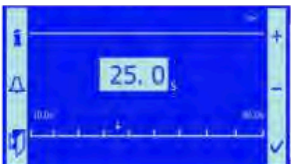
#### 6.3.1.4.10.1 Menu 1.14.10.1 Max. Power Pause



Setting of the lag between two doses of fuel for achievement of the boiler maximum (nominal) capacity. The lag value means the least possible span of time between the doses of fuel




3. select menu  

4. press enter 

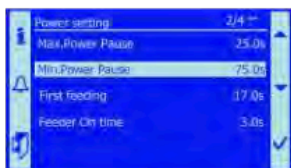




5. set by pressing  


6. press enter to confirm 


#### 6.3.1.4.10.2 Menu 1.14.10.2 Min. Power Pause



Setting of the lag between two doses of fuel for achievement of the boiler minimum capacity (30% of its nominal value). The lag value means the longest possible span of time between the doses of fuel




3. select menu  

4. press enter 






5. set by pressing  


6. press enter to confirm 

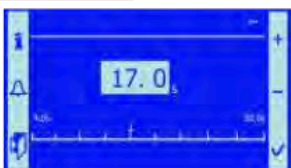
#### 6.3.1.4.10.3 Menu 1.14.10.3 First feeding



Setting of the initial dose of fuel to burner for its proper firing. The dose varies depending the type of fuel used




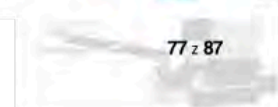
3. select menu  

4. press enter 



5. select menu  

6. press enter to confirm 



77 z 87

#### 6.3.1.4.10.4 Menu 1.14.10.4 Feeder on time

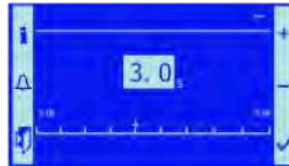
Setting of the fuel dose. Once set, this amount of fuel feeding motor running time is constant for a particular fuel.



3. select menu



4. press enter



5. set by pressing



6. press enter to confirm





## 7 Operation

### 7.1.1 Light up the boiler

The boiler is fitted with an automatic light-up. After programming it is ready for the automatic light-up. Before boiler start-up, please, open the checking door and monitor the furnace. After switching the main switch of the boiler the state of the boiler shall be evaluated. If the flue gases temperature does not exceed the preset temperature of the switch-off of light-up, the mode of light-up shall be initialized. The volume weight (kg/m<sup>3</sup>) of the burnt material (wood chips x sawdust) is different; therefore it is necessary to change the combustion programme for the combustion of another type of material. The chimney fan, primary fan, secondary fan, hot-flue pistol and the first stoking of the material burnt to the combustion chamber shall be initialized. As soon as you see the first indications of smoke, please, close the checking door. The lighting-up of the fuel occurs and the boiler is still in the light-up mode until the flue gases temperature reaches the temperature of the switch-off of light-up. After reaching this temperature the boiler switches over into the mode: "Normal operation".

It is also possible to light-up the boiler manually by means of paper (old newspapers, cardboard paper, etc.), never use any combustibles (petrol, diluting agents, etc.). Go into the "Manual operation" (the particular parts of the boiler shall be switched off), switch on the storage bin engine (MANUAL OPERATION /ENGINES CONTROL/ENGINE OF STOKER) and refuel the material combusted into the combustion chamber. Light-up the paper, put it on the material and close the combustion chamber door. Return from the "Manual operation" back to the MENU start page. The boiler shall evaluate the state and shall initialize the automatic "Lighting-up mode". The lighting-up of the fuel occurs and the boiler is still in the light-up mode until the flue gases temperature reaches the temperature of the switch-off of light-up. After reaching this temperature the boiler switches over into the mode: "Normal operation".

If the material is too moist, the light-up fails and on the display there will be displayed a "Lighting-up failure".

By pressing the key ENTER we shall cancel the failure and repeat the cycle again.

### 7.1.2 Normal operation

After boiler light-up the control unit regulates the boiler operation. Parameters' setting-up for the particular types of fuel changes automatically the quantity of the material stoked, volume of the air combusted, etc. This setting-up is performed by a technician from our company during the heating test. The volume weight (kg/m<sup>3</sup>) of the burnt material of chips and sawdust is different; therefore it is necessary to change the combustion programme due to another type of combustion. During the normal operation the cleaning cycles are running according to the preset values, too – the boiler operates according to the programme. The boiler output is being reduced according to the difference between the required and actual output temperatures of the boiler depending on the PID regulator. After exceeding the required temperature the boiler switches over into the mode: "Heating stopped". As soon as the temperature decreases, the boiler switches automatically over back into the mode "Normal operation". As soon as any failure occurs, the boiler puts itself out of operation, the airproof flap valve of the protection against fire is closed and the control unit shall signal the failure state on the start page instead of the date and time, or the control unit shall replace the sign "Normal operation" on the other displays.

Please, contact the Service Department, if any differences from the programme occur.

### 7.1.3 Manual operation

After clicking on the relevant icon on the main page of the control unit display, the particular parts of the boiler can be started manually, regardless the regulation. The manual operation is used during the checks and service works, when the particular engines can be initialized separately. This part is reserved for the experienced operating personnel and



service workers. The particular engines and signals are initialized by the up-arrow and are switched-off by the repeated clicking on this icon.

#### 7.1.4 Return run

The boiler is fitted with a switch of return run for the purposes of maintenance. This switch shall change the direction of rotation of the conveyers, exchanger cleaning and ash-removing grate engines. It serves for the release of jammed conveyers, caused by the jammed worms, or by any stuck foreign matters (bodies) in the conveyer, etc. This function can be used only in the "Manual mode".

**USE this return run only during the maintenance works, for several seconds only (5 seconds)! If used for a longer period of time at the conveyer of material, a failure of the leaf springs of the discharging device may occur.**

**USE the return run only in the mode of "Manual operation".**

#### 7.1.5 Boiler shutdown

It is necessary to put the boiler out of operation during the maintenance works on the equipment. If the works are executed in the space of the combustion chamber, the boiler should be put out of operation four hours before the beginning of works.

**If the partial load (power) "P<sub>C</sub>" drops below the determined limit mentioned in the RATINGS, the correct functioning of the boiler cannot be ensured.**



## 7.2 Failures

In the event of a failure of any boiler part, a description of the failure shall be displayed in the line "STATUS" on the controlling display. After remedying the failure it is necessary to confirm this state on the controlling display by clicking on the icon for the failure confirmation. After this confirmation the boiler shall pass to the automatic operation.

Please, contact our Service Department, if any problems occur.

### 7.2.1 Restart of the controlling unit

The restart of the controlling unit is executed by switching-off the main switch on the boiler. The repeated switching-on of the boiler on the main switch can be performed after 30 seconds.

## 8 Maintenance

### 8.1 Checking book

It is necessary to execute the following checks and record them in the checking book, which you will find in the "Enclosure".

### 8.2 Regular maintenance

**For the safety reasons the main switch must be always switched-off, when the maintenance works are being carried out.**

If you have to enter in the storage bin or the fuel-bunker, do it only under the supervision of another person. Possible carbon monoxide poisoning may endanger your life.

#### 8.2.1 Weekly checks

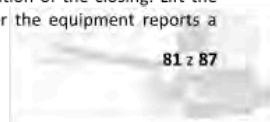
Once a week it is necessary to visually check the whole heating equipment, including the fuel storage. The discovered defects must be immediately remedied.

- Cleaning of the space under turbulators; remove (dismount) the exchanger side door and take out the settled ash.
- Cleaning of the chimney connection, if the boiler is fitted with this connection; unscrew the cover sheet and clean the settled ash.
- If the boiler is fitted with an ultrasonic probe of the material level in the intermediate storage bin, wipe the dust settled on this probe.

#### 8.2.2 Monthly checks

It is necessary to perform monthly the following checks and record them in the checking book:

- Functionality of the flap valve of backward burning, especially of the safe operation of the closing. Lift the protection cover against overfilling of the spatial conveyer and check, whether the equipment reports a



failure. Open the cover fully and by means of a lamp check visually the tightness of the flap valve of protection against fire. In order to check its functionality, place and insert in the marked opening a hexagonal wrench and open the valve by turning the wrench. In order to secure the flap valve, turn shortly in the opposite direction. In the released (unlocked) state the flap valve should be independently and completely closable.

- Functionality of the emergency fire extinguisher including the water supply. The valve should open due to the pressure acting on the pin. Press the pin only shortly. After releasing the pin the valve should be tightly closed again.
- Faultless operation of the control. Especially the switching of circulation pump at the pre-set temperature of switching and, the switching of shorting pump at the reached difference between the input and output temperature of boiler. The time cycles of the stoking of material. If the boiler is fitted with an ultrasonic probe, check the batching of material into the intermediate storage bin – there must be a sufficient quantity in order to prevent any long-term idle run. Check out the functionality of the particular parts of boiler by means of the “Manual mode”.
- If the boiler is fitted with a failure message device/alarm equipment, check its functionality
- Check the faultless operation of the combustion and exhaust fans, by switching-over into the “Manual mode”, and by switching the particular fans separately
- Due state of the combustion space, distinct deformation and fatigue of material
- Readiness of functionality of the hand fire extinguisher
- Due storage of the ash
- No combustibles can be stored in the boiler room
- The roof must be free of any combustible deposits
- Lubrication of bearings of the turbulators and bearings placed close to the boiler walls [by petroleum jelly (vaseline), which withstands the thermal load of 400°C, for example Gleit HP500]

### 8.2.3 Half-year checks

It is necessary to perform a half-yearly general inspection of the boiler, to lubricate all the bearings and to execute all the maintenance works. At least once a year this inspection should be performed by our Service Department or by a contractual service company (it is valid for the length of the guarantee period).

### 8.2.4 Sequence of works

Open the cleaning cover on the chimney connection and remove the fly-ash lying here.

Remove from the furnace space the burner cover including the collar of the post-combustion and remove the fly-ash. Completely remove from the heating plate any adherent remains of ashes. If the vent holes are clogged, it is necessary to pierce them by a metal point. If you have to remove the heating plate (it is fastened down by means of three spring pins), pay attention to that it should be fitted back tightly during the mounting. When mounting back the collar of the post-combustion, the burner plate and the ash removing disk (grate) must be placed in the middle of this collar. All the channels for the air flow must be clean, too (without any remains of ashes and any other contamination).





Check out the function of emergency fire extinguisher. The valve should open due to the pressure acting on the pin. Press the pin only shortly. After releasing the pin the valve should be tightly closed again.



Remove the aluminum cover of the boiler and lubricate the bearings. Lubricate also the chain of self-cleaning drive. Pay attention that the chain should be taut. The tension is reached by moving the cleaning engine. If you remove the chain, it should be laid according to attached diagram; otherwise the cleaning does not function correctly.



Remove the cover under the control unit and lubricate 6 bearings of the shaft of the worms' drive and mechanism for the ash removing.



It is necessary to remove the ash storage bin and then lubricate the visible bearing of the material worm by warm bearing grease. It is possible that the lubrication should be performed more frequently due to the high thermal load. Check at the same time the tightness of the ash storage bin.



Lift the protective cover against overfilling of the spiral conveyor and check, whether the equipment reports a failure. Open the cover fully and by means of a lamp check visually the tightness of flap valve of protective cover against fire. In the order to check its functionality, place and insert in the marked opening a hexagonal wrench and open the valve by turning the wrench. In the order to secure the flap valve, turn shortly in the opposite direction. In the released (unlocked) state the flap valve should be independently and completely closable.





Pay attention to that the equipment should release (unlock) the flap valve again, except the state of „Maintenance mode“.



Remove the cover of the spiral conveyer drive and lubricate the bearings and the chain. Check out the tension of the drive chain.

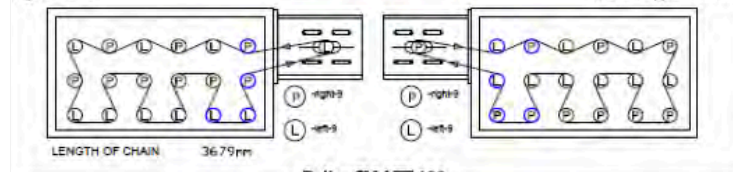
Open the door in the bottom part of exchanger and remove the ash settled here.

### 8.3 Diagram of the chain gear of the turbulators

#### Boiler SMART 150:

Boiler type – right-hand

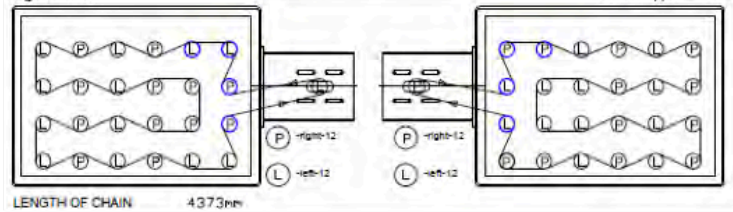
Boiler type – left-hand



#### Boiler SMART 180:

Boiler type – right-hand

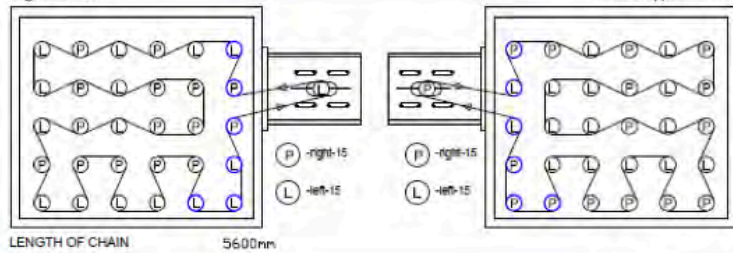
Boiler type – left-hand



#### Boiler SMART 220:

Boiler type – right-hand

Boiler type – left-hand



## 9 Operating data

TECHNICAL DATA OF THE BOILER							
Marking			150	180	220	250	300
Nominal power Ph	kW		150	180	220	250	300
Partial load(power) Pp	kW		40	45	55	65	75
Boiler efficiency at Pn	%		> 93	> 93	> 93	> 93	> 93
Boiler class			3	3	3	3	3
Water							
Water volume	1		380	420	460	500	690
Diameter of the water connection	„		3	3	3	3	3
Diameter of the water connection	DN		80	80	80	80	80
Hydraulic-pressure drop of the boiler at the temperature fall 20°	mbar		65	73	80	87	95
Boiler temperature	°C		60-90	60-90	60-90	60-90	60-90
Minimal temperature of returnable water	°C		55	55	55	55	55
Maximal operational pressure	bar		3.5	3.5	3.5	3.5	3.5
Test pressure	bar		6.5	6.5	6.5	6.5	6.5
Temperature of furnace	°C		900 - 1000				
Pressure of furnace	mbar		-0,04	-0,04	-0,04	-0,04	-0,04
Required draught of the chimney	mbar		0.2	0.2	0.2	0.2	0.2
Requirement for the forced draught			Yes	Yes	Yes	Yes	Yes
Products of combustion temperature at Pn	°C		220	220	220	220	220
Products of combustion temperature at Pč	°C		140	140	140	140	140
Specific flow of gases at Pn	kg/h		345	390	435	470	520
Specific flow of gases at Pč	kg/h		90	105	116	125	140
Diameter of smoke pipe	mm		220	220	220	220	300
Diameter of chimney	mm		250	250	250	250	350
Type of chimney			Moisture-resistant				
Fuel							
Maximal size	cm		3	3	3	3	3
Minimal moisture	%		30	30	30	30	30
Electrical installation							
Connector			400 V, 50 Hz, 3-phase with neutral conductor				
Conveyer engine	W		550	550	550	550	550
Feeding worm engine	W		550	550	550	550	550
Exchanger cleaning equipment	W		550	550	550	550	550
Ash-removing equipment	W		550	550	550	550	550
Fan of primary air	W		83	83	83	83	83
Fan of secondary air 1	W		105	105	105	105	105
Fan of secondary air 2	W		83	83	83	83	83
Chimney fan	W		300	300	300	300	300
Electrical ignition	W		1600	1600	1600	1600	1600
Separating flap valve	W		6.5	6.5	6.5	6.5	6.5
Total	W		4377,5	4377,5	4377,5	4377,5	4377,5





Continuation:

TECHNICAL DATA OF THE BOILER					
<b>Marking</b>		350	400	450	500
Nominal power P <sub>n</sub>	kW	350	400	450	500
Partial load (power) P <sub>p</sub>	kW	90	100	115	140
Boiler efficiency at P <sub>n</sub>	%	> 93	> 93	> 93	> 93
Boiler class		3	3	3	3
<b>Water</b>					
Water volume	l	740	790	850	900
Diameter of the water connection	mm	4	4	4	4
Diameter of the water connection	DN	100	100	100	100
Hydraulic-pressure drop of the boiler at the temperature fall 20°	mbar	102	110	122	130
Boiler temperature	°C	60-90	60-90	60-90	60-90
Minimal temperature of returnable water	°C	55	55	55	55
Maximal operational pressure	bar	3.5	3.5	3.5	3.5
Test pressure	bar	6.5	6.5	6.5	6.5
Temperature of furnace	°C	-0,04	-0,04	-0,04	-0,04
Pressure of furnace	mbar	0.2	0.2	0.2	0.2
Required draught of the chimney	mbar	Yes	Yes	Yes	Yes
Requirement for the forced draught					
Products of combustion temperature at P <sub>n</sub>	°C	200	200	200	200
Products of combustion temperature at P <sub>č</sub>	°C	120	120	120	120
Specific flow of gases at P <sub>n</sub>	kg/h	570	620	670	720
Specific flow of gases at P <sub>č</sub>	kg/h	150	165	180	192
Diameter of smoke pipe	mm	300	300	300	300
Diameter of chimney	mm	350	350	350	350
Type of chimney		Moisture-resistant			
<b>Fuel</b>					
Maximal size	cm	3	3	3	3
Minimal moisture	%	30	30	30	30
<b>Electrical installation</b>					
Connector		400 V, 50 Hz, 3-phase with neutral conductor			
Conveyer engine	W	550	550	550	550
Feeding worm engine	W	550	550	550	550
Exchanger cleaning equipment	W	2x550	2x550	2x550	2x550
Ash-removing equipment	W	550	550	550	550
Fan of primary air	W	83	83	83	83
Fan of secondary air 1	W	105	105	105	105
Fan of secondary air 2	W	315	315	315	315
Chimney fan	W	1100	1100	1100	1100
Electrical ignition	W	1600	1600	1600	1600
Separating flap valve	W	6.5	6.5	6.5	6.5
Total	W	5959.5	5959.5	5959.5	5959.5





**Spare Parts List**

**Motor and Devices List**

# Alarm List

SENSORS	Faulty part	Description of the fault	Analysis	Clearing the faults
Safety limit thermostat:Fault	none	Open safety thermostat	Check the boiler temperature	Finding out the cause of the boiler overheating!!!
		Boiler is overheated more than 95°C		Make sure that you take out excess heat
		At the same time you will see KM1 and KM2 fault		After the temperature drop to 65°C. Reactivate Sec. Thermostat
KM1 Fault:Fault	Contactor KM1	Different position of the contactor KM1 than KM2	Check the position of connector KM1	Contactor replacement
		When is correctly functioning both KM1 and KM2 has to have the same position.	Check the wire connection with el. scheme.	Contactor repair
				Check the safety thermostat
KM2 Fault:Fault	Contactor KM2	Different position of the contactor KM2 than KM1.	Check the position of connector KM2	Contactor replacement
		When is correctly functioning both KM1 and KM2 has to have the same position.	Check the wire connection with el. scheme.	Contactor repair
				Check the safety thermostat
Safe tank:Empty	none	Low water level in the water tank.	Check the water inside the tank	Fill the water in to a tank
	Level sensor	Faulty thermostat - false error message	Check the position of the level sensor	Correct and firmly attach the position of the level sensor
			Check the correct functionality of the sensor	Measure by using ohmmeter
	Faulty cabling or connector		Check the correct functionality of the sensor on clamps X1.87,X1.88	Measure by using ohmmeter
			Check the correct functionality of the sensor on clamps POL985 T3 X5,T3 M	Measure by using ohmmeter
TKM Conveyor 2:On	none	Open end switch of Conveyor	Check the cover	Clean up the space between the cover and the conveyor body
			Check the quality and amount of the fuel, if it does not lift up the cover, which can open the end switch connection.	Use only recommended fuel
	Thermocontact , motor	Temperature of the motor is higher than 95°C	Blocked auger or the auger is having a hard time with the fuel	Take out the parts which has blocked the auger
				Take out the parts which has blocked the flaps inside of the silo
	Connector or cabling	Interruption of el. power	Check the connection in the thermocontact M2 and end switch X1.70,X1.71,X1.72 for any cut or other visible damage on the wire.	Measure by using ohmmeter
TK Burner cleaning:Fault	Thermocontact , motor	Temperature of the motor is higher than 95°C	Blocked grating wheel or the motor is having a hard time to move the wheel.	Take out the parts which has blocked the grating system
	Connector or cabling	Interruption of el. power	Check the connection in the thermocontact M6 X1.66,X1.67 for any cut or other visible damage on the wire.	Measure by using ohmmeter
Tkdeasching:Fault	Thermocontact , motor	Temperature of the motor is higher than 95°C	Blocked auger or the motor is having a hard time to move the auger	Take out the parts which has blocked the auger system
	Connector or cabling	Interruption of el. power	Check the connection in the thermocontact M6 X1.63,X1.65 for any cut or other visible damage on the wire.	Measure by using ohmmeter

TKfeeder 1:Fault	Thermocontact , motor	Temperature of the motor is higher than 95°C	Blocked auger or the motor is having a hard time to move the auger	Take out the parts which has blocked the auger system
	Connector or cabling	Interruption of el. power	Check the connection in the thermocontact M6 X1.69,X1.71 for any cut or other visible damage on the wire.	Measure by using ohmmetr
TKExchanger cleaning:Fault	Thermocontact , motor	Temperature of the motor is higher than 95°C	Blocked turbulators or the motor is having a hard time to move turbulators	Take out the parts which has blocked the turbulator system
	Connector or cabling	Interruption of el. power	Check the connection in the thermocontact M6 X1.69,X1.72 for any cut or other visible damage on the wire.	Measure by using ohmmetr
TK Exch.deasching	Thermocontact , motor	Temperature of the motor is higher than 95°C	Blocked turbulators or the motor is having a hard time to move turbulators	Take out the parts which has blocked the auger system
	Connector or cabling	Interruption of el. power	Check the connection in the thermocontact M6 X1.63,X1.65 for any cut or other visible damage on the wire.	Measure by using ohmmetr
Exhaust Damper				
Damper Off		On		
		Not Off		
Damper On		Not On		
		Off		
Pneumatic_Transport.EmSwitch_TK_Conveyor	TK Conveyor			
Ignition Error				
Underpressure Faults				
aoPneumatic Transport.max_attempts:PWM				

# Operator's Checklist

## Section Level Descriptions

### **Supplemental Checklist - Operation and Maintenance of Hamont / Smart Heating Technology Boilers**

This document is prepared by Northline Energy at customer's request and is intended as an aid to users and servicers of Hamont biomass boiler technology. It reflects best practices and our experience with the technology. It is not a substitute for, nor is it intended to replace the manufacturer's guidance as contained in Sections 7 and 8 of the manual supplied with the boiler.

The Checklist is divided into three sections or levels of responsibility:

1. Level 1: Site Operator – This information is intended for the owner/user of the boiler and does not require any special tools or technical knowledge. Standard safety precautions such as those used when operating a wood stove must be observed. Safety equipment such as gloves and eye protection are required when the combustor is to be checked.
2. Level 2: Regular Maintenance – This information is intended for the service technician who will be responsible for regular periodic boiler maintenance. Please note that in some jurisdictions, such service may only be legally provided by a licensed technician. (The State of Maine, for example, requires that such service be provided by a licensed Master Solid Fuel Technician or by a Journeyman under the direct supervision of a licensed Master Solid Fuel Technician.)
3. Level 3: Full Boiler Service – This is the procedure for complete cleaning and servicing of the boiler plant and is recommended to be performed twice a year, once following boiler shutdown in the spring and again midway through the heating season. Again, note that in some jurisdictions, such service may only be legally provided by a licensed technician.

These checklists and schedules are for guidance only and are consistent with manufacturer's recommendations and requirements. Frequency may vary with application use and fuel quality, etc. It is the responsibility of the user to make judgments as to the required service by licensed professional and to make adjustments as needed.



# Level 1 Site Supervision

## Supplemental Checklist - Operation and Maintenance of Hamont / Smart Heating Technology Boilers

Level 1 – Site Supervision – by designated operator or owner's representative

Tasks	Frequency	Details
Walk Through Check	Daily if possible or after a weekend or holiday	Go into the boiler room. Make a visual and audible assessment of boiler operation. Any unusual smells, noises and general operation should be noted. Open fire box access door and check pellet level in combustor. Check for unusual ash build up on burn plate.
Ash Bin	Weekly	Check ash level in bin. Note color and consistency. Normal is a fine gray powder. Empty if more than 2/3 full.
Turbolators Ash Collection	Weekly	Remove the exchanger side door. Remove settled ash from the area below the turbolators.
Clean Ultrasonic Probes	Weekly	Wipe ultrasonic probes in vacuum system and intermediate bin to remove pellet dust buildup.
Pneumatic Cyclone	Weekly	Check for dust build up on intake screen of pneumatic cyclone and clean
On Site Light Diagnostic	As required	If any upset or unusual conditions are noticed or if there are alarms, provide visual assistance, and perhaps some light inspections to assist in remote diagnosis of problem and solution. Be able to provide photos. Basic control operation may be required.
Notification	As Required	Notify service provider or owner of any upset or unusual conditions
Combustion Pot	Every 3 days or after long weekend	Inspect the combustion chamber. Knock off any ash crusted on the primary ring. Check that the ash and pellet level are at or below the primary air ring.
Documentation	Whenever a check is completed	Make a log entry of any conditions or findings, service performed, etc. (ash bin emptied) for future reference and service

## Level 2 Regular Maintenance

### Supplemental Checklist - Operation and Maintenance of Hamont / Smart Heating Technology Boilers

Level 2 – Regular Maintenance – by a trained and qualified technician (check local regulations)

Task	Frequency	Details
All Level 1 tasks	On site visit, recommended monthly	See Level 1 above.
Complete Ash Removal (with additions to those in Level 1)	Monthly	Clean all ash collection points: 1. Empty ash bin 2. Empty turbolators collection box 3. Empty cyclone collection box 4. Empty flue gas transition box located on the back of the combustor 5. Clean combustor area and check that all air passages are clear of ash
Check flap valve function	Monthly	Confirm proper operation of the valve below the vacuum system per manual.
Check emergency water	Monthly	Check water level and function of valve per manual.
Control	Monthly	Review settings and make any indicated adjustments based on notes, experience. Use manual mode to confirm operations as required.
Check fan operation	Monthly	Operate fans manually to confirm proper operation.
Check the combustion chamber	Monthly	Check for any abnormalities, including deformation or unusual buildup of ash, plugging, etc.
Lubricate key points in high temperature areas	Monthly	Lubricate turbolators bearings and those in proximity to the boiler walls with high temperature grease.

## Level 3 Full Boiler Service

### Supplemental Checklist - Operation and Maintenance of Hamont / Smart Heating Technology Boilers

Level 3- Full Boiler Service – by a trained and qualified technician (check local regulations)

Task	Frequency	Details
All Level 1 tasks	Twice per year – after the heating season and mid heating season	See Level 1 above.
All Level 2 tasks	Twice per year – after the heating season and mid heating season	See Level 2 above.
All lubrication points	Twice per year – after the heating season and mid heating season	Refer to manufacturer's IOM, section 8.2.4.
Full mechanical check and cleaning	Twice per year – after the heating season and mid heating season	Refer to manufacturer's IOM, section 8.2.4.

Fuel Input Calculator

	Pellets	250kW	
	Output calculator	fuel 18MJ =5,0 kWh	
	auger 125mm		
	gearbox	3600	
Change timing F1	F1 on	<input type="text" value="4"/>	sec
	F1 off	<input type="text" value="31"/>	sec
	cycle	35	
		103period	
		411sec	
			Konstanta
			185.00g/s
			76.114kg/hod
			329.12kW

**Commissioning Sheet**

# Combustion Settings

	A	B	C	D	E	F	G	H	I	J	K
1	Hamont Boiler Control Setting Inputs										
2	CCAR 250 Kw										
3								Values			
4	Configuration							Jan 2013	1/25/13	1/29/2013	
5	Buffer							Off		Off	
6	KNX							Off		Off	
7	Demand 0-10v							Off		Off	
8											
9	User Setting Menu										
10	temperature										
11	Setting value							C	75c	80c	80
12								C	55c		55
13	Service Setting Menu										
14	Underpressure										
15	Underpressure setting							Pa	25		25
16	Reduce underpressure settings							Pa	8	6	6
17	offtime							Min	35	20	35
18	O <sub>2</sub> Sensor										
19	Setting O <sub>2</sub> concentration							%	9.2		9.2
20	O <sub>2</sub> calibration							Status	off		off
21	Decreasing powe								10.0	5.0	10
22	increasing power								30.0		30
23	clear err flags								off		off
24											
25	Fans										
26	Primary Fan 1										
27	30%							%	50		58
28	40%							%	56		63
29	50%							%	62		74
30	60%							%	68		78
31	70%							%	70		82
32	80%							%	78		87
33	90%							%	82		90
34	100%							%	85		95
35											
36	Secondary Fan1										
37	30%							%		30	45
38	40%							%		32	50
39	50%							%		35	60
40	60%							%		39	65
41	70%							%		45	70
42	80%							%	50	50	75
43	90%							%	53	53	78
44	100%							%	55	58	80
45	Secondary Fan2										
46	30%							%	30	60	20
47	40%							%	32	65	29
48	50%							%	35	70	32
49	60%							%	39	80	38
50	70%							%	45	90	43
51	80%							%	49	92	49
52	90%							%	50	95	51
53	100%							%	58	95?	55
54	Run Out Time							Min	5		7
55	Underpressure Hysteresis							Pa	12		12
56											
57	Engines										
58	De-ashing Number of Charges							ea	100		150

	A	B	C	D	E	F	G	H	I	J	K
59						De-ashing Time	Sec	60		60	
60											
61						Exchanger Number of Charges	ea	100		100	
62						Exchanger Time	Sec	45		20	
63											
64						Burner Number of Charges	ea	5		5	
65						Burner Cleaning Time	Sec	15		15	
66											
67						Exchanger Number of Charge	ea	100			
68						Time Exchanger cleaning	Sec	40			
69											
70						Pnuematic Conveyor					
71						M1 Max Time feeding	min	15.0		15.0	
72						Waiting Time Minimum Power	min	10.0		10.0	
73						Waiting Time Maximum Power	min	6.0		6.0	
74						Clack On delay	Sec	15		15	
75						Clack off Delay	Sec	15		15	
76						Min Off Time	Min	5		5	
77						PWM on time	Sec	40		40	
78						PWM off time	Sec	20		20	
79						PWM number of attempt	ea	5		5	
80											
81						Damper					
82						Exchanger Temp Open Clack	C	80.0		80	
83						Exchanger Temp close Clack	C	60.0		60	
84						Damper Delay	sec	90		90	
85						Boiler Temp Close Clack	C	90		90	
86											
87						Pumps					
88						Min Boiler Temperature	C	48		48	
89						Max Boiler Temperature	C	80		80	
90											
91						Ignition					
92						Ignition Time	Min	10.0		10	
93						Exh Temp Ignition	C	55.0		55	
94						Space between ignition	Sec	60.0		60	
95						ignition repetition	Times	5		5	
96						Exhaust against boiler temperature	Status	OK		0	
97						Hysexhmout	K	10		10	
98						feeding betwee ignition	%	50.0		20	
99						Hvs at open exchanger	K	10		10	
100						Lock Ignition at close Exchanger Clack	Sec	90		120	
101						Cold Start					
102						Enable Cold Start		On		Off	
103						Feed Cold Start	Seconds	5		1	
104						Cold Start Pause	s	50		50	
105						Cold Start Max Ttime	Min	3.0		3	
106						Exh gas Difference	K	15		15	
107						Upkeep Mode					
108						Enable Up keep	Status	off		off	
109						Exhaust	C	50		50	
110						exh hyst	K	5		5	
111						O2 level	%	19.8		19.8	
112						Feed time	Sec	5.0		5.0	
113						Pause	Min	6.0		6.0	
114						fan Power	%	65		65	
115						Time Fan Run	Sec	60		60	

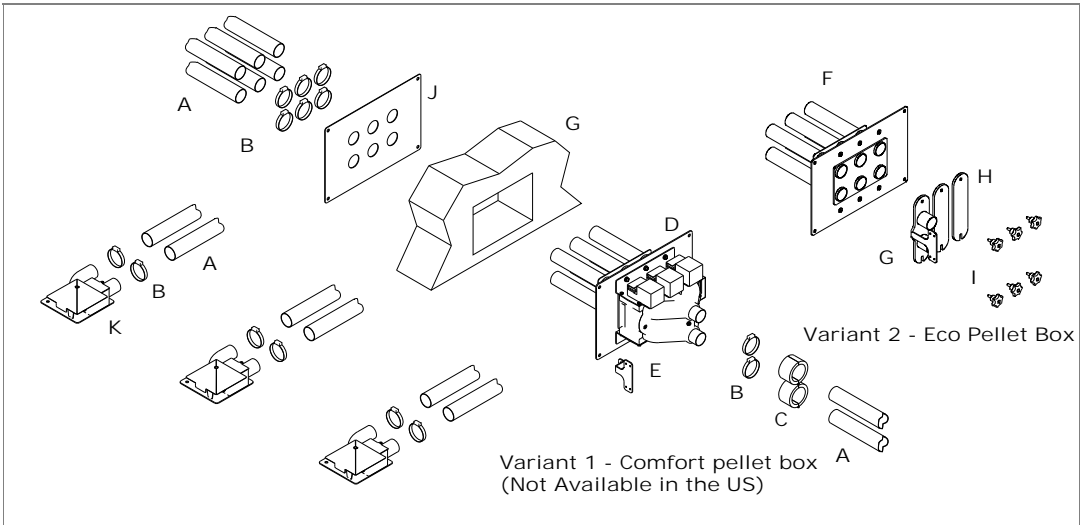


	A	B	C	D	E	F	G	H	I	J	K
116						Lock Ignition after Upkeep	Sec	65		65	
117						Valves					
118						Open time	Sec	120.0		120	
119						Close time	Sec	120.0		120	
120						Power Settings					
121						Max Power Pause	Sec	50.0		36	
122						Min Power Pause	Sec	100.0		100	
123						First Feeding	Sec	12.0		12	
124						Feeder On Time	Sec	2.5		2	
125						Diagnostic					
126						Version					
127						BPS version		9			
128						Application Information		30.11.2012			
129								template VVS9			
130								POL 687			
131						TCP/IP					
132						DHCP		Passive			
133						Actual IP		192.168.1.42			
134						Actual Mask		255.255.255.0			
135						Act Gateway		192.168.1.1			
136						Given IP		192.168.1.42			
137						Given Mask		255.255.255.0			
138						Given Gateway		192.168.1.1			
139						100 Mbit		active			
140						Name		POL687_04F6E0			
141						MAC		00-A0-03-04-F6-E0			
142						Link		ACTIVE			
143						User name		ADMIN			
144						Web password		SBTAdmin!			
145						FTP user name		ADMIN			
146						Rest					

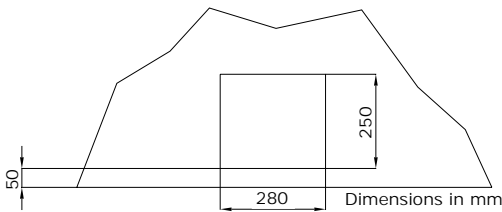
# Section 6 Vacuum System

3.5 Install delivery system

3.5.1 Universal suction system



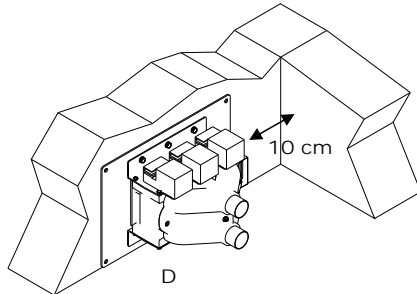
A	25 m Suction hose	G	Manual re-arranging unit (Variant 2)
B	Hose clamps 50-65 mm	H	2 Blind plates (Variant 2)
C	2 Fire protection choke collar (Used only in Austria)	I	6 Star-shaped handle (Variant 2)
D	Comfort pellet box (Variant 1) (Not available in US)	J	Cover plate for wall
E	Support for fire protection choke collar (Variant 1)	K	Suction probe
F	Installation module for wall		



Before installation:

- ❑ Prepare hole in the wall for the pellet box (width: 11" (28cm), height: 10" (25cm)).
- ☞ Maintain a distance of at least 2" (5 cm) from the finished floor.

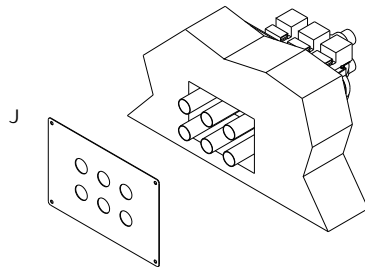
## Variant 1 - Comfort Pellet Box (Not available in the US)



- ❑ Position Comfort Pellet Box (D) at hole in the wall.

☞ For maintenance purposes, the distance to the wall on the board side of the pellet box should be at least 4" (10 cm).

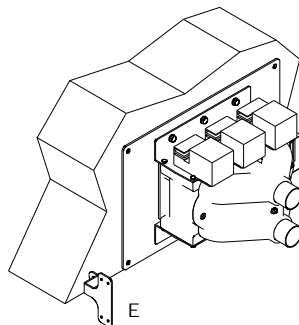
- ❑ Attach Pellet Box to the wall with 4 frame screws M8x50 and 10 mm dowels.



- ❑ Pack the space in the hole in the wall with a non-flammable material.

- ❑ Put the cover plate for the wall (J) onto the pipe of the pellet box.

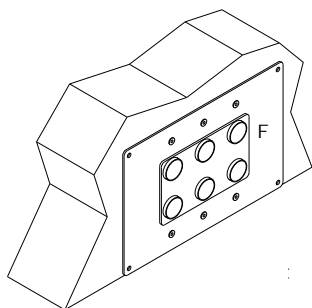
- ❑ Secure the cover plate to the wall using four M8x50 frame screws and 10 mm Rawlplugs.



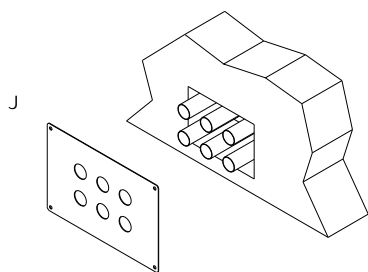
- ❑ Mount the bracket (E) for fire protection choke collars on the pellet box.

☞ Fire protection choke collars only in Austria.

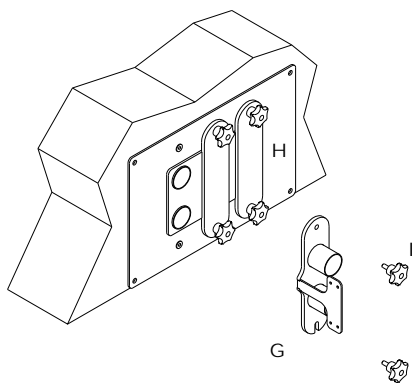
### Variant 2 - Eco Pellet Box



- ❑ Place the wall installation module (F) by the hole in the wall.
- ❑ Secure the insertion module to the wall using four M8x50 frame screws and 10 mm Rawlplugs.

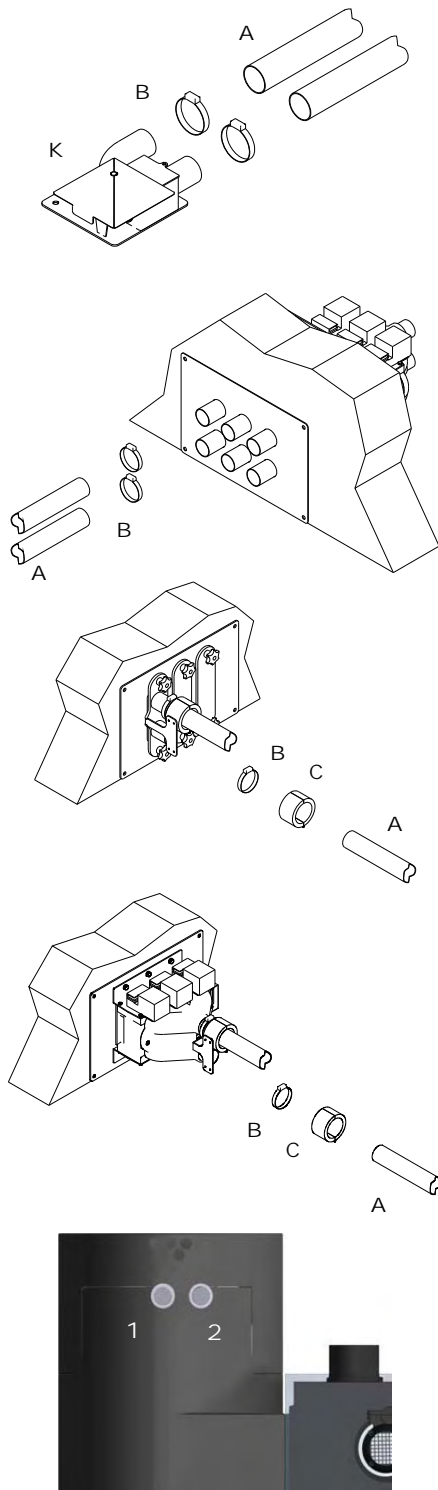


- ❑ Pack the space in the hole in the wall with a non-flammable material.
- ❑ Place the wall cover plate (J) on the installation module pipes.
- ❑ Secure the cover plate to the wall using four M8x50 frame screws and 10 mm Rawlplugs.



- ❑ Fit 2 cover plates (H) to the installation module using two star-shaped screws (I).
- ❑ Fit change unit (G) with 2 star-shaped screws.
- ☞ The position of the change unit is not specified!

## Installing the suction probes and lines



- ❑ Position the suction probes (K) at equal distances in the pellet supply bin.
- ❑ Secure the suction probes to the bottom using frame screws.
- ❑ Fix hose lines (A) to the suction probe using hose clips (B).
- ❑ Lay the hose lines to the pellet box and secure them using hose clips.

- ⚠ WARNING! Read the label on the suction probe or pellet box about the suction line and return-air line! Ensure correct connection!
- ⚠ WARNING! When connecting the hose lines, beware of potential equalisation!
- ➔ [Page 12, Proper Hose Grounding.](#)

- ❑ Thread the fire protection choke collar (C) on to the hose line (A).
- ⚠ Fire protection choke collars only in Austria.
- ❑ Attach the hose lines to the pellet box pipes using hose clips (B).
- ❑ Lay the hose lines to the boiler, through identified openings at the back plate and install with hose clamps to the identified connections.

- ⚠ WARNING! Read the label on the suction probe or pellet box about the suction line and return-air line! Ensure correct connection!
- ⚠ Suction line: hose line to left connection (1) on the back of the boiler.
- ⚠ Return-air line: hose line to right connection (2) on the back of the boiler.

- ⚠ WARNING! When connecting the hose lines, beware of potential equalisation!
- ➔ [Page 12, Proper Hose Grounding.](#)

Actuators



### Technical data sheet

## 227-024-05

### Rotary drive without spring return

#### Description

Actuator for adjusting air dampers of 90° angle of rotation to be used in HVAC installations.

- Torque Motor 5 Nm
- Nominal Voltage 24 VAC/DC
- Control 2/3 Point
- Damper size up to approx. 1 m²
- Damper coupling Clamp  
Ø 8-12 mm / Ø 8-16 mm



#### Technical data

<b>Nominal voltage</b>	Nominal voltage	24 VAC/DC
	Nominal voltage range	19... 29 VAC/DC
	Power consumption Motor (Motion)	2 W
	Power consumption Standby (end position)	1 W
	Wire sizing	3 VA
	Control	2/3 Point
	Position feedback	-
	Auxiliary switch	-
	Contact load	-
	Switching point	-
	Connection Motor	Cable 1000 mm, 3 x 0.75 mm² (halogen free)
	Connection Auxiliary switch	-
	Connection Position feedback	-
	Connection GLUC	-
<b>Functional data</b>	Torque Motor	>5 Nm
	Synchronised speed	-
	Direction of rotation	selected by switch
	Manual override	Gearing latch disengaged with pushbutton, self-resetting
	Angle of rotation	0°... max. 95° can be limited with adjustable mechanical end stop min 20°
	Running time Motor	< 60... 120 s / 90°
	Sound power level Motor	< 35 dB(A)
	Damper coupling	Clamp Ø 8-12 mm / Ø 8-16 mm
	Position indication	mechanical with pointer

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227-024-05

Actuators >> Technical data sheet

**GRUNER**  
Schafter und Schalter

## Technical data

<b>Functional data</b>	Service life	>60'000 cycles (0° - 95° - 0°)
<b>Safety</b>	Protection class	III (low voltage safety current)
	Degree of protection	IP54 (Cable downwards)
	CE	73/23 EWG, 89/336 EWG
	Mode of operation	Typ 1 (EN 60730-1)
	Rated impulse voltage	0,8 kV (EN 60730-1)
	Control pollution degree	3 (EN 60730-1)
	Ambient temperature Normal operation	-30°...+50°
	Storage temperature	-30°...+80°
	Ambient humidity	5...95% r.F., non- condensating (EN 60730-1)
<b>Dimensions/ Weight</b>	Maintenance	maintenance free
	Dimensions	115 x 65 x 61 mm
	Weight	ca. 530 g

## Operating mode / Properties

### Operating mode

2- point.

Through connecting the power supply to BU+BN (1+2) and the direction of rotation switch on position "R" moves the actuator to position 1. Is also BK (1+2+3) connected to the power supply the actuator is moving to position 0.

3- point.

Through connecting the power supply to BU+BN (1+2) and the direction of rotation switch on position "R" moves the actuator to position 1. If the power supply is interrupted the actuator maintains its current position. Is also BU+BK (1+3) connected to the power supply the actuator is moving in direction 0.

The actuator is overload-proof, requires no limit switches and automatically stops when the end stop is reached.

### Direct mounting

Simple direct mounting on the damper spindle with a universal spindle clamp, supplied with an anti-rotation strap to prevent the actuator from rotating.

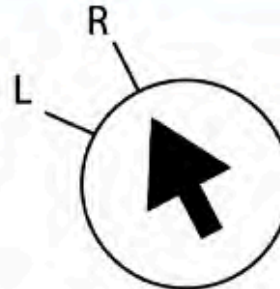
### Manual override

Manual override is possible with the self-resetting pushbutton (the gearing latch remains disengaged as long as the pushbutton is pressed)

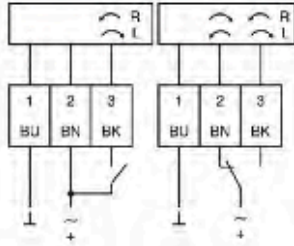
### Rotary direction switch

R= clockwise

L= counter clockwise



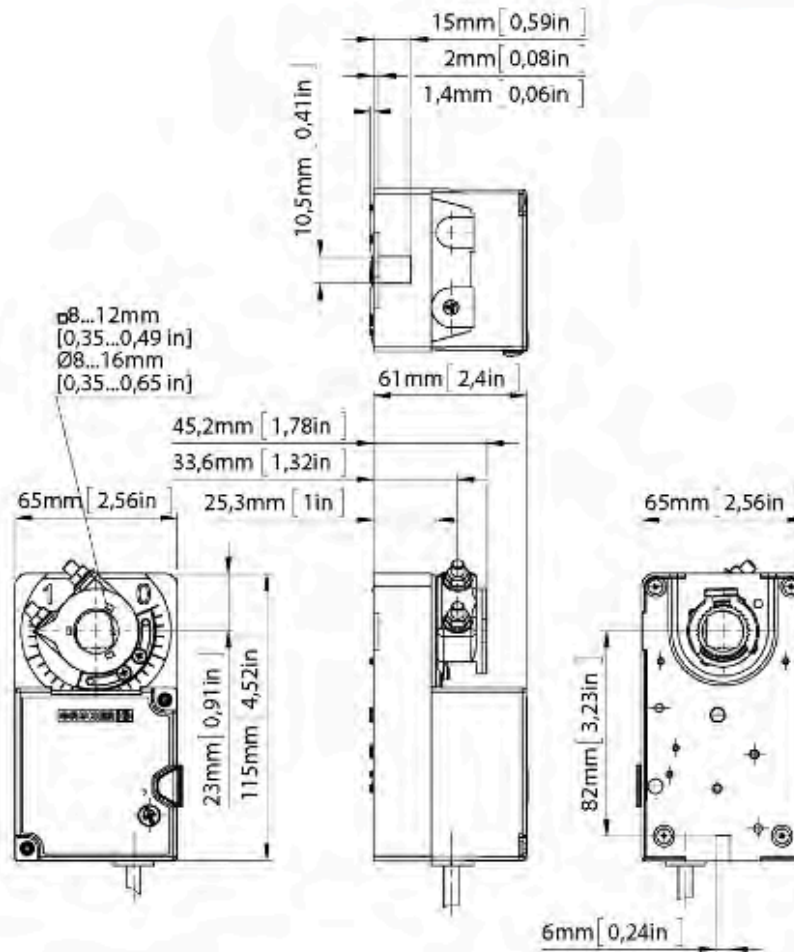
## Connection / Safety remarks



## Safety remarks

- Connect via safety isolation transformer
- The actuator is not allowed to be used outside the specified field of application, especially in airplanes.
- It may only be installed by suitably trained personnel. Any legal regulations or regulations issued by authorities must be observed during assembly.
- The device may only be opened at the manufacturer's site.
- When calculating the required torque, the specifications supplied by the damper manufacturers (cross-section, design, installation site), and the air flow conditions must be observed.
- The actuator is not allowed to be disposed of as household refuse. All locally valid regulations and requirements must be observed.

## Technical drawing



# Froling Pick Up



Suction Line

Return Air Line

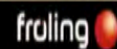
Suction pick up pellet fuel "probe", this example unpowered.



Return air turbulating/stirring port, also not seen other ports inside



Roof creates void under pellet pile



Tarm Biomass ■ 4 Britton Lane ■ Lyme, NH 03768 ■ 800.782.9927 ■ [www.tarmbiomass.com](http://www.tarmbiomass.com)

## Section 7 Heat Meter

# MULTICAL® 602

Heat metering with ULTRAFLOW® 54



### Unlimited communication

MULTICAL® 602 offers you a complete range of communication modules. The meter can be fitted with LON, SIOX, M-Bus, a data module and the new solutions Metasys N2 and Ethernet/IP for wired communication. If the meter is to be integrated in a wireless network, you can select radio, Wireless M-Bus, ZigBee, or new options like: GSM/GPRS or High-Power RadioRouter with High-Power supply. – MULTICAL® 602 provides unlimited communication.

### Sharp analysis

MULTICAL® 602 is your guarantee that power supply, leakages and bursts are monitored and appear in the display in the form of an info code. An info logger registers and stores all irregularities and changes. Furthermore MULTICAL® 602 is fitted with an integral RTC and saves yearly, monthly, daily and hourly loggers, which you easily read and analyse as part of your daily operations optimisation.

### Measurable saving

In case of power failure data is backed up, thus securing billing of consumption data. If the meter is fitted with a battery, the battery lifetime is prolonged to 13 years incl. Wireless M-Bus reading. MULTICAL® 602 is your guarantee that consumption data is accurately and constantly billed during the meter's whole lifetime without need for service checks. The operating costs are minimal and cost saving thereby a reality.



  
**Kamstrup**





## MULTICAL® 602 and ULTRAFLOW® 54 – power your communication

### The calculator MULTICAL® 602

Kamstrup's heat meters are based on state of the art heat technology.

The advanced calculator, MULTICAL® 602, is used together with the flow sensor, ULTRAFLOW® 54, as well as two temperature sensors for calculation of energy and measurement of flow, power and temperature - with the best measuring accuracy on the market. The energy calculations and flow, power and temperature measurements are data logged and can be read direct from the display or through remote reading in a wireless network.

### The flow sensor ULTRAFLOW® 54

The ULTRAFLOW® 54 range for heat metering includes flow sensors between qp 0.6 and qp 1,000 m³/h.

ULTRAFLOW® 0.6 to 100 m³/h registers the heat consumption in all water based installations with medium temperatures between 15°C and 130°C, whereas the larger flow sensors qp 150 to 1,000 m³/h are approved for temperatures from 2°C to 150°C.

ULTRAFLOW® 54 is based on ultrasonic measurement and is fitted with a new power-saving microprocessor. Ultrasonic measurement is a long-term stable and accurate measuring principle which guarantees the highest measuring quality and reliability on the market.

The threaded sensors from qp 0.6 up to qp 10.0 m³/h are made of brass, whereas all flange sensors are made of stainless steel with minimum lead content in line with increasingly stringent environmental demands. In order to ensure immunity to flow disturbances - and thereby obtain the most accurate measurements - sensors up to DN20 apply the parallel ultrasonic principle, whereas sensors size DN25 to DN100 apply the triangular principle.

The measuring principle is the bidirectional ultrasonic principle, which secures pinpoint accuracy and at the same time counteracts flow disturbances.

The built in signal converter, which is placed on the flow sensor, transfers calibrated pulses to the calculator.

## Types of communication





### High demands require high standards

#### Reliability and long-term stability

The unique temperature measuring circuit and the accurately matched temperature sensors guarantee reliable measuring results, even at temperature differences below 1K. The long-term stability and accuracy of the flow sensor are not influenced by the flow velocity. Even if the nominal velocity is doubled, the long-term stability and accuracy of the flow sensor remain unchanged.

#### High-Power

MULTICAL® 602 has been designed for communication via GSM/GPRS and Ethernet too. Furthermore, the High-Power RadioRouter module fulfils the demand for increased transmitting power compared to traditional radio communication. These three communication modules require a High-Power supply module, which supplies more power than traditional supply modules. Kamstrup's High-Power supply module applies Switch Mode technology and is available in 230 VAC or 24 VAC version.

#### Info codes

MULTICAL® 602 constantly monitors a number of key functions. In case of power failure, leakage, burst, or if the flow sensor has been installed in the wrong flow direction, an Info-event counter shows the number of changes.

An Info logger saves the latest 50 changes, of which the 36 latest changes can be displayed. Furthermore, MULTICAL® 602 is fitted with an error hour counter which registers the hours during which the Info code exceeds zero.

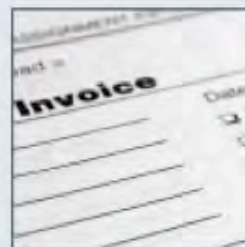
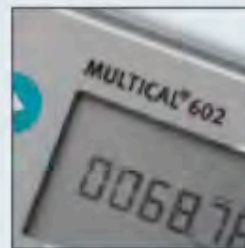
#### Data loggers

MULTICAL® 602 stores yearly, monthly, daily, and hourly data with a logging depth of 15 years, 36 months, 460 days and 1392 hours respectively. Furthermore, the meter is fitted with a programmable data logger and Info loggers. Analysis of these data loggers is the key to troubleshoot possible pressure loss, reveal manipulation of the meter and analyse the amount of energy consumed during which periods with a view to reducing energy consumption.

#### Billing

Guarantee for accurate meter data is decisive when it comes to the consumer's reliance in consumption billing. Wireless reading using one of Kamstrup's network solutions guarantees you reliable meter data, operation and data security. Thus, MULTICAL® 602 and ULTRAFLOW® 54 provide you with correct energy consumption any time, which makes the consumers satisfied and secures the utility its income.

MULTICAL® 602 is also available for cooling metering.





# Kamstrup Multical 602 Technical Description

Technical description

**MULTICAL® 602**



**Kamstrup**

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## List of contents

<b>1</b>	<b>General description .....</b>	<b>6</b>
<b>2</b>	<b>Technical Data .....</b>	<b>7</b>
2.1	Approved meter data .....	7
2.2	Electrical data .....	8
2.3	Mechanical data .....	10
2.4	Materials .....	10
2.5	Accuracy .....	10
<b>3</b>	<b>Type overview .....</b>	<b>11</b>
3.1	Type and programming overview .....	11
3.2	Type number combination .....	12
3.3	PROG, A-B-CCC-CCC .....	14
3.4	Display coding .....	21
3.5	›EE‹ Configuration of MULTITARIFF .....	23
3.6	›FF‹ Input A (VA) - pulse divider, ›GG‹ Input B (VB) - pulse divider .....	25
3.7	Configuration of pulse outputs in the top module .....	26
3.8	›MN‹ Configuration of leak limits .....	26
3.9	›T‹ Configuration of encryption level .....	26
3.10	Data for configuration .....	27
<b>4</b>	<b>Dimentional sketches .....</b>	<b>28</b>
<b>5</b>	<b>Installation .....</b>	<b>29</b>
5.1	Flow pipe and return pipe placing .....	29
5.2	EMC conditions .....	30
5.3	Climatic conditions .....	30
5.4	Electric installations .....	30
<b>6</b>	<b>Calculator functions .....</b>	<b>31</b>
6.1	Energy calculation .....	31
6.2	Application types .....	32
6.3	Calculator with two flow sensors .....	37
6.4	Combined heat/cooling metering .....	38
6.5	Flow measurement, V1 and V2 .....	39
6.6	Power measurement, V1 .....	40
6.7	Min. and max. flow and power, V1 .....	41
6.8	Temperature measurement .....	42
6.9	Display functions .....	44
6.10	Real Time Clock (RTC) .....	47
6.11	Info codes .....	48
6.12	Tariff functions .....	51
6.13	Data loggers .....	56

6.14	Leak surveillance .....	58
6.15	Reset functions .....	61
6.16	SMS Commands .....	61
6.17	Set-up via the front keys .....	63
6.18	Reset via the front keys .....	65
<b>7</b>	<b>Flow sensor connection .....</b>	<b>66</b>
7.1	Volume inputs V1 and V2 .....	66
7.2	Flow sensor with active 24 V pulse output ④ .....	68
7.3	Pulse inputs VA and VB .....	71
<b>8</b>	<b>Temperature sensors.....</b>	<b>73</b>
8.1	Sensor types .....	74
8.2	Cable influence and compensation .....	75
8.3	Pocket sensors .....	77
8.4	Pt500 short direct sensor set .....	78
<b>9</b>	<b>Voltage supply .....</b>	<b>79</b>
9.1	Integral D-cell lithium battery .....	79
9.2	Battery lifetimes.....	80
9.3	High Power supply module 230 VAC .....	81
9.4	High Power supply module 24 VAC .....	81
9.5	Supply module 230 VAC.....	82
9.6	Supply module 24 VAC.....	82
9.7	Exchanging the supply unit .....	84
9.8	Mains supply cables .....	84
9.9	Back-up of data during power down .....	85
9.10	Danish regulations for connection of mains operated meters.....	85
<b>10</b>	<b>Plug-in modules .....</b>	<b>86</b>
10.1	Top modules .....	86
10.2	Base modules.....	92
10.3	Retrofitting modules .....	101
<b>11</b>	<b>Data communication .....</b>	<b>102</b>
11.1	MULTICAL® 602 data protocol .....	102
11.2	MULTICAL® 602 communication paths .....	104
11.3	Optical eye .....	104
<b>12</b>	<b>Calibration and verification .....</b>	<b>105</b>
12.1	High-resolution energy reading .....	105
12.2	High-resolution volume for test .....	106
12.3	Pulse interface .....	107
12.4	True energy calculation .....	108

<b>13</b>	<b>METER TOOL for MULTICAL® 602 .....</b>	<b>109</b>
13.1	Introduction.....	109
13.2	METER TOOL MULTICAL® 602.....	110
13.3	Verification with METER TOOL MULTICAL® 602.....	114
13.4	LogView MULTICAL® 602 .....	117
<b>14</b>	<b>Approvals .....</b>	<b>119</b>
14.1	CE marking .....	119
14.2	Measuring instrument directive.....	119
<b>15</b>	<b>Trouble-shooting .....</b>	<b>121</b>
<b>16</b>	<b>Disposal .....</b>	<b>122</b>
<b>17</b>	<b>Documents .....</b>	<b>123</b>
<b>18</b>	<b>Appendix A - MULTICAL® 602 vs. previous meters.....</b>	<b>124</b>

## 1 General description

MULTICAL® 602 is a thermal energy meter with many applications. In addition to being a precise and reliable heat meter for battery or mains operation, MULTICAL® 602 is also used for:

- Cooling measurement in water-based systems
- Bifunctional heat/cooling measurements in separate registers
- Leak surveillance of hot and cold-water installations
- Power and flow limiter with valve control
- Data logger
- Data communication
- Energy measurement in open systems

In designing the MULTICAL® 602 we have attached great importance to flexibility via programmable functions and plug-in modules (see chapter 10) in both the calculator top as well as in the base unit to ensure optimal use in a large number of applications. In addition, the construction ensures that already installed MULTICAL® 602 meters can be updated via the PC program METERTOOL.

This technical description is prepared to give utility managers, meter electricians, consulting engineers and distributors the possibility of utilizing all functions available in the MULTICAL® 602. Furthermore, the description is made for laboratories for the testing and verification process.

## 2 Technical Data

### 2.1 Approved meter data

Standard	EN 1434:2007, prEN 1434:2009 and OIML R75:2002	
EU directives	Measuring Instrument Directive, Low Voltage Directive, Electromagnetic Compatibility Directive	
Heat meter approval	DK-0200-MI004-020	
Temperature range	$\theta$ : 2°C...180°C	The stated minimum temperatures apply to the type approval only. The meter has no cut-off for low temperature and thus measures as low temperatures as 0.01°C and 0.01 K.
Differential range	$\Delta\theta$ : 3 K...170 K	
Cooling meter		
Temperature range	$\theta$ : 2°C...50°C	0.01°C and 0.01 K.
Differential range	$\Delta\theta$ : 3 K...40 K	
Accuracy	$E_c \pm (0.5 + \Delta\theta_{min}/\Delta\theta) \%$	
Temperature sensors	-Type 602-A -Type 602-B and 602-D -Type 602-C	Pt100 – EN 60 751, 2-wire connection Pt500 – EN 60 751, 4-wire connection Pt500 – EN 60 751, 2-wire connection
Compatible flow sensor types	-ULTRAFLOW® -Electronic meters with an active 24 V pulse output -Mechanical meters with an electronic pick-up unit -Mechanical meters with a Reed switch	
Flow sensor sizes	[kWh] qp 0.6 m³/h...15 m³/h [MWh] qp 0.6 m³/h...1500 m³/h [GJ] qp 0.6 m³/h...3000 m³/h	
EN 1434 designation	Environmental class A and C	
MID designation	Mechanical environment: Class M1 Electromagnetic environment: Class E1 and E2 5...55°C, non condensing, closed location (indoor installation)	





## 2.2 Electrical data

### Calculator data

Typical accuracy	Calculator: $E_c \pm (0.15 + 2/\Delta\Theta) \%$ Sensor set: $E_s \pm (0.4 + 4/\Delta\Theta) \%$
Display	LCD – 7 (8) digits with a digit height of 7.6 mm
Resolution	9999.999 – 99999.99 – 999999.9 – 9999999
Energy units	MWh – kWh – GJ – Gcal
Data logger (EEPROM)	Standard: 1392 hours, 460 days, 36 months, 15 years, 50 info codes Option: Data loggers with programmable interval
Clock/calendar	Clock, calendar, compensation for leap years, target date, Real time clock with battery back-up
Data communication	KMP protocol with CRC16 used for optical communication and for top and base modules

Power in temperature sensors < 10  $\mu$ W RMS

**Supply voltage** 3.6 VDC  $\pm$  0.1 VDC

**Battery** 3.65 VDC, D-cell lithium

Stand-by current < 15  $\mu$ A excluding flow sensor

Replacement interval

- Mounted on the wall 12+1 years @  $t_{BAT} < 30^\circ\text{C}$

- Mounted on the flow sensor 10 years @  $t_{BAT} < 40^\circ\text{C}$

The replacement interval is reduced when using data modules, frequent data communication and high ambient temperature. See chapter 9.2.

**Mains supply** 230 VAC  $\pm$  15/-30%, 50/60 Hz  
24 VAC  $\pm$  50%, 50/60 Hz

Insulation voltage 4 kV

Power supply < 1W

Back-up supply Integral super-cap eliminates operational disturbances due to short-term power cuts (Power supply modules type 602-0000-7 and type 602-0000-8 only)

EMC data Meets prEN 1434-4:2009 class C (MID class E2)

### Temperature measurement

		T1	T2	T3	T4
<b>602-A</b> <b>2-W Pt100</b>	Measuring range	0.00...185.00°C	0.00...185.00°C	0.00...185.00°C	N/A
	Preset range	0.01...180.00°C	0.01...180.00°C	0.01...180.00°C	0.01...180.00°C
<b>602-B/D</b> <b>4-W Pt500</b>	Measuring range	0.00...185.00°C	0.00...185.00°C	N/A	N/A
	Preset range	0.01...180.00°C	0.01...180.00°C	N/A	0.01...180.00°C
<b>602-C</b> <b>2-W Pt500</b>	Measuring range	0.00...185.00°C	0.00...185.00°C	0.00...185.00°C	N/A
	Preset range	0.01...180.00°C	0.01...180.00°C	0.01...180.00°C	0.01...180.00°C

Max. cable lengths	Pt100, 2-wire	Pt500, 2-wire	Pt500, 4-wire
	2 x 0.25 mm <sup>2</sup> : 2.5 m	2 x 0.25 mm <sup>2</sup> : 10 m	4 x 0.25 mm <sup>2</sup> : 100 m
	2 x 0.50 mm <sup>2</sup> : 5 m	2 x 0.50 mm <sup>2</sup> : 20 m	-

<b>Flow measuring V1 and V2</b>	ULTRAFLOW® V1: 9-10-11 and V2: 9-69-11	Reed switches V1: 10-11 and V2: 69-11	24 V active pulses V1: 10B-11B and V2: 69B-79B
EN 1434 pulse class	IC	IB	(IA)
Pulse input	680 k $\Omega$ pull-up for 3.6 V	680 k $\Omega$ pull-up for 3.6 V	12 mA at 24 V
Pulse ON	< 0.4 V in > 0.5 msec.	< 0.4 V in > 100 msec.	< 4 V in > 3 msec.
Pulse OFF	> 2.5 V in > 10 msec.	> 2.5 V in > 100 msec.	> 12 V in > 10 msec.
Pulse frequency	< 128 Hz	< 1 Hz	< 128 Hz
Integration frequency	< 1 Hz	< 1 Hz	< 1 Hz
Electrical isolation	No	No	2 kV
Max. cable length	10 m	25 m	100 m

**Pulse inputs without bounce damping:**

<b>Pulse inputs VA and VB</b>	Water meter connection VA: 65-66 and VB: 67-68 FF(VA) and GG(VB) = 71...90	Electricity meter connection FF(VA) and GG(VB) = 50...60
Pulse input	680 k $\Omega$ pull-up for 3.6 V	680 k $\Omega$ pull-up for 3.6 V
Pulse ON	< 0.4 V in > 30 msec.	< 0.4 V in > 30 msec.
Pulse OFF	> 2.5 V in > 100 msec.	> 2.5 V in > 100 msec.
Pulse frequency	< 1 Hz	< 3 Hz
Electrical isolation	No	No
Max. cable length	25 m	25 m
Requirements to external contact	Leakage current at function open < 1 $\mu$ A	

**Pulse inputs with bounce damping:**

<b>Pulse inputs VA and VB</b>	Water meter connection VA: 65-66 and VB: 67-68 FF(VA) and GG(VB) = 01...40
Pulse input	680 k $\Omega$ pull-up for 3.6 V
Pulse ON	< 0.4 V i > 200 ms.
Pulse OFF	> 2.5 V i > 500 ms.
Pulse frequency	< 1 Hz
Electrical isolation	None
Max. Cable length	25 m
Requirements to external contact	Leakage current at function open < 1 $\mu$ A

**Pulse outputs CE and CV**

- via top module	67-0B	602-0C
Type	Opto FET	Open collector (OB)
External voltage	5...48 VDC/AC	5...30 VDC
Current	1...50 mA	1...10 mA
Residual voltage	$R_{ON} \leq 40 \Omega$	$U_{CE} \approx 1 \text{ V at } 10 \text{ mA}$
Electrical isolation	2 kV	2 kV
Max. cable length	25 m	25 m
Pulse length	Optional 32 msec. or 100 msec.	

## 2.3 Mechanical data

Environmental class	Meets EN 1434 class A and C
Ambient temperature	5...55°C non condensing, closed location (indoor installation)
Protection class	IP54
Storage temperature	-20...60°C (drained meter)
Weight	0.4 kg excluding sensors and flow sensor
Connection cables	ø3.5...6 mm
Supply cable	ø5...10 mm

## 2.4 Materials

Top cover	PC
Base unit	ABS with TPE packings (thermoplastic elastomer)
Print box	ABS
Wall brackets	PC + 30% glass

## 2.5 Accuracy

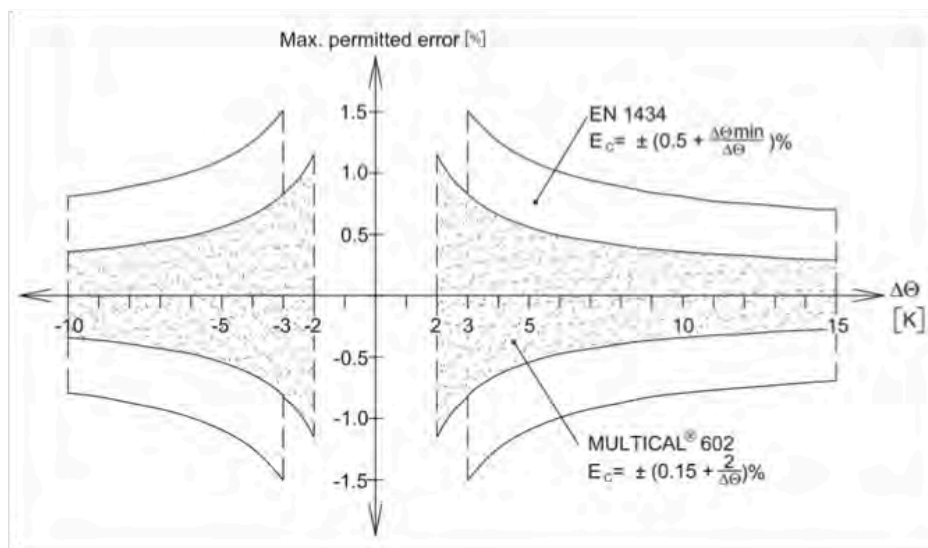


Figure 1. MULTICAL® 602 typical accuracy compared with EN 1434.

### 3 Type overview

MULTICAL® 602 can be ordered in a countless number of combinations as required by the customer. First the required hardware is selected in the type overview. Then "Prog", "Config" and "Data" are selected to suit the application in question.

The meter is delivered completely configured and ready for use from the factory but it can also be retrofitted/reconfigured after installation.

Please note that the items marked "Totalprog" can only be changed when the verification seal is broken. This requires that the change must be made at an accredited meter laboratory.

New functions and modules for MULTICAL® 602 are constantly being developed. Please contact Kamstrup A/S, if the described variants do not meet your requirements.

#### 3.1 Type and programming overview

##### Type number (Total prog.)

**602-X-X-XX-X-XX-X-XXX**

Selection of Pt100/ Pt500  
calculator, modules, supply,  
sensor set, flow sensor and  
language on label

##### PROG (Total prog.)

**A-B-CCC-CCC**

- Flow pipe/ Return pipe
- Energy unit
- Flow meter code

##### CONFIG (Partial prog.)

**DDD-EE-FF-GG-M-N-T**

- Display
- Tariff
- Pulse inputs
- Leak sensibility
- Pulse outputs
- AMR Encryption level

##### DATA (Partial prog.)

- Customer no.
- Target date
- Tariff limits
- Average peak time max./ min.
- Date/ time

## MULTICAL® 602      Type 602-

5512-931 GB/06.2012/Rev. E1

### 3.2.1 Comments to the Type number survey

When placing orders please state ULTRAFLOW® type numbers separately.

<sup>1)</sup> See paragraph 10.2 for further details.

<sup>2)</sup> Requires two identical flow sensors.

### 3.2.2 Accessories

66-00-200-100	D-cell battery
602-0000-4000000	24 VAC high power isolated SMPS
602-0000-3000000	230 VAC high power isolated SMPS
602-0000-8000000	24 VAC isolated linear supply
602-0000-7000000	230 VAC isolated linear supply
66-99-624	Pulse transmitter/divider for 602-A and 602-C
66-99-614	4-wire connection PCB with pulse inputs for 24 V active pulses (for 602-D)
66-99-098	Data cable w/USB plug
66-99-099	Infrared optical reading head w/USB plug
66-99-144	Infrared optical reading head for Kamstrup/EVL w/USB plug
66-99-102	Infrared optical reading head w/D-sub 9F
66-99-106	Data cable RS 232, D-sub 9F
66-99-397/-398/-399	Verification unit (used with METERTOOL)
65-56-4x-xxx	Temperature sensor set with connection head (2/4-wire)
67-9xxxxxx2xx	External Communication Box
66-99-718	METER TOOL for MULTICAL® 602
66-99-719	METER TOOL LogView for MULTICAL® 602

Please contact Kamstrup A/S for questions concerning further accessories.

### 3.3 PROG, A-B-CCC-CCC

The legal parameters of the meter are determined by Prog, which can only be changed when the verification seal is broken. The change must then be made at an accredited meter laboratory.

**The A-code** indicates whether the flow sensor (V1) is installed in flow or return pipe. As water has a larger volume at higher temperatures, the calculator must be adjusted for the current installation type. Wrong programming or installation results in measuring errors. For further details on placing the flow and return pipe of the flow sensor in connection with heat and cooling meters, see paragraph 5.1.

**The B-code** indicates the measuring unit used for the energy register. GJ, kWh or MWh are used most frequently, whereas Gcal is only used in some countries outside the EEA.

**The CCC code** indicates the calculator's adaptation to a concrete flow sensor type, i.e. the calculation speed and display resolution are optimised to the selected flow sensor type and at the same time the type approval regulations concerning min. resolution and max. register overflow are met. The CCC codes are divided into several tables to give a better survey.

CCC(V1) indicates the CCC code of the flow sensor and is connected to flow sensor input V1 on terminal 9-10-11 (or 10B-11B), which in most applications is the flow sensor used for calculating energy.

CCC(V2) indicates the CCC code of an extra flow sensor, if any, to be connected to terminal 9-69-11 (or 69B-79B). If V2 is not used, CCC(V2) = CCC(V1). In connection with leakage surveillance CCC(V2) = CCC(V1).

<b>Prog. number</b>	<b>A</b>	<b>-</b>	<b>B</b>	<b>-</b>	<b>CCC (V1)</b>	<b>-</b>	<b>CCC (V2)</b>
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### 3.3.1 CCC-table for MULTICAL® 602

The CCC tables are divided into fast pulse codes (CCC=4XX, 2XX and 1XX) for electronic meters, e.g. ULTRAFLOW®, and slow codes for e.g. reed contacts (CCC=0XX).

#### CCC= 4XX Electronic meters with fast and bounce-free pulses as well as info codes for ULTRAFLOW® X4

Max. pulse frequency: 128 Hz

Max. integration frequency: 1 Hz

#### CCC= 1XX, 2XX Electronic meters with fast and bounce-free pulses

Max. pulse frequency: 128 Hz

Max. integration frequency: 1 Hz

#### CCC= 0XX Mechanical meters delivering slow pulses with bounce (flow sensor type "L")

Max. pulse frequency: 1 Hz

Max. integration frequency: 1 Hz

Max. integration frequency is 1 Hz for all types. The CCC codes are arranged in a way that  $q_{s+20\%}$  (or  $Q_{max+20\%}$ ) does not exceed the 1 Hz in the integration frequency.

Example: CCC=107 (applies for a qp 1.5 m³/h meter) : 1 Hz in the integration frequency is obtained at  $q = 3.6 \text{ m}^3/\text{h}$ .

EN 1434 makes demands on the resolution and registre size of the energy reading. MULTICAL® 602 meets these demands when connected to below flow sensor sizes:

[kWh]	qp 0.6 m³/h...15 m³/h
[MWh]	qp 0.6 m³/h...1500 m³/h
[GJ]	qp 0.6 m³/h...3000 m³/h

### 3.3.2 CCC codes for mechanical flow sensors with Reed switch

CCC no.	Pre-counter	Flow factor	Number of decimals on the display								l/pulses	Pulses/l	Qmax [m³/h]	Flow sensor
			kWh	MWh Gcal	GJ	m³ [ton]	m³/h	l/h	kW	MW				
010	1	921600	1	-	3	3	-	0	1	-	1	1	≤ 3,0	L
011	1	921600	-	3	2	2	2	-	0	-	10	0.1	1...30	L
012	1	921600	-	2	1	1	1	-	-	2	100	0.01	10...300	L
013	1	921600	-	1	0	0	0	-	-	1	1000	0.001	100...3000	L
020	4	230400	0	3	2	2	2	-	0	-	2.5	0.4	≤ 6	L
021	4	230400	-	2	1	1	1	-	-	2	25	0.04	3...60	L
022	4	230400	-	1	0	0	0	-	-	1	250	0.004	30...600	L

Current flow (l/h or m³/h) reading is calculated on the basis of the measured period between 2 volume pulses (see paragraph 6.5)

When one of above CCC codes has been selected both CCC (V1) and CCC (V2) must be selected from this table.

**Note:** Continuous maximum water flow and permanent  $\Delta\Theta \quad 75 \text{ K}$  may cause overflow in the daily data logger at CCC=010-011-012-013-150-202-205. With these combinations we recommend you to use Prog. data logger type 67-0B or type 67-00-22.

3.3.3 CCC codes for ULTRAFLOW® II, type 65 54 XXX

CCC no.	Pre-counter	Flow factor	Number of decimals on the display								Pulses/l	qp [m³/h]	Type no.	Flow sensor
			kWh	MWh Gcal	GJ	m³ [ton]	l/h	m³/h	kW	MW				
116	3000	78642	0	3	2	2	0	-	1	-	300	0.6	65 54 A8X 65 54 AAX	1-2-7-8
119	1000	235926	0	3	2	2	0	-	1	-	100	1.5	65 54 A6X 65 54 A7X 65 54 A1X 65 54 A2X 65 54 A3X	1-2-7-8
136	500	471852	0	3	2	2	0	-	1	-	50.0	2.5	65 54 A4X 65 54 ADX	1-2-7-8
151	5000	471852	-	2	1	1	0	-	1	-	50.0	3.5	65 54 B1X 65 54 B7X	1-2-7-8
137	2500	943704	-	2	1	1	0	-	1	-	25.0	6.0 6.0 10 10	65 54 B2X 65 54 B5X 65 54 BGX 65 54 BHX	1-2-7-8
120	1000	2359260	-	2	1	1	0	-	1	-	10.0	15 25	65 54 B4X 65 54 B8X	1-2-7-8
158	5000	471852	-	1	0	0	-	2	0	-	5.0	40	65 54 B9X	1-2-7-8
170	2500	943704	-	1	0	0	-	2	-	3	2.5	60	65 54 BAX	1-2-7-8
147	1000	2359260	-	1	0	0	-	2	-	3	1.0	150	65 54 BBX	1-2-7-8
194	400	5898150	-	1	0	0	-	2	-	3	0.4	400	65 54 BCX	1-2-7-8
195	250	9437040	-	1	0	0	-	2	-	3	0.25	1000	65 54 BKX	1-2-7-8

Current flow reading (l/h or m³/h) is calculated on the basis of volume pulses/10 sec. (see paragraph 6.5)

3.3.4 CCC codes for ULTRAFLOW® type 65-R/S/T

CCC no.	Pre-counter	Flow-factor	Number of decimals on the display										Type no.	Flow part
			kWh	MWh Gcal	GJ	m³ [ton]	l/h	m³/h	kW	MW	Pulses/l	qp [m³/h]		
116	3000	78642	0	3	2	2	0	-	1	-	300	0.6	65-X-CAAA-XXX 65-X-CAAD-XXX	1-2-7-8
119	1000	235926	0	3	2	2	0	-	1	-	100	1.5	65-X-CDAC-XXX 65-X-CDAD-XXX 65-X-CDAE-XXX 65-X-CDAF-XXX 65-X-CDAA-XXX	1-2-7-8-M
136	500	471852	0	3	2	2	0	-	1	-	50.0	3.0	65-X-CFAF-XXX 65-X-CFBA-XXX	1-2-7-8-M
151	5000	471852	-	2	1	1	0	-	1	-	50.0	3.5	65-X-CGAG-XXX 65-X-CGBB-XXX	1-2-7-8-M
137	2500	943704	-	2	1	1	0	-	1	-	25.0	6 6 10 10	65-X-CHAG-XXX 65-X-CHBB-XXX 65-X-C1AJ-XXX 65-X-C1BD-XXX	1-2-7-8-M
178	1500	1572840	-	2	1	1	0	-	1	-	15.0	10	65-X-CJAJ-XXX 65-X-CJBD-XXX	1-2-7-8-M
120	1000	2359260	-	2	1	1	0	-	1	-	10.0	15	65-X-CKBE-XXX	1-2-7-8-M
179	600	3932100	-	2	1	1	0	-	1	-	6.0	25	65-X-CLBG-XXX	1-2-7-8
120	1000	2359260	-	2	1	1	0	-	1	-	10.0	25	65-X-C2BG-XXX	1-2-7-8-M
158	5000	471852	-	1	0	0	-	2	0	-	5.0	40	65-X-CMBH-XXX	1-2-7-8-M
170	2500	943704	-	1	0	0	-	2	-	3	2.5	60	65-X-FABL-XXX 65-X-FACL-XXX	1-2-7-8-M
180	1500	1572840	-	1	0	0	-	2	-	3	1.5	100	65-X-FBCL-XXX	1-2-7-8
147	1000	2359260	-	1	0	0	-	2	-	3	1.0	150	65-X-FCBN-XXX 65-X-FCCN-XXX	1-2-7-8-M
181	600	3932100	-	1	0	0	-	2	-	3	0.6	250	65-X-FDCN-XXX	1-2-7-8
191	400	589815	-	1	0	0	-	1	-	2	0.4	400	65-X-FEBN-XXX 65-X-FEBR-XXX 65-X-FECN-XXX 65-X-FECP-XXX 65-X-FECP-XXX	1-2-7-8-M
192	250	943704	-	1	0	0	-	1	-	2	0.25	600 600 1000 1000	65-X-FFCP-XXX 65-X-FFCR-XXX 65-X-F1BR-XXX 65-X-F1CR-XXX	1-2-7-8-M
193	150	1572840	-	1	0	0	-	1	-	2	0.15	1000	65-X-FGBR-XXX	1-2-7-8

Current flow reading (l/h or m³/h) is calculated on the basis of volume pulses/10 sec. (see paragraph 6.5)

## 3.3.5 CCC codes with high resolution for ULTRAFLOW® (for cooling meters etc.)

CCC no.	Pre-counter	Flow factor	Number of decimals on the display								Pulses/l	qp [m³/h]	Type no.	Flow sensor
			kWh	MWh Gcal	GJ	m³ [ton]	l/h	m³/h	kW	MW				
184	300	78642	1	-	3	3	0	-	1	-	300	0.6		1-2-7-8
107	100	235926	1	-	3	3	0	-	1	-	100	1.5		1-2-7-8-M
136	500	471852	0	3	2	2	0	-	1	-	50.0	3.5		1-2-7-8-M
138	250	943704	0	3	2	2	0	-	1	-	25.0	6.0 10		1-2-7-8-M
183	150	1572840	0	3	2	2	0	-	1	-	15.0	10		1-2-7-8
185	100	2359260	0	3	2	2	0	-	1	-	10.0	15		1-2-7-8-M
186	500	471852	-	2	1	1	-	2	0	-	5.0	40		1-2-7-8-M
187	250	943704	-	2	1	1	-	2	-	3	2.5	60		1-2-7-8-M
188	150	1572840	-	2	1	1	-	2	-	3	1.5	100		1-2-7-8
189	100	2359260	-	2	1	1	-	2	-	3	1.0	150		1-2-7-8-M
191	400	589815	-	1	0	0	-	1	-	2	0.4	400		1-2-7-8-M
192	250	943704	-	1	0	0	-	1	-	2	0.25	600 1000		1-2-7-8-M
193	150	1572840	-	1	0	0	-	1	-	2	0.15	1000		1-2-7-8

Current flow reading (l/h or m³/h) is calculated on the basis of volume pulses/10 sec. (see paragraph 6.5)

## 3.3.6 CCC codes for other electronic meters with a passive output

CCC no.	Pre-counter	Flow factor	Number of decimals on the display						l/pulse	Pulses/l	Qmax [m³/h]	Type	Flow sensor
			MWh Gcal	GJ	m³ [ton]	m³/h	kW	MW					
147	1000	2359260	1	0	0	2	-	3	1	-	18...75	SC-18	K-M
148	400	5898150	1	0	0	2	-	3	2.5	-	120...300	SC-120	K-M
149	100	2359260	1	0	0	1	-	2	10	-	450...1200	SC-450	K-M
150	20	11796300	1	0	0	1	-	2	50	-	1800...3000	SC-1800	K-M
175	7500	314568	1	0	0	2	-	3	-	7.5	15...30	DF-15	K-M
176	4500	524280	1	0	0	2	-	3	-	4.5	25...50	DF-25	K-M
177	2500	943704	1	0	0	2	-	3	-	2.5	40...80	DF-40	K-M

CCC no.	Pre-counter	Flow factor	Number of decimals on the display					l/pulse	Pulse/l	Qp range [m³/h]	Qs (m³/h)	Type	Flow sensor
			MWh Gcal	GJ	m³ [ton]	m³/h	MW						
201	100	235926	2	1	1	1	2	1	1	10...100	75	FUS380 DN50-65	K-M
202	40	589815	2	1	1	1	2	2.5	0.4	40...200	240	FUS380 DN80-100	K-M
203	400	589815	1	0	0	1	2	2.5	0.4	100...400	500	FUS380 DN125	K-M
204	100	235926	1	0	0	0	1	10	0.1	150...1200	1600	FUS380 DN150-250	K-M
205	20	1179630	1	0	0	0	1	50	0.02	500...3000	3600	FUS380 DN300-400	K-M

Current flow reading (l/h or m³/h) is calculated on the basis of volume pulses/10 pcs. (see paragraph 6.5)

## 3.3.7 CCC codes for other electronic meters with an active output

Flow sensor with active 24 V pulse output, see paragraph 7.2

3.3.8 CCC codes for vane wheel meters with an electronic pick-up unit

CCC no.	Pre-counter	Flow factor	Number of decimals on the display								Pulses/l	qp [m³/h]	Type	Flow sensor
			kWh	MWh Gcal	GJ	m³ [ton]	l/h	m³/h	kW	MW				
102	560	421296	0	3	2	2	0	-	1	-	56.0	1.5/2.5	GWF-MT3	K
103	300	786420	0	3	2	2	0	-	1	-	30.0	3.5	GWF-MT3	K
104	2520	936214	-	2	1	1	0	-	1	-	25.2	6	GWF-MT3	K
105	1230	1918098	-	2	1	1	0	-	1	-	12.3	10	GWF-MT3	K
106	1080	2184500	-	2	1	1	0	-	1	-	10.8	15	GWF-MT3	K
108	1403	168158	0	3	2	2	0	-	1	-	140.3	0.6	GWF	K
109	957	246527	0	3	2	2	0	-	1	-	95.7	1.0	GWF	K
110	646	365211	0	3	2	2	0	-	1	-	64.6	1.5	GWF	K
111	404	583975	0	3	2	2	0	-	1	-	40.4	1.5 (2.5)	HM (GWF)	K
112	502	469972	0	3	2	2	0	-	1	-	50.2	1.5 – 2.5*	GWF	K
113	2350	1003940	-	2	1	1	0	-	1	-	23.5	3.5 - 6*	GWF	K
114	712	331357	-	2	1	1	0	-	1	-	7.12	10 - 15*	GWF	K
115	757	311659	0	3	2	2	0	-	1	-	75.7	1.0*	GWF	K
116	3000	78642	0	3	2	2	0	-	1	-	300.0	0.6*	GWF	K
117	269	877048	0	3	2	2	0	-	1	-	26.9	1.5	Brunata	K
118	665	354776	0	3	2	2	0	-	1	-	66.5	1.5	Aquastar	K
119	1000	235926	0	3	2	2	0	-	1	-	100.0	0.6	HM	K
121	294	802469	0	3	2	2	0	-	1	-	29.4	1.5 – 2.5		K
122	1668	141442	0	3	2	2	0	-	1	-	166.8	0.6	HM	K
123	864	273063	0	3	2	2	0	-	1	-	86.4	0.75 - 1*	HM	K
124	522	451966	0	3	2	2	0	-	1	-	52.2	2.5 (1.5*)	CG (HM)	K
125	607	388675	0	3	2	2	0	-	1	-	60.7	1.5 - 1* 1.5*	HM	K
126	420	561729	0	3	2	2	0	-	1	-	42.0	1.0 (2.5*)	CG (HM)	K
127	2982	791167	-	2	1	1	0	-	1	-	29.82	2.5 3.5*	HM	K
128	2424	973292	-	2	1	1	0	-	1	-	24.24	3.5*	HM	K
129	1854	1272524	-	2	1	1	0	-	1	-	18.54	6*	HM	K
130	770	3063974	-	2	1	1	0	-	1	-	7.7	10*	HM	K
131	700	3370371	-	2	1	1	0	-	1	-	7.0	15*	HM	K
132	365	645665	0	3	2	2	0	-	1	-	36.54	2.5	Wehrle	K
133	604	390154	0	3	2	2	0	-	1	-	60.47	1.5	Wehrle	K
134	1230	191732	0	3	2	2	0	-	1	-	123.05	0.6	Wehrle	K
135	1600	1474538	-	2	1	1	0	-	1	-	16.0	10*	HM	K
139	256	921586	0	3	2	2	0	-	1	-	25.6	1.5 – 2.5	GWF	K
140	1280	1843172	-	2	1	1	0	-	1	-	12.8	3.5 – 5.0	GWF	K
141	1140	2069526	-	2	1	1	0	-	1	-	11.4	6	GWF	K
142	400	589815	-	2	1	1	-	2	-	3	4	10	GWF	K
143	320	737269	-	2	1	1	-	2	-	3	3.2	10 - 15	GWF	K
144	1280	1843172	-	1	0	0	-	2	-	3	1.28	25 - 40	GWF	K
145	640	3686344	-	1	0	0	-	2	-	3	0.64	60	GWF	K
146	128	18431719	-	1	0	0	-	2	-	3	0.128	125	GWF	K
152	1194	1975930	-	2	1	1	0	-	1	-	11.94	10	GWF	K
153	1014	2326686	-	2	1	1	0	-	1	-	10.14	15	GWF	K
156	594	397182	0	3	2	2	0	-	1	-	59.4	1.5	Metron	K
157	3764	626796	-	2	1	1	0	-	1	-	37.64	2.5	Metron	K
163	1224	192750	0	3	2	2	0	-	1	-	122.4	0.6 – 1.0	GWF/U2	K
164	852	280064	0	3	2	2	0	-	1	-	85.24	1.5	GWF/U2	K
165	599	393735	0	3	2	2	0	-	1	-	59.92	2.5	GWF/U2	K
168	449	5259161	-	2	1	1	0	-	1	-	4.486	15/25	HM/WS	K
169	1386	1702208	-	1	0	0	-	2	0	-	1.386	40	HM/WS	K
173	500	471852	-	1	0	0	-	1	-	2	0.5	80	Westland	K

Current flow reading (l/h or m³/h) is calculated on the basis of volume pulses/10 sec. (see paragraph 6.5)

\* Multiple-jet water meter



3.3.9 ULTRAFLOW® X4 CCC-codes

CCC no.	Pre-counter	Flow factor	Number of decimals on the display								Pulses/l	qp [m³/h]	Type	Flow sensor
			kWh	MWh Gcal	GJ	m³ [ton]	l/h	m³/h	kW	MW				
416	3000	78642	0	3	2	2	0	-	1	-	300	0.6	65-X-CAAA-XXX 65-X-CAAD-XXX 65-X-CAAF-XXX	1-2-7-8
484	300	78642	1	-	3	3	0	-	1	-	300	0.6		1-2-7-8
419	1000	235926	0	3	2	2	0	-	1	-	100	1.5	65-X-CDA1-XXX 65-X-CDAA-XXX 65-X-CDAC-XXX 65-X-CDAD-XXX 65-X-CDAE-XXX 65-X-CDAF-XXX 65-X-CDBA-XXX	1-2-7-8
407	100	235926	1	-	3	3	0	-	1	-	100	1.5		1-2-7-8
498	600	393210	0	3	2	2	0	-	1	-	60	2.5	65-X-CEAF-XXX 65-X-CEBA/CECA-XXX 65-X-CEAD-XXX	1-2-7-8
451	5000	471852	-	2	1	1	0	-	1	-	50	3.5	65-X-CGAG-XXX 65-X-CGBB/CGCB-XXX	1-2-7-8
436	500	471852	0	3	2	2	0	-	1	-	50	3.5		1-2-7-8
437	2500	943704		2	1	1	0		1		25	6	65-X-CHAF-XXX 65-X-CHAG-XXX 65-X-CHAH-XXX 65-X-CHBB/CHCB-XXX	1-2-7-8
438	250	943704	0	3	2	2	0	-	1	-	25	6		1-2-7-8
478	1500	1572840	-	2	1	1	0	-	1	-	15	10	65-X-CJA1-XXX 65-X-CJB2/CJC2-XXX 65-X-CJBD/CJCD-XXX	1-2-7-8
483	150	1572840	0	3	2	2	0	-	1	-	15	10		1-2-7-8
420	1000	2359260	-	2	1	1	0	-	1	-	10	15	65-X-CKB4/CKC4-XXX 65-X-CKBE/CKCE-XXX	1-2-7-8
485	100	2359260	0	3	2	2	0	-	1	-	10	15		1-2-7-8
479	600	3932100	-	2	1	1	0	-	1	-	6	25	65-X-CLBG/CLCG-XXX	1-2-7-8
458	5000	471852	-	1	0	0	-	2	0	-	5	40	65-X-CMBH/CMCH-XXX 65-X-CMBJ/CMCJ-XXX	1-2-7-8
486	500	471852	-	2	1	1	-	2	0	-	5	40		1-2-7-8
470	2500	943704	-	1	0	0	-	2	-	3	2.5	60	65-X-FACL-XXX	1-2-7-8
487	250	943704	-	2	1	1	-	2	-	3	2.5	60		1-2-7-8
480	1500	1572840	-	1	0	0	-	2	-	3	1.5	100	65-X-FBCL-XXX	1-2-7-8
488	150	1572840	-	2	1	1	-	2	-	3	1.5	100		1-2-7-8
447	1000	2359260		1	0	0		2		3	1	150	65-X-FCCN-XXX	1-2-7-8
489	100	2359260		2	1	1		2		3	1	150		1-2-7-8
481	600	3932100		1	0	0		2		3	0.6	250	65-X-FDCN-XXX 65-X-FECN-XXX 65-X-FECP-XXX 65-X-FECP-XXX	1-2-7-8
491	400	589815		1	0	0		1		2	0.4	400	65-X-FFCP-XXX 65-X-FFCR-XXX	1-2-7-8
492	250	943704		1	0	0		1		2	0.25	600		1-2-7-8
493	150	1572840		1	0	0		1		2	0.15	1000	65-X-FGCR-XXX	1-2-7-8
ULTRAFLOW® CCC- codes with high resolution														

### 3.4 Display coding

The display code "DDD" indicates the active readings for the individual meter type. "1" is the first primary reading whereas e.g. "1A" is the first secondary reading. The display automatically returns to reading "1" after 4 minutes.

				Date stamp	Heat meter DDD=210	Cooling meter DDD=510	Heat/cooling DDD=610	Heat volume DDD=710	Cold Volume DDD=810	Energy meter DDD=910
1.0	Heat energy (E1)									
		1.1	Yearly data	•						
		1.2	Monthly data	•						
2.0	Cooling energy (E3)									
		2.1	Yearly data	•						
		2.2	Monthly data)	•						
3.X		3.1	E2							
		3.2	E4							
		3.3	E5							
		3.4	E6							
		3.5	E7							
		3.6	E8 (m3*tf)							
		3.7	E9 (m3*tr)							
4.0	Volume V1									
		4.1	Yearly data	•						
		4.2	Monthly data	•						
		4.3	Mass 1							
		4.4	P1							
5.0	Volume V2									
		5.1	Yearly data	•						
		5.2	Monthly data	•						
		5.3	Mass 2							
		5.4	P2							
6.0	Hour counter									
		6.1	Error hour counter (N° 60)							
7.0	T1 (Flow)									
		7.1	Year-to-date average							
		7.2	Month-to date average							
8.0	T2 (Return flow)									
		8.1	Year-to-date average							
		8.2	Month-to-date average							
9.0	T1-T2 (Δt) - = cooling									
10.0	T3									
11.0	T4 (prog.)									
12.0	Flow (V1)									
		12.1	Max this year	•						
		12.2	Max. yearly data	•						
		12.3	Min. this year	•						
		12.4	Min. yearly data	•						
		12.5	Max. this month	•						
		12.6	Max. monthly data	•						
		12.7	Min. this month	•						
		12.8	Min. monthly data	•						
13.0	Flow (V2)									
14.0	Power (V1)									
		14.1	Max. this year	•						
		14.2	Max. yearly data	•						
		14.3	Min. this year	•						
		14.4	Min. yearly data	•						
		14.5	Max. this month	•						
		14.6	Max. monthly data	•						
		14.7	Min. this month	•						
		14.8	Min. monthly data	•						

				Date stamp	Heat meter DDD=410	Cooling meter DDD=510	Heat/cooling DDD=610	Heat volume DDD=710	Cold volume DDD=810	Energy meter DDD=910
15.0	VA (Input A)	15.1	Meter no. VA							
		15.2	Yearly data	•						
		15.3	Monthly data	•						
		15.4	L/Imp for VA (N° 65)							
16.0	VB (Input B)	16.1	Meter no. VB							
		16.2	Yearly data	•						
		16.3	Monthly data	•						
		16.4	L/Imp for VA (N° 67)							
17.0	TA2	17.1	TL2							
18.0	TA3	18.1	TL3							
19.0	Info code	19.1	Info event counter							
		19.2	Info logger (last 36 events)	•						
20.0	Customer number (N° 1+2)	20.1	Date							
		20.2	Time							
		20.3	Target date							
		20.4	Serial no. (N° 3)							
		20.5	Prog. (A-B-CCC-CCC) (N° 4)							
		20.6	Config 1 (DDD-EE) (N° 5)							
		20.7	Config 2 (FF-GG-M-N-T) (N° 6)							
		20.8	Software edition (N° 10)							
		20.9	Software check-sum (N° 11)							
		20.10	Segment test							
		20.11	Top module type (N° 20)							
		20.12	Top module primary adr. (N° 21)							
		20.13	Top module second. adr. (N° 22)							
		20.14	Base module type (N° 30)							
		20.15	Base module primary adr. (N° 31)							
		20.16	Base module second. adr. (N° 32)							
Number of yearly data shown in the display (1...15)										
Number of monthly data shown in the display (1...36)										

DDD=210 is the "standard code" for heat meters with meter type 602xxxxxx2xx. Please contact Kamstrup for other combinations. Max. number of readings of a DDD code is 110. Of these, reading of data logger counts for 4 readings. Top module no. and base module no. to be left out of account.

A complete survey of existing display codes (DDD) appears from a separate document. Please contact Kamstrup for further details.

Note: Data reading can retrieve up to 36 monthly data and up to 15 yearly data. Number of yearly and monthly data to be shown in the display is determined by the DDD code in each case.



### 3.4.1 Energy overview

Above energy types E1 to E9 are calculated as follows:

Formula	$\Delta\Theta$	Example of an application	Included in Application No. (see paragraph 6.2)	Register type
$E1 = V1(T1 - T2)k$ <small>T1: Flow / T2: Return</small>	$T1 > T2$	Heat energy (V1 in flow or return flow)	1+2+3+4+5+6+8+10	Legal Display/ Data/ Log
$E2 = V2(T1 - T2)k$ <small>T2: Return</small>	$T1 > T2$	Heat energy (V2 in return flow)	2+7	Display/ Data/ Log
$E3 = V1(T2 - T1)k$ <small>T2: Flow / T1: Return</small>	$T2 > T1$	Cooling energy (V1 in flow or return flow)	1+11	Legal Display/ Data/ Log
$E4 = V1(T1 - T3)k$ <small>T1: Flow</small>	$T1 > T3$	Flow energy	7+9+11	Display/ Data/ Log
$E5 = V2(T2 - T3)k$ <small>T2: Flow</small>	$T2 > T3$	Return energy or tap from return flow	5+7+9	Display/ Data/ Log
$E6 = V2(T3 - T4)k$ <small>T3: Flow</small>	$T3 > T4$	Tap water energy, separate	3+6	Display/ Data/ Log
$E7 = V2(T1 - T3)k$ <small>T3: Return</small>	$T1 > T3$	Return energy or tap from flow	4+8	Display/ Data/ Log
$E8 = m^3 \times T1$	-	Average temperature in flow	See paragraph 6.2.2	Display/ Data/ Log
$E9 = m^3 \times T2$	-	Average temperature in return		Display/ Data/ Log

### 3.5 Configuration of MULTITARIFF

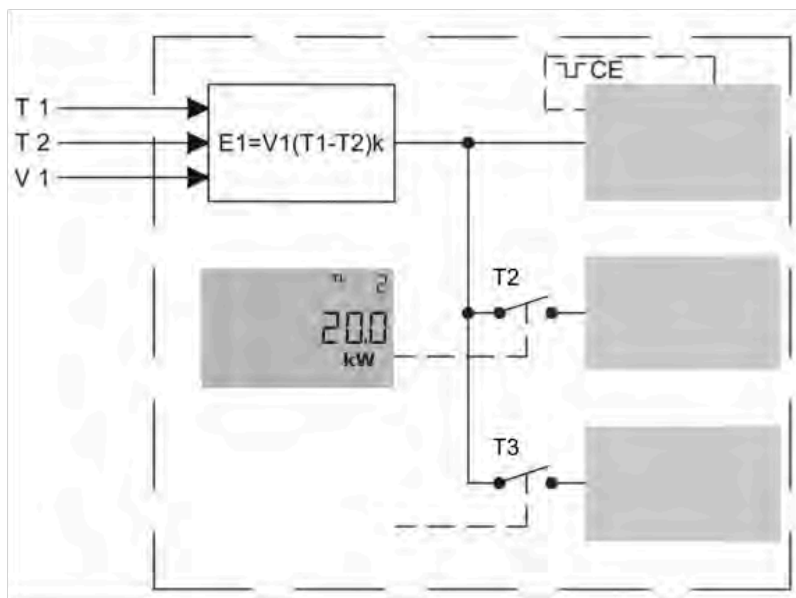
MULTICAL® 602 has 2 extra registers, TA2 and TA3, that accumulates energy E1 or E3 (EE=20 accumulates volume) in parallel with the main register based on the limits programmed to tariff limits TL2 and TL3.

Example: EE=11 (power tariff)

TA2 shows the energy consumed ...



...above the power limit TL2 (but below TL3)



Example: Power tariff (EE=11); TL2=20 kW; TL3=30 kW; the meter is a heat meter.

The heat energy E1 is always counted in the main register. When the power exceeds the limit set for TL2, i.e. 20 kW, but is below the limit set for TL3, i.e. 30 kW, the heat energy E1 is counted in TA2, but only as long as TL2 exceeds 20 kW and is lower than 30 kW. It functions as a contact T2, which closes the moment TL2 surpasses 20 kW. As soon as the power either surpasses 30 kW or falls below 20 kW, the contact breaks again and counting stops in the TA-register. If the power surpasses 30 kW the contact T3 closes and now all the energy E1, which is consumed as long as the power remains above 30 kW is counted in T3. This energy E1 is counted in both the main register and in TA3.

EE=	TARIFF TYPE	FUNCTION	Country code 2xx	Country code 4xx	Country code 5xx	Country code 6xx	Country code 7xx	Country code 8xx	Country code 9xx
00	No tariff active	No function							
11	Power tariff	Energy is accumulated in TA2 and TA3 based on the power limits in TL2 and TL3.	•	•	•				
12	Flow tariff	Energy is accumulated in TA2 and TA3 based on the flow limits in TL2 and TL3.	•	•	•				
13	Cooling tariff	Energy is accumulated in TA2 and TA3 based on the $\Delta t$ limits in TL2 and TL3.	•	•	•				
14	Flow temperature tariff	Energy is accumulated in TA2 and TA3 based on the $t_F$ -limits in TL2 and TL3.	•	•	•				
15	Return flow temperature tariff	Energy is accumulated in TA2 and TA3 based on the $t_R$ -limits in TL2 and TL3.	•	•	•				
19	Time-controlled tariff	TL2=Starting time for TA2 TL3=Starting time for TA3	•	•	•				
20	Heat/cooling volume tariff (TL2 and TL3 are not used)	Volume (V1) is split up into TA2 for heat ( $T1>T2$ ) and TA3 for cooling ( $T1<T2$ ) (Recommended on Heating/Cooling applications)				•	•	•	
21	PQ tariff	Energy at $P>TL2$ is stored in TA2 and energy at $Q>TL3$ is stored in TA3	•	•	•				

Please note that only tariff No. 20 can be used in a combined heat / cooling meter. All other tariffs may only be used for either a heat meter or a cooling meter. The meter can not distinguish heat energy (E1) from cooling energy (E3) and vice versa.

See paragraph 6.12 for further details on the tariff registers.

### 3.6 >FF< Input A (VA) - pulse divider, >GG< Input B (VB) - pulse divider

MULTICAL® 602 has 2 extra pulse inputs, VA and VB, that are placed on the base modules (see paragraph 7.3 for further information). The inputs are configured via the FF and the GG codes as shown in below diagram.

By default the inputs are configured to FF = 24 and GG = 24, unless otherwise informed by the customer.

Input A Terminal 65-66		Input B Terminal 67-68		Pre-counter	Wh/pulses	l/pulse	Measuring unit and decimal point	
FF	Max. input f ≤1Hz	GG	Max. input f ≤1 Hz					
Pulse input with bounce damping (for meters with Reed-switch):								
01	100 m³/h	01	100 m³/h	1	-	100	vol A/vol b (m³)	000000.0
02	50 m³/h	02	50 m³/h	2	-	50	vol A/vol b (m³)	000000.0
03	25 m³/h	03	25 m³/h	4	-	25	vol A/vol b (m³)	000000.0
04	10 m³/h	04	10 m³/h	10	-	10	vol A/vol b (m³)	000000.0
05	5 m³/h	05	5 m³/h	20	-	5.0	vol A/vol b (m³)	000000.0
06	2.5 m³/h	06	2.5 m³/h	40	-	2.5	vol A/vol b (m³)	000000.0
07	1 m³/h	07	1 m³/h	100	-	1.0	vol A/vol b (m³)	000000.0
24	10 m³/h	24	10 m³/h	2	-	10	vol A/vol b (m³)	00000.00
25	5 m³/h	25	5 m³/h	4	-	5.0	vol A/vol b (m³)	00000.00
26	2.5 m³/h	26	2.5 m³/h	10	-	2.5	vol A/vol b (m³)	00000.00
27	1 m³/h	27	1 m³/h	10	-	1.0	vol A/vol b (m³)	00000.00
40	1000 m³/h	40	1000 m³/h	1	-	1000	vol A/vol b (m³)	0000000
Pulse input without bounce damping (for meters with electronic pulse output):								
71	100 m³/h	71	100 m³/h	1	-	100	vol A/vol b (m³)	000000.0
72	50 m³/h	72	50 m³/h	2	-	50	vol A/vol b (m³)	000000.0
73	25 m³/h	73	25 m³/h	4	-	25	vol A/vol b (m³)	000000.0
74	10 m³/h	74	10 m³/h	10	-	10	vol A/vol b (m³)	000000.0
75	5 m³/h	75	5 m³/h	20	-	5.0	vol A/vol b (m³)	000000.0
76	2.5 m³/h	76	2.5 m³/h	40	-	2.5	vol A/vol b (m³)	000000.0
77	1 m³/h	77	1 m³/h	100	-	1.0	vol A/vol b (m³)	000000.0
84	10 m³/h	84	10 m³/h	1	-	10	vol A/vol b (m³)	00000.00
85	5 m³/h	85	5 m³/h	2	-	5.0	vol A/vol b (m³)	00000.00
86	2.5 m³/h	86	2.5 m³/h	4	-	2.5	vol A/vol b (m³)	00000.00
87	1 m³/h	87	1 m³/h	10	-	1.0	vol A/vol b (m³)	00000.00
90	1000 m³/h	90	1000 m³/h	1	-	1000	vol A/vol b (m³)	0000000
FF	Max. Input f ≤ 3 Hz	GG	Max. Input f ≤ 3 Hz	Pre-counter	Wh/pulses	l/pulses	Measuring unit and decimal point	
50	2500 kW	50	2500 kW	1	1000	-	EL A/EL b (kWh)	0000000
51	150 kW	51	150 kW	60	16.67	-	EL A/EL b (kWh)	0000000
52	120 kW	52	120 kW	75	13.33	-	EL A/EL b (kWh)	0000000
53	75 kW	53	75 kW	120	8.333	-	EL A/EL b (kWh)	0000000
54	30 kW	54	30 kW	240	4.167	-	EL A/EL b (kWh)	0000000
55	25 kW	55	25 kW	340	2.941	-	EL A/EL b (kWh)	0000000
56	20 kW	56	20 kW	480	2.083	-	EL A/EL b (kWh)	0000000
57	15 kW	57	15 kW	600	1.667	-	EL A/EL b (kWh)	0000000
58	7,5 kW	58	7,5 kW	1000	1.000	-	EL A/EL b (kWh)	0000000
59	750 kW	59	750 kW	10	100	-	EL A/EL b (kWh)	0000000
60	1250 kW	60	1250 kW	2	500	-	EL A/EL b (kWh)	0000000
61	75 kW	61	75 kW	100	10.00	-	EL A/EL b (kWh)	0000000
62	15 kW	62	15 kW	500	2.000	-	EL A/EL b (kWh)	0000000
70	25000 kW	70	25000 kW	1	10000	-	EL A/EL b (MWh)	00000.00

FF and GG are only used for configuration of inputs.

l/pulse can also be set via the front buttons. Please see 6.17 for further information.

### 3.7 Configuration of pulse outputs in the top module

See paragraph 10.1

### 3.8 »MN« Configuration of leak limits

When MULTICAL® 602 is used for leakage surveillance, the sensitivity is "M-N" in connection with configuration.

District heat leakage search (V1-V2)		Cold-water leakage search (VA)	
M=	Sensitivity in leakage search	N=	Constant leakage at no consumption (pulse resolution 10 l/pulses)
0	OFF	0	OFF
1	1.0% qp + 20% q	1	20 l/h 3x10 min. (½ hour without pulses)
2	1.0% qp + 10% q	2	10 l/h 6x10 min. (1 hour without pulses)
3	0.5% qp + 20% q	3	5 l/h 12x10 min. (2 hours without pulses)
4	0.5% qp + 10% q		

**NB:** M=2 and N=2 are default values when leakage surveillance is used. Higher degree of sensitivity, e.g. M=4 can only be obtained by means of METERTOOL.

Info codes for leakage/bursting (info 256/512) are only active when M > 0 or N > 0.

#### 3.8.1 Example of District Heat Leakage level (Leak level)

In this example M=2. Having a qp=0.6 m³/h flowmeter, qp must be converted to l/h: qp=600 l/h.

If we assume that there has been a means flow of 50 l/h then there will be counted approximately 1200 l/day. 10% of this value is 120 l/day. Further, 1% of qp=600 l/h is 6 l/h equivalent to 24 x 6 l/h = 144 l/day. Leak level in this case will be 120 + 144 = 264 l/day or equivalent of 6 l/h.

### 3.9 »T« Configuration of encryption level

MULTICAL® 602 is available without or with encryption of the data transmission. If encryption of data is selected, 128 bit AES counter mode encryption is applied. The encryption level cannot be changed after production.

Encryption level	
T=	
0	No encryption
1	Reserved for future use
2	Reserved for future use
3	Encryption with separately forwarded key (individual key)
4	Reserved for future use

#### T=0

Default value. Data has not been encrypted.

#### T=3

The meter can only be read if the reading system recognizes the individual meter's encryption key. The encryption key is forwarded to the customer and "matched" with the individual meter's serial number in the reading system.

If the encryption key is lost, the meter cannot be read. A new encryption key must be supplied by Kamstrup.

Only encrypted data via the base modules can be read by Wireless M-Bus.

### 3.10 Data for configuration

	Automatic	To be stated when ordering	Default
Serial no. (S/N) and year	E.g. 65.000.000/2012	-	-
Customer number	-	Up to 16 digits.	Customer number = S/N
Display No. 1 = 8 digits MSD		Limited to 11 digits regarding PcBase compatibility	
Display No. 2 = 8 digits LSD			
Target date	-	MM=1-12 and DD=1-28	Depending on country code
TL2	-	5 digits	0
TL3	-	5 digits	0
Max./min. average peak time	-	1...1440 min.	60 min.
H/C change over ( $\theta_{hc}$ )	-	0.01...180.00°C	25°C at DDD=5xx and 6xx
T2 prog.		0.01...180°C	-
T3 prog.		0.01...180°C	5°C
T4 prog.		0.01...180°C	0°C
Date/time	YYYY.MM.DD/hh.mm.ss GMT+offset according to country code	GMT ± 12.0 hours (0.5 hour in jumps)	-

#### Data registers for configuration of top/base modules

qp [l/h]	from CCC table	-	-
Valve traction time	-	20...500 sec.	300 sec.
hysteresis	-	0.5...5 sec.	0.5 sec.
Telephone number #1	-	Max. 16 (0-9+P)	-
Telephone number #2	-	Max. 15 (0-9+P)	-
Telephone number #3	-	Max. 15 (0-9+P)	-
Primary Data Address			
Secondary Data Address			
Baud-rate			
Reserved			
Reserved			
Reserved			
.....			
Reserved			

Reserved: These registers are prepared for later extensions of the functionality of the modules and therefore, they have not yet any concrete designations.

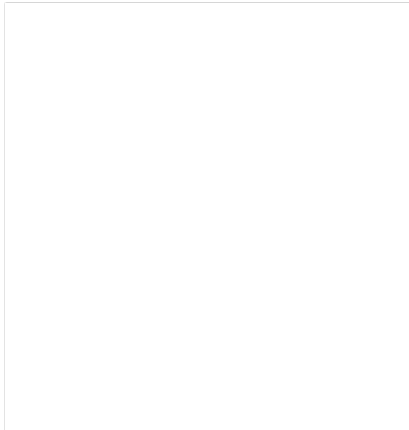
#### - COUNTRY CODES

For information on country codes see 55 14-414.

#### - MAINTENANCE

See instruction no. 55 08-781 concerning updating of programming, configuration and country codes.

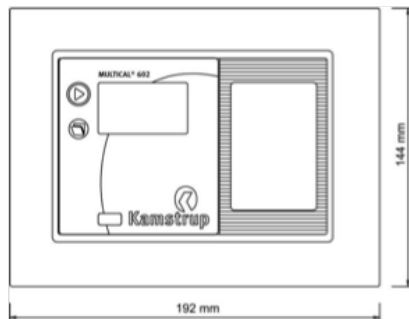
## 4 Dimentional sketches



MULTICAL® 602's front dimensions

Wall-mounted MULTICAL® 602 seen from the side

Panel-mounted MULTICAL® 602 seen from the side



Panel-mounted MULTICAL® 602 seen from the front

## 5 Installation

### 5.1 Flow pipe and return pipe placing

Prog. number

A

MULTICAL® 602 is programmed for flow sensor placing in either flow or return pipe. Below diagram shows the installation conditions for:

- ◆ Heat meters
- ◆ Cooling meters
- ◆ Heat/cooling meters

## 5.2 EMC conditions

MULTICAL® 602 is designed and CE marked in accordance with EN 1434 Class A and Class C (corresponding to Electromagnetic environment: Class E1 and E2 in the Measuring Instruments Directive) and can therefore be installed in domestic and industrial environments.

All control cables must be installed separately and not in parallel with e.g. power cables or other cables with the risk of induction of electromagnetic interferences. Control cables are laid at a min. distance of 25 cm from other installations.

## 5.3 Climatic conditions

MULTICAL® 602 is designed for indoor installation in noncondensing environments with ambient temperatures from 5...55°C, however, max. 30°C for optimal battery lifetime.

Protection class IP54 allows periodic splashes of water, but the apparatus cannot stand constant moisture and flooding.

## 5.4 Electric installations

See paragraph 9.



## 6 Calculator functions

### 6.1 Energy calculation

MULTICAL® 602 calculates energy based on the formula in EN 1434-1:2007 in which the international temperature scale from 1990 (ITS-90) and the pressure definition of 16 bar is used.

The energy calculation can in a simplified way be expressed as:  $\text{Energy} = V \times \Delta\Theta \times k$ .

The calculator always calculates energy in [Wh], and then it is converted into the selected measuring unit.

E [Wh] =	$V \times \Delta\Theta \times k \times 1000$
E [kWh] =	$E [\text{Wh}] / 1,000$
E [MWh] =	$E [\text{Wh}] / 1,000,000$
E [GJ] =	$E [\text{Wh}] / 277,780$
E [Gcal] =	$E [\text{Wh}] / 1,163,100$

**V** is the supplied (or simulated) water volume in m<sup>3</sup>. E.g. if a CCC code = 119 is used, the calculator will be programmed to receive 100 pulses/liter. E.g. if 10,000 pulses are added this corresponds to 10,000/100 = 100 liters or 0.1 m<sup>3</sup>.

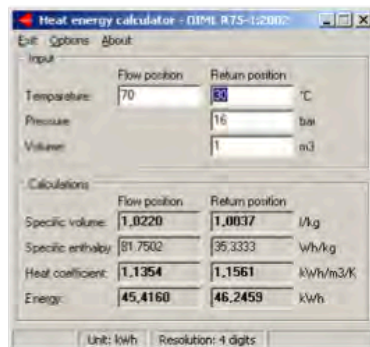
**ΔΘ** is the temperature difference measured, e.g.  $\Delta\Theta = \text{flow temperature} - \text{return flow temperature}$ . Please note, that various temperatures are used to calculate  $\Delta\Theta$  as MULTICAL® 602 calculates various different energy types. Both in the display and during data reading each energy type is uniquely defined, e.g.:

Heat energy:  $E1 = V1(T1-T2)k$

Cooling energy:  $E3 = V1 (T2-T1)k$



**k** is the thermal coefficient of water which is calculated on the basis of formula in EN 1434-1:2007 (identical with the energy formula in OIML R75-1:2002). For control calculations Kamstrup can supply an energy calculator (available on intranet):



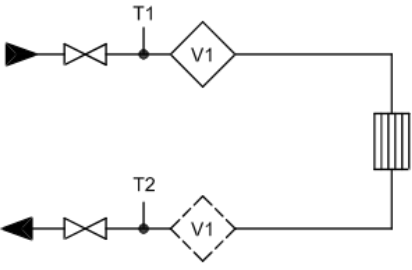
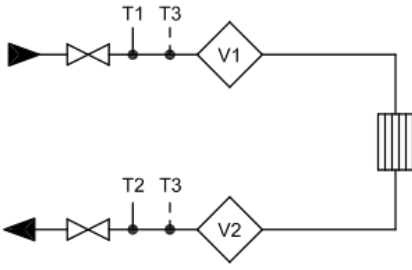
## 6.2 Application types

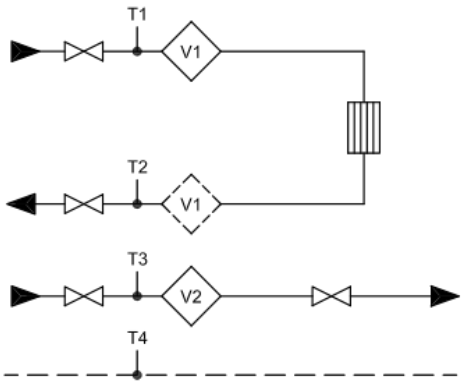
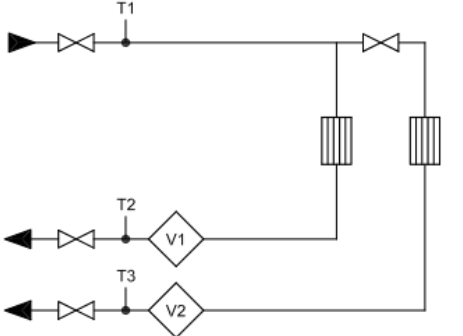
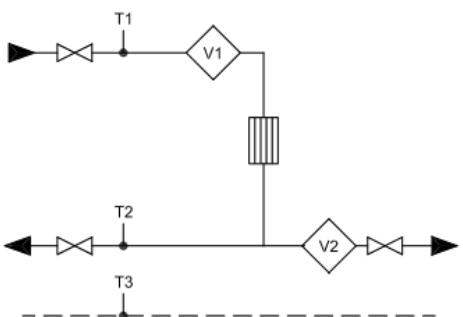
MULTICAL® 602 operates with 9 different energy formulas, E1...E9, that are all calculated in parallel with each integration no matter how the meter is configured.

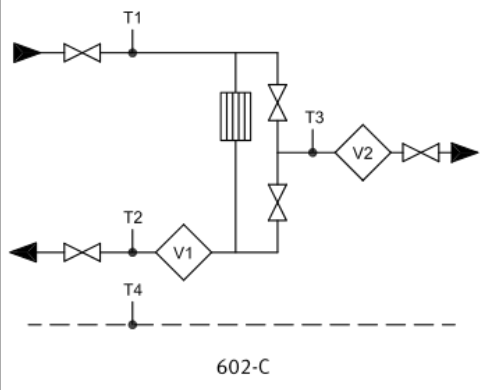
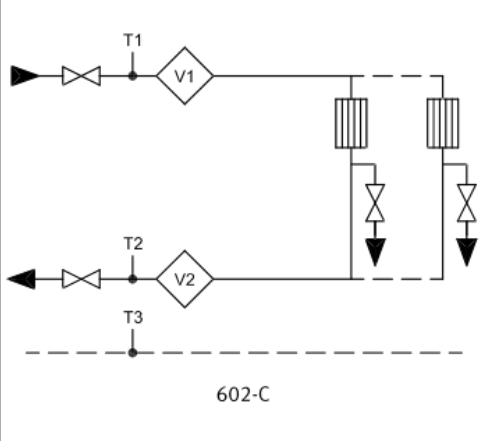
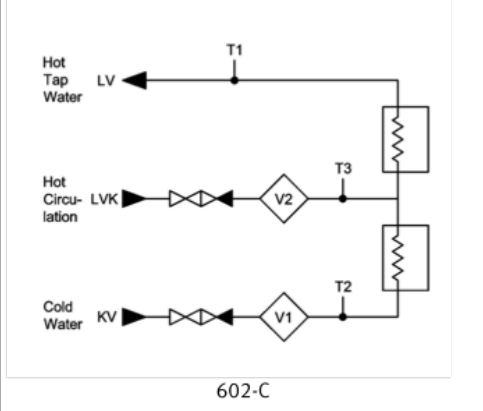
Formula	$\Delta\Theta$	Example of an application	Included in Application No.	Register type
$E1 = V1(T1 - T2)k_{T1: \text{Flow} / T2: \text{Return}}$	T1 T2	Heat energy (V1 in flow or return flow)	1+2+3+4+5+6+8+10	Legal Display/Data/Log
$E2 = V2(T1 - T2)k_{T2: \text{Return}}$	T1 T2	Heat energy (V2 in return flow)	2+7	Display/Data/Log
$E3 = V1(T2 - T1)k_{T2: \text{Flow} / T1: \text{Return}}$	T2 T1	Cooling energy (V1 in flow or return flow)	1+11	Legal Display/Data/Log
$E4 = V1(T1 - T3)k_{T1: \text{Flow}}$	T1 T3	Flow energy	7+9+11	Display/Data/Log
$E5 = V2(T2 - T3)k_{T2: \text{Flow}}$	T2 T3	Return energy or tap from return flow	5+7+9	Display/Data/Log
$E6 = V2(T3 - T4)k_{T3: \text{Flow}}$	T3 T4	Tap water energy, separate	3+6	Display/Data/Log
$E7 = V2(T1 - T3)k_{T3: \text{Return}}$	T1 T3	Return energy or tap from flow	4+8	Display/Data/Log
$E8 = m^3 \times T1$	-	Average temperature in flow	See paragraph 6.2.2	Display/Data/Log
$E9 = m^3 \times T2$	-	Average temperature in return		Display/Data/Log

### 6.2.1 E1...E7

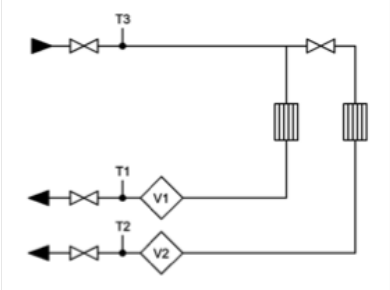
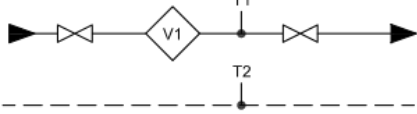
The energy types E1...E7 are described with application examples below.

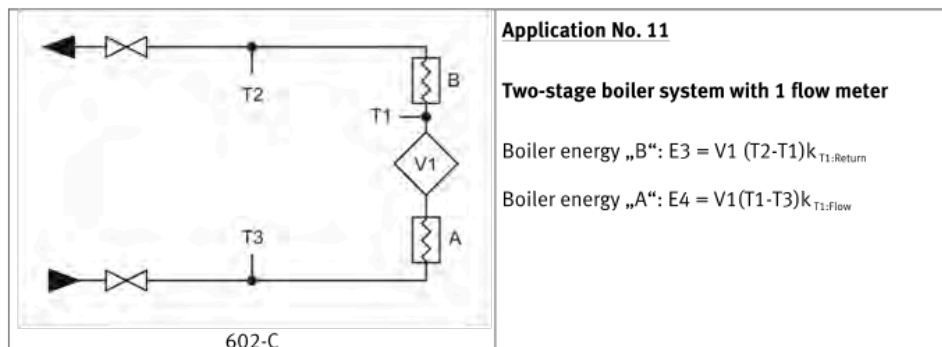
 <p>602-A/B/C/D</p>	<p><b>Application No. 1</b></p> <p><b>Closed thermal system with 1 flow sensor</b></p> <p>Heat energy: <math>E1 = V1(T1 - T2)k_{T1: \text{Flow} \text{ or } T2: \text{Return}}</math></p> <p>Cooling energy: <math>E3 = V1(T2 - T1)k_{T2: \text{Flow} \text{ or } T1: \text{Return}}</math></p> <p>Flow sensor V1 is placed in flow or return pipe as chosen under PROG options.</p> <p>Mass: <math>M1 = V1(K_{\text{mass } t1})</math> or Mass: <math>M1 = V1(K_{\text{mass } t2})</math> depending on the Flow/Return programming</p>
 <p>602-C</p>	<p><b>Application No. 2</b></p> <p><b>Closed thermal system with 2 identical flow sensors</b></p> <p>Billing energy: <math>E1 = V1(T1 - T2)k_{T1: \text{Flow}}</math></p> <p>Control energy: <math>E2 = V2(T1 - T2)k_{T2: \text{Return}}</math></p> <p>T3 can be used for control measurement of either the flow or return temperature, but T3 is not included in calculations.</p> <p>Mass: <math>M1 = V1(K_{\text{mass } t1})</math> Mass: <math>M2 = V2(K_{\text{mass } t2})</math></p>

 <p style="text-align: center;">602-C</p>	<p><b>Application No. 3</b></p> <p><b>2 string system with 2 flow sensors</b></p> <p>Heat energy: <math>E1 = V1(T1-T2)k_{T1:Flow \text{ or } T2:Return}</math></p> <p>Tap water energy: <math>E6 = V2(T3-T4)k_{T3:Flow}</math></p> <p>T3 is measured or programmed T4 is programmed</p> <p>Flow sensor V1 is placed in flow or return pipe as chosen under PROG options.</p> <p>Mass: <math>M1 = V1(K_{mass} t1)</math> or Mass: <math>M1 = V1(K_{mass} t2)</math> depending on the Flow/Return programming Mass: <math>M2 = V2(K_{mass} t3)^*</math></p>
 <p style="text-align: center;">602-C</p>	<p><b>Application No. 4</b></p> <p><b>2 heat circuits with joint flow</b></p> <p>Heat energy #1: <math>E1 = V1(T1-T2)k_{T2:Return}</math></p> <p>Heat energy #2: <math>E7 = V2(T1-T3)k_{T3:Return}</math></p> <p>T3 is measured or programmed Mass: <math>M1 = V1(K_{mass} t2)</math> Mass: <math>M2 = V2(K_{mass} t3)^*</math></p>
 <p style="text-align: center;">602-C</p>	<p><b>Application No. 5</b></p> <p><b>Open system with tap from return flow</b></p> <p>Heat energy: <math>E1 = V1(T1-T2)k_{T1:Flow}</math></p> <p>Tap water energy: <math>E5 = V2(T2-T3)k_{T2:Flow}</math></p> <p>T3 is measured or programmed.</p> <p>Mass: <math>M1 = V1(K_{mass} t1)</math> Mass: <math>M2 = V2(K_{mass} t2)</math></p>

	<p><b>Application No. 6</b></p> <p><b>Open system with separate flow sensor for tap water</b></p> <p>Heat energy: <math>E1 = V1 (T1 - T2) k_{T2:Return}</math></p> <p>Tap water energy: <math>E6 = V2 (T3 - T4) k_{T3:Flow}</math></p> <p>T3 is measured or programmed T4 is programmed</p> <p>Mass: <math>M1 = V1 (K_{mass} t2)</math> Mass: <math>M2 = V2 (K_{mass} t3)^*</math></p>
	<p><b>Application No. 7</b></p> <p><b>Open system with 2 flow sensors</b></p> <p>Flow energy: <math>E4 = V1 (T1 - T3) k_{T1:Flow}</math></p> <p>Return energy: <math>E5 = V2 (T2 - T3) k_{T2:Flow}</math></p> <p>(<math>\Delta E = E4 - E5</math> can be calculated by the topmodule, but only if the 2 flow sensors are identical)</p> <p>Heat energy: <math>E2 = V2 (T1 - T2) k_{T2:Return}</math></p> <p>T3 is measured or programmed.</p> <p>Mass: <math>M1 = V1 (K_{mass} t1)</math> Mass: <math>M2 = V2 (K_{mass} t2)</math></p>
	<p><b>Application No. 8</b></p> <p><b>Hot-water boiler with circulation</b></p> <p>Total consumption: <math>E1 = V1 (T1 - T2) k_{T2:Return}</math></p> <p>Circulated consumption: <math>E7 = V2 (T1 - T3) k_{T3:Return}</math></p>

\*  $M2 = V2 (K_{mass} t3)^*$  only on selected country codes (930...939)!

 <p>602-C</p>	<p><b>Application No. 9</b></p> <p><b>2 cooling circuits with joint flow</b></p> <p>Cooling energy #1: <math>E_4 = V_1(T_1 - T_3)k_{T1:Flow}</math></p> <p>Cooling energy #2: <math>E_5 = V_2(T_2 - T_3)k_{T2:Flow}</math></p>
 <p>602-C</p>	<p><b>Application No. 10</b></p> <p><b>Hot tap water energy: <math>E_1 = V_1 (T_1 - T_2)K_{T1:Flow}</math></b></p> <p>T1 is measured with a 2-wire sensor (602-C) or with a 4-wire sensor (602-B/D)</p> <p>T2 is either measured with a 2-wire sensor ( -C) or with a 4-wire sensor ( -B/D)</p> <p>Or</p> <p>T2 is programmed with a fixed temperature value</p> <p>Or</p> <p>T2 is programmed via the scheduler and hourly datalogger top module, type 602-0A. The temperature T2 will then follow a schedule where T2 changes up to 12 times per year.</p>



### 6.2.2 E8 and E9

E8 and E9 are used as calculation basis for calculating volume based average temperatures in flow and return pipe, respectively. For each integration (every 0.01 m³ for qp 1.5 m³/h) the registers are accumulated with the product of m³×°C, for such purposes E8 and E9 is a suitable basis for calculating volume based average temperatures.

E8 and E9 can be used for average calculation in any period of time as long as the volume register is read at the same time as E8 and E9.

**E8** = m³ × t<sub>f</sub> E8 is accumulated with the product of m³ × t<sub>f</sub>

**E9** = m³ × t<sub>r</sub> E9 is accumulated with the product of m³ × t<sub>r</sub>



### Resolution on E8 and E9

E8 and E9 are depending on the volume resolution (m)

Volume resolution	E8 and E9 resolution
0000.001 m³	m³ × °C × 10
00000.01 m³	m³ × °C
000000.1 m³	m³ × °C × 0.1
0000001 m³	m³ × °C × 0.01

**Example 1:** After 1 year a heat installation has consumed 250.00 m³ of district heating water and the average temperatures have been 95°C in flow and 45°C in return pipe.  
E8 = 23750 and E9 = 11250.

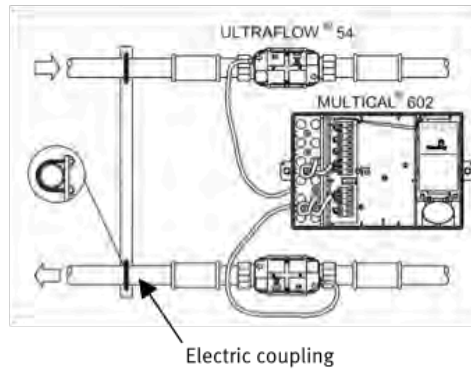
**Example 2:** It is required that the average temperatures are measured at the same time as the yearly reading, and therefore E8 and E9 are included in the yearly reading.

Reading date	Volume	E8	Average flow	E9	Average return flow
2003.06.01	534.26 m³	48236		18654	
2002.06.01	236.87 m³	20123		7651	
Yearly consumption	297.39 m³	28113	28113/297.39 = 94.53°C	11003	11003/297.39 = 36.99°C

Table 1

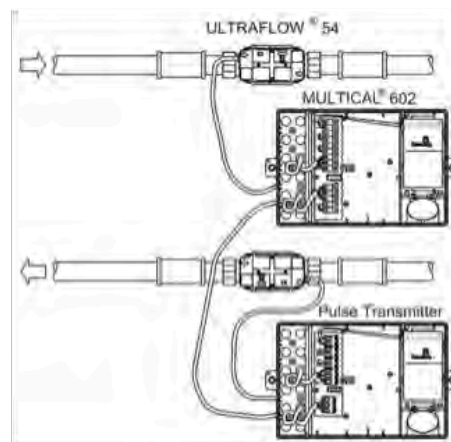
### 6.3 Calculator with two flow sensors

MULTICAL® 602 can be used in various applications with two flow sensors, e.g. leak surveillance or open systems. When two ULTRAFLOW® are direct connected to one MULTICAL® 602, a close electric coupling between the two pipes ought to be carried out as a main rule. If the two pipes are installed in a heat exchanger, close to the flow sensors, however, the heat exchanger will provide the necessary electric coupling.



- Forward and return pipes are closely electrically coupled
- No welded joints occur

In installations where the electric coupling cannot be carried out, or where welding in the pipe system can occur, the cable from one ULTRAFLOW® must be routed through a Pulse Transmitter with galvanic separation before the cable enters MULTICAL® 602.



- Forward and return pipes are not necessarily closely coupled
- Electric welding<sup>1)</sup> can occur

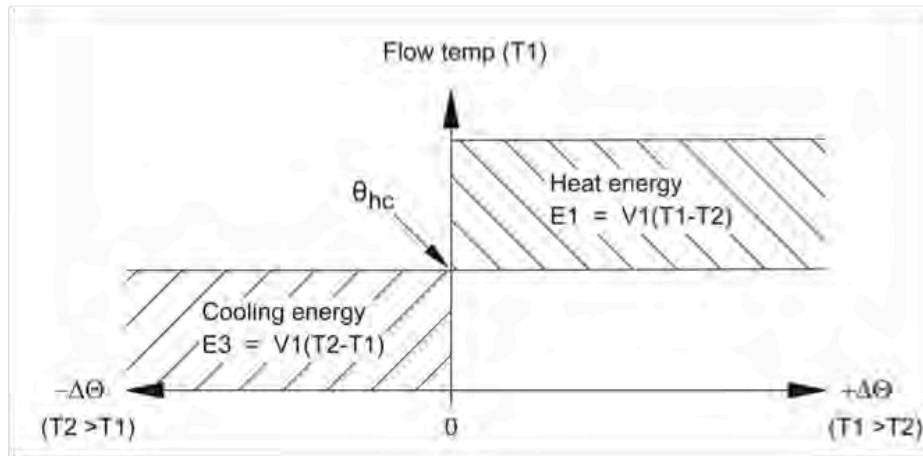
<sup>1)</sup> Electric welding must always be carried out with the earth pole closest to the welding point. Damage to meters due to welding is **not** comprised by our factory guarantee.

## 6.4 Combined heat/cooling metering

MULTICAL® 602 is available as e.g. heat meter (Meter type 2xx), cooling meter (Meter type 5xx) or combined heat/cooling meter (Meter type 6xx).

Meter type	
Heat meter with MID marking	2
Heat meter, closed systems	4
Cooling meter	5
Heat/cooling meter	6
Volume meter, hot water	7
Volume meter, cooling water	8
Energy meter, open systems	9
Delivery code (language on label etc.)	
	XX

If MULTICAL® 602 has been supplied as a combined heat/cooling meter (meter type 6xx), it measures heat energy (E1) at a positive temperature difference ( $T1 - T2$ ), whereas it measures cooling energy (E3) at a negative temperature difference ( $T2 - T1$ ). Temperature sensor T1 (with a red type sign) must be installed in the hydraulic forward pipe, whereas T2 (with a blue type sign) is installed in the return pipe.



If the current T1 exceeds, or equals  $\theta_{hc}$  only heat energy can be measured. If the current T1 is lower than or equals  $\theta_{hc}$  only cooling energy can be measured.

$\theta_{hc}$  is the temperature point used to change between heat and cooling measurement.  $\theta_{hc}$  is configurable in temperature range 0.01...180.00°C.

In combined heat/cooling meters  $\theta_{hc}$  should correspond to the highest occurring flow pipe temperature in connection with cooling, e.g. 25°C. If the meter is to be used for "purchase and sale of heat",  $\theta_{hc}$  is set at 200.00°C, which cancels the  $\theta_{hc}$  function.

The change between heat and cooling measurement involves no hysteresis ( $\Delta\theta_{hc} = 0.00K$ ).

$\theta_{hc}$  is configured by means of METERTOOL (see paragraph 13.2).  $\theta_{hc}$  is also mentioned as H/C change-over.



## 6.5 Flow measurement, V1 and V2

MULTICAL® 602 calculates current water flow according to two different principles depending on the connected flow sensor type:

### 6.5.1 Fast volume pulses (CCC > 100)

The current water flow for fast volume pulses is calculated, without average determination, as the number of volume pulses per 10 sec. multiplied by a scaling factor.

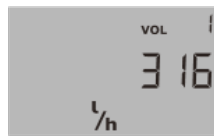
$$q = (\text{pulses}/10 \text{ sec.} \times \text{flow factor})/65535 \text{ [l/h] or [m}^3\text{/h]}$$

Example:

ULTRAFLOW® qp 1.5 m³/h with 100 pulses/l (CCC=119), flow factor = 235926

Current water flow = 317 l/h corresponding to 88 pulses/10 sec.

$$q = (88 \times 235926)/65535 = 316.8 \text{ which is shown in the display as } 316 \text{ [l/h]}$$



Current water flow in V1

### 6.5.2 Resolution of the actual flow rate (CCC > 100)

The display resolution of the actual flow rate can be derived from the flow factor and the number of decimals.

Example 1:

ULTRAFLOW® qp 1.5 m³/h with 100 pulses/l (CCC=119), flow factor = 235926

$$\text{Resolution} = 235926/65535 = 3.6 \text{ which is shown in the display as } 3 \text{ [l/h]}$$

Example 2:

FUS380 Qs 75 m³/h with 1 pulses/l (CCC=201), flow factor = 235926

$$\text{Resolution} = 235926/65535 = 3.6 \text{ which is shown in the display as } 3.6 \text{ [m}^3\text{/h]}$$

### 6.5.3 Slow volume pulses (CCC = 0XX)

The current water flow for slow volume pulses (typically from flow sensors with a Reed switch) is calculated without average determination as a scaling factor divided by the period of time between two volume pulses.

$$q = \text{flow factor}/(256 \times \text{period in sec.}) \text{ [l/h] or [m}^3\text{/h]}$$

Example:

Mechanical flow sensor Qn 15 qp m³/h with 25 l/pulse (CCC=021), flow factor = 230400

Current water flow = 2.5 m³/h corresponding to 36 sec. in the period of time between 2 pulses

$$q = 230400/(256 \times 36) = 25, \text{ which is shown in the display as } 2.5 \text{ [m}^3\text{/h]}$$

V1 and V2 must be the same type (either quick (CCC > 100) or slow (CCC = 0XX)) but can have different qp-codings (CCC).

Using top modules 67-02 or 67-09, V1 and V2 must have identical qp-codings (CCC).

The actual flow rate on the display will be shown a "0", when the period between pulses exceed 15 min.

## 6.6 Power measurement, V1

MULTICAL® 602 calculates the current power based on the current water flow and the temperature difference measured at the last integration based on following formula:

$$P = q (T1 - T2) \times k \text{ [kW] or [MW]}$$

where "k" is the water's heat coefficient that is constantly calculated by MULTICAL® 602 according to EN 1434:2007.

Example:

Current water flow,  $q = 316 \text{ l/h}$  and flow sensor is placed in return pipe

$T1 = 70.00^\circ\text{C}$  and  $T2 = 30.00^\circ\text{C}$ , k-factor is calculated for  $1.156 \text{ kWh/m}^3/\text{K}$

$$P = 0.316 (70-30) \times 1.156 = 14.6 \text{ [kW]}$$



Current power in V1

Both heat power and cooling power are shown numerically

## 6.7 Min. and max. flow and power, V1

MULTICAL® 602 registers both minimum and maximum flow and power both on a monthly and on a yearly basis. These values can be read in full via data communication. In addition, a small number of monthly and yearly registers can be read on the display depending on the selected DDD code.

Min. and Max. registration comprises following flow and power values including date.

Registration type:	Max. data	Min. data	Yearly data	Monthly data
Max. this year (since last target date)	•		•	
Max. yearly data, up to 15 years back	•		•	
Min. this year (since last target date)		•	•	
Min. yearly data, up to 15 years back		•	•	
Max. this month (since last target date)	•			•
Max. monthly data, up to 36 months back	•			•
Min. this month (since last target date)		•		•
Min. monthly data, up to 36 months back		•		•

All max. and min. values are calculated as largest and smallest average of a number of current flow or power measurements. The average period used for all calculations are selected in the interval 1...1440 min. in jumps in 1 min. (1440 min. = 1 full day).

The average period and target date are stated in connection with orders or re-configured by means of METERTOOL. Where nothing has been stated when the order was placed the average period is set at 60 min. and the target date is set at the standard applying for the country code used.

In connection with commencement of a new year or month the max. and min. values are stored in the data logger and the current max. and min. registers are "reset" according to the selected target date and the internal clock and calendar of the meter.

"Reset" is made by putting the max. value at zero and min. value at 10000.0 kW at e.g. CCC=119.

If the max. or min. registration is used for billing purposes, we recommend to supplement MULTICAL® 602 with a top module containing real time clock and battery back-up.

Date for year-to-date max.



Value for year-to-date max.



Date for min. in the current month



Value for min. in the current month



### 6.8 Temperature measurement

MULTICAL® 602 has a high resolution analog/digital converter that measures the temperatures T1, T2 and T3 with a resolution of 0.01°C (T3 is not available on meters with 4-wire sensor inputs). The same measuring circuit is used for all 3 temperature inputs to obtain the lowest possible measuring error on the temperature difference. Prior to each temperature measurement an automatic adjustment of the internal measuring circuit is made on the basis of integral reference resistances at 0°C and 100°C, respectively. This ensures a very good accuracy and a very stable long-term operation.



Current T1

Temperature measurings are made in connection with each integration (energy calculation) and every 10 sec. when the display shows temperature. The measuring circuit has a temperature range of 0.00°C...185.00°C. In case of a disconnected temperature sensor the display shows 200.00°C and in connection with a short-circuited temperature sensor it shows 0.00°C. In both cases the info code for sensor error will appear.

To reduce the influence from the mains frequency which can e.g. be inducted to long sensor cables, double measurings are made with a delay of ½ period, and the average of the 2 measurings make up the temperature measurement used for calculation and display. Supressing of the mains frequency is optimised to either 50 Hz or 60 Hz depending on the selected country code.

#### 6.8.1 Measuring current and power

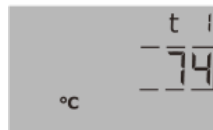
Measuring current is only sent through the temperature sensors in the short period of time it takes to measure the temperature. However, the effective power that is consumed in the sensor elements is minimal and the influence on the self-heating of the temperature sensors is typically less than 1/1000 K.

	Pt100	Pt500
Testing current	< 3 mA	< 0.5 mA
Peak power	< 1.5 mW	< 0.2 mW
RMS power	< 10 µW	< 1 µW

### 6.8.2 Average temperatures

MULTICAL® 602 constantly calculates the average temperatures for flow and return (T1 and T2) in the entire °C range and the background calculations E8 and E9 ( $m^3 \times T1$  and  $m^3 \times T2$ ) are made for each energy calculation (e.g. for each  $0.01 m^3$  for qp 1.5 meter size), whereas the display value is updated every day. Thereby the average calculations are weighted according to volume and can therefore be used for control purposes.

Registration type:	Average	Yearly data	Monthly data
Year-to-date average (since last target date)	•	•	
Month-to-date average (since last target date)	•		•



Year-to-date average for T1.

(Current date with "comma lines" under year or month is shown just BEFORE this reading)

### 6.8.3 Programmed temperatures

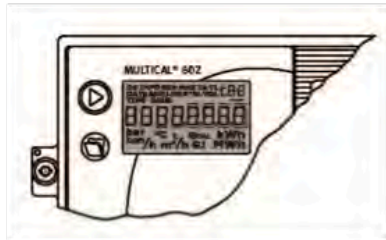
The temperatures T3 and T4 can be programmed in the memory of the calculator, and these temperatures can be used for calculating energy with fixed temperature reference, as used in connection with the calculations of the energy types E4, E5, E6 and E7 (see the application drawings in paragraph 6.2)

The temperatures can be programmed when placing orders or by means of METERTOOL in the range  $0.01...180^{\circ}\text{C}$ , once the meter is installed.

## 6.9 Display functions

MULTICAL® 602 is equipped with a clear LC display including 8 digits, units of measurement and information panel. In connection with energy and volume readings 7 digits and the corresponding units of measurement are used, whereas 8 digits are used when e.g. a meter number is shown.

As a starting point the display shows the accumulated energy. When the push buttons are activated the display reacts immediately by showing other readings. The display automatically returns to energy reading 4 minutes after last activation of the push buttons.



### 6.9.1 Primary and secondary readings

The upper button is used to switch between the primary readings of which the consumers typically use the first primary readings in connection with self-reading for billing purposes.

The lower push button is used to show secondary information on the primary reading that has been selected.

Example: When the primary reading selected is "Heat energy" the secondary readings will be yearly data and monthly data for heat energy.



Heat energy E1 in MWh



Yearly data, date for LOG 1 (last yearly reading)



Yearly data, value for LOG 1 (last yearly reading)



Monthly data, date for LOG 1 (last monthly reading)

### 6.9.2 Display structure

Below diagram shows the display structure with up to 20 primary readings and a number of secondary readings under most primary readings. The number of secondary readings for yearly data and monthly data has been laid down under the DDD code. If nothing is informed in connection with placing the order, the reading is set at 2 yearly data and 12 monthly data. The target date is set at the standard valid for the country code used.

As the display is configured according to the needs of the customer (by selecting DDD code), the display will usually contain fewer readings than shown below.

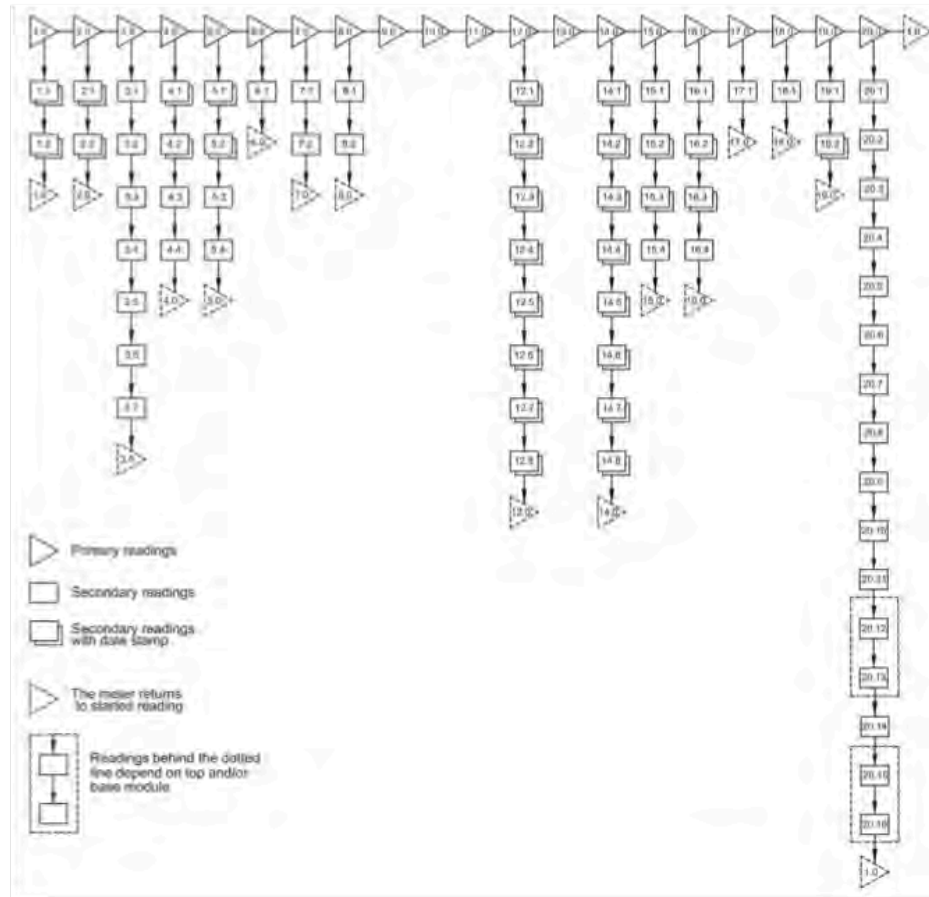




Figure 2

### 6.9.3 Display grouping

MULTICAL® 602 can be configured for a number of various applications, which creates the need for various display groupings. In the overview below the possible readings [•] will appear for heat meter, cooling meter etc., which readings are supported by date stamps, and which reading is automatically shown 4 min. after last activation of the push buttons [1•]. (This chapter applies to design of DDD-codes only).

						Date stamp	Heat meter DDD=2xx/4xx	Cooling meter DDD=5xx	Heat/cooling DDD=6xx	Heat volume DDD=7xx	Cold volume DDD=8xx	Energy Meter DDD=9xx
1.0	Heat energy (E1)						1 •		1 •			1 •
		1.1	Yearly data	•	•		•		•			•
		1.2	Monthly data	•	•		•		•			•
2.0	Cooling energy (E3)							1 •				•
		2.1	Yearly data	•			•	•				•
		2.2	Monthly data	•			•	•				•
3.X	Other energy types	3.1	E2									•
		3.2	E4									•
		3.3	E5									•
		3.4	E6									•
		3.5	E7									•
		3.6	E8 (m3*tf)		•							•
		3.7	E9 (m3*tr)		•							•
4.0	Volume V1						•	•	•	1 •	1 •	•
		4.1	Yearly data	•	•	•	•	•	•	•	•	•
		4.2	Monthly data	•	•	•	•	•	•	•	•	•
		4.3	Mass 1		•	•	•	•	•	•	•	•
		4.4	P1		•	•	•	•	•	•	•	•
5.0	Volume V2									•	•	•
		5.1	Yearly data	•						•	•	•
		5.2	Monthly data	•						•	•	•
		5.3	Mass 2							•	•	•
		5.4	P2							•	•	•
6.0	Hour counter						•	•	•	•	•	•
		6.1	Error hour counter (N° 60)				•	•	•	•	•	•
7.0	T1 (Flow)						•	•	•			•
		7.1	Year-to-date average				•	•	•			•
		7.2	Month-to-date average				•	•	•			•
8.0	T2 (Return flow)						•	•	•			•
		8.1	Year-to-date average				•	•	•			•
		8.2	Month-to-date average				•	•	•			•
9.0	T1-T2 (Δt) - = cooling						•	•	•			•
10.0	T3						•	•	•			•
11.0	T4 (programmed)											•
12.0	Flow (V1)						•	•	•	•	•	•
		12.1	Max. this year	•	•	•	•	•	•	•	•	•
		12.2	Max. yearly data	•	•	•	•	•	•	•	•	•
		12.3	Min. this year	•	•	•	•	•	•	•	•	•
		12.4	Min. yearly data	•	•	•	•	•	•	•	•	•
		12.5	Max. this month	•	•	•	•	•	•	•	•	•
		12.6	Max. monthly data	•	•	•	•	•	•	•	•	•
		12.7	Min. this month	•	•	•	•	•	•	•	•	•
		12.8	Min. monthly data	•	•	•	•	•	•	•	•	•
13.0	Flow (V2)						•			•	•	•
14.0	Power (V1)						•	•	•			•
		14.1	Max. this year	•	•	•	•	•	•			•
		14.2	Max. yearly data	•	•	•	•	•	•			•
		14.3	Min. this year	•	•	•	•	•	•			•
		14.4	Min. yearly data	•	•	•	•	•	•			•
		14.5	Max. this month	•	•	•	•	•	•			•
		14.6	Max. monthly data	•	•	•	•	•	•			•
		14.7	Min. this month	•	•	•	•	•	•			•
		14.8	Min. monthly data	•	•	•	•	•	•			•



				Date stamp	Heat meter DDD=2xx/4xx	Cooling meter DDD=5xx	Heat/cooling DDD=6xx	Heat volume DDD=7xx	Cold volume DDD=8xx	Energy meter DDD=9xx
15.0	VA (Input A)				*	*	*	*	*	*
		15.1	Meter no. VA		*	*	*	*	*	*
		15.2	Yearly data	*	*	*	*	*	*	*
		15.3	Monthly data	*	*	*	*	*	*	*
		15.4	L/imp for VA (N° 65)		*	*	*	*	*	*
16.0	VB (Input B)				*	*	*	*	*	*
		16.1	Meter no. VB		*	*	*	*	*	*
		16.2	Yearly data	*	*	*	*	*	*	*
		16.3	Monthly data	*	*	*	*	*	*	*
		16.4	L/imp for VB (N° 67)		*	*	*	*	*	*
17.0	TA2				*	*	*	*	*	*
		17.1	TL2		*	*	*	*	*	*
18.0	TA3				*	*	*	*	*	*
		18.1	TL3		*	*	*	*	*	*
19.0	Info code				*	*	*	*	*	*
		19.1	Info event counter		*	*	*	*	*	*
		19.2	Info logger (last 36 events)	*	*	*	*	*	*	*
20.0	Customer number (N° 1+2)				*	*	*	*	*	*
		20.1	Date		*	*	*	*	*	*
		20.2	Time		*	*	*	*	*	*
		20.3	Target date		*	*	*	*	*	*
		20.4	Serial no. (N° 3)		*	*	*	*	*	*
		20.5	Prog. (A-B-CCC-CCC) (N° 4)		*	*	*	*	*	*
		20.6	Config 1 (DDD-EE) (N° 5)		*	*	*	*	*	*
		20.7	Config 2 (FF-GG-M-N-T) (N° 6)		*	*	*	*	*	*
		20.8	Software edition (N° 10)		*	*	*	*	*	*
		20.9	Software check-sum (N° 11)		*	*	*	*	*	*
		20.10	Segment test		*	*	*	*	*	*
		20.11	Top module type (N° 20)		*	*	*	*	*	*
		20.12	Top module primary adr. (N° 21)		*	*	*	*	*	*
		20.13	Top module second. adr. (N° 22)		*	*	*	*	*	*
		20.14	Base module type (N° 30)		*	*	*	*	*	*
		20.15	Base module primary adr. (N° 31)		*	*	*	*	*	*
		20.16	Base module second. adr. (N° 32)		*	*	*	*	*	*



Display example showing the PROG number.

A complete survey of existing display codes (DDD) appears from a separate document. Please contact Kamstrup for further details.

## 6.10 Real Time Clock (RTC)

MULTICAL® 602 has built-in real time clock and battery backup. This is valuable for applications where correct date/time in data loggers as well as time-controlled tariffs are important. The battery will ensure the RTC function for at least 3 years without power during the entire lifetime of MULTICAL® 602. This small battery will only back-up the RTC, meaning that the display will go blank, when the main supply or main battery is off.

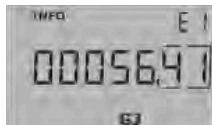
If a top module with RTC is mounted, the top module's RTC will not have any effect on the meter's own RTC.

## 6.11 Info codes

MULTICAL® 602 constantly surveys a number of important functions. Where serious errors have occurred in the measuring system or in the installation, a flashing "INFO" will appear in the display while the error exists. The "INFO" panel will flash for as long as the error exists no matter which reading is selected. The "INFO" panel will automatically turn off, when the source of error has been corrected.

### 6.11.1 Examples of info codes on the display

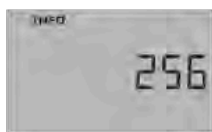
Ex. 1



#### Flashing "INFO"

If the info code exceeds 0 a flashing "INFO" will appear in the information panel.

Ex. 2



#### Current info code

When the upper (primary) push button is activated several times the current info code can be shown on the display.

Ex. 3



#### Info event counter

- indicates how many times the info code has been changed.

Ex. 4



#### Info logger

By pressing the lower push button once more the data logger for the info code is displayed.

First, the date of the first change is displayed ...



...then the info code appearing on that particular date is displayed. In this case there has been a "bursting alarm" on 4<sup>th</sup> January 2011.

The data logger stores the last 50 changes, of which the last 36 changes are shown in the display. All 50 changes can be read by means of LogView/ MT Pro.

Time, E1 (heat energy) and E3 (Cooling energy – if available) will be logged when the info code is changed. Naturally, the info code will still be logged during changed info codes. To read out Time and E1 together with the info code it is necessary to use LogView.

In addition, the info code is stored in the hourly logger, the daily logger, the monthly logger and the yearly logger for diagnostic purposes.

### 6.11.2 Types of info codes

Info code	Description	Response time
0	No irregularities	-
1	Supply voltage has been cut off	-
8	Temperature sensor T1 outside measuring range	1...10 min.
4	Temperature sensor T2 outside measuring range	1...10 min.
32	Temperature sensor T3 outside measuring range	1...10 min.
64	Leak in the cold-water system	1 day
256	Leak in the heating system	1 day
512	Burst in the heating system	120 sec.
<b>ULTRAFLOW® X4 info (if activated CCC=4XX)</b>		
16	Flow sensor V1, Datacomm error	After reset and 1 day (00:00)
1024	Flow sensor V2, Datacomm error	After reset and 1 day (00:00)
2048	Flow sensor V1, Wrong meter factor	After reset and 1 day (00:00)
128	Flow sensor V2, Wrong meter factor	After reset and 1 day (00:00)
4096	Flow sensor V1, Signal too low (Air)	After reset and 1 day (00:00)
8192	Flow sensor V2, Signal too low (Air)	After reset and 1 day (00:00)
16384	Flow sensor V1, Wrong flow direction	After reset and 1 day (00:00)
32768	Flow sensor V2, Wrong flow direction	After reset and 1 day (00:00)

Info code 1 will be logged when the mains supply/main battery is switched OFF and Info code 1 will be deleted when the mains supply/main battery is switched ON. Thereby the time without power can be retrieved from the logger data.

If several info codes appear at the same time the sum of the info codes is shown. E.g. if both temperature sensors are outside measuring range, info code 12 will appear.

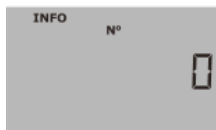
During configuration at the factory the individual info - active or passive - are set and in this way a standard heat meter not using T3, cannot display info code 32.

Info = 16-1024-2048-128-4096-8192-16384-32768 functions via data communication between MULTICAL® and ULTRAFLOW® 54. See paragraph 13.2.3, Info code setup, in order to change the settings.

### 6.11.3 Transport mode

When the meter leaves the factory it is in transport mode, and the info codes are only active on the display and not in the data logger. This prevents both "info event" to increment and the storage of non relevant data in the info logger. When the meter has summed up the volume register for the first time after installation the info code is automatically set at active.

#### 6.11.4 Info event counter



Info event counter

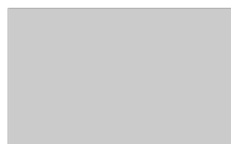
Counting takes place every time the info code is changed.

The info event counter will be 0 on receipt, as "transport mode" prevents counting during transport

Info code	"INFO" on display	Registration in the info, daily, monthly or yearly logger	Counting of info events
1	No	Yes	At each "Power-On-Reset"
4, 8, 32	Yes	Yes	When info 4, 8, 32 are set or removed. Max. 1 per measurement of temperature
64, 256	Yes	Yes	When info is set and when info is deleted. Max. 1 time/ day
512	Yes	Yes	When info is set and when info is deleted. Max. 1 time/ 120 sec.
16, 1024, 2048, 4096, 8192, 16384, 32768	Yes	Yes	When info is set and when info is deleted. Max. 1 time/ day

#### 6.11.5 Error hour counter

An error hour counter is added. This will sum up the approx. number of hours with info code > zero.



### 6.12 Tariff functions

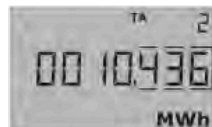
MULTICAL® 602 has 2 extra registers TA2 and TA3 to accumulate heat energy or cooling energy (EE=20 accumulates volume) in parallel to the main register based on a programmed tariff condition. No matter which tariff form is selected the tariff registers are indicated as TA2 and TA3 in the display.

The main register is always accumulated as it is considered a legal billing register, irrespective of the selected tariff function. The tariff conditions TL2 and TL3 are monitored before each integration. When the tariff conditions are fulfilled the consumed heat energy is counted in either TA2 or TA3, in parallel to the main register.

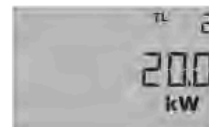
To each tariff function two tariff conditions, TL 2 and TL3 are connected, which are always used in the same tariff type. Therefore, it is not possible to "mix" two tariff types.

Example: EE=11 (Power tariff)

TA2 shows the consumed energy...



...over the power limit TL2 (but under TL3)



### 6.12.1 Tariff types

Below table indicates which tariff types MULTICAL® 602 can be configured to:

EE=	TARIFF TYPE	FUNCTION	Country code 2xx	Country code 4xx	Country code 5xx	Country code 6xx
00	No tariff active	No function				
11	Power tariff	Energy is accumulated in TA2 and TA3 based on the power limits in TL2 and TL3	•	•	•	
12	Flow tariff	Energy is accumulated in TA2 and TA3 based on the flow limits in TL2 and TL3	•	•	•	
13	Cooling tariff	Energy is accumulated in TA2 and TA3 based on the $\Delta t$ limits in TL2 and TL3	•	•	•	
14	Flow temperature tariff	Energy is accumulated in TA2 and TA3 based on the $t_f$ -limits in TL2 and TL3	•	•	•	
15	Return flow temperature tariff	Energy is accumulated in TA2 and TA3 based on the $t_R$ -limits in TL2 and TL3	•	•	•	
19	Time-controlled tariff	TL2=Starting time for TA2 TL3=Starting time for TA3	•	•	•	
20	Heat/cooling volume tariff (TL2 and TL3 are not used)	Volume (V1) is split up into TA2 for heat ( $T1 > T2$ ) and TA3 for cooling ( $T1 < T2$ ) (Recommended on Heating/Cooling applications)				•
21	PQ tariff	Energy at $P > TL2$ is stored in TA2 and energy at $Q > TL3$ is stored in TA3	•	•	•	

Please note that only tariff No. 20 can be used in a combined heat / cooling meter. All other tariffs can only be used with either a heat meter or a cooling meter. The meter cannot distinguish heat energy (E1) from cooling energy (E3) and vice versa.

#### EE=00 No tariff active

If the tariff function should not be used, select the set-up for EE=00.

However, the tariff function can be made active at a later date by a reconfiguring the function by means of METERTOOL for MULTICAL® 602. See paragraph 13 METERTOOL.

#### EE=11 Power controlled tariff

When the current power is higher than TL2, but lower than/equal to TL3, the energy is counted in TA2 in parallel to the main register. If the current power exceeds TL3, the energy is counted in TA3 in parallel to the main register.

$P \leq TL2$	Counting in main register only	TL3 > TL2
$TL3 \geq P > TL2$	Counting in TA2 and the main register	
$P > TL3$	Counting in TA3 and the main register	

When setting up data TL3 must always be higher than TL2. Among other things the power controlled tariff is used as a basis for calculating the individual consumer's connection costs. Furthermore, this tariff form can provide valuable statistical data when the energy supplier evaluates new installation activities.

**EE=12 Flow controlled tariff**

When the current water flow is higher than TL2 but lower than/equal to TL3, the energy is counted in TA2 in parallel to the main register. If the current water flow becomes higher than TL3, the energy is counted in TA3 in parallel to the main register. When setting up data, TL3 must always be higher than TL2.

$q \leq TL2$	Counting in main register only	TL3 > TL2
$TL3 \geq q > TL2$	Counting in TA2 and the main register	
$q > TL3$	Counting in TA3 and the main register	

Among other things the flow controlled tariff is used as a basis for calculating the individual consumer's connection costs. Furthermore, this tariff form provides valuable statistical data when the energy supplier evaluates new installation activities.

When the power or flow tariff is used it is possible to get a total overview of the total consumption compared to the part of the consumption, that is used above the tariff limits.

**EE=13 Differential temperature tariff ( $\Delta t$ )**

When the current T1-T2 ( $\Delta t$ ) is lower than TL2, but higher than TL3, the energy is counted in TA2 in parallel to the main register. If the current cooling drops to less than/equal to TL3, the energy is counted in TA3 in parallel to the main register.

$\Delta t \geq TL2$	Counting in main register only	TL3 < TL2
$TL3 < \Delta t < TL2$	Counting in TA2 and the main register	
$\Delta t \leq TL3$	Counting in TA3 and the main register	

When setting up tariff limits TL3 must always be lower than TL2.

The T1-T2 tariff can be used to form the basis for a weighted user payment. Low  $\Delta t$  (small difference between flow and return flow temperatures) is uneconomical for e.g. the heat supplier.

**EE=14 Flow temperature tariff**

When the current flow temperature (T1) is higher than TL2, but lower than/equal to TL3, the energy is counted in TA2 in parallel to the main register. If the current flow temperature becomes higher than TL3, the energy is counted in TA3 in parallel to the main register.

$T1 \leq TL2$	Counting in main register only	TL3 > TL2
$TL3 \geq T1 > TL2$	Counting in TA2 and the main register	
$T1 > TL3$	Counting in TA3 and the main register	

When setting up data TL3 must always be higher than TL2.

The flow temperature tariff can form the basis of billing of those customers who are guaranteed a given flow temperature. When the "guaranteed" minimum temperature set at TL3, the calculated consumption is accumulated in TA3.

**EE=15 Return temperature tariff**

When the current return temperature (T2) is higher than TL2 but lower than/equal to TL3, the energy is counted in TA2 in parallel to the main register. If the current return temperature becomes higher than TL3, the energy is counted in TA3 in parallel to the main register.

$T2 \leq TL2$	Counting in main register only	TL3 > TL2
$TL3 \geq T2 > TL2$	Counting in TA2 and the main register	
$T2 > TL3$	Counting in TA3 and the main register	

When setting up data TL3 must always be higher than TL2.

The return temperature tariff can form the basis of a weighted user payment. A high return flow temperature indicates insufficient heat utilization which is uneconomical for e.g. the heat supplier.

**EE=19 Time-controlled tariff**

The time-controlled tariff is used for time division of the heat consumption. If TL2 = 08:00 and TL3 = 16:00 the consumption of the entire day from 08:00 till 16:00 will be accumulated in TA2, whereas the consumption of the evening and the night from 16:01 till 07:59 will be accumulated in TA3.

TL2 must have a lower number of hours than TL3.

$TL3 \geq \text{Clock} \geq TL2$	Counting in TA2 and the main register	TL3 > TL2
$TL2 > \text{Clock} > TL3$	Counting in TA3 and the main register	

Among other things the time tariff is suitable for billing in housing sectors close to industrial sectors with a large consumption of district heating and for billing industrial customers.

**EE=20 Heat/cooling volume tariff**

The heat/cooling volume tariff is used for dividing volume into heat and cooling consumption. TA2 accumulates the volume consumed together with E1 (heat energy) and TA3 accumulates the volume consumed together with E3 (cooling energy).

$T1 \geq T2$	Volume is accumulated in TA2 and V1	TL2 and TL3 are not used
$T2 > T1$	Volume is accumulated in TA3 and V1	

In connection with combined heat/cooling measurement the total volume in the V1 register is accumulated, whereas the heat energy is accumulated in E1 and the cooling energy in E3. The heat/cooling tariff divides the consumed volume into heating and cooling volume.

EE=20 should always be selected together with combined heat/cooling meters, type 602-xxxxxxx-6xx.



**EE=21 PQ tariff**

The PQ tariff is a combined power and flow tariff. TA2 functions as a power tariff and TA3 as a flow tariff.

$P \leq TL2$ and $q \leq TL3$	Counting in the main register only	TL2 = power limit (P) TL3 = flow limit (q)
$P > TL2$	Counting in TA2 and the main register	
$q > TL3$	Counting in TA3 and the main register	
$P > TL2$ and $q > TL3$	Counting in TA2, TA3 and the main register	

Among other things the PQ tariff is used for customers paying a fixed duty based on max. power and max. flow.

### 6.13 Data loggers

MULTICAL® 602 contains a permanent memory (EEPROM), where the results of a number of various data loggers are stored. The meter contains following data loggers:

Data logging interval	Data logging depth	Logged value	Logger read-out
Yearly logger	15 years	Counter registers	LogView/MT Pro •
Monthly logger	36 months	Counter registers	LogView/MT Pro •
Daily logger	460 days	Consumption (increase)/day	LogView/MT Pro ♦
Hourly logger	1392 hours	Consumption (increase)/hour	LogView/MT Pro ♦
Programmable data logger top module 67-0B and base module 67-00-22	1080 loggings Logging interval 1-1440 min. (e.g. 45 days' hour loggings or 11 days' 15 min. loggings)	30 registers and values	AMR *), LogView/MT Pro •
Info logger	50 events (36 events can be displayed)	Info code, date, time and energy (E1/E2 **)	LogView/MT Pro

\*) Example of AMR (Automatic Meter Reading) for the data logger is GSM/GPRS. See chapter 13.4 about LogView.

\*\*) Only info code and date appear from the display.

The loggers are static and therefore the register types cannot be changed, furthermore, the logging intervals are fixed. When the last record has been written in the EEPROM the oldest one is overwritten.

#### 6.13.1 Yearly, monthly, daily and hourly loggers

Following registers are logged every year and every month on target date as counter values. In addition, the increases of the day and the hour are logged at midnight.

Register type	Description	Yearly logger	Monthly logger	Daily logger	Hourly logger	67-0B 67-00-22 Prog. logger
Date (YY.MM.DD)	Year, month and day for logging times	•	•	♦	♦	•
Clock (hh.mm.ss.)	Time	-	-	-	-	•
Log Info	Status, quality stamping of log record	-	-	-	-	•
E1	E1=V1(T1-T2)k Heat energy	•	•	♦	♦	•
E2	E2=V2(T1-T2)k Heat energy	•	•	♦	♦	•
E3	E3=V1(T2-T1)k Cooling energy	•	•	♦	♦	•
E4	E4=V1(T1-T3)k Flow energy	•	•	♦	♦	•
E5	E5=V2(T2-T3)k Return flow energy or tap from return flow	•	•	♦	♦	•
E6	E6=V2(T3-T4)k Tap water energy, separate	•	•	♦	♦	•
E7	E7=V2(T1-T3)k Tap water energy from flow	•	•	♦	♦	•
E8	E8=m³ x T1 (flow)	•	•	♦	-	•
E9	E9=m³ x T2 (return flow)	•	•	♦	-	•
TA2	Tariff register 2	•	•	-	-	-
TA3	Tariff register 3	•	•	-	-	-
V1	Volume register for Volume 1	•	•	♦	♦	•
V2	Volume register for Volume 2	•	•	♦	♦	•
VA	Extra water or electricity meter connected to Input A	•	•	♦	♦	•
VB	Extra water or electricity meter connected to Input B	•	•	♦	♦	•
M1	Mass corrected V1	-	-	♦	♦	•
M2	Mass corrected V2	-	-	♦	♦	•
INFO	Information code	•	•	♦	♦	•
DATE FOR MAX. FLOW V1	Date stamp for max. flow in the period	•	•	-	-	-
MAX. FLOW V1	Value for max. flow in the period	•	•	-	-	-
DATE FOR MIN. FLOW V1	Date stamp for min. flow in the period	•	•	-	-	-
MIN. FLOW V1	Value for min. flow in the period	•	•	-	-	-

DATE FOR MAX. POWER V1	Date stamp for max. power in the period	•	•	-	-	-
MAX. POWER V1	Value for max. power in the period	•	•	-	-	-
DATE FOR MIN. POWER V1	Date stamp for min. power in the period	•	•	-	-	-
MIN. POWER V1	Value for min. power in the period	•	•	-	-	-
T1avg	Time based average for T1	-	-	♦	♦	-
T2avg	Time based average for T2	-	-	♦	♦	-
T3avg	Time based average for T3	-	-	♦	♦	-
P1avg	Time based average for P1	-	-	♦	♦	-
P2avg	Time based average for P2	-	-	♦	♦	-
Operating hour counter	Accumulated number of operating hours	•	•	-	-	•
T1	Current value of T1	-	-	-	-	•
T2	Current value of T2	-	-	-	-	•
T3	Current value of T3	-	-	-	-	•
T4	Current value of T4	-	-	-	-	•
T1-T2 (Δt)	Current differential value	-	-	-	-	•
Flow (V1)	Current water flow of V1	-	-	-	-	•
Flow (V2)	Current water flow of V2	-	-	-	-	•
Power (V1)	Actual power	-	-	-	-	•
P1	Current pressure of flow	-	-	-	-	•
P2	Current pressure of return	-	-	-	-	•

**Note:** Continuous maximum water flow and permanent  $\Delta\Theta$  75 K may cause overflow in the daily data logger at CCC=010-011-012-013-150-202-205. With these combinations we recommend you to use Prog. data logger type 67-0B or type 67-00-22.

### 6.13.2 Info logger

Every time the information code is changed, date and info code are logged. Thereby, it is possible to data read the last 50 changes in the information code and the date of the change.

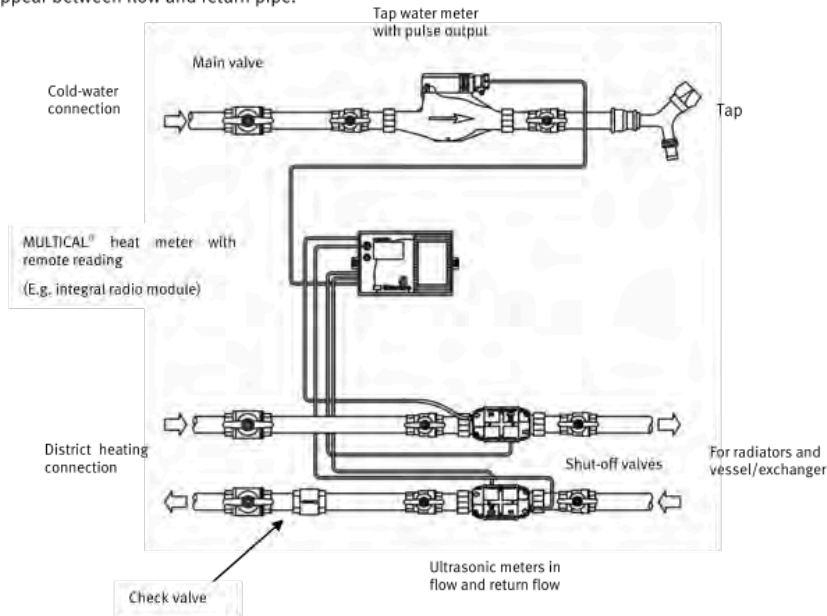
Register type	Description
Date (YY.MM.DD)	Year, month and day for the logging time
Info	Information code on above date
E1	Heat energy
E3	Cooling energy
Clock (hh.mm.ss.)	Time

When the info logger is read on the display the last 36 changes including dates can be read. Heat energy, cooling Energy, and time can be read out via LogView only. Please see 6.11 for more information.

## 6.14 Leak surveillance

### 6.14.1 District heating installations

The leak surveillance system is primarily intended for directly connected district heating installations, i.e. installations without heat exchanger between the district heating network and the heating system of the housing. The surveillance system consists of two water meters based on the ultrasonic principle placed in both flow and return pipe, and of temperature sensors in both pipes. In addition, the electronic unit MULTICAL® 602, which in addition to calculating the heat energy also surveys the mass difference (temperature compensated volume) that may appear between flow and return pipe.



If a difference of more than 20% of the measuring range (corresponding to 300 l/h in a single-family house) is registered, an alarm will be sent within 120 sec. via remote communication.

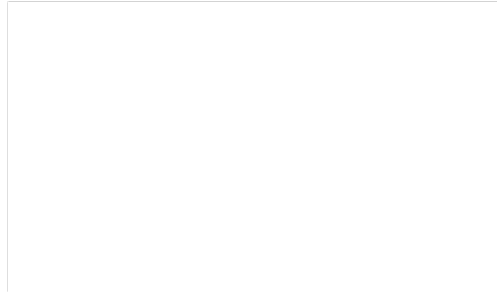
Small leaks from 15 kg/h and upwards for  $q_p \geq 1.5 \text{ m}^3/\text{h}$  are under surveillance on the basis of a 24-hour average to rule out incorrect alarms as a consequence of air pockets and fast flow changes e.g. from hot-water exchangers.

District heating leak surveillance (V1-V2)	
M=	Sensitivity in leak surveillance
0	OFF
1	$1.0\% q_p + 20\% q$
2	$1.0\% q_p + 10\% q$
3	$0.5\% q_p + 20\% q$
4	$0.5\% q_p + 10\% q$

**NB:** M=2 is a default value when leak surveillance is used. Higher degrees of sensitivity, e.g. M=4 is only possible by means of METERTOOL. Please see 3.8.1 for an example of how the sensitivity is calculated.

Info codes for leak/bursting are only active when  $M > 0$  or  $N > 0$ , respectively.

Example: The curve below illustrates the difference between Mass V1 and Mass V2 in an extract of 60 days before the leak in a floor heating pipe was the reason for a leak alarm. As will appear from below, there is a fluctuation of approx.  $\pm 1$  kg/hour in the first 43 days which is a normal fluctuation for installations without leaks.



**6.14.5 Surveillance, but no automatic blocking**

The leak surveillance system is based on installation at a large number of private district heating customers'. Usually, the individual utility installs and maintains the leak surveillance, integrated with the compulsory heat metering at all district heating customers in their area. In this way, the individual private district heating customers neither maintain the system nor perform other technical tasks in connection with the installed leak surveillance system, and the surveillance system must not imply an increased risk of faulty blocking that may lead to frost bursts. As a consequence of this the entire system must have a reliability that ensures operation for 12 years without maintenance. As neither thermally nor electrically activated shut-off valves can be expected to have such a long lifetime it will not be possible to use automatic blocking.

**6.14.6 First day after reset**

The first day after installation (when the meter has had no supply voltage) no infocodes will be set and no alarms will be sent in case of calculated district heating or cold-water leak.

This limitation has been introduced to avoid wrong alarms as a result of the installation and the shortened metering period.

The alarm function can be tested via remote communication by pressing both push buttons simultaneously, until a "Call" appears in the display.



## 6.15 Reset functions

### 6.15.1 Resetting the hour counter

As the hour counter usually is used to control that the meter has been in operation in the entire billing period (e.g. 1 year = 8760 hours) the district heating supplier must always be informed which meters have had their hour counter reset.

The operational hour counter can only be reset via the front buttons. Please see 6.18.



### 6.15.2 Resetting data loggers

Separate reset of data loggers, info loggers, max. & min. loggers (without resetting the legal registers) are only possible by means of METERTOOL. See paragraph 13 for further details.

### 6.15.3 Resetting all registers

Resetting all legal and non-legal registers including all data loggers, info loggers, max. & min. loggers can only be made by using METERTOOL or via NOWA, if the verification seal is broken and the internal "Total programming lock" is short-circuited. As the verification seal is broken, this can only be made at an accredited laboratory.

Following registers are reset:

All legal and non-legal registers including all data loggers, info loggers, max. & min. loggers (max. values are set at zero, whereas min. values are set at 100000).

After reset "Date" is set at 2000.01.01 and is then changed to current date/time of the PC used for the task. Remember to check correct date/time (technical standard time = "winter-time") on the PC before the reset function is initiated.

## 6.16 SMS Commands

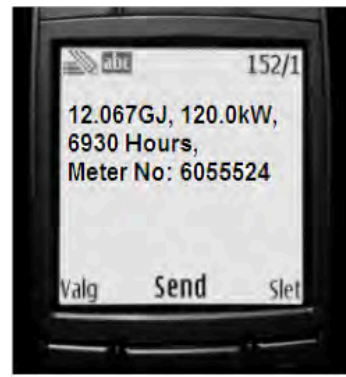
MULTICAL® 602 can be read by means of an SMS. In order to do so, a GSM-module (68G6xxxxx) fitted with a SIM-card must be connected to the meter. To read the meter you send an SMS from a mobile phone direct to the meter. Subsequently, you receive a reply with the following values:

- Acc. energy: [kWh], [MWh], [GJ] or [Gcal]
- Current power: [kW] or [MW]
- Hour counter
- Meter number

It is also possible to read the modem's signal strength by means of an SMS. You receive a reply with the modem's current signal strength on a scale of 0 to 31, the best value being 31. The signal strength must be minimum 12. See the examples on the next page.

NOTE: SMS commands must be written in **either** capital letters **or** small letters, i.e. an SMS command must not include a mixture of capital and small letters.

READ_HEAT_METER – for reading a MULTICAL® 602	
Syntax	=READ_HEAT_METER#
Return reply, error	NO ANSWER
Example of SMS command	=READ_HEAT_METER#
Example of correct reply	12.067Gj, 120.0kW 6930 Hours, Meter No.: 6055524



SIGNAL – for reading the signal strength	
Syntax, command	=SIGNAL#
Return reply, error	NO ANSWER
Example of SMS command	=SIGNAL#
Example of correct reply	Signal: 16(0-31)



## 6.17 Set-up via the front keys

Via the main key  and the sub-key  on MULTICAL® 602, a number of settings can be selected.

### 6.17.1 Activate the setup-menu

The setup-menu is activated in the following way:

- 1) Select the display reading that you wish to change
- 2) Remove the calculator from the base
- 3) Wait until the display goes blank (up to 2.5 minutes). Meanwhile do not touch the front keys
- 4) While replacing the calculator on the base, press and hold the main key for approx. 8 seconds
- 5) The setup-menu is now active

Having activated the setup-menu, the register that you wish to change is now displayed with the rightmost digit flashing (in the below example the "Date" has been selected):

If a display register that is not supported by the front key set-up is selected, the meter will show the normal display without activating the setup-menu.

### 6.17.2 Setup of a display register

When the setup-menu is activated, the actual value in the register selected will be displayed (in the below example the date 2011.07.14)

The value of the flashing digit can be increased by pressing the sub-key:

⇒

When pressing the main key, the next digit to the left will be flashing:

⇒

### 6.17.3 Exit setup-menu

When the display value has been changed as required, hold the main key for 10 seconds, until the "OK" segment is displayed. The display reverts to legal reading.

The new value is checked. If it is valid, the new value is saved. If it is invalid, the old value is kept and the "OK" segment will not be displayed within approx. 3 seconds. The display reverts to legal reading.



If you wish to exit the setup-menu without saving the new value:

- 1) Remove the calculator from the base
- 2) Wait until the display goes blank (up to 2.5 minutes). Meanwhile do not touch the front keys
- 3) Replace the calculator on the base without pressing the front keys

Allow some seconds for the meter to boot-up without pressing the front keys. The normal display register is now shown and the setup menu is deactivated.

Note that if the front keys are not activated for 4 minutes in the setup-menu, the setup-menu will be deactivated and the meter will automatically return to normal operation.

No data will be stored in the meter's memory, unless the "OK" segment is displayed.

### 6.17.4 Display registers supported by the setup-menu

The following registers are supported by the setup-menu:

- Date
- Clock
- Primary M-Bus address (for both top and base module if mounted)
- Preset of Input A
- Preset of Input B
- Meter No. for Input A
- Meter No. for input B
- Pulse value for Input A
- Pulse value for Input B

## 6.18 Reset via the front keys

Via the the main key  and the sub-key  on MULTICAL® 602, a number of reset functions can be made.

### 6.18.1 Activate the reset-menu

The reset-menu is activated in the following way:

- 1) Select the display reading that you wish to reset
- 2) Remove the calculator from the base
- 3) Wait until the display goes blank (up to 2.5 minutes). Meanwhile do not touch the front keys
- 4) While replacing the calculator on the base, press and hold the main key for approx. 8 seconds
- 5) The reset-menu has now been activated

Having activated the reset menu, either the operation hour counter, the infoevent-counter or the error hour counter will be displayed, depending on the register which was selected before activating the reset menu.

When the reset menu has been activated, "0" will be displayed. It is not possible to change to any other value. It is only possible to "save" the value = 0 in order to reset the register, or to leave the reset menu without reset.

If a display register that is not supported by the reset-menu is selected, the meter will show the normal display without activating the reset menu.

### 6.18.2 Exit the reset menu

When the operation hour counter, the info-event counter or the error hour counter displays "0", hold the main key for 5-6 seconds, until the "OK" segment is displayed, and the display reverts to legal reading.

If you wish to exit the reset menu without resetting any registers:

- 4) Remove the calculator from the base
- 5) Wait until the display goes blank (up to 2.5 minutes). Meanwhile do not touch the front keys
- 6) Replace the calculator on the base without pressing the front keys

Allow some seconds for the meter to boot-up without pressing the front keys. The normal display register is now displayed and the reset menu is deactivated.


Note that if the front keys are not activated for 4 minutes in the setup-menu, the setup-menu will be deactivated and the meter will automatically return to normal operation.

No data will be reset in the meter's memory, unless the "OK" segment is shown.

### 6.18.3 Time-out

If no keys are activated for 4 min., the reset menu is deactivated and the display reverts to legal reading. If the "OK" is not displayed, no data have been saved.

## 6.18 Reset via the front keys

Via the the main key  and the sub-key  on MULTICAL® 602, a number of reset functions can be made.

### 6.18.1 Activate the reset-menu

The reset-menu is activated in the following way:

- 1) Select the display reading that you wish to reset
- 2) Remove the calculator from the base
- 3) Wait until the display goes blank (up to 2.5 minutes). Meanwhile do not touch the front keys
- 4) While replacing the calculator on the base, press and hold the main key for approx. 8 seconds
- 5) The reset-menu has now been activated

Having activated the reset menu, either the operation hour counter, the infoevent-counter or the error hour counter will be displayed, depending on the register which was selected before activating the reset menu.

When the reset menu has been activated, "0" will be displayed. It is not possible to change to any other value. It is only possible to "save" the value = 0 in order to reset the register, or to leave the reset menu without reset.

If a display register that is not supported by the reset-menu is selected, the meter will show the normal display without activating the reset menu.

### 6.18.2 Exit the reset menu

When the operation hour counter, the info-event counter or the error hour counter displays "0", hold the main key for 5-6 seconds, until the "OK" segment is displayed, and the display reverts to legal reading.

If you wish to exit the reset menu without resetting any registers:

- 4) Remove the calculator from the base
- 5) Wait until the display goes blank (up to 2.5 minutes). Meanwhile do not touch the front keys
- 6) Replace the calculator on the base without pressing the front keys

Allow some seconds for the meter to boot-up without pressing the front keys. The normal display register is now displayed and the reset menu is deactivated.

Note that if the front keys are not activated for 4 minutes in the setup-menu, the setup-menu will be deactivated and the meter will automatically return to normal operation.

No data will be reset in the meter's memory, unless the "OK" segment is shown.

### 6.18.3 Time-out

If no keys are activated for 4 min., the reset menu is deactivated and the display reverts to legal reading. If the "OK" is not displayed, no data have been saved.

## 7 Flow sensor connection

MULTICAL® 602 can be used with up to 4 pulse inputs, of which V1 and V2 are used for energy calculation and leak surveillance, whereas VA and VB are used to accumulate pulses e.g. from tap-water meters and electricity meters.

V1 and V2 can either be used for fast pulses (CCC > 100) or for slow pulses (CCC = OXX). Fast and slow pulses cannot be used simultaneously.

### 7.1 Volume inputs V1 and V2

MULTICAL® 602 can be connected to one or two flow sensors depending on the required application. Typical heat installations with one flow sensor are always connected to V1 irrespective if this flow sensor is installed in flow pipe or return pipe.

Almost all available flow sensor types with pulse output can be connected as the standard connection PCB receives pulses from both electronic and mechanical meters. In addition, a connection PCB that receives 24 V active pulses



#### 7.1.1 Flow sensor with transistor- or FET output ①

Typically, the signaller is an optocoupler with a transistor or a FET output. V1 is connected to terminal 10(+) and 11(-), V2 is connected to terminals 69(+) and 11(-). Terminal 9 is not used in this application.

The leak current in the transistor or FET output must not exceed 1 µA in OFF state and there must be max. 0.4 V in ON state.

A suitable CCC code must be selected with the same number of pulses/liter as the flow part, and for this flow sensor type the CCC code must be CCC > 100.

Example: CCC=147 fits an electronic meter with 1 pulse/liter and qp of 150 m³/h.

#### 7.1.2 Flow sensor with Reed switch output ②

The signaller is a Reed switch typically mounted on vane wheel or Woltmann meters, or a relay output from e.g. a magnetic inductive flow sensor. V1 is connected to the terminals 10(+) and 11(-), V2 is connected to the terminals 69(+) and 11(-). Terminal 9 is not used in this application.

The leak current must not exceed 1 µA in OFF state and there must be max. 10 kΩ in ON state.

A suitable CCC code must be selected with the same number of pulses/liter as the flow part, and for this flow sensor type the CCC code must be in the range 010 ≤ CCC ≤ 022.

Example: CCC=012 fits a mechanical flow sensor with 100 liter/pulse. Flow sensors with Qmax. in the range 10...300 m³/h can use this CCC code.

**7.1.3 Flow sensor with active output supplied from MULTICAL® ③**

This connection is used both together with Kamstrup's ULTRAFLOW® and Kamstrup's electronic pick-up units for vane wheel meters. The power consumption in these units is very low and is adapted to MULTICAL®'s battery lifetime.

A suitable CCC code must be selected with the same number of pulses/litre as the flow part, and for this flow sensor type the CCC code must be CCC > 100.

Example: CCC=119 fits an electronic meter with 100 pulses/litre and typical qp is 1.5 m³/h.

V1 and V2 are connected as shown in below diagram.

	V1	V2
<b>Red (3.6 V)</b>	9	9
<b>Yellow (Signal)</b>	10	69
<b>Blue (GND)</b>	11	11

Table 2

**7.1.3.1 Use of Pulse Transmitter between ULTRAFLOW® and MULTICAL®**

In general it is permissible to use up to 10 m cable between MULTICAL® and ULTRAFLOW®. If longer cable is required, a Pulse Transmitter can be inserted between ULTRAFLOW® and MULTICAL®. In this way the cable length can be extended up to 50 m.

When a Pulse Transmitter is used between ULTRAFLOW® and MULTICAL®, volume pulses from the flow meter will be transferred to the calculator. However, the calculator is unable to data communicate with the flow meter. In order to avoid erroneous info codes it is, therefore, necessary to deselect the info codes, which are based on data communication between MULTICAL® and ULTRAFLOW® 54 (Info = 16-1024-2048-128-4096-8192-16384-32768).

The above-mentioned info codes can be deselected by means of the PC-program METERTOOL, either by changing from CCC-code 4xx to 1xx, or by using the "Info code setup" function under "Utility". See paragraph 13.2.3 Info code setup.

7.2 Flow sensor with active 24 V pulse output ④

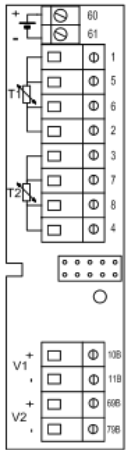
When MULTICAL® is connected to "industrial" flow sensors with a 24 V active pulse output, the connection board type 66-99-614 must be used in MULTICAL® 602 type 602-B or 602-D, with a 4 wire temperature sensor connection.

602-D is mounted w

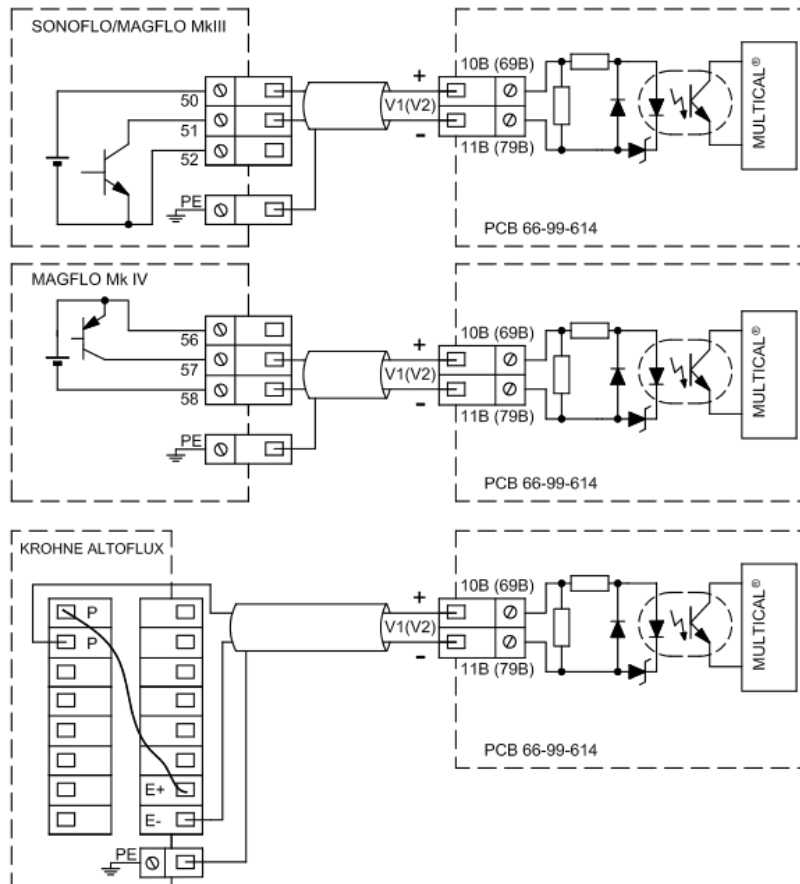
Technical data

Pulse input voltage	12...32 V
Pulse current	Max. 12 mA at 24 V
Pulse frequency	Max. 128 Hz
Pulse duration	Min. 3 msec.
Cable length V1 and V2	Max. 100 m (including min. 25 cm distance to other cables)
Galvanic insulation	The inputs V1 and V2 are both individually insulated and insulated from MULTICAL®
Insulation voltage	2 kV
Net supply to MULTICAL®	24 VAC or 230 VAC
Battery life time for MULTICAL®	When using V1: 12+1 years When using both V1 and V2: 10 years

If in addition, a data communication modules is used in MULTICAL® the battery lifetime will be reduced further. See paragraph 9.2 for further details.



7.2.1 Connection examples





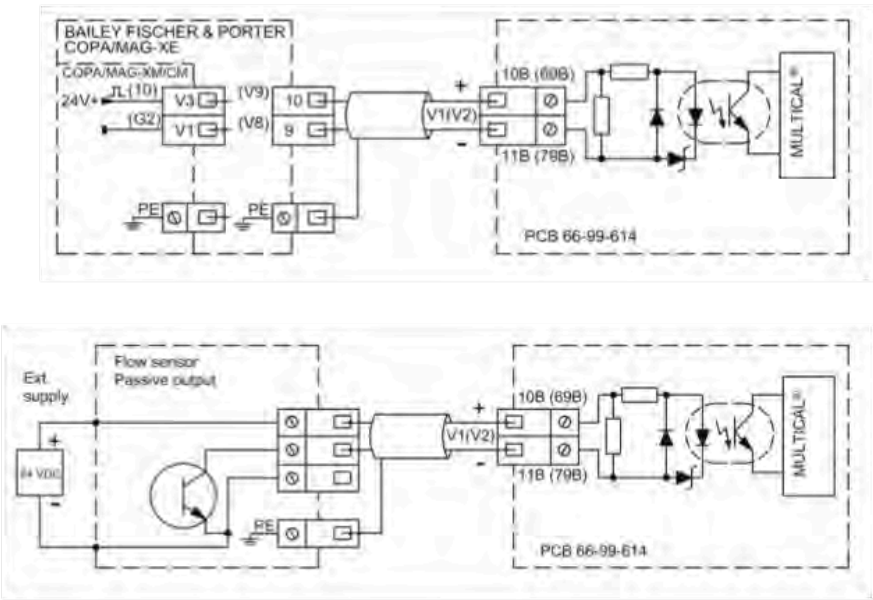


Figure 3

7.2.2 Flow sensor coding

In connection with installation it is important that both the flow sensor and the MULTICAL® are programmed correctly. Below table states the possibilities:

CCC no.	Pre-counter	Flow factor	Number of decimals on the display							Qp range [m³/h]	Qs [m³/h]	Type	Flow sensor
			MWh (Gcal)	GJ	m³ [ton]	m³/h	MW	l/pulse	Pulse/l				
201	100	235926	2	1	1	1	2	1	1	10...100	75	FUS380 DN50-65	K-M
202	40	589815	2	1	1	1	2	2,5	0,4	40...200	240	FUS380 DN80-100	K-M
203	400	589815	1	0	0	1	2	2,5	0,4	100...400	500	FUS380 DN125	K-M
204	100	235926	1	0	0	0	1	10	0,1	150...1200	1600	FUS380 DN150-250	K-M
205	20	1179630	1	0	0	0	1	50	0,02	500...3000	3600	FUS380 DN300-400	K-M

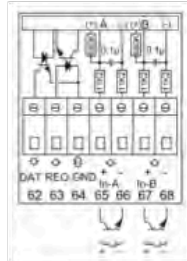
Table 3



### 7.3 Pulse inputs VA and VB

In additions to the pulse inputs V1 and V2 MULTICAL® 602 has two extra pulse inputs, VA and VB, to collect and accumulate pulses remotely, e.g from cold-water meters and electricity meters. The pulse inputs are physically placed on the "base modules" as for instance on the "data/pulse input module" that can be placed in the connection base, however, accumulation and data logging of values are made by the calculator.

The pulse inputs VA and VB function independantly of the other inputs/outputs and thereby they are not included in any energy calculations.



Both pulse inputs are constructed identically and can individually be set up to receive pulses from water meters with max. 1 Hz or pulses from electricity meters with max. 3 Hz.

Configuration to correct pulse value is made at the factory on the basis of order information or are configured by means of METERTOOL. See paragraph 3.6 concerning configuration of VA (FF codes) and VB (GG codes).

MULTICAL® 602 registers the accumulated consumption for the meters connected to VA and VB and stores the registers every month and every year on the target date. To facilitate the identification during data reading it is also possible to store the meter numbers for the two meters that are connected to VA and VB. Programming is made by means of METERTOOL.

The registers that can both be read on the display (by selecting a suitable DDD code) and via data communication contains the following information as well as date of yearly and monthly data:

<b>Registration type:</b>	<b>Count</b>	<b>Identification</b>	<b>Yearly data</b>	<b>Monthly data</b>
<b>VA (accumulated register)</b>	•			
Meter number VA		•		
Yearly data, up to 15 years back			•	
Monthly data, up to 36 months back				•
<b>VB (accumulated register)</b>	•			
Meter number VB		•		
Yearly data, up to 15 years back			•	
Monthly data, up to 36 months back				•

By using METERTOOL the registers VA and VB can be preset to the value of the connected meters at the time of installation.

### 7.3.1 Display example, VA

In the example below VA is configured to FF=24, which corresponds to 10 liters/pulse and a max. flow of 10 m<sup>3</sup>/h. The meter that is connected to VA has meter number 75420145 which is stored in MULTICAL® 602's internal memory by means of METER TOOL.



Accumulated register for VA (Input A)



Meter number for VA (max. 8 digits)



Yearly data, date for LOG 1 (last target date)



Yearly data, value for LOG 1 (last yearly reading)  
This is the accumulated volume registered on VA on the 1<sup>st</sup> January 2006.

## 8 Temperature sensors

For MULTICAL® 602 either Pt100 or Pt500 temperature sensors are used according to EN 60751 (DIN/IEC 751). A Pt100 or Pt500 temperature sensor is a platinum sensor with a nominal ohmic resistance of 100.000  $\Omega$  and 500.000  $\Omega$ , respectively, at 0.00°C and 138.506  $\Omega$  and 692.528  $\Omega$  at 100.00°C, respectively. All values for the ohmic resistance are laid down in the international standard IEC 751 valid for Pt100 temperature sensors. The values for the ohmic resistances in Pt500 sensors are 5 times higher. In below tables the resistance values in [ $\Omega$ ] are stated for every whole degree celcius for both Pt100 and for Pt500 sensors:

Pt100										
°C	0	1	2	3	4	5	6	7	8	9
0	100.000	100.391	100.781	101.172	101.562	101.953	102.343	102.733	103.123	103.513
10	103.903	104.292	104.682	105.071	150.460	105.849	106.238	106.627	107.016	107.405
20	107.794	108.182	108.570	108.959	109.347	109.735	110.123	110.510	110.898	111.286
30	111.673	112.060	112.447	112.835	113.221	113.608	113.995	114.382	114.768	115.155
40	115.541	115.927	116.313	116.699	117.085	117.470	117.856	118.241	118.627	119.012
50	119.397	119.782	120.167	120.552	120.936	121.321	121.705	122.090	122.474	122.858
60	123.242	123.626	124.009	124.393	124.777	125.160	125.543	125.926	126.309	126.692
70	127.075	127.458	127.840	128.223	128.605	128.987	129.370	129.752	130.133	130.515
80	130.897	131.278	131.660	132.041	132.422	132.803	133.184	133.565	133.946	134.326
90	134.707	135.087	135.468	135.848	136.228	136.608	136.987	137.367	137.747	138.126
100	138.506	138.885	139.264	139.643	140.022	140.400	140.779	141.158	141.536	141.914
110	142.293	142.671	143.049	143.426	143.804	144.182	144.559	144.937	145.314	145.691
120	146.068	146.445	146.822	147.198	147.575	147.951	148.328	148.704	149.080	149.456
130	149.832	150.208	150.583	150.959	151.334	151.710	152.085	152.460	152.835	153.210
140	153.584	153.959	154.333	154.708	155.082	155.456	155.830	156.204	156.578	156.952
150	157.325	157.699	158.072	158.445	158.818	159.191	159.564	159.937	160.309	160.682
160	161.054	161.427	161.799	162.171	162.543	162.915	163.286	163.658	164.030	164.401
170	164.772	165.143	165.514	165.885	166.256	166.627	166.997	167.368	167.738	168.108

Pt100, IEC 751 Amendment 2-1995-07

Table 4

Pt500										
°C	0	1	2	3	4	5	6	7	8	9
0	500.000	501.954	503.907	505.860	507.812	509.764	511.715	513.665	515.615	517.564
10	519.513	521.461	523.408	525.355	527.302	529.247	531.192	533.137	535.081	537.025
20	538.968	540.910	542.852	544.793	546.733	548.673	550.613	552.552	554.490	556.428
30	558.365	560.301	562.237	564.173	566.107	568.042	569.975	571.908	573.841	575.773
40	577.704	579.635	581.565	583.495	585.424	587.352	589.280	591.207	593.134	595.060
50	596.986	598.911	600.835	602.759	604.682	606.605	608.527	610.448	612.369	614.290
60	616.210	618.129	620.047	621.965	623.883	625.800	627.716	629.632	631.547	633.462
70	635.376	637.289	639.202	641.114	643.026	644.937	646.848	648.758	650.667	652.576
80	654.484	656.392	658.299	660.205	662.111	664.017	665.921	667.826	669.729	671.632
90	673.535	675.437	677.338	679.239	681.139	683.038	684.937	686.836	688.734	690.631
100	692.528	694.424	696.319	698.214	700.108	702.002	703.896	705.788	707.680	709.572
110	711.463	713.353	715.243	717.132	719.021	720.909	722.796	724.683	726.569	728.455
120	730.340	732.225	734.109	735.992	737.875	739.757	741.639	743.520	745.400	747.280
130	749.160	751.038	752.917	754.794	756.671	758.548	760.424	762.299	764.174	766.048
140	767.922	769.795	771.667	773.539	775.410	777.281	779.151	781.020	782.889	784.758
150	786.626	788.493	790.360	792.226	794.091	795.956	797.820	799.684	801.547	803.410
160	805.272	807.133	808.994	810.855	812.714	814.574	816.432	818.290	820.148	822.004
170	823.861	825.716	827.571	829.426	831.280	833.133	834.986	836.838	838.690	840.541

Pt500, IEC 751 Amendment 2-1995-07

Table 5

## 8.1 Sensor types

MULTICAL® 602	Type 602-
Pt500 sensor set	
No sensor set	00
Pocket sensor set w/1.5 m cable	0A
Pocket sensor set w/3.0 m cable	0B
Pocket sensor set w/5 m cable	0C
Pocket sensor set w/10 m cable	0D
Short direct sensor set w/1.5 m cable	0F
Short direct sensor set w/3.0 m cable	0G
3 Pocket sensors in sets w/1.5 m cable	0L
3 Pocket sensors in sets w/3.0 m cable	0M
3 Pocket sensors in sets w/5 m cable	0N
3 Pocket sensors in sets w/10 m cable	0P
3 Short direct sensors in sets w/1.5 m cable	Q3
3 Short direct sensors in sets w/3.0 m cable	Q4

## 8.2 Cable influence and compensation

### 8.2.1 2 wire sensor set

Small and medium-sized heat meters only need a relatively short temperature sensor length, and the 2 wire sensor set can be

The cable length and the cross sectional area must always be identical for the 2 sensors used as a temperature sensor pair for a heat meter. The length of the cable sensors must neither be shortened nor extended.

The limitations attached to using the 2 wire sensor set according to EN 1434-2:2007 are stated in below table. Kamstrup supply Pt500 sensor sets with up to 10 m cable (2 x 0.25 mm<sup>2</sup>)

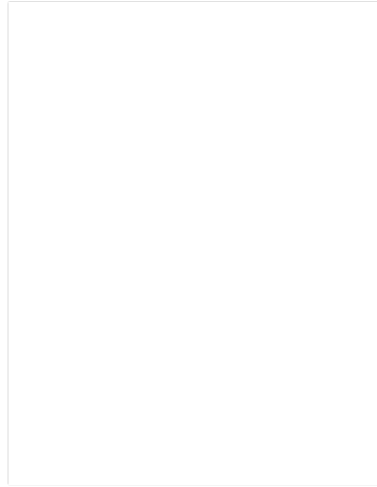
Cable cross section [mm <sup>2</sup> ]	Pt100 sensors		Pt500 sensors	
	Max. cable length [m] according to EN 1434-2:2007	Temperature increase [K/m] <i>Copper @ 20 °C</i>	Max. cable length [m] according to EN 1434-2:2007	Temperature increase [K/m] <i>Copper @ 20 °C</i>
0.25	2.5	0.450	12.5	0.090
0.50	5.0	0.200	25.0	0.040
0.75	7.5	0.133	37.5	0.027
1.50	15.0	0.067	75.0	0.013

Table 6

### 8.2.2 4 wire sensor set

For installations requiring longer cable lengths than stated in above table, we recommend a 4 wire sensor set and a MULTICAL® 602 type 602-B with 4 wire connection.

The 4 wire construction uses two conductors for testing current and the two other conductors for measuring signal. In this way, the construction will in theory not be affected by long sensor cables. However, in practice cables longer than 100 m should not be used. We recommend to use 4 x 0.25 mm<sup>2</sup>.





### 8.3 Pocket sensors

The Pt500 cable sensor is constructed with a 2 wire silicone cable and closed with a shrunk-on stainless steel tube with a diameter of  $\varnothing 5.8$  mm that protects the sensor element.

The steel tube is fitted in a sensor pocket (pocket) which has an inside diameter of  $\varnothing 6$  and an outside diameter of  $\varnothing 8$  mm. The sensor pockets are supplied with an R $\frac{1}{2}$  (conical  $\frac{1}{2}$ "") connection in stainless steel with a length of 65, 90 or 140 mm. The sensor construction with separate pocket allows replacement of sensors without turning off the water flow. The large selection of pocket lengths also ensures that the sensors can be fitted in all pipe sizes.

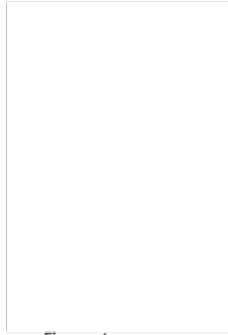


Figure 4

The plastic tube on the sensor cable is placed opposite the seal screw and the screw is tightened lightly by hand before sealing.

Figure 5

The stainless steel pockets is used in PN25 installations!

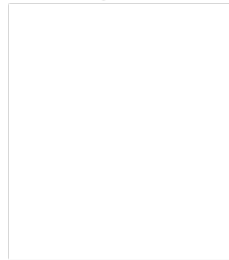
#### 8.4 Pt500 short direct sensor set

The Pt500 short direct sensor is constructed according to the European standard for thermal heat meters EN 1434-2. The sensor is constructed for fitting directly in the measuring medium, i.e. without sensor pocket. In this way an extremely fast response time on temperature changes from e.g. domestic water exchangers is obtained.

The sensor is based on a 2 wire silicone cable. The sensor tube is made of stainless steel and has a diameter of  $\varnothing 4$  mm at the tip where the sensor element is placed. Fitting can also be made directly in many flow sensor types, which reduces the installation costs.

The sensor is fitted in special T-sections, that is available for  $\frac{1}{2}$ ",  $\frac{3}{4}$ " and 1" pipe installations.

Figure 6



In addition, the short direct sensor is fitted by means of a  $R\frac{1}{2}$  or  $R\frac{3}{4}$  for M10 nipple in a standard 90° tee.

Figure 7

To obtain the best serviceability during meter replacements, the short direct sensor can be placed in a ball valve with a sensor connecting piece.

Ball valves with a sensor connecting piece are available in  $G\frac{1}{2}$ ,  $G\frac{3}{4}$  and G1.

No.	6556-474	6556-475	6556-476
	$G\frac{1}{2}$	$G\frac{3}{4}$	G1

Max. 130°C and PN16

Figure 8

## 9 Voltage supply

MULTICAL® 602 must always be supplied internally with 3.6 VDC ( $\pm 0.1$  VDC) on terminals 60(+) and 61(-). This is obtained by one of the following supply modules:

	MULTICAL 602®	Type 602-					
<b>Supply</b>							
Battery, D-cell					2		
230 VAC high power isolated SMPS					3		
24 VAC high power isolated SMPS					4		
230 VAC isolated linear supply					7		
24 VAC isolated linear supply					8		

The above supply modules are all included in the extensive type test made on MULTICAL® 602. Within the frameworks of the type approval, the CE declaration and the factory guarantee, no other types of supply modules must be used than those mentioned above.

### 9.1 Integral D-cell lithium battery

A lithium D-cell battery (Kamstrup type 66-00-200-100) must be used for the meter. The battery is placed at the right in the base unit and can easily be replaced just by using a screwdriver.

The battery lifetime partly depends on the temperature to which the battery is exposed and partly of the selected meter application.

## 9.2 Battery lifetimes

Supply options and battery lifetime for wall mounted MULTICAL® 602 with ULTRAFLW® 54

Estimated battery lifetime in years

Top ⇒ Base ↓	67-00 Without Top module	67-02 ΔE + H-Log 67-09 ΔV + H-Log	67-03 PQ + H-Log 67-07 M-Bus	67-05 Data + H-Log	67-0A 2 pulse out + H-Log + scheduler	67-0B 2 pulse out + prog. datalogger	602-0C 2 pulse out
67-00-00 Without base module	12+1	12+1	Mains only	12+1	10	9	10
67-00-10 Data+ pulse inp.	Monthly: 12 daily: 12 hourly: 10 min.: 5	Monthly: 12 daily: 12 hourly: 10 min.: 5	Mains only	Monthly: 12 daily: 12 hourly: 10 min.: 5	Monthly: 10 daily: 9 hourly: 8 min.: 5	Monthly: 9 daily: 8 hourly: 7 min.: 4	Monthly: 10 daily: 9 hourly: 8 min.: 5
67-00- 20/27/28/29 M-Bus+ pulse inp.	Monthly: 12 daily: 11 hourly: 9 min.: 1	Monthly: 12 daily: 11 hourly: 9 min.: 1	Mains only	Monthly: 12 daily: 11 hourly: 9 min.: 1	Monthly: 10 daily: 9 hourly: 7 min.: 1	Monthly: 9 daily: 8 hourly: 6 min.: 1	Monthly: 10 daily: 9 hourly: 7 min.: 1
67-00-21 Radio Router +pulse inp.	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
67-00-22 Prog. datalogger + analog inputs	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
67-00-23 0/4-20 Analogue Out	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
67-00-24 LONWorks +pulse inp.	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
67-00-25/26 RF+p/i, read by Hand Held Terminal	Monthly: 10 daily: 9 hourly: - min.: -	Monthly: 9 daily: 8 hourly: - min.: -	Mains only	Monthly: 9 daily: 8 hourly: - min.: -	Monthly: 8 daily: 7 hourly: - min.: -	Monthly: 7 daily: 6 hourly: - min.: -	Monthly: 8 daily: 7 hourly: - min.: -
67-00-30 WM-Bus Mode C1 + pulse inp.	12+1	12+1	Mains only	12+1	10	9	10
67-00-35 WM-Bus Mode C1 Alt.reg. + pulse inp.	12+1	12+1	Mains only	12+1	10	9	10
67-00-60 ZigBee + pulse inp.	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
67-00-62 Metasys N2 +pulse inp.	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
602-00-64 SIOX	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
602-00-66 BACnet MS/TP + pulse inp.	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
602-00-80 GSM/GPRS	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only
602-00-81 3G GSM/GPRS modul (GSM8H)	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only
602-00-82 Ethernet/IP	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only
602-00-84 High Power RF + pulse inp.	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only

- Note 1: Battery lifetime in [years] at one data reading per month, day, hour or minute.  
 Note 2: Battery temperature between 30 and 45°C (pipe mounted calculator) will reduce the lifetime by 1-3 years.  
 Note 3: Connection of 2 ULTRAFLW® will reduce the lifetime by 3 years.  
 Note 4: With top module 67-0B, log intervals from 60 to 1 min. will reduce the battery lifetime by up to 3 years.  
 Note 5: Connecting ULTRAFLW® 65 instead of ULTRAFLW® 54 will reduce the lifetime by 3 years.  
 Note 6: Pulse outputs are calculated at an average of 50% qp for standard CCC-codes and 32 ms. pulse duration.

### 9.3 High Power supply module 230 VAC

This PCB module is galvanically separated from the mains supply and is suited for direct 230 V mains installation. The module is a **Switch Mode Power Supply (SMPS)** that meets the demands for double insulation when the calculator top is mounted. The power consumption is less than 1.7 VA/ 1 W.

National electricity installation requirements must be met. The 230 VAC module must be connected/ disconnected by the utility staff, whereas the fixed 230 V installation for the switch cabinet must only be made by an authorised electrician. If mains disappears, this SMPS will keep the meter running for a few seconds.

### 9.4 High Power supply module 24 VAC

This PCB module is galvanically separated from the 24 VAC mains supply and is suited for industrial installations with joint 24 VAC supply and individual installations supplied from a separate 230/ 24 V safety transformer in the switch cabinet. The module is a **Switch Mode Power Supply (SMPS)** that meets the demands for double insulation when the calculator top has been mounted. The power consumption is less than 1.7 VA/ 1 W.

National electricity installation requirements must be met. The 24 VAC module must be connected/ disconnected by the utility staff, whereas installation of 230/ 24 V in the switch cabinet must only be made by an authorised electrician.

The module is specially suited for installation together with a 230/ 24 V safety transformer, e.g. type 66-99-403, that can be installed in the switch cabinet before the safety relay. When the transformer is used the power consumption will be less than 1.7 W for the entire meter including the 230/ 24 V transformer. If mains disappears, this SMPS will only keep the meter running for a few seconds.

### 9.5 Supply module 230 VAC

This PCB module is galvanically separated from the mains supply and is suited for direct 230 V mains installation. The module contains a double chamber safety transformer that meets the demands for double insulation when the calculator top has been mounted. The power consumption is less than 1.5 VA/ 0.7 W.

National electricity installation requirements must be met. The 230 VAC module must be connected/ disconnected by the utility staff, whereas the fixed 230 V installation for the switch cabinet must only be made by an authorised electrician. If mains disappears, this power supply will keep the meter running for a few minutes.

### 9.6 Supply module 24 VAC

This PCB module is galvanically separated from the 24 VAC mains supply and is suited for industrial installations with joint 24 VAC supply and individual installations supplied from a separate 230/ 24 V safety transformer in the switch cabinet. The module contains a double chamber safety transformer that meets the demands for double insulation when the calculator top has been mounted. The power consumption (without an external 230/ 24 V transformer) is less than 1.5 VA/ 0.7 W.

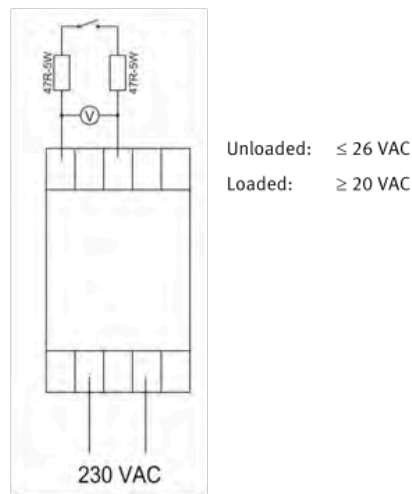
National electricity installation requirements must be met. The 24 VAC module must be connected/ disconnected by the utility staff, whereas installation of 230/ 24 V in the switch cabinet must only be made by an authorised electrician.

The module is especially suited for installation together with a 230/24 V safety transformer, e.g. type 66-99-403, that can be installed in the switch cabinet before the safety relay. When the transformer is used the power consumption will be less than 2.2 W for the entire meter including the 230/24 V transformer. If mains disappears, this power supply will keep the meter running for a few minutes.



#### 9.6.1 Requirements for the transformer 230/24V

Transformer type 66-99-403 is recommended for connection to a 24 VAC high-power supply module. Other types may be used, however it ought to be secured that the transformer has the correct output voltage. This is the case if the transformer has an off-load voltage of  $\leq 26$  VAC and a voltage of  $\geq 20$  VAC loaded at 100 Ohm (or at two times 47 Ohm connected in series).



## 9.7 Exchanging the supply unit

The power supply unit for MULTICAL® 602 can be exchanged from mains supply to battery or vice versa as the needs at the utility change. In this way, mains supplied meters can be exchanged for battery meters with advantage in connection with buildings in the course of construction, as the mains supply may be unstable or lack periodically.

Exchange from battery to mains supply does not require reprogramming, as MULTICAL® 602 does not contain an information code for worn out batteries.

However, exchange from mains supply to battery must not be made on MULTICAL® 602 with following base modules:

Base module	MULTICAL 602®	Type 602-						
Radio Router/pulse inputs			21					
Prog. data logger + RTC + 4...20 mA inputs + pulse inputs			22					
0/4...20 mA outputs			23					
LonWorks + pulse inputs			24					
ZigBee 2.4 GHz int.ant. + pulse inputs			60					
Metasys N2 (RS485 + pulse inpts			62					
SIOX module (Auto detect Baud rate)			64					
BACnet MS/TP + pulse inputs			66					
GSM/GPRS module (GSM6H)			80					
3G GSM/GPRS modul (GSM8H)			81					
Ethernet/IP module (IP201)			82					
High Power Radio Router + pulse inputs			84					

See paragraph 10.1.5 re supply options for top and base modules.

## 9.8 Mains supply cables

MULTICAL® 602 is available (length = 1.5 m):



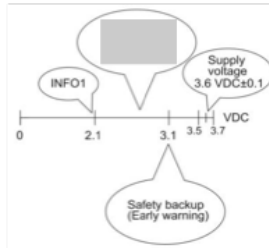
"H05 VV-F" is the designation for a heavy PVC cable, that stands max. 70°C. The supply cable must therefore be installed with a sufficient distance to hot pipes and the like.



### 9.9 Back-up of data during power down

An early warning circuit and corresponding software is added, securing safety back-up of all main registers during power down. In fact, this will function as the hourly data back-up, but also during power down. This will ensure that the meter always starts up with the same display values as before the power break.

This will be effective for both 24V and 230V power break and also when the top part of MULTICAL® 602 is removed from the base, or in case of a battery failure.



The battery has been constructed to maintain a constant voltage level of 3.6 VDC  $\pm 0.1$  V throughout its entire life-time. Shortly before the battery's energy is used up completely, the voltage falls. When the battery reaches 3.1 V the meter safety backs up. When the voltage is further reduced, "bAt LO" is displayed to indicate that the battery voltage of the meter is too low to carry out measurements. At 2.1 V info code = 1 is logged in the info event logger with time and date, to make it possible to see when the battery's energy has been completely used up.

### 9.10 Danish regulations for connection of mains operated meters

Installation to electric mains operated equipment for consumption registration ([www.sik.dk](http://www.sik.dk), safety notification electric services no. 27/09, February 2009).

The consumption of energy and resources (electricity, heat, gas and water) of the individual consumer is to an increasing extent registered by electronic meters, and often equipment for remote reading and remote control of both electronic and non-electronic meters is used.

General regulations for carrying out installations must be observed. However, the following modifications are permitted:

- If meter or equipment for remote reading or remote control is double-isolated, it is not necessary to run the protective conductor all the way to the connection point. This also applies if the connection point is a plug socket provided that it is placed in a casing which is sealable or can be opened with key or tool only.

If meter or equipment used for remote reading and remote control is connected to a safety transformer mounted in the panel and direct connected to the branch conductor, no on-off switch or separate overcurrent protection in either primary or secondary circuit is required, provided that the following conditions are fulfilled:

- The safety transformer must either be inherently short-circuit-proof or fail-safe
- The conductor of the primary circuit must either be short-circuit protected by the overcurrent protection of the branch conductor or short-circuit safely run.
- The conductor of the secondary circuit must have a cross section of at least 0.5 mm<sup>2</sup> and a current value which exceeds the absolute maximum current deliverable by the transformer
- It must be possible to separate the secondary circuit, either by separators, or it must appear from the installation instructions that the secondary circuit can be disconnected at the transformer's terminals

#### General information

Work on the fixed installation, including any intervention in the group panel, must be carried out by an authorized electrician.

It is not required that service work on equipment comprised by this notification as well as connection and disconnection of the equipment outside the panel is carried out by an authorized electrician. These tasks can also be carried out by persons or companies, who professionally produce, repair or maintain equipment if only the person carrying out the work has the necessary expert knowledge.

## 10 Plug-in modules

Plug-in modules can be added to MULTICAL® 602 both in the calculator top (top modules) and in the base unit (base modules), in this way the meter adapts to a number of various applications.

All plug-in modules are included in the extensive type test which MULTICAL® 602 has gone through. Within the framework of the type approval, the CE declaration and the factory guarantee other types of plug-in modules than those mentioned below cannot be used:

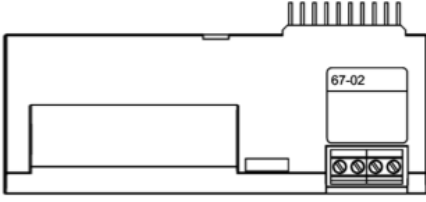
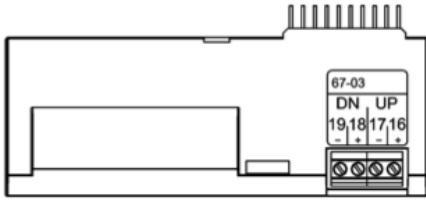
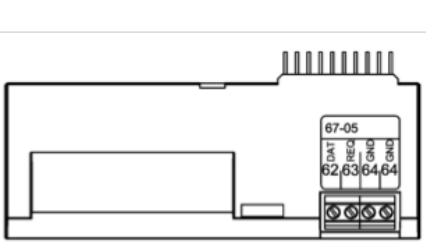
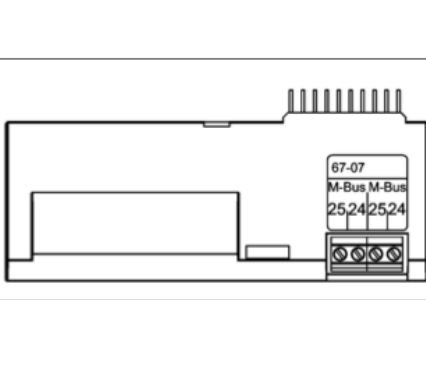
### 10.1 Top modules

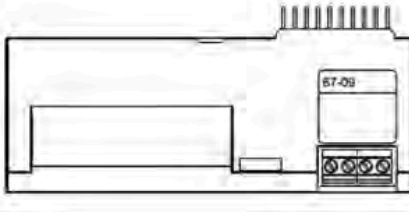
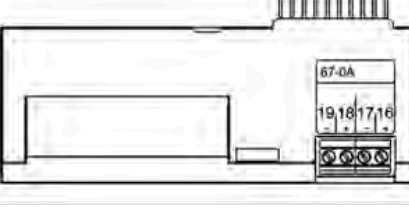
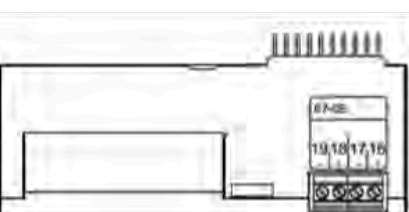
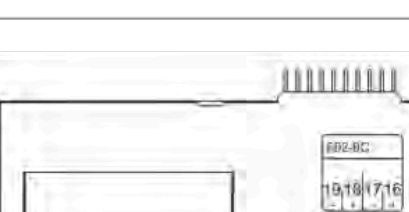
	MULTICAL 602®	Type 602-							
<b>Top module</b>									
RTC + $\Delta$ Energy calculation + hourly data logger			2						
RTC + PQ or $\Delta t$ -limiter + hourly data logger			3						
RTC + data output + hourly data logger			5						
RTC + M-Bus			7						
RTC + $\Delta$ Volume + hourly data logger			9						
RTC + 2 pulse outputs CE and CV + hourly data logger + scheduler			A						
RTC + 2 pulse outputs CE and CV + prog. data logger			B						
2 Pulse outputs CE and CV			C						

The top modules are build up on the above joint hardware platform. The application program in the micro controller and the component location vary according to the task.

Modules developed for MULTICAL® 601 can also be used in MULTICAL® 602 (except for the 67-06 module that does not work in MC602), but only with the functions from MULTICAL® 601. When a top module with RTC is mounted in MULTICAL® 602 the top module's RTC will not have any effect on the meter's own RTC.

10.1.1 Top module overview

	<p><b>Type 67-02: Δ energy calculation and hourly data logger</b></p> <p>This top module calculates the difference between forward and return energy, whereby an expression of the tapped energy in open systems is obtained.</p> <p>Differential energy <math>dE = E4 - E5</math>.</p> <p>The module also comprises an hourly data logger. Besides the differential energy <math>dE</math>, the logger includes registers such as daily logger (see paragraph 6.13 Data loggers).</p> <p><i>Terminal screws are not used in this module.</i></p>
	<p><b>Type 67-03: PQ-limiter + hourly data logger</b></p> <p>The module has two pulse outputs which can be used for UP/DOWN control of a low-speed three-point motor-operated valve via an external solid-state relay, type S75-90-006 and a 230/24 V trafo, type 66-99-403.</p> <p>The required power and flow limits are entered into MULTICAL® 602 via the PC-program METERTOOL.</p> <p>Also see instructions: 5512-498</p> <p>The module also includes an hourly data logger.</p>
	<p><b>Type 67-05: Data output + hourly data logger</b></p> <p>The module has a galvanically separated data port which functions together with the KMP-protocol. The data output can be used for e.g. connection of external communication units or other hardwired data communication which it is not expedient to carry out via the optical communication on the meter's front.</p> <p>62: DATA (Brown) – 63: REQ (White) – 64: GND (Green). Use data cable type 66-99-106 with 9-pole D-sub or type 66-99-098 with USB connector.</p> <p>The module also includes an hourly data logger.</p> <p>Only current and accumulated data can be read. Data loggers for time/days/months/years cannot be read through the data port of top module 67-05.</p>
	<p><b>Type 67-07: M-Bus</b></p> <p>M-Bus can be connected in star, ring and bus topology.</p> <p>Depending on M-Bus master and cable length/cross section, up to 250 meters can be connected with primary addressing, and even more using secondary addressing.</p> <p>Cable resistance in network: &lt; 29 Ohm</p> <p>Cable capacity in network: &lt; 180 nF</p> <p>The connection polarity of terminals 24-25 is unimportant.</p> <p>The module should only be used in mains supplied meters.</p> <p>Unless otherwise stated in the order, the primary address consists of the last three digits of the customer number, but it can be changed via the PC program METERTOOL.</p> <p>In order to function correctly in a MC602, minimum program version D1, released in March 2011, is required.</p>

	<p><b>Type 67-09: ΔVolume calculation and hourly data logger</b></p> <p>This top module calculates the difference between forward and return volume, whereby an expression of the tapped volume in open systems is obtained. Differential volume <math>dV=V1-V2</math>.</p> <p>The module also comprises an hourly data logger. Besides the differential volume, the logger includes registers such as daily logger (see paragraph 6.13 Data loggers). Requires CCC1=CCC2 and a suitable DDD-code.</p> <p><i>Terminal screws are not used in this module.</i></p>
	<p><b>Type 67-0A: 2 pulse outputs for CE and CV + hourly data logger + scheduler</b></p> <p><b>See Application no. 10 on page 33, Hot water meter</b></p> <p>The top module has the same functions as the 602-0C top module and furthermore the module is able to simulate a cold water temperature according to a programmed scheduler, where the programmed temperature for T2, T3 or T4 can be programmed with up to 12 individual dates/temperatures per year.</p> <p>See paragraph 10.1.2 concerning the function of the pulse outputs.</p>
	<p><b>Type 67-0B: 2 pulse outputs for CE and CV + prog. data logger</b></p> <p>Pulse output functions of this top module are identical with the functions described under top module 602-0C. Type 67-0B however, is supplied with Opto FET output for AC/DC pulses. See paragraph 2.2 Electrical data as to specifications of pulse outputs CE and CV.</p> <p>The top module is prepared for use in a Kamstrup radio network together with the High Power Radio Router base module 6020084, read data being transferred to the system software via network unit RF Concentrator.</p> <p>See paragraph 10.1.2 concerning the function of the pulse outputs.</p> <p>See paragraph 6.13 Data loggers.</p>
	<p><b>Type 602-0C: 2 pulse outputs for CE and CV</b></p> <p>This top module has two configurable pulse outputs, which are suitable for volume and energy pulses for heat meters, cooling meters and combined heat/cooling meters.</p> <p>The pulse resolution follows the display (fixed in the CCC-code). E.g. CCC=119 (qp 1.5): 1 pulse/kWh and 1 pulse/0.01 m .</p> <p>The pulse outputs are optoinsulated and can be charged with 30 VDC and 10 mA.</p> <p>Normally, energy (CE) is connected to 16-17 and volume (CV) to 18-19, but other combinations can be selected via the PC program METERTOOL, also used to select pulse duration 32 or 100 ms.</p> <p>See paragraph 10.1.2 concerning the function of the pulse outputs.</p>

### 10.1.2 Top modules 67-0A, 67-0B and 602-0C pulse outputs

These top modules has two configurable pulse outputs, which are suitable for combined heating/cooling applications among other things:

Meter function	Output C (16-17)	Output D (18-19)	Pulse duration
Heat meter	CE+ Heat energy (E1)	CV+ Volume (V1)	32 msec. or 100 msec.
Volume meter	CV+ Volume (V1)	CV+ Volume (V1)	
Cooling meter	CE- Cooling energy (E3)	CV+ Volume (V1)	
Heat/cooling meter	CE+ Heat energy (E1)	CE- Cooling energy (E3)	

Pulse resolution follows the display (fixed in CCC-code). E.g. CCC=119: 1 pulse/kWh and 1 puls/0.01m<sup>3</sup>

The module includes the configuration data, which will also follow the module in case of replacement.

CV- (TA3) is only used in connection with tariff EE=20.

### 10.1.3 Fitting and removing the top module

The top module is released by pressing downwards in the middle of the plastic piece on the left, and at the same time pushing the top module towards the left.



Figure 9

10.1.4 Supply options for top and base modules

Top ⇒ Base ↓	67-02 ΔE + H-Log 67-09 ΔV + H-Log	67-03 PQ + H-Log 67-07 M-Bus	67-05 Data + H- Log	67-0A H-Log+ 2 pulse out +scheduler	67-0B 2 pulse out+prog.d atalog	602-0C 2 pulse outputs (CE/CV)
67-00-10 Data + pulse inp.	Battery or mains	Mains only	Battery or mains	Battery or mains	Battery or mains	Battery or mains
67-00-20/27/28/29 M-Bus + pulse inp.	Battery or mains	Mains only	Battery or mains	Battery or mains	Battery or mains	Battery or mains
67-00-21 Radio Router + pulse inp.	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
67-00-22 4-20 inp.	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
67-00-23 0/4-20 out	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
67-00-24 LonWorks + pulse inp.	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
67-00-25 RF + pulse inp.	Battery or mains	Mains only	Battery or mains	Battery or mains	Battery or mains	Battery or mains
67-00-26 RF + pulse inp.	Battery or mains	Mains only	Battery or mains	Battery or mains	Battery or mains	Battery or mains
67-00-30 wM-Bus + pulse inp.	Battery or mains	Mains only	Battery or mains	Battery or mains	Battery or mains	Battery or mains
602-00-35 wM-Bus Alt.reg. + pulse inp.	Battery or mains	Mains only	Battery or mains	Battery or mains	Battery or mains	Battery or mains
67-00-60 ZigBee + pulse inp.	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
67-00-62 Metasys N2 + pulse inp.	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
602-00-64 SIOX	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
602-00-66 BACnet MS/TP + pulse inp.	Mains only	Mains only	Mains only	Mains only	Mains only	Mains only
602-00-80 GSM/GPRS	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only
602-00-81 3G GSM/GPRS modul (GSM8H)	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only
602-00-82 Ethernet/IP (IP201)	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only
602-00-84 High power Radio Router + pulse inp.	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only	HP Mains only

10.1.5 Module survey for Top module 67-05 with external communication box

Top → Ext. box ↓	67-05 Data + H-Log	Comments/restrictions in use
67-00-10	N/A	
67-00-20/27/28/29	N/A	
67-00-21	N/A	
67-00-22	N/A	
67-00-23	N/A	
67-00-24 LonWorks	Mains only	The module type in the external communication box is not displayed in MC602. Only accumulated and actual data. No hourly/daily/monthly/yearly data loggers can be read through the data port on the 602-05 top module. LonWorks always requires mains supply.
67-00-25	N/A	
67-00-26	N/A	
67-00-30	N/A	
602-00-35	N/A	
67-00-60	N/A	
67-00-62	N/A	
602-00-64	N/A	
602-00-66	N/A	
602-00-80	N/A	
602-00-81	N/A	
602-00-82	N/A	
602-00-84	N/A	

**Note:** Pulse inputs for VA and VB (terminals 65-66-67-68) are not connected when a module is installed in an external connection box.

## 10.2 Base modules

The base modules for MULTICAL® 602 can be divided into 4 groups:

<b>602-00-8X</b>	Modules specifically developed for MULTICAL® 602 to be used together with 230 VAC or 24 VAC high power SMPS module.
<b>67/602-00-6X, 67/602-00-3X</b>	Modules specifically developed for MULTICAL® 602 and the KMP protocol.
<b>67-00-2X</b>	Modules specifically developed for MULTICAL® 602 and the KMP protocol.
<b>67-00-1X</b>	Modules with simple functions and without a microprocessor.

MULTICAL 602®		Type 602-							
Base module									
No module									00
Data + pulse inputs									10
M-Bus + pulse inputs									20
Radio Router + pulse inputs									21
Prog. data logger + RTC + 4...20 mA inputs + pulse inputs									22
0/4...20 mA outputs									23
LonWorks + pulse inputs									24
Radio + pulse inputs (internal antenna) 434 or 444 MHz									25
Radio + pulse inputs (external antenna connection) 434 or 444 MHz									26
M-Bus module with alternative registers + pulse inputs									27
M-Bus module with medium data package + pulse inputs									28
M-Bus module with MC-III data package + pulse inputs									29
Wireless M-Bus Mode C1 + pulse inputs									30
Wireless M-Bus Mode C1 Alt. reg. + pulse inputs									35
ZigBee 2.4 GHz int.ant. + pulse inputs									60
Metasys N2 (RS485) + pulse inputs									62
SIOX module (Auto detect Baud rate)									64
BACnet MS/TP + pulse inputs									66
GSM/GPRS (GSM6H)									80
3G GSM/GPRS modul (GSM8H)									81
Ethernet/IP (IP201)									82
High Power RadioRouter + pulse inputs									84



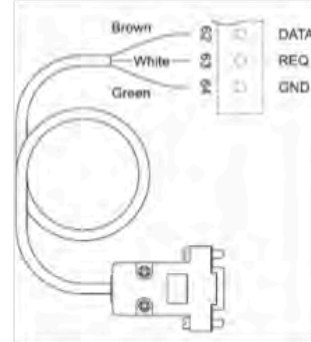
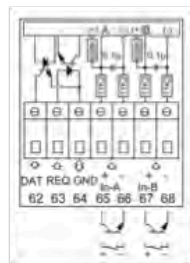
### 10.2.1 Data + pulse inputs (67-00-10) (PCB 5550-369)

The module has a galvanically separated data port that functions with the KMP protocol. The data output can be used for connection of external communication units or another wired data communication which is not suitable to perform via optical communication on the front of the meter.

See paragraph 7.3 Pulse inputs VA and VB concerning functioning of the pulse inputs.

The module comprises data connection, which can be used for external data plug, designed for use with the hand-held terminal from Kamstrup, or as a semi-permanent PC connection.

The data connection is galvanically isolated from the optocouplers which makes it necessary to use data cable type 66-99-105 or 66-99-106 in order to adjust the signal to RS-232 level, which is used by PC and with the hand-held terminal from Kamstrup. See section 11. *Data communication* for information on data strings and protocols. If the computer does not have a COM port, a data cable with USB connection, type 66-99-098, can be used.



**10.2.2 M-Bus + pulse inputs (67-00-20) (PCB 5550-831)**

The M-Bus module is supplied via the M-Bus network and is independent of the meter's own supply. M-Bus and the energy meters communicate two-way via opto couplers which gives galvanically separation between M-Bus and the meter. The module supports primary, secondary and enhanced secondary addressing.

The M-Bus module has 2 extra inputs. See paragraph 7.3 Pulse inputs VA and VB concerning functioning of the pulse inputs.

In order to function correctly in a MC602, minimum program version H1, released in March 2011, is required.

**10.2.3 RadioRouter + pulse inputs (67-00-21) (PCB 5550-805)**

The radio module is supplied as standard to operate in a licence-free frequency band but can also be supplied to other frequencies requiring licence.

The radio module is prepared to form part of a Kamstrup radio network, where the data are automatically transferred to system software via the network components **RFRouter** and **RFConcentrator**.

The radio module has 2 extra inputs. See paragraph 7.3 Pulse inputs VA and VB regarding functioning of the pulse inputs. The **RadioRouter** module must be used with mains supply.

**10.2.4 Prog. data logger + RTC + 4..20 mA inputs + pulse inputs (67-00-22) (PCB 5550-925 )**

The module has connection possibility for two pressure transmitters on terminals 57, 58 and 59 and can be adjusted for current reading or pressure ranges of 6, 10 or 16 bar.

The module is prepared for remote reading, data from meter/ module being transferred to the system software via the connected external **GSM/ GPRS** modem on terminals 62, 63 and 64.

Furthermore, the module has two extra pulse inputs, see section 7.3: Pulse inputs VA and VB as to function. The module must always be powered by 24 VAC.

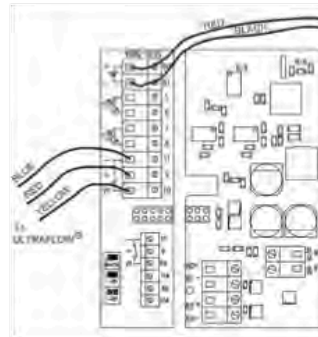
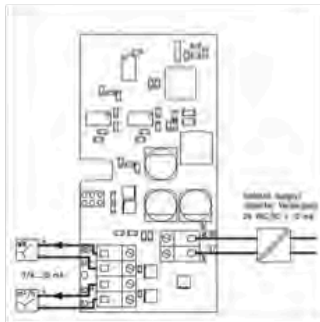
Pressure transmitter requirements: 4..20 mA, 2-wire, loop-powered, loop voltage max. 16 VDC  
(e.g. type CTL from Baumer A/S)



#### 10.2.5 0/4...20 mA outputs (67-00-23) (PCB 5550-1005)

The module is furnished with two active analogue outputs, which can both be configured for 0...20 mA or for 4...20 mA. In addition, the outputs can be configured to any measuring value (power, flow, or temperature) and to any range scaling. All values of the two analog outputs are updated every 10 seconds.

The module must be mounted in MULTICAL® 602. It cannot be used separately together with flow meters. The configuration is carried out via the menu "Bottom module" in METERTOOL.



#### 10.2.6 LonWorks + pulse inputs (67-00-24) (PCB 5550-1128)

The LON-module is used for data transfer from MULTICAL® 602 either for data reading or for regulation purposes via the LON-bus, which is ideal for climate control and building automation among other things. The high-speed data communication makes it possible to connect many applications to a LON-network.

The cabling between the LON-module and the other LON-nodes consists of standard twisted pair cable of up to 2700 m length at bus topology or 500 m length at free topology.

The module requires that MULTICAL® 602 is externally supplied (24-VAC / 230-VAC), battery supply of MULTICAL® 602 is not possible. See paragraph 7.3 as to the function of pulse inputs VA and VB.

Regarding network variable list (SNVT) and further information on the LonWorks module we refer to data sheet 5810-1144. GB-version 5810-1043 and DE-version 5810-1044. As to installation we refer to Installation instructions 5512-1101 (DK) or 5512-1105 (GB).

As the module is de-energised when the calculator top is not mounted, it is not possible to send Neuron ID by activating the button on the module.

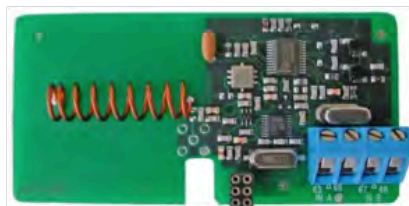
Neuron ID is sent by simultaneous activation of both front plate keys of MULTICAL® 602. When "Call" is displayed the Neuron ID has been sent.

**10.2.7 Radio + pulse inputs (67-00-25/26) (PCB 5550-608/640)**

The radio module is supplied as standard to operate in a licence-free frequency band but can also be supplied to other frequencies requiring licence.

The radio module is prepared to form part of a Kamstrup radio network, where read data automatically is transferred to system software via the network components **FF**Router and **FF**Concentrator.

The radio module has 2 extra inputs. See paragraph 7.3 Pulse inputs VA and VB regarding functioning of the pulse inputs.



67-00-25: Internal antenna

67-00-26: External antenna connection

**10.2.8 M-Bus module with alternative registers + pulse inputs (67-00-27) (PCB 5550-997)**

The M-Bus module is supplied via the M-Bus network and is independent of the meter's own supply. M-Bus and the energy meters communicate two-way via opto couplers which gives galvanically separation between M-Bus and the meter. The module supports primary, secondary and enhanced secondary addressing.

The M-Bus module has 2 extra inputs. See paragraph 7.3 Pulse inputs VA and VB concerning functioning of the pulse inputs.

In order to function correctly in a MC602, minimum program version F1 released in April 2011, is required.

**10.2.9 M-Bus module with medium data package + pulse inputs (67-00-28) (PCB 5550-1104)**

A new M-Bus base module has been developed for MULTICAL® 602 and can solely be used in MULTICAL® 602.

The "Error hour counter" has been added to the M-Bus telegram and following registers has been removed: TA2, TA3 in actual and target data and EB, E9, TL2, TL3 in manufacture specified data.

In order to function correctly in a MC602, minimum program version D1 released in April 2011, is required.

**10.2.10 M-Bus module with MC-III data package + pulse inputs (67-00-29) (PCB 5550-1125)**

The M-Bus module 670029 comprises the same data packet as M-Bus module 6604 for MC III/ 66-C and module 660S for MCC/ MC 401.

The module can e.g. be used together with the old M-Bus master with display, old regulators and old reading systems not supporting the newer M-Bus modules.

In order to function correctly in a MC602, minimum program version E1, released in June 2011, is required.

**10.2.11 Wireless M-Bus + 2 pulse inputs (67-00-30, 602-00-35) (PCB 5550-1098/1200)**

The radio module has been designed to form part of Kamstrup's hand-held Wireless M-Bus Reader systems, which operate within the unlicensed frequency band in the 868 MHz area.

The module fulfils the C-mode specifications of prEN13757-4 and can thus form part of other systems using Wireless M-Bus C-mode communication.

The radio module comes with internal antenna and external antenna connection as well as two pulse inputs (VA + VB). Paragraph 7.3 "Pulse inputs VA and VB" describes how the pulse inputs function.

The Wireless M-Bus radio transmitter is switched off before dispatch from the factory. It switches on automatically when one litre of water has run through meter. The radio transmitter can also be switched on by making a forced call (keep both front keys activated for approx. 5 sec. until CALL is displayed).

**10.2.12 ZigBee + 2 pulse inputs (67-00-60) (PCB 5550-992)**

The ZigBee module is mounted direct in the meter and is powered by the meter's supply. The module operates within the 2.4 GHz area and is ZigBee Smart Energy certified. The certification secures that the meter can form part of other ZigBee networks, e.g. reading several meter types from different meter suppliers.

To be able to offer a compact solution the module uses an internal antenna.

Paragraph 7.3 "Pulse inputs VA and VB" describes how the pulse inputs function.

#### 10.2.13 Metasys N2 (RS485) + 2 pulse inputs (VA, VB) (67-00-62) (PCB 5550-1110)

The N2 module is used for data transfer from MULTICAL® heat and cooling meters to an N2 Master in a Johnson Controls System. The N2 module transfers accumulated energy and volume, current temperatures, flow and power from the heat or cooling meter to an N2 Master. N2 Open from Johnson Controls is a widespread and established field bus protocol used within building automation. The N2 module for MULTICAL® ensures simple integration from Kamstrup's heat and cooling meters to N2 Open based systems. Address area is 1-255 determined by the last three digits of the meters customer number.

Further details about the Metasys N2 module appear from data sheet 5810-925, GB-version.

#### 10.2.14 SIOX module (Auto detect Baud rate) (602-00-64) (PCB 5920-193)

SIOX is used for data reading of small and medium size groups of heat meters via cable, the data reading being presented by the main system, e.g. Mcom, Fix or Telefrang. Further information on these systems can be ordered from the supplier in question. Furthermore, a configuration tool is available from Telefrang.

The two-wire serial SIOX bus connection is optoisolated from the meter and is connected without regard to polarity (i.e. the polarity is unimportant). The module is powered by the SIOX bus. Communication speed between 300 and 19,200 baud. The module automatically uses the highest possible communication speed. The module converts data from KMP protocol to SIOX protocol.

#### 10.2.15 BACnet MS/TP (B-ASC) RS485 + 2 pulse inputs (VA, VB) (67-00-66) (PCB 5550-1240)

The BACnet module is used for data transfer from MULTICAL heat cooling and water meters into BACnet systems. The BACnet module transfers Meter number (programmable), Serial number, Accumulated heat energy (E1), Accumulated cooling energy (E3), Accumulated volume flow (V1), Flow temperature, Return temperature, Temperature difference, Actual flow, Actual power, Accumulated values from additional meters with via puls InA, InB, Info codes from the heat, cooling and water meter to the BACnet system. BACnet is a widespread and established field bus protocol used within building automation. The BACnet module for MULTICAL ensures simple integration from Kamstrup's heat, cooling and water meters to BACnet based systems. The Module can be used as both master or slave, depending on the used MAC address.

Further details about the BACnet MS/TP module appear from data sheet 5810-1055, GB-version.



**10.2.16 GSM/GPRS module (GSM6H) (602-00-80) (PCB 5550-1137)**

The GSM/GPRS module functions as transparent communication path between reading software and MULTICAL® 602 and is used for data reading. The module includes an external dual-band GSM antenna which must always be used. The module itself includes a line of light emitting diodes indicating signal strength which are very useful during installation.

Further details about the GSM/GPRS module appear from data sheet 5810-627. GB-version 5810-628, DE-version 5810-629, SE-version 5810-630.

Regarding mounting we refer to installation instructions DK-version 5512-686, GB-version 5512-687, DE-version 5512-688.

The GSM/GPRS module (602-00-80) must be used together with the High Power mains supply (230 VAC: 602-00-00-3 and 24 VAC: 602-00-00-4).

**10.2.17 3G GSM/GPRS module (GSM8H) (67-00-81) (PCB - 5550-1209)**

Like GSM6H this module functions as transparent communication path between reading software and MULTICAL® 602 and is used for data reading.

However, this module supports both 2G (GSM/GPRS) and 3G (UMTS) which makes it applicable in areas with 3G coverage only.

The module requires an external Antenna, which covers both 900 MHz, 1800 MHz and 2100 MHz.

The module itself is fitted with a line of light emitting diodes indicating signal strength which are very useful during installation. Furthermore, it is indicated whether the module is connected to a 2G or a 3G network.

Additional details about the 3G module appear from data sheet 58101057 DK-version, 55101058 GB-version, 58101059 DE-version, 58101061 FI-version and 58101060 SE-version.

Regarding mounting we refer to installation instructions 55121121 DK-version, 55121122 GB-version, 55121123 DE-version, 55121124 FI-version and 55121125 SE-version.

**10.2.18 Ethernet/IP module (IP201) (602-00-82) (PCB 5550-844)**

The IP module functions as transparent communication between reading software and MULTICAL® 602 and is used for data reading. The module supports both dynamic and static addressing. This is specified in the order or selected during subsequent configuration. The module has no built-in security and must, therefore, always be used in connection with a firewall or NAT.

Further details appear from the data sheet, DK-version 5810-541, GB-version 5810-542, DE-version 5810-543, SE-version 5810-544. As far as installation is concerned we refer to installation instructions, DK version 5512-934, GB-version 5512-937, DE-version 5512-938, SE-version 5512-939.

The Ethernet/IP module (602-00-82) must be used together with the High Power mains supply (230 VAC: 602-00-00-3 and 24 VAC: 602-00-00-4).

**10.2.19 High Power Radio Router + 2 pulse inputs (VA, VB) (602-00-84) (PCB 5550-1116)**

The High Power RadioRouter module has built-in router functionality and is thus optimized to form part of a Kamstrup radio network, the read data being automatically transferred to system software via the network unit RF Concentrator.

Furthermore, the module can be read by Kamstrup's hand-held reading systems, e.g. USB Meter Reader and MT Pro.

The RadioRouter module is available for operation in both licence-free and licence demanding frequencies permitting a transmitting strength of up to 500 mW. The module is by default fitted with internal antenna, connection for external antenna, and two extra pulse inputs.

See paragraph 7.3 Pulse inputs VA and VB regarding the function of the pulse inputs.

The High Power RadioRouter module (602-00-84) must be used together with the High Power mains supply (230 VAC: 602-00-00-3 and 24 VAC: 602-00-00-4).



### 10.3 Retrofitting modules

Top as well as base modules for MULTICAL® 602 can be supplied separately for retrofitting. The modules are configured from the factory and ready to be mounted. Some of the modules, however, need individual configuration after installation, which can be carried out by means of METERTOOL.

Top module		Possible configuration after installation
ΔEnergy calculation + Hourly data logger	2	N/A
PQ or Δt-limiter + hourly data logger	3	Magnification, hysteresis and possible flow cut-off must be adjusted during commissioning. All parameters and limits can be changed via METERTOOL
Data output + hourly data logger	5	N/A
M-Bus	7	Primary and secondary M-Bus addresses can be changed via METERTOOL or M-Bus. Furthermore, monthly logger data can be selected instead of yearly logger data by means of M-Bus
ΔVolume + hourly data logger	9	N/A
2 pulse outputs for CE and CV + hourly data logger + scheduler	A	Configuration of pulse outputs.
2 pulse outputs for CE and CV + prog. data logger	B	Configuration of pulse outputs.
2 pulse outputs for CE and CV	C	Configuration of pulse outputs.
Base module		
Data/pulse inputs	10	Pulse values of VA and VB are changed via METERTOOL
M-Bus/pulse inputs	20	Pulse values of VA and VB are changed via METERTOOL Primary and secondary M-Bus addresses can be changed via METERTOOL or M-Bus. Furthermore, monthly logger data can be selected instead of yearly logger data via M-Bus
Radio Router/pulse inputs	21	Pulse values of VA and VB are changed via METERTOOL
Prog. data logger + 4...20 mA inputs + pulse inputs	22	Pulse values of VA and VB are changed via METERTOOL
0/4...20 mA outputs	23	Config data must be programmed into the calculator by means of METERTOOL in case of retrofitting. Furthermore, all parameters can be changed via METERTOOL
LonWorks + pulse inputs	24	Pulse values of VA and VB are changed via METERTOOL. All other configurations via LonWorks
Radio + pulse inputs (internal antenna)	25	Pulse values of VA and VB are changed via METERTOOL
Radio + pulse inputs (external antenna)	26	Pulse values of VA and VB are changed via METERTOOL
M-Bus module with alternative registers + pulse inputs	27	Pulse values of VA and VB are changed via METERTOOL. Primary and secondary M-Bus addresses can be changed via METERTOOL or M-Bus. Furthermore, monthly logger data can be selected instead of yearly logger data via M-Bus
M-Bus module with medium data package + pulse inputs	28	Pulse values of VA and VB are changed via METERTOOL. Primary and secondary M-Bus addresses can be changed via METERTOOL or M-Bus. Furthermore, yearly logger data can be selected instead monthly logger via M-Bus.
M-Bus module with MC-III data package + pulse inputs	29	Pulse values of VA and VB are changed via METERTOOL. Primary and secondary M-Bus addresses can be changed via METERTOOL or M-Bus.
Wireless M-Bus + pulse inputs	30/ 35	Pulse values of VA and VB are changed via METERTOOL
ZigBee 2.4 GHz internal antenna + pulse inputs	60	Pulse values of VA and VB are changed via METERTOOL
Metasys N2 (RS485) + pulse inputs	62	Pulse values of VA and VB are changed via METERTOOL
SIOX module (Auto detect Baud Rate)	64	N/A
BACnet MS/TP + pulse inputs	66	N/A
GSM/GPRS module (GSM6H)	80	N/A
3G GSM/GPRS modul (GSM8H)	81	N/A
Ethernet/IP module (IP201)	82	N/A
High Power Radio Router + pulse inputs	84	Pulse values of VA and VB are changed via METERTOOL

## 11 Data communication

### 11.1 MULTICAL® 602 data protocol

Internally in MULTICAL® 602 the data communication is built up with a Kamstrup Meter Protocol (KMP) that both gives a fast and flexible reading structure, and fulfils future demands on data reliability.

The KMP protocol is common for all Kamstrup consumption meters introduced in 2006 and later. The protocol is used on the optical eye and via pins to the base module. Base modules with e.g. M-Bus interface uses the KMP protocol internally and the M-Bus protocol externally.

The KMP protocol is constructed to handle point-to-point communication in a master/slave system (bus system, if required) and is used for data reading of Kamstrup energy meters.

#### *Software and parameter protection*

The meter's software is implemented into ROM and can after that not be changed neither deliberately nor non-deliberately. The legal parameters cannot be changed via data communication without breaking the legal seal and short-circuiting the "total programming lock".

#### *Software conformity*

The check sum of the software, based on CRC16, is available via data communication and on the display.

#### *Integrity and authenticity of data*

All data parameters contain type, measuring unit, scaling factor and CRC16 check sum.  
Each meter produced contains a unique identification number.

In the communication between master and slave two different formats are used. Either a data frame format or an application knowledge.

- Request from master to slave always takes place with a data frame.
- Response from the slave either takes place with a data frame or an application knowledge.

The data frame is based on the OSI model, in which the physical layer, data link layer and the application layer are used.

Number of bytes in each field	1	1	1	0-?	2	1
Field description	Start byte	Destination address	CID	Data	CRC	Stop byte
OSI – lag			Application layer			
		Data link layer				
	Physical layer					

The protocol is based on half duplex serial asynchronous communication with the setup: 8 databits, no parity and 2 stopbits. The data bit rate is 1200 or 2400 baud. CRC16 is used in both request and response.

Data is transferred byte for byte in a binary data format where the 8 databits thereby represent a byte data.

"Byte Stuffing" is used to extend the data domain.

11.1.1 MULTICAL® 602 Register ID's

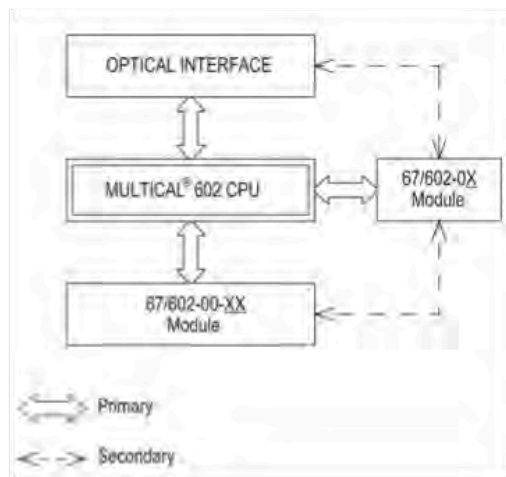
ID	Register	Description
1003	DATE	Current date (YYMMDD)
60	E1	Energy register 1: Heat energy
94	E2	Energy register 2: Control energy
63	E3	Energy register 3: Cooling energy
61	E4	Energy register 4: Flow energy
62	E5	Energy register 5: Return flow energy
95	E6	Energy register 6: Tap water energy
96	E7	Energy register 7: Heat energy Y
97	E8	Energy register 8: [ x T1]
110	E9	Energy register 9: [ x T2]
64	TA2	Tariff register 2
65	TA3	Tariff register 3
68	V1	Volume register V1
69	V2	Volume register V2
84	VA	Input register VA
85	VB	Input register VB
72	M1	Mass register V1
73	M2	Mass register V2
1004	HR	Operational hour counter
113	INFOEVENT	Info-event counter
1002	CLOCK	Current time (hhmmss)
99	INFO	Infocode register, current
86	T1	Current flow temperature
87	T2	Current return flow temperature
88	T3	Current temperature T3
122	T4	Current temperature T4
89	T1-T2	Current temperature difference
91	P1	Pressure in flow
92	P2	Pressure in return flow
74	FLOW1	Current flow in flow
75	FLOW2	Current flow in return flow
80	EFFEKT1	Current power calculated on the basis of V1-T1-T2
123	MAX FLOW1DATE/ÅR	Date for max. this year
124	MAX FLOW1/ÅR	Max. value this year
125	MIN FLOW1DATE/ÅR	Date for min. this year
126	MIN FLOW1/ÅR	Min. value this year
127	MAX EFFEKT1DATE/ÅR	Date for max. this year
128	MAX EFFEKT1/ÅR	Max. value this year
129	MIN EFFEKT1DATE/ÅR	Date for min. this year
130	MIN EFFEKT1/ÅR	Min. value this year
138	MAX FLOW1DATE/MÅNED	Date for max. this month
139	MAX FLOW1/MÅNED	Max. value this month
140	MIN FLOW1DATE/MÅNED	Date for min. this month
141	MIN FLOW1/MÅNED	Min. value this month
142	MAX EFFEKT1DATE/MÅNED	Date for max. this month
143	MAX EFFEKT1/MÅNED	Max. value this month
144	MIN EFFEKT1DATE/MÅNED	Date for min. this month
145	MIN EFFEKT1/MÅNED	Min. value this month
146	AVR T1/ÅR	Year-to-date average for T1
147	AVR T2/ÅR	Year-to-date average for T2
149	AVR T1/MÅNED	Month-to-date average for T1
150	AVR T2/MÅNED	Month-to-date average for T2
66	TL2	Tariff limit 2
67	TL3	Tariff limit 3
98	XDAY	Target date (reading date)
152	PROG NO	Program no. ABCCCCC
153	CONFIG NO 1	Config no. DDDEE
168	CONFIG NO 2	Config. no. FGGGMN
1001	SERIE NO	Serial no. (unique number for each meter)
112	METER NO 2	Customer number (8 most important digits)
1010	METER NO 1	Customer number (8 less important digits)
114	METER NO VA	Meter no. for VA
104	METER NO VB	Meter no. for VB
1005	METER TYPE	Software edition
154	CHECK SUM 1	Software check sum
155	HIGH RES	High-resolution energy register for testing purposes
157	TOPMODUL ID	ID number for top module
158	BOTMODUL ID	ID number for base module
175	INFOHOUR	Error hour counter
234	IMPINa	I/imp. for VA
235	IMPINb	I/imp. for VB

### 11.1.2 Data protocol

Utilities and other relevant companies who want to develop their own communication driver for the KMP protocol can order a demonstration program in C# (.net based) as well as a detailed protocol description (in English language).

## 11.2 MULTICAL® 602 communication paths

Physically, it is possible to communicate directly as shown below. Via destination addresses data communication can be routed internally between modules and calculator.



## 11.3 Optical eye

For data communication via the optical interface an optical eye can be used. The optical eye must be located at the front of the calculator, just above the IR-diode as shown on the photo below. Please note that the optical eye contains a very powerful magnet that should be protected with the magnet protector when not in use.

Different variants of the optical eye can be found in the list of accessories (see chapter 3.2.2).

### 11.3.1 Current saver for the optical eye

The circuit around the optical eye has been improved by a magnet sensor that only allows current consumption for the optical eye when a magnet (optical head) is attached to the meter.

## 12 Calibration and verification

### 12.1 High-resolution energy reading

If a need for high resolution of the energy reading arises during testing and verification it can be initialised as follows:

Lift up the calculator top from the base unit and wait for the display to turn off

Press both push buttons simultaneously while the calculator top is placed in the base unit again and keep pressing both push buttons until the display becomes active

The display now shows energy with a 0.1 [Wh] resolution until one of the push buttons are activated



The display example shows 345.4 [Wh] which corresponds to the energy accumulated at flow = 43.00°C and return flow = 40.00°C and a return volume of 0.1 m³.

The high-resolution energy reading is displayed in Wh at a volume resolution of 0.01 m³ (qp 1.5 m³/h). In connection with large meters the energy shown must be multiplied by 10 or 100.

m³	Wh
0.001	x 0.1
<b>0.01</b>	<b>x 1</b>
0.1	x 10
1	x 100

The high-resolution energy can be used for both heat energy (E1) and for cooling energy (E3).


#### 12.1.1 Data reading of high-resolution energy

Data reading of the register "HighRes" is possible with ID = 155.

The read value will show correct measuring unit and value irrespective of the meter size.

## 12.2 High-resolution volume for test

Should high-resolution reading of volume (V1HighRes) be required for test or verification it can be initialised as follows:

- Lift the calculator top off the connection base and wait for the display to turn off.
- Press the sub-button  and re-mount the calculator top keeping the button pressed for approx. 8 seconds until the display becomes active in HighRes mode.
- The display remains active in HighRes verification mode until one of the push buttons is activated, or the calculator top is reset.



Example:

V1	V1HighRes
0.001 m3	0.0001 L
0.01 m3	0.001 L
0.1 m3	0.01 L
1 m3	0.1 L

Example of a high-resolution volume (V1HighRes) reading:

The example below starts at a display value of 573.24 m<sup>3</sup> (v1). Having activated HighRes mode the display changes to a high resolution and reading in litres appears. Subsequently, a pulse value for Verification can be added, in this example 20.205.

```

00573.24 m³
(0057)3.240000 m³
3240.000 L
+ 20.205 L
3260.205 L

```

Note:

- V1HighRes is periodically updated every 10 seconds.

### 12.2.1 Data reading of high-resolution Volume

The register "HighRes" can be data read via ID = 239.

Data reading provides correct measuring unit and measuring value irrespective of meter size.

### 12.3 Pulse interface

During test and verification of MULTICAL® 602, where high resolution energy pulses are needed, the verification adapter, type 66-99-275, can be used in the module area of the connection bracket.

The pulse interface gets serial data from MULTICAL® 602 every 7. sec. and converts these to high resolution energy pulses with the same resolution as the high resolution display mode. (see chapter 12.1)

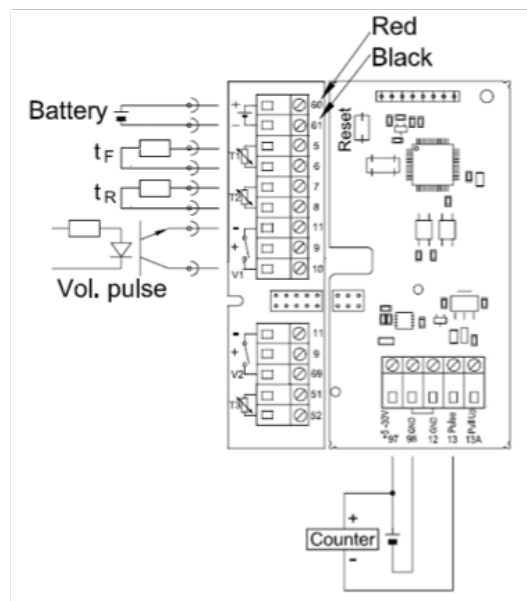
The pulse interface must be power supplied on terminal 97-98 from an external 5...30 VDC. The current consumption is max. 5 mA.

The high resolution energy pulses is a open collector signal on terminal 13-12. An additional pull-up resistor on 10 kOhm can be connected via terminal 13A.

#### 12.3.1 Meter types

Pulse interface type 5550-888 can be used for verification of the below 4 variants of MULTICAL® 602, if the correct connection PCB and the correct temperature sensors/simulators and flow simulator is used.

Meter type	602-A	602-B	602-C	602-D
Connection PCB	5550-492	5550-568	5550-492	5550-732
Sensor type	Pt100, 2-Wire	Pt500, 4- Wire	Pt500, 2- Wire	Pt500, 4- Wire
Volume input	ULTRAFLOW® (11-9-10) or Reed-contact (11-10)			24 V pulses (10B-11B)



Pulsinterface 5550-888 (to the right) with connection PCB 5550-492 (to the left)

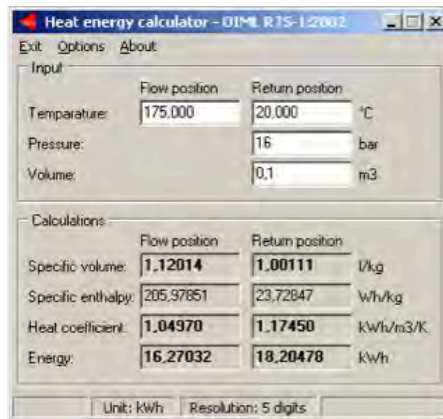
### 12.3.2 Technical data

Power supply (97-98):	5...30 VDC
Current consumption:	Max. 5 mA
Volume simulation:	Max. 128 Hz for CCC=1xx (ULTRAFLow®) Max. 1 Hz for CCC=0xx (Reed-contact)
HF-energy output (13-12):	Open collector, 5...30 VDC max. 15 mA
Pulse frequency (13-12):	Max. 32 kHz as burst per integration
Data interval:	Ca. 7 sec.
Time-out with no data:	Ca. 35 sec.

### 12.4 True energy calculation

During test and verification the energy calculation of the heat meter is compared with the "true energy" calculated according to the formular stated in EN 1434-1:2007 or OIML R75:2002.

The PC program METERTOOL from Kamstrup contains an energy calculator suitable for the purpose:



The conventional true energy at the most frequent verification points is stated in below table.

T1 [°C]	T2 [°C]	ΔΘ [K]	Flow [Wh/0.1 m³]	Return flow [Wh/0.1 m³]
42	40	2	230.11	230.29
43	40	3	345.02	345.43
53	50	3	343.62	344.11
50	40	10	1146.70	1151.55
70	50	20	2272.03	2295.86
80	60	20	2261.08	2287.57
160	40	120	12793.12	13988.44
160	20	140	14900.00	16390.83
175	20	155	16270.32	18204.78



## 13 METERTOOL for MULTICAL® 602

### 13.1 Introduction

METER TOOL for MULTICAL® 602 consists of two separate programs:

**"METER TOOL MULTICAL® 602"** is configuration and verification software for reconfiguration and test/verification of MULTICAL® 602 (ordering no. 66-99-718).

**"LogView MULTICAL® 602"** for log data readout as well as interval logging. The read data can be used for analysis and diagnostic test of the heating installation. Data can be presented as table and graphics, tables can be exported direct to "Windows Office Excell" ( ordering no. 66-99-719).

#### 13.1.1 System requirements

METER TOOL/LogView requires minimum Windows XP SP3, Windows 7 SP1 or higher as well as Explorer 5.01.

<b>Minimum:</b>	Pentium III or equivalent	<b>Recommended:</b>	Pentium 4 or equivalent
	256 MB RAM		512 MB RAM
	1 GB HD		10 GB HD
	Display resolution 1024 X 768		
	USB and CD-ROM drive		
	Printer installed		

Administrator rights to the PC are needed in order to install and use the programs. Must be installed under the logon of the person, who is to use the programs.

#### 13.1.2 Interface

The following interfaces can be used:

Verification equipment	type	66-99-399	Verification of 67-C (2-W/Pt500) and total/partial reconfiguration
Verification equipment	type	66-99-398	Verification of 67-B/D(4-W/Pt500) and total/partial reconfiguration
Verification equipment	type	66-99-397	Verification of 67-A (2-W/Pt100) and total/partial reconfiguration
Programming base	type	S-7590-014	Total/partial reconfiguration
Programming base	type	66-99-360	Configuration/programming hardware for MC602/S6, to be used together with optical eye
Optical eye USB	type	66-99-099	Partial reconfiguration
Optical eye Comport	type	66-99-102	Partial reconfiguration
USB 3-wire	type	66-99-098	Partial reconfiguration via module

Using equipment with Kamstrup USB, the USB driver must be installed before connection.

#### 13.1.3 Installation

Check that system requirements are fulfilled.

Close other open programs before starting the installation.

Insert the CD in the drive and follow the program's directions through the installation.

When the installation is completed, the icon "METER TOOL MULTICAL® 602" and/or "LogView MULTICAL® 602" will appear from the menu "start" and as a link on the desktop. Doubleclick on link or icon in order to start the required program.

## 13.2 METERTOOL MULTICAL® 602

### 13.2.1 General information

It is important to be familiar with the calculator's functions before starting programming.

There are two programming options "Partial programming" and "Total programming".

"Partial programming" does not allow change of coding which is important to energy calculation, e.g. Type number and Program number.

"Total programming" makes it possible also to change the rest of the values. Programming is only possible if the internal programming lock is closed (short circuit pen 66-99-278).

It is not possible to change the series number, as this is a unique number which is allocated to the meter during production.

"V2(CCC)", "T1", "T2" and "Max T1 for cooling" can be disabled, depending on the meter type in question.



The program is self-explanatory as to most coding numbers (see text in "combo-boxes"), further details can be found in the respective paragraphs of the technical description.

### 13.2.2 Total programming

To do total programming the meter must be connected via an optical eye to a PC with the METERTOOL software running. Break the verification seal and short circuit the TOTAL PROG button on the inside of the calculator top with a short circuit pen (66-99-278).

**Note!** This should only be done by an accredited laboratory, since breaking of the verification seal revokes the legal verification as well as the factory warranty.

After shorting the total programming circuit, the meter is set in programming mode for 4 minutes. As long as METERTOOL is communicating with the meter, the time for programming mode is extended, and after 4 minutes of inactivity the meter will return to normal mode. When the desired values are set, METERTOOL will terminate the programming mode by a reset, and the meter returns to normal mode ready for use.



Figure 10



Figure 11

### 13.2.3 File

The menu "File" includes printer setup as well as printout possibility of new meter label or test certificate.

<b>Exit</b>	Close METERTOOL
<b>Certificate</b>	Initiates printout of test certificate
<b>Print Label</b>	Initiates printout of meter label
<b>Select Label Printer</b>	Printer setup

### 13.2.4 Utility

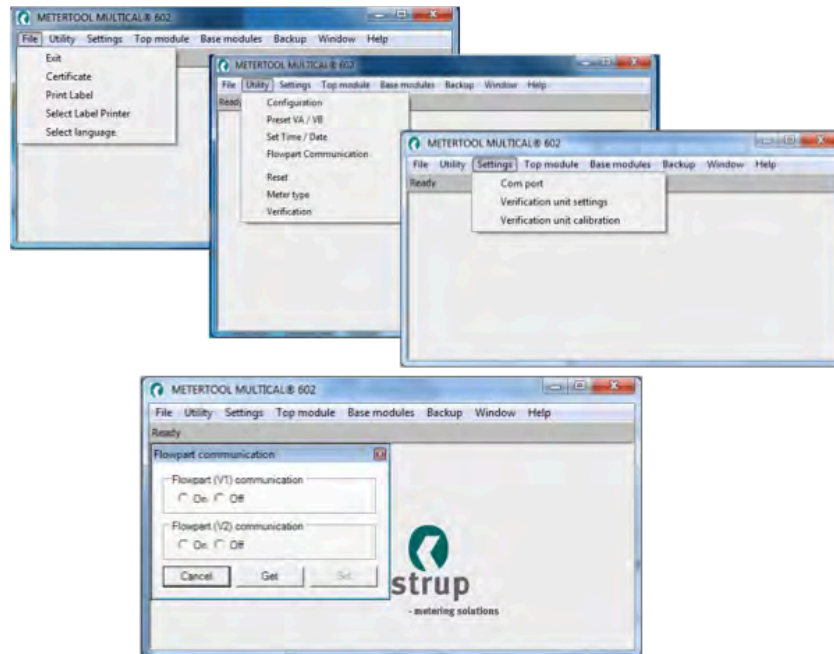
The menu "Utility" includes the following configuration and test points:

<b>Configuration</b>	Overall view which is used during reading and programming (see example at top of page)
<b>Preset VA/VB</b>	Presets the register values of the two extra pulse inputs for water and electricity meters
<b>Time/Date</b>	Transfer of date and time to MULTICAL® 602 calculator and top module
<b>Info code setup</b>	Used for disabling/enabling data communication between MULTICAL® 602 and ULTRAFLOW® 54
<b>Reset</b>	Normal reset, i.e. reset of data logger and total reset
<b>Meter Type</b>	Reads meter type, software revision and CRC checksum
<b>Verification</b>	See separate paragraph, <b>13.3</b> Verification

"Info code setup" is used for disabling/enabling data communication between MULTICAL® 602 and ULTRAFLOW® 14/54. "Info code setup" is carried out via optical reading head without breaking the meter's verification sealing.

MULTICAL® 602 can communicate with ULTRAFLOW® 54 in order to receive error messages from the flow meter. This communication is only supported if MULTICAL® 602 and ULTRAFLOW® 54 are direct connected (not via Pulse Transmitter). In case of connection via Pulse Transmitter, or if ULTRAFLOW® 65 is used, the communication must be disabled, otherwise MULTICAL® 602 will display the info code for missing communication.

In MULTICAL® 602 and ULTRAFLOW® 14 (cooling meter) communication is supported using Pulse Transmitter type 66-99-618.



Open "Flowpart communication" and activate "Get" in order to read the meter's setup of communication with flow sensors.

Select the required values for flow sensor 1 and flow sensor 2.

Subsequently, activate "Set" in order to send the change to the meter.

The meter now supports the selected setup.

NOTE! If the meter is subsequently configured, the communication setup is reset to standard setup. The change of communication setup must, therefore, be repeated.

### 13.2.5 Settings

**Comport** Setup of comport for interface of calculator /equipment.

**Verification unit settings** Input and maintenance of verification data of connected verification equipment.  
See separate paragraph, **13.3 Verification with METERTOOL MULTICAL® 602.**

**Verification unit calibration** Used for changing between temperature set points during calibration.

### 13.2.6 Top modules

The menu "Top modules" includes identification as well as configuration of top module mounted in MULTICAL®. Top modules and possible configurations are described in paragraph 10.1 Top modules.

**Note!** Top module no. 67-01 cannot be identified, as this module does not include identification which can be read by MULTICAL® 602.

### 13.2.7 Base modules

The menu "Bottom modules" is used for the configuration of base module data. See section 10.2 Base modules.

### 13.2.8 Backup

Used for exporting/importing a backup file of saved verification data.

### 13.2.9 Windows

The function makes it possible to change between open dialog boxes of the program.

### 13.2.10 Help

**Output** Opens the communication log, which is used in connection with troubleshooting in the program.

**Contact** Mail address for registration of METERTOOL users, and questions on subjects related to METERTOOL.

**About** Includes program numbers and revisions of the various components of the installed version. In connection with error reports on METERTOOL software we ask you to e-mail us a screen dump of "About".

### 13.2.11 Application

Doubleclick on link or icon in order to start the program.

Activate "Configuration" under "Utility" in order to start meter configuration.

Enter the present configuration by activating "Read meter".

Make the required coding changes and activate "Program" in order to carry out the changes in the meter.

**Note!** Please remember setup of comport the first time the program is used.

### 13.3 Verification with METERTOOL MULTICAL® 602

#### 13.3.1 General information

Verification of MULTICAL® 602 requires verification equipment, and verification data must be entered into the METERTOOL program.

#### 13.3.2 Verification equipment

Verification equipment, e.g. type 66-99-399, is used for verification of the calculator MULTICAL® 602. Verification includes energy verification of "E1" and "E3", test of volume inputs "V1", "V2", "VA" and "VB" as well as test of temperature input "T3".

Different temperatures are simulated for the two sensor inputs, "T1" and "T2", which form the basis of the verification of the energy calculation together with the volume simulation.

The equipment was primarily constructed for use in laboratories, which test and verify heat meters, but can also be used for performance testing the meter.

The computer program "METERTOOL MULTICAL® 602" type 66-99-704 is used for configuration, test and verification.

Verification equipment for MULTICAL® 602 includes USB interface (type 66-99-098) as well as corresponding driver software. During installation this interface creates a "Virtual comport" which figures in the computer as an optional comport of the METERTOOL MULTICAL® 602 software. As this "Virtual comport" only exists when the equipment is connected, the verification equipment *must* always be connected to the computer before the program "METERTOOL MULTICAL® 602" is started.

Furthermore, the verification equipment requires mains supply via the included mains adapter.



Verification does not apply to temperature sensors and flow part(s).

The verification equipment is available in three different types, depending on the MULTICAL® 602 type used and the temperature points to be tested.

66-99-397 Standard (EN1434/MID) Type 67-A (2-wire Pt100)	T1 [°C] 160 80 43	T2 [°C] 20 60 40	T3 [°C] 5
66-99-398 Standard (EN1434/MID) Type 67-B/D (4-wire Pt500)	T1 [°C] 160 80 43	T2 [°C] 20 60 40	T3 [°C] -
66-99-399 Standard (EN1434/MID) Type 67-C (2-wire Pt500)	T1 [°C] 160 80 43	T2 [°C] 20 60 40	T3 [°C] 5

For other equipment variants (types or temperature points), please contact Kamstrup A/S.

### 13.3.3 Function

Verification equipment, e.g. type 66-99-399, which is mounted in a standard MULTICAL® base, includes battery, verification PCB with connection terminals, microprocessor, control relays and precision resistors.

The calculator can simply be mounted on this base instead of the calculator base.

During test the calculator is supplied by the battery. The verification PCB is powered with 12 VDC by the enclosed external mains adapter. The microprocessor simulates volume based on pulse frequency and the number of pulses per test point selected in the computer program. The temperature simulation is obtained by means of fixed precision resistors, which are automatically changed via relays controlled by the microprocessor.

After test the computer reads all registers of the calculator and compares these values with the calculated values.

The calibration result in percentage of each test point can be stored in the computer under the series number of the tested MULTICAL® 602 to be printed out later on a test certificate.

### 13.3.4 Verification data

The first time METERTOOL and the verification equipment is used a number of calibration data must be entered into the menu "Verification" under "Settings" in the program METERTOOL. Calibration data is electronically included in the verification equipment (also enclosed with the verification equipment as a certificate on paper). In order to transfer calibration data from the equipment to the program select "Verification" from the menu "Settings" and activate "Read". Calibration data is now transferred to and saved in the program METERTOOL.

The screenshot shows the 'Verification Settings' window in the METERTOOL MULTICAL® 602 software. The window has a menu bar (File, Utility, Settings, Top module, Base modules, Backup, Window, Help) and a status bar (Ready). The main content area is divided into several sections:

- Verification Unit:** Serial Number: 621883, Configured: 28-07-2008 09:07:42, Counts: 37, Clear button.
- Verification:** Avg. room temp.: 21, Room temp. range: 5.
- Permissible Error:** 1st: 1.43 %, 2nd: 0.65 %, 3rd: 0.52 %.
- Uncertainty:** 1st: 0.68 %, 2nd: 0.16 %, 3rd: 0.02 %.
- Heat Coefficients - Flow Pipe:** 1st: 4.1399 MJ / (m³ °C), 2nd: 4.0708 MJ / (m³ °C), 3rd: 3.8328 MJ / (m³ °C).
- Heat Coefficients - Return Pipe:** 1st: 4.1452 MJ / (m³ °C), 2nd: 4.1175 MJ / (m³ °C), 3rd: 4.2144 MJ / (m³ °C).
- Test Points:** A table with columns: Measured Resistance, True Temperature, Nominal Temperature.
 

	Measured Resistance	True Temperature	Nominal Temperature
1st Tf	583.955 Ω	43.239 °C	43 °C
1st Tr	577.755 Ω	40.026 °C	40 °C
2nd Tf	653.801 Ω	79.642 °C	80 °C
2nd Tr	616.255 Ω	60.024 °C	60 °C
3rd Tf	804.507 Ω	159.589 °C	160 °C
3rd Tr	639.028 Ω	20.031 °C	20 °C
T3	609.750 Ω	4.953 °C	5 °C
- Number of Integrations:** 1st: 5, 2nd: 2, 3rd: 1.

Buttons at the bottom: Edit, Write, Read.

The calibration data of the equipment and the program verification data are compared every time the verification equipment is connected in order to secure that verification data is updated if the verification data of the equipment have been changed. For instance this can be due to recalibration of verification equipment. Calibration data of the verification equipment can be maintained by changing the verification data in the program METERTOOL and clicking on "Write" this new data into the equipment. In order to avoid unintentional change of calibration data "write" is protected by a password, which can be obtained from Kamstrup A/S.

Calibration data include test points, permissible error, uncertainty, ambient temperature (fixed value) and number of Integrations per test.



Having entered verification data the program automatically calculates the true k-factor in accordance with the formula of EN 1434 and OIML R75:2002.

### 13.3.5 Verification

The verification program menu is opened by activating "Verification" in the menu "Utility".

The screenshot shows the 'Verification' window of the METERTOOL MULTICAL® 602 software. The window is divided into several sections:

- Test Information:** Includes fields for Date (30 januar 2012), Manufacturer, Operator, Calib. procedure, Order No., and Comments. There are checkboxes for 'Energy & volume (Test result can be saved)' and 'Volume only (No saving of test results)'.
- Equipment:** Includes fields for Serial Number (621883), Meter, Serial No. (65000276), Customer No. (0000000065000276), Type No. (602C6200F1219), Program No. (33419419), and Config No. (210000101000).
- Energy test results:** A table with columns: True volume, True T1, True T2, True Energy, Measured Energy, and Error. It contains three rows of data.
- Volume test results:** A table with columns: Volume (V1), Volume (V2), Input (I/A), and Input (I/B). It contains two rows of data.
- Display values:** A table with columns: Energy, Volume (V1), and Temperatures (True T3, Measured T3). It contains two rows of data.
- Buttons:** 'Save' and 'Start verification' buttons are located at the bottom right.

Click on "Start verification" in order to start test/verification.

When the test has been completed the result will be displayed. If the result can be approved click on "Save". The result is now saved in the database under the series number of the calculator. You can save several results under one series number without overwriting earlier results.

### 13.3.6 Certificate

If you want to print out a certificate with saved results, select "Certificate" in the menu "File". You can now find the test/verification result according to series number, and the certificate can be printed out.

The screenshot shows the 'Create Certificate' window of the METERTOOL MULTICAL® 602 software. The window is divided into several sections:

- Search criteria:** Includes fields for Serial No from, Serial No to, Calibrated from (04-01-2012), and Calibrated to (21-02-2012). There is a 'Search' button.
- Customer:** Includes fields for Name, Address 1, Address 2, Address 3, Address 4, Signature, and Report type (English).
- Print:** A 'Print' button is located below the search criteria.
- Results List:** A table with columns: Selected, Serial No, and Created. It contains two rows of data.



### 13.4 LogView MULTICAL® 602

#### 13.4.1 Introduction and installation

Regarding "Introduction", "Interface" and "Installation" see paragraph 13.1 Introduction METERTOOL.

#### 13.4.2 General information

"LogView MULTICAL® 602" is used for read-out of logging data from MULTICAL® 602 calculator and top modules (e.g. hourly data) as well as interval logging. The read out data can be used for analysis and diagnostic test of the heating installation. Data can be presented as table and graphics, tables can be exported to "Windows Office Excel" (ordering no. 66-99-719).

For available logging data see paragraph 6.10 Data loggers.

#### 13.4.3 "File"

**Settings** Setup of comport for interface of calculator/equipment.

**Note!** Please remember that the USB interface must be connected before starting the LogView program.

**Exit** Exit LogView

#### 13.4.4 "Log"

Select the required data function.

**Interval Data** allows interval reading of current MULTICAL® 602 counts at optional intervals between 1 and 1440 minutes as well as an optional number of repetitions of the reading between 1 and 9999 times.

For read-out of "current" counts, enter interval: 1 and repetition: 1. Thereby you obtain one "instantaneous" reading.

**Daily Data, Monthly Data and Yearly Data** allow read-out of data logged by MULTICAL® 602, with optional data period and values.

**Info Data** allows read-out of the latest 50 info events from MULTICAL® 602, reading includes date and info code of the info event.

#### 13.4.5 "Top Module Log"

This function makes it possible to read out logging data, which have been logged by and stored in a top module. This will mainly be read-out of e.g. "Hourly Logging Data", for other possibilities see paragraph 10.1.1 Top modules

#### 13.4.6 "Bottom Module Log"

Is used for reading of logger data collected in base modules.

#### 13.4.7 "Quick Figure"

Quick figure reads out the energy register during verification and calculates the related Quick figure.

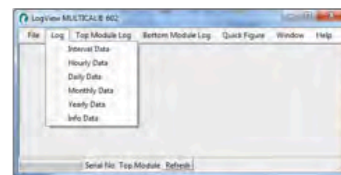
#### 13.4.8 "Window"

The function makes it possible to change between open dialog boxes in the program.

#### 13.4.9 "Help"

**Contact** Mail address for registration as LogView user as well as for requests on LogView related subjects.

**About** Includes program numbers and revisions of the different components of the installed version. In connection with error reports on LogView software we ask you to mail us a screen dump of "About".

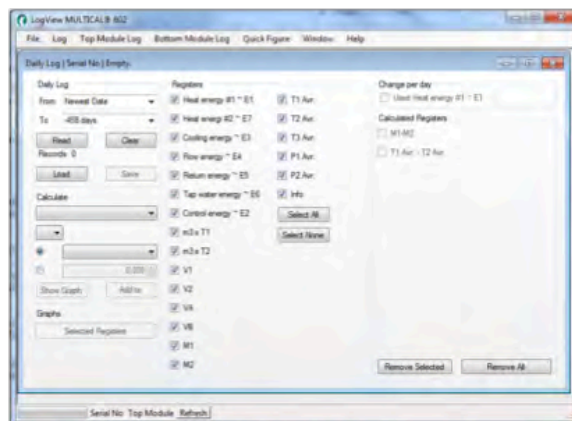


### 13.4.10 Application

Doubleclick on link or icon for "LogView MULTICAL® 602" in order to start the program, and select the required data function.

**Note!** Remember to set up the comport the first time the program is used.

"Daily Data" is used as an example:



After read-out nonselected data registers are toned grey and cannot be used during further processing/analysis. To read out all data, activate "Select All" to select all values.

When read-out has been completed the program automatically asks whether the data should be saved. We recommend you to save the read-outs, securing that data can be reopened later for further analysis or documentation.

Additional functions can now be selected for the read data. By means of "Calculation" individual calculations can be carried out, and graphs/tables with the values appear by activating "Show Graph". If you want to save calculation forms for reuse, select "Add to" and the function is added to "Calculated Registers".

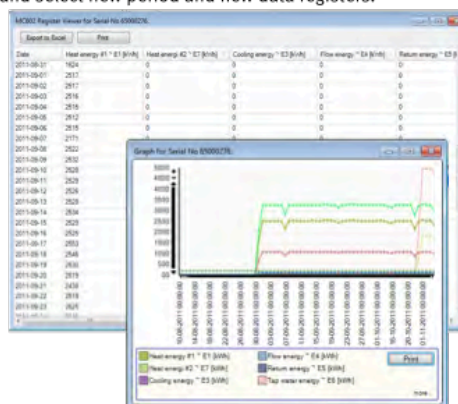
In order to carry out a new data read-out, click on "Clear", and select new period and new data registers.

Choosing "Selected Registers" under "Graphs" graph(s)/table with the marked registers are displayed.

Tables can be exported direct to "Windows Office Excel" or printed.

To zoom in activate (+), to zoom out activate (-) on the axes.

The arrows (↑↓→←) on the axes are used for manoeuvring in the graph area.



## 14 Approvals

### 14.1 CE marking

MULTICAL® 602 is CE-marked in accordance with following directives:

EMC directive      2004/108/EC

LV directive        2006/95/EC

### 14.2 Measuring instrument directive

MULTICAL® 602 is available with CE-marking according to MID (2004/22/EC). The certificates have the following numbers:

B-Module:    DK-0200-MI004-020

D-Module:    DK-0200-MIQA-001



## Declaration of Conformity

**Overensstemmelseserklæring**  
**Déclaration de conformité**  
**Konformitätserklärung**  
**Deklaracja Zgodności**  
**Declaración de conformidad**  
**Declaratie de conformitate**

We  
 Vi  
 Nous  
 Wir  
 My  
 Nosotros  
 Noi

**Kamstrup A/S**  
**Industrivej 28, Stilling**  
**DK-8660 Skanderborg**  
**Denmark**  
**Tel: +45 89 93 10 00**

declare under our sole responsibility that the product(s):  
 erklærer under ensomst ansvar, at produkt(erne):  
 déclarent sous notre responsabilité que le/les produit(s):  
 erklærer in unserer Verantwortung, dass/daß Produkt(e):  
 deklarujemy z pełnej odpowiedzialności, że produkt(y):  
 Declaración, bajo responsabilidad propia que el/los producto:  
 declarăm pe proprie răspundere că produsul/produsele:

Instrument	Type	Type No.:	Classes	Type Approval Ref.:
Heat Meter	MULTICAL® 401	66-V and 66-W	CI 2/3, M1, E1	DK-0200-MI004-001
Heat Meter	MULTICAL® 402	402-V, 402-W, 402-T	CI 2/3, M1, E1	DK-0200-MI004-013
Temperature Sensors	PL and DS	65-00-0A/B/C/D 66-00-0F/G 65-00-0L/M/N/P 66-00-0Q3/4 65-56-4	M1	DK-0200-MI004-002
Flow Sensor	ULTRAFLOW® qp 0.6...400 m³/h	65-S/R/T	CI 3, M1, E1	DK-0200-MI004-003
Flow Sensor	ULTRAFLOW® qp 0.6...40 m³/h and qp 150...400 m³/h	65-S/R/T	CI 2/3, M1, E1	DK-0200-MI004-003
Calculator	MULTICAL® 601	67-A/B/C/D	M1, E1/E2	DK-0200-MI004-004
	MULTICAL® 601+	67-E	M1, E1/E2	DK-0200-MI004-004
	MULTICAL® 602	602-A/B/C/D	M1, E1/E2	DK-0200-MI004-020
	SVM S6	S6-A/B/C/D	M1, E1/E2	DK-0200-MI004-020
	MULTICAL® 801	67-F/G/K/L	M1, E1/E2	DK-0200-MI004-009
Flow Sensor	ULTRAFLOW® 54/34 qp 0.6...100 m³/h qp 150...1000 m³/h	65-5/65-3	CI 2/3 M1, E1/E2 M1/M2, E1/E2	DK-0200-MI004-008
Water Meter	MULTICAL® 21	021-66	CI 2, M1, E1/E2	DK-0200-MI001-015
	MULTICAL® 41	66-Z	CI 2, M1, E1	DK-0200-MI001-003
	MULTICAL® 61	67-Z	CI 2, M1, E1, B	DK-0200-MI001-010
	MULTICAL® 62	62-Z	CI 2, M1, E1, B	DK-0200-MI001-016

are in conformity with the requirements of the following directives:

se 1 overensstemmelse med kravene i følgende direktiver:  
 sunt conforme(c) aux exigences de la/des directives:  
 are în conformanță cu cerințele următoarelor directive:  
 są zgodne z wymaganiami następujących dyrektyw:  
 se/son conformes aux les requirements de las siguientes directivas:  
 este/sunt în conformitate cu cerințele următoarelor directive:

Measuring Instrument Directive 2004/22/EC  
 EMC Directive 2004/108/EC  
 LVD Directive 2006/95/EC  
 PE-Directive (Pressure) 97/23/EC  
 R&TTE 1999/5/EC

Notified Body, Module D Certificate:  
 Force Certification A/S  
 EC Notified Body nr. 0200  
 Park Alle 345, 2605 Brøndby  
 Denmark

Date: 2012-06-18

Sign.:

**Lars Bo Hammer**  
**Quality Assurance Manager**

5512-931 Rev.: V1, Kamstrup A/S, DK8660 Skanderborg, Denmark

## 15 Trouble-shooting

MULTICAL® 602 is constructed with a view to fast and simple mounting as well as long-term, reliable operation at the heat consumer's.

Should you, however, experience an operating problem with the meter, the error detection table below may help you clarify the possible reason.

In connection with repair, if necessary, we recommend to replace only battery and temperature sensors and communication modules. Alternatively, the entire meter must be replaced.

Major repairs must be made in our factory.

Before sending in the meter for repair, you must go through below error detection table to help clarify the possible cause of the problem.

Symptom	Possible cause	Suggested corrections
No display function (blank display)	No power supply.	Replace the battery or check the mains supply. Is there 3.6 VDC on terminal 60(+) and 61(-) ?
No accumulation of energy (e.g. MWh) and volume (m <sup>3</sup> )	Read "info" on the display.	Check the error indicated by the info code (see section 6.8)
	If "info" = 000, 16384 or 32768 ⇒	Check that the flow direction corresponds with the arrow on the flow sensor
	If "info" = 004, 008 or 012 ⇒	Check the temperature sensors. If defects are detected, replace the sensor set.
	If "info" = 4096 or 8192 ⇒	There is air in the installation. Ventilation necessary.
Accumulation of volume (m <sup>3</sup> ), but not of energy (e.g. MWh)	Flow and return sensors have been reversed, either during installation or connection.	Mount the sensors correctly
No accumulation of volume (m <sup>3</sup> )	No volume pulses	Check that the flow direction corresponds with the arrow on the flow sensor. Check the flow sensor connection
Incorrect accumulation of volume (m <sup>3</sup> )	Incorrect programming. If "info" = 128 or 2048 ⇒	Check if the pulse figure on the flow sensor corresponds with the calculator
Incorrect temperature indication	Defective temperature sensor	Replace the sensor set.
	Insufficient installation	Check the installation
Temperature display is too low or accumulated energy is too little (e.g. MWh)	Poor thermal sensor contact Heat dissipation Sensor pockets too short	Place the sensors in the bottom of the sensor pockets. Insulate the sensor pockets. Replace sensor pockets with longer ones.

## 16 Disposal

Kamstrup A/S is environmentally certified according to ISO 14001, and as far as possible and as part of our environmental policy we use materials that can be recycled in an environmentally correct way.

Kamstrup A/S has calculated carbon footprint of all meters.



- **Disposal by Kamstrup A/S**

Kamstrup accepts worn-out meters for environmentally correct disposal according to previous agreement. The disposal is free of charge to the customer, except for the cost of transportation to Kamstrup A/S.

- **The customer sends for disposal**

The meters must not be disassembled prior to dispatch. The complete meter is handed in for approved national/local disposal. Enclose a copy of this in order to inform the recipient of the contents.

Please note that lithium cells, and meters containing lithium cells must be shipped as dangerous goods. Please see Kamstrup document 5509-682 "Shipping of battery powered heat meters and lithium batteries"

Subject	Material	Recommended destruction
Lithium cells in MULTICAL® 602	Lithium and Thionylchlorid >UN 3090< D-cell: 4.9 g lithium	Approved destruction of lithium cells
PC boards in MULTICAL® 602 (LC-display must be removed)	Copper epoxide laminate with soldered componenets	Print board scrap for concentration of noble metals
LC-display	Glass and liquid crystals	Approved processing of LC displays
Cables for flow sensor and sensors	Copper with silicone mantle	Cable recycling
Transparent top cover	PC	Plastic recycling
Print box and base unit	Noryl and ABS with TPE gaskets	Plastic recycling
Other plastic parts, cast	PC + 20% glass	Plastic recycling
Meter case, ULTRAFLOW®	> 84% alpha brass/redbrass < 15% standard steel (St 37) < 1% stainless steel	Metal recycling
Packing	Environmental cardboard	Cardboard recycling (Resy)
Packing	Polystyrene	EPS recycling

Please direct any questions you may have concerning environmental matters to:

## 17 Documents

	Danish	English	German	Russian
Technical description	5512-930	5512-931	5512-932	5512-933
Data sheet	5810-938	5810-939	5810-940	5810-957
Installation and user guide	5512-951	5512-952	5512-953	5512-956

## 18 Appendix A - MULTICAL® 602 vs. previous meters

This paragraph briefly describes the compatibility with other/previous meters. The description is not final.

### 18.1 Kamstrup Meter Protocol (KMP)

MULTICAL® 602 uses Kamstrup's Meter Protocol (KMP) and, thus, has the same communication platform as MULTICAL® 402/61/601/801. KMP is used internally in the meter as well as via the optical eye and contact pins for the base module. Thus, base modules with e.g. M-Bus interface use the KMP protocol internally and the M-Bus protocol externally. Further information on the KMP protocol appears from paragraph 11.1.

### 18.2 M-Bus module with MULTICAL® III compatible data packet (67-00-29)

A variety of M-Bus modules are available for the Kamstrup MULTICAL® 61/601/801 meters. The contents of the module's M-Bus data package are similar to the data of the M-Bus modules for MULTICAL® III and MULTICAL® Compact, allowing installation in older applications originally designed for e.g. MULTICAL® III.

The module can also be used together with the old 40-slave M-Bus Master with display from Kamstrup as well as older regulators and reading software. The module is mounted in the meter's module area and is used for remote reading and programming of MULTICAL® 61/601/602/801.

### 18.3 SIOX module (602-00-64)

The SIOX module can be used in a series of Kamstrup's meters, e.g. MULTICAL® 61/601/602/801, making it possible to read meter data via the SIOX-bus. The SIOX-bus is a well-known bus-system, which has been used in many meter relations. This module makes it possible to use MULTICAL® 61/601/602/801 in a SIOX-network.

### 18.4 MULTICAL® 66-C compatibility module (67-06)

Concerning MULTICAL® 601 a top module made MULTICAL® 601 data compatible with MULTICAL® 66-C, making it possible to use a series of previous base modules for MULTICAL® 66-C in MULTICAL® 601 too. This module has been discontinued and does not function together with MULTICAL® 602.

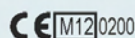




## ULTRAFLOW® 54 DN15-125 DATA SHEET

- Ultrasonic flow sensor
- For flow from 0.6 m³/h up to 100 m³/h
- Compact design
- Static meter with no moving parts
- Large dynamic range
- No wear
- Exceptionally accurate
- Longevity

MID-2004/22/EC



### Application

ULTRAFLOW® 54 is a static flow sensor based on the ultrasonic measuring principle. The prime area of application is as a volume flow sensor for use with thermal heat meters such as MULTICAL®. ULTRAFLOW® 54 has been designed for use in heating installations where water is used as the heat-bearing medium.

ULTRAFLOW® 54 employs micro-processor technology and ultrasonic measuring techniques. All circuits for calculating and measuring are collected on a single board, providing compact and rational design in addition to an exceptionally high level of measuring accuracy and reliability.

The flow is measured using bidirectional ultrasonic technique based on

the transit time method, with proven long-term stability and accuracy. Two ultrasonic transducers are used to send the sound signal both against and with the flow direction.

The ultrasonic signal travelling with the flow direction reaches the opposite transducer first. The time difference between the two signals can be converted to a flow velocity and thus a volume.

A three-wire pulse cable is used to connect ULTRAFLOW® 54 to MULTICAL®. This cable is used to supply the flow sensor from the calculator and also to send the signal to the calculator. The signal corresponds to the flow, or more correctly, a number of pulses proportional to the water

volume flowing through the meter is transmitted.

If required a Pulse Transmitter can be used to supply ULTRAFLOW® 54, e.g. if the distance between MULTICAL® and ULTRAFLOW® 54 is 10 m or more. If ULTRAFLOW® 54 is used as pulse generator for other equipment, it must be connected through a Pulse Transmitter.

The Pulse Transmitter has a built-in supply and a galvanically separated pulse outlet.



# ULTRAFLOW® 54 DN15-125

## DATA SHEET

### Table of contents

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Approvals	3
Technical data	3
Flowdata	4
Materials	5
Type summary	6
Dimension sketches	6
Pulse Transmitter	8
Pressure loss	9
Pressure loss graphs	9
Installation	10
Examples of installation	11
Electrical connection	12
Example of connecting ULTRAFLOW® 54 and MULTICAL®	12
Order specification	13
Accessories	14

# ULTRAFLOW® 54 DN15-125

## DATA SHEET

### Approvals

#### Type approval

ULTRAFLOW® 54 approved in accordance with MID-2004/22/EC.  
EC-Type Examination certificate: DK-0200-MI004-008.

Please contact Kamstrup A/S for further information relating to type approval and verification.

#### CE-marking

ULTRAFLOW® 54 is marked in accordance with:

- |                 |   |
|-----------------|---|
| – MID-directive | 2004/22/EC  |
| – LV-directive  | 2006/95/EC (together with the Pulse Transmitter or the Pulse Divider) |
| – PE-directive  | 97/23/EC (DN50...DN125 category I)                                    |

MID-2004/22/EC



#### MID designation

- |                               |  |
|-------------------------------|--|
| – Mechanical environment      | Class M1   |
| – Electromagnetic environment | Class E1 and E2  |
| – Ambient temperature         | 5...55°C, non condensing closed location (indoor installation) |

### Technical data

#### Mechanical data

Metrological class	2 and 3
Environmental class	Complies with DS/EN 1434 class C
Ambient temperature	0...55°C
Protection class	
– Flow sensor	IP65
– Pulse Transmitter	IP54
Temperature* of medium	15...130°C
Storage temperature (empty sensor)	
– Meter without battery	-25...70°C
– Meter with battery	-25...60°C
Pressure stage	PN16, PN25 flange

\* If the temperature of the medium exceeds 90°C a flange meter should be used. Additionally, MULTICAL® calculator or the Pulse Transmitter should be wall-mounted.

# ULTRAFLOW® 54 DN15-125

## DATA SHEET

### Technical data

#### Electrical data

Supply voltage	3.6 V ± 0.1 V
Battery (Pulse Transmitter)	3.65 VDC, D-Cell lithium
Replacement interval	6 years @ $t_{BAT} < 30^{\circ}\text{C}$
Power supply (Pulse Transmitter)	230 VAC +15/-30%, 48...52 Hz 24 VAC ±30%
Back-up supply	Integral super-cap eliminates operational disturbances due to short-term power-cuts
Cable length, flow sensor	Max. 10 m
Cable length (Pulse Transmitter)	Depends on calculator
EMC data	Complies with DS/EN 1434 class C

### Flowdata

Nom. flow $q_p$ [m³/h]	Nom. diameter [mm]	Meter factor <sup>1)</sup> [imp./l]	Dynamic range $q_i:q_p$	$q_s:q_p$	Flow @125 Hz <sup>2)</sup> [m³/h]	$\Delta p@q_p$ [bar]	Min. cut off [l/h]
0.6	DN15 & DN20	300	1:50 & 1:100	2:1	1.5	0.04	2
1.5	DN15 & DN20	100	1:50 & 1:100	2:1	4.5	0.22	3
2.5	DN20	60	1:50 & 1:100	2:1	7.5	0.03	5
3.5	DN25	50	1:50 & 1:100	2:1	9	0.07	7
6	DN25	25	1:50 & 1:100	2:1	18	0.2	12
10	DN40	15	1:50 & 1:100	2:1	30	0.06	20
15	DN50	10	1:50 & 1:100	2:1	45	0.14	30
25	DN65	6	1:50 & 1:100	2:1	75	0.06	50
40	DN80	5	1:50 & 1:100	2:1	90	0.05	80
60	DN100	2.5	1:50 & 1:100	2:1	180	0.03	120
100	DN100	1.5	1:50 & 1:100	2:1	300	0.07	200
100	DN125	1.5	1:50 & 1:100	2:1	300	0.1	200

<sup>1)</sup> The meter factor can be seen on the ULTRAFLOW® label on the meter.

<sup>2)</sup> Saturation flow. Max. pulse frequency 128 Hz is maintained at higher flow rates.

# ULTRAFLOW® 54 DN15-125

## DATA SHEET

### Materials

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#### Wetted parts

##### ULTRAFLOW® 54, $q_p$ 0.6 og 1.5 m<sup>3</sup>/h

Housing, gland	DZR brass (Dezincification resistant brass)
Housing, flange	Stainless steel, W.no. 1.4308
Transducers	Stainless steel, W.no. 1.4401
Gaskets	EPDM
Reflectors	Thermoplastic, PES 30% GF and stainless steel, W.no. 1.4301
Measuring pipe	Thermoplastic, PES 30% GF

##### ULTRAFLOW® 54, $q_p$ 2.5 til 100 m<sup>3</sup>/h

Housing, gland	DZR brass (Dezincification resistant brass)
Housing, flange	Stainless steel, W.no. 1.4308
Transducers	Stainless steel, W.no. 1.4401
Gaskets	EPDM
Measuring pipe	Thermoplastic, PES 30% GF
Reflectors	Stainless steel, W.no. 1.4301

#### Electronic housing

Base	Thermoplastic, PBT 30% GF
Lid	Thermoplastic, PC 20% GF

#### Connection cable $q_p$ 0.6 to 100 m<sup>3</sup>/h

Silicone cable (3 x 0.5 mm<sup>2</sup>)

# ULTRAFLOW® 54 DN15-125

## DATA SHEET

### Type summary

Nom. flow $q_p$ [m³/h]	Size				
0.6	G $\frac{3}{4}$ B x 110 mm	G1B x 130 mm			
1.5	G $\frac{3}{4}$ B x 110 mm	G $\frac{3}{4}$ B x 165 mm	G1B x 130 mm	G1B x 190 mm	(G1B x 165 mm)
2.5	G1B x 190 mm	DN20 x 190 mm			
3.5	G5/4B x 260 mm	DN25 x 260 mm			
6	G5/4B x 260 mm	DN25 x 260 mm			
10	G2B x 300 mm	DN40 x 300 mm			
15	DN50 x 270 mm				
25	DN65 x 300 mm				
40	DN80 x 300 mm				
60	DN100 x 360 mm				
100	DN100 x 360 mm	DN125 x 350 mm			

(...) Country specific variants

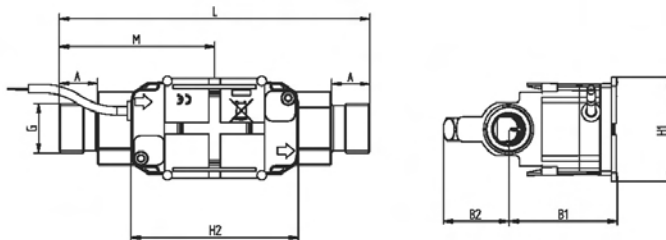
Thread ISO 228-1

Flange EN 1092, PN25

### Dimension sketches

ULTRAFLOW® 54, G $\frac{3}{4}$ B and G1B

All measurements are in mm, unless otherwise stated.



Thread ISO 228-1

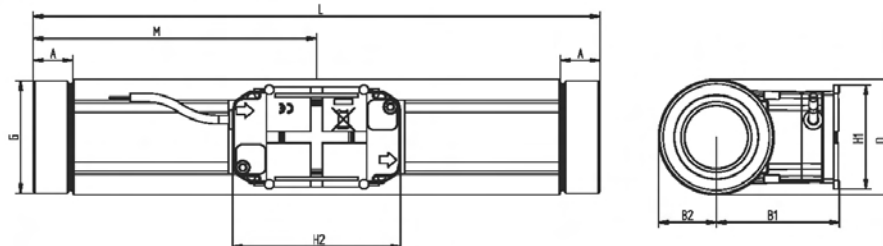
Thread	L	M	H2	A	B1	B2	H1	App. weight [kg]
G $\frac{3}{4}$ B	110	L/2	89	10.5	58	35	55	0.8
G1B	130	L/2	89	20.5	58	35	55	1.1
G $\frac{3}{4}$ B	165	L/2	89	20.5	58	35	55	1.2
G1B	165	L/2	89	20.5	58	35	55	1.2
G1B ( $q_p$ 1.5)	190	L/2	89	20.5	58	35	55	1.5
G1B ( $q_p$ 2.5)	190	L/2	89	20.5	58	36	55	1.3

# ULTRAFLOW® 54 DN15-125

## DATA SHEET

### Dimension sketches

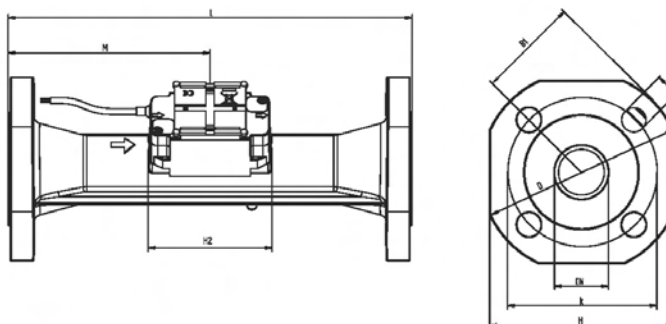
ULTRAFLOW® 54, G5/4B and G2B



Thread ISO 228-1

Thread	L	M	H2	A	B1	B2	H1	App. weight [kg]
G5/4B	260	L/2	89	17	58	22	55	2.3
G2B	300	L/2	89	21	65	31	55	4.5

ULTRAFLOW® 54, DN20 to DN50



Flange EN 1092, PN25

Nom. diameter	L	M	H2	B1	D	H	k	No.	Bolts		App. weight [kg]
									Thread	d <sub>2</sub>	
DN20	190	L/2	89	58	105	95	75	4	M12	14	2.9
DN25	260	L/2	89	58	115	106	85	4	M12	14	5.0
DN40	300	L/2	89	<D/2	150	136	110	4	M16	18	8.3
DN50	270	155	89	<D/2	165	145	125	4	M16	18	10.1

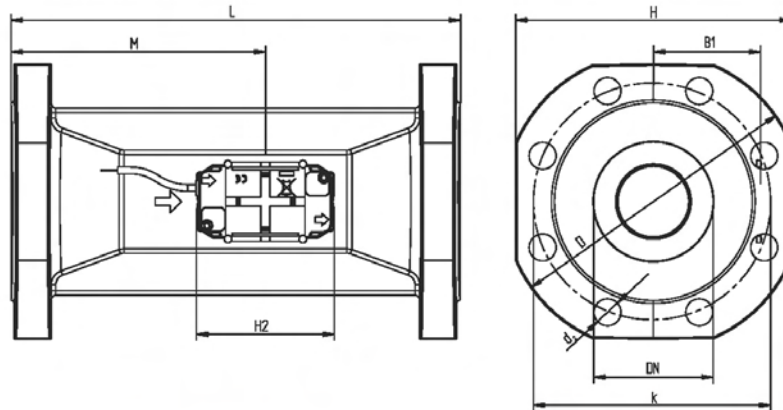


# ULTRAFLOW® 54 DN15-125

## DATA SHEET

### Dimension sketches

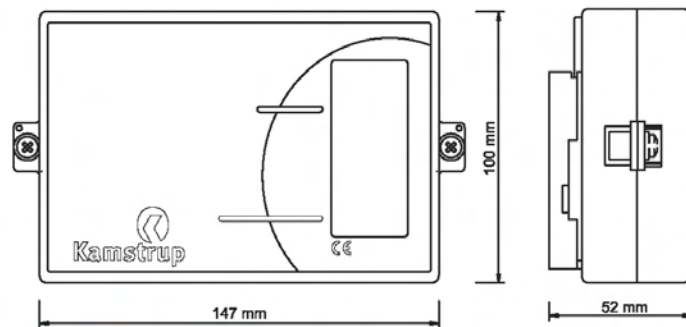
ULTRAFLOW® 54, DN65 to DN125



Flange EN 1092, PN25

Nom. diameter	L	M	H2	B1	D	H	k	Bolts			App. weight [kg]
								No.	Thread	d <sub>2</sub>	
DN65	300	170	89	<H/2	185	168	145	8	M16	18	13.2
DN80	300	170	89	<H/2	200	184	160	8	M16	18	16.8
DN100	360	210	89	<H/2	235	220	190	8	M20	22	21.7
DN125	350	212	89	<H/2	270	260	220	8	M24	28	28.2

### Pulse Transmitter



# ULTRAFLOW® 54 DN15-125

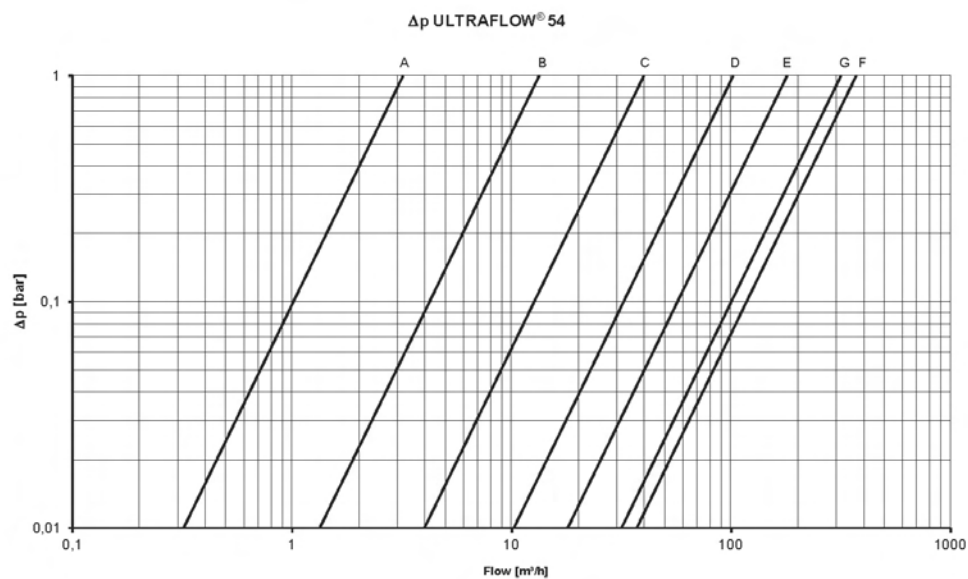
## DATA SHEET

### Pressure loss

Graph	$q_p$ [m³/h]	Nom. diameter	$k_v^{3)}$	$Q@0.25 \text{ bar}$ [m³/h]
A	0.6 & 1.5	DN15 & DN20	3.2	1.6
B	2.5 & 3.5 & 6	DN20 & DN25	13.4	6.7
C	10 & 15	DN40 & DN50	40	20
D	25	DN65	102	51
E	40	DN80	179	90
F	60 & 100	DN100	373	187
G	100	DN125	316	158

<sup>3)</sup>  $q = k_v \times \sqrt{\Delta p}$

### Pressure loss graphs

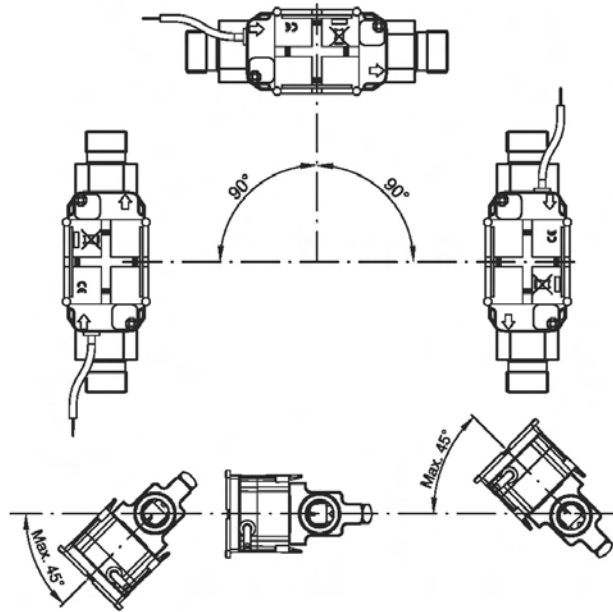


# ULTRAFLOW® 54 DN15-125

## DATA SHEET

### Installation

Installation angle for ULTRAFLOW® 54



ULTRAFLOW® 54 may be installed horizontally, vertically or at an angle.

#### IMPORTANT!

With ULTRAFLOW® 54, the electronics/plastic case must be placed to the side (with horizontal installation).

ULTRAFLOW® 54 may be turned up to  $\pm 45^\circ$  in relation to the pipe axis.

#### Straight inlet

ULTRAFLOW® requires neither straight inlet nor outlet to meet the Measuring Instruments Directive (MID) 2004/22/EC, OIML R75:2002 and EN 1434:2007. Only in case of heavy flow disturbances before the meter will a straight inlet section be necessary. We recommend to follow the guidelines in CEN CR 13582.

#### Working Pressure

In order to prevent cavitation the back pressure at ULTRAFLOW® 54 must be min. 1.5 bar at  $q_s$  and min. 2.5 bar at  $q_v$ . This applies to temperatures up to approx. 80°C.

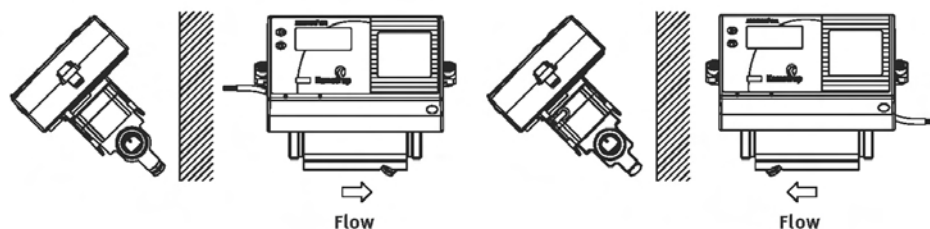
ULTRAFLOW® 54 must not be exposed to lower pressure than the ambient pressure (vacuum).

# ULTRAFLOW® 54 DN15-125

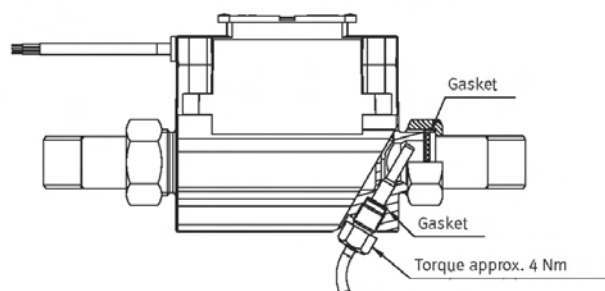
## DATA SHEET

### Examples of installation

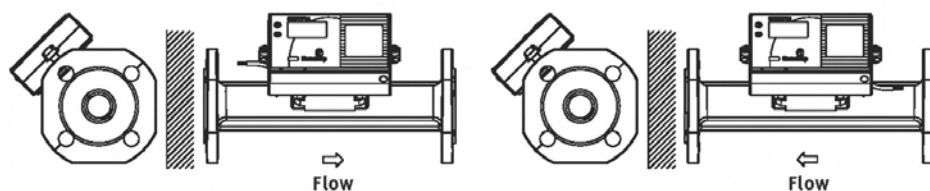
Gland meter with MULTICAL®/Pulse Transmitter fitted directly on ULTRAFLOW® 54.



Glands and short direct sensor fitted in ULTRAFLOW® 54 (G $\frac{3}{4}$ B (R $\frac{1}{2}$ ) and G1B (R $\frac{3}{4}$ ) only).



Flange meter with MULTICAL®/Pulse Transmitter fitted directly on ULTRAFLOW® 54.



# ULTRAFLOW® 54 DN15-125

## DATA SHEET

### Electrical connection

#### Connecting MULTICAL® & ULTRAFLOW® 54

ULTRAFLOW® 54	->	MULTICAL®
Blue (GND)/11A	->	11
Red (supply)/9A	->	9
Yellow (signal)/10A	->	10

#### Connecting via Pulse Transmitter

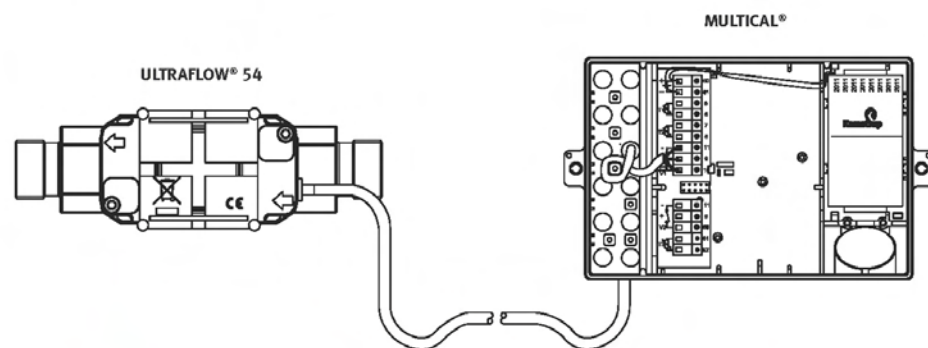
3.65 VDC supply <sup>*)</sup>	->	Pulse Transmitter
Red (+)	->	60
Black (-)	->	61

<sup>\*)</sup> from battery or supply module.

ULTRAFLOW® 54	->	Pulse Transmitter		->	MULTICAL®
		In	Out		
Blue (GND)/11A	->	11	11A	->	11
Red (supply)/9A	->	9	9A	->	9
Yellow (signal)/10A	->	10	10A	->	10

If long signal cables are used, please consider the installation carefully. There must be **at least 25 cm** between the signal cable and all other cables due to EMC.

### Example of connecting ULTRAFLOW® 54 and MULTICAL®



# ULTRAFLOW® 54 DN15-125

## DATA SHEET

### Order specification

The list below shows type numbers for ULTRAFLOW® 54

Type number <sup>3)</sup>	q <sub>p</sub> [m³/h]	q <sub>i</sub> [m³/h]	q <sub>s</sub> [m³/h]	Connection	Length [mm]	Meter factor [pulses/l]	CCC (high res.)	Material
65-5- CAAA -XXX	0.6	0.006	1.2	G¾B (R½)	110	300	416 (484)	Brass
65-5- CAAD -XXX	0.6	0.006	1.2	G1B (R¾)	130	300	416 (484)	Brass
65-5- CDAA -XXX	1.5	0.015	3	G¾B (R½)	110	100	419 (407)	Brass
65-5- CDAC -XXX	1.5	0.015	3	G¾B (R½)	165	100	419 (407)	Brass
65-5- CDAD -XXX	1.5	0.015	3	G1B (R¾)	130	100	419 (407)	Brass
(65-5- CDAE -XXX)	1.5	0.015	3	G1B (R¾)	165	100	419 (407)	Brass
65-5- CDAF -XXX	1.5	0.015	3	G1B (R¾)	190	100	419 (407)	Brass
65-5- CEAF -XXX	2.5	0.025	5	G1B (R¾)	190	60	498 (-)	Brass
65-5- CECA -XXX	2.5	0.025	5	DN20	190	60	498 (-)	Stainless steel
65-5- CGAG -XXX	3.5	0.035	7	G5/4B (R1)	260	50	451 (436)	Brass
65-5- CGCB -XXX	3.5	0.035	7	DN25	260	50	451 (436)	Stainless steel
65-5- CHAG -XXX	6	0.06	12	G5/4B (R1)	260	25	437 (438)	Brass
65-5- CHCB -XXX	6	0.06	12	DN25	260	25	437 (438)	Stainless steel
65-5- CJAJ -XXX	10	0.1	20	G2B (R1½)	300	15	478 (483)	Brass
65-5- CJCD -XXX	10	0.1	20	DN40	300	15	478 (483)	Stainless steel
65-5- CKCE -XXX	15	0.15	30	DN50	270	10	420 (485)	Stainless steel
65-5- CLCG -XXX	25	0.25	50	DN65	300	6	479 (-)	Stainless steel
65-5- CMCH -XXX	40	0.4	80	DN80	300	5	458 (486)	Stainless steel
65-5- FACL -XXX	60	0.6	120	DN100	360	2.5	470 (487)	Stainless steel
65-5- FBCL -XXX	100	1	200	DN100	360	1.5	480 (488)	Stainless steel
65-5- FBCM -XXX	100	1	200	DN125	350	1.5	480 (488)	Stainless steel

<sup>3)</sup> XXX-code pertaining to final assembly, approvals etc. is determined by Kamstrup A/S. Some variants may not be included in national approvals.  
(...) Country specific variants

ULTRAFLOW® 54 is as standard supplied with 2.5 m cable, but can also be supplied with 5 or 10 m cable.

#### Pulse Transmitter – type No. 66-99-603

The Pulse Transmitter is supplied with built-in supply for ULTRAFLOW® 54. Battery, 24 VAC and 230 VAC supply are available. Please state the required supply type when ordering.

# ULTRAFLOW® 54 DN15-125

## DATA SHEET

### Accessories

#### Glands including gaskets (PN16)

Size	Nipple	Union	Type No.	2 pcs.
DN15	R½	G¾	-	6561-323
DN20	R¾	G1	-	6561-324
DN25	R1	G5/4	6561-325	-
DN40	R1½	G2	6561-315	-

#### Gaskets for flange meters (PN25)

Size	Type No.
DN20	2210-147
DN25	2210-133
DN40	2210-132
DN50	2210-099
DN65	2210-141
DN80	2210-140
DN100	1150-142
DN125	1150-153

#### Gaskets for glands

Size (union)	Type No.
G¾	2210-061
G1	2210-062
G5/4	2210-063
G1½	2210-064
G2	2210-065