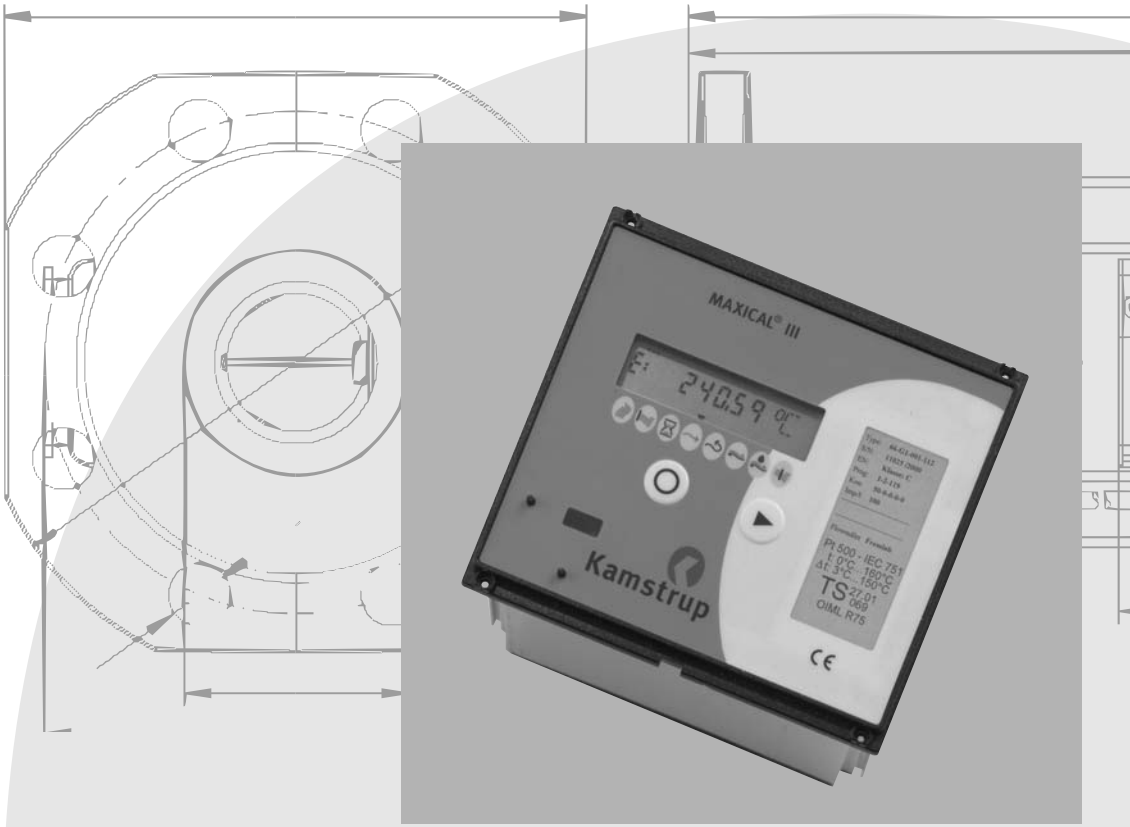
# MAXICAL III

## Technical Description

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# 1. Table of Contents

# 2. Design and Areas of Application

MAXICAL® III is designed for measuring, calculating and registering energy consumption in large heat installations with water as the heat transferring agent.

Typical applications include main heat metering at CHP (cogeneration heat and power) suppliers, heat metering through transmission nets or exchange stations.

In addition to energy metering, MAXICAL® III has various other functions including; display of prevailing and peak values, relay, pulse and analogue outputs, tariff registering, and data communication. All of which make it the most obvious choice for industrial management and regulation applications.

Thermal energy is calculated on the basis of the differential temperature measured across the flow and return pipes and the volume of water. The value is automatically corrected for density and enthalpy.

4-wire technique is used for measuring and adjusting the temperature, ensuring optimal accuracy and reliability.

The flow meter input comprises galvanically connected stages, which can supply electronic pick-ups. Galvanically isolated stages are used for flow meters with active outputs up to 5 or 10 kHz.

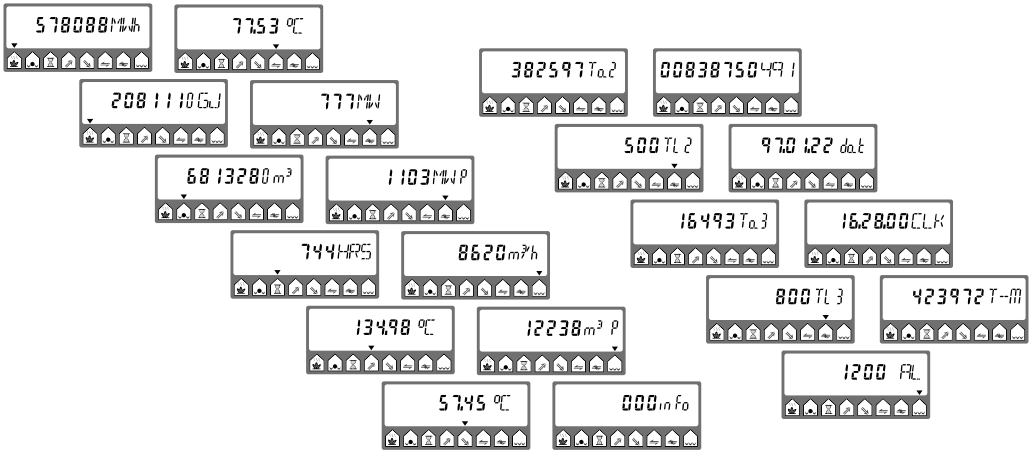
All operating parameters can be programmed by means of the optical eye on the front of the meter and a computer equipped with a Windows software package which facilitates quick and simple startup.

## 2.1. Display

MAXICAL® III is equipped with a liquid crystal display with 8 numerical digits plus 3 alphanumerical characters. 7 digits indicate the current and accumulated values. The last three alphanumerical characters indicate the relevant unit of measurement or symbol.

Once the integrator has been connected to the mains, a discreet background lighting will appear in the display, ensuring that readings are clearly visible - even in areas with poor lighting.

Press the right or left key, as appropriate, to move from one displayed value to another. Note that only values selected during configuration can be displayed [DD].




1) The peak value displayed is the highest average of 1...120 minutes actual values recorded over the last 24 hour period. The average period can be programmed. Depending on the programming, either peak power or peak flow will be displayed.

2) The tariff or alarm type selected will be indicated by an arrow at $t_F$, $t_R$, $\Delta t$, power or flow as appropriate.

**N.B.:**

The display will revert automatically to showing accumulated energy consumption approx. 8 minutes after the key has been depressed.

## 2.2. Calculation

In MAXICAL® III, thermal energy is calculated after a given amount of water has been recorded. The typical integration interval is 10 litres with a Qn 1.5 m³/h flow meter and 1 m³, if a Qn 120 m³/h to Qn 1400 m³/h flow meter is connected. The thermal energy is derived by multiplying the volume of water by the actual cooling and the relevant correction factor - derived from Dr. Stuck's k-factor table. Any remainder which cannot be displayed due to the resolution of the display will be saved and added to the next integration. Pulse separation and the number of pulses per litre, which ensure that the flow meter and the integrator tally, is determined by the CCC program.

The current water flow and thermal power are calculated at 5 (CCC≥ 100) or 30 (CCC<100) second intervals, depending on the configuration selected, based on the no. of pulses emitted by the flow meter during the given period of time. MAXICAL® III is configured to an average flow and peak value, if a flow meter with few volume pulses is connected, e.g. a mechancial meter with a reed switch output (CCC<100).

## 2.3. Logging Peak Values

The highest thermal power - or the highest water flow - in each 24 hour period is stored in the memory, together with the date and time for the measurement. The peak value for this period is the highest average, determined over a period between 1 and 120 minutes as required, occuring between 2400 hours and 2400 hours the next day.

The value is stored in the permanent EEPROM memory and - as with all other data - covers the last 31 days.

## 2.4. Measuring Temperature

MAXICAL® III can measure flow and return temperatures between 0.01°C and 182.00°C. Temperatures measured which exceed these limits will be registered as sensor faults after 10-20 minutes - please refer to section 2.6. *Information Codes*.

The differential temperature is accurately calculated throughout the whole measuring range - even with cooling down to 0.01°C. Accuracy is, however, slightly affected below Δt=3°C. If a negative differential temperature is registered, this will be perceived as 0.00°C. Energy registering will then stop.

MAXICAL® III measures temperature every 5 seconds, updating the display and analogue outputs with the new reading. Prior to each temperature measurement, the A/D converters zero point and span is adjusted automatically, based on the internal precision resistors. Flow and return temperatures are then measured twice, the second measurement being taken a number of 10 msec. after the first to ensure optimal damping of 50 Hz mains interference.

Depending on the type of meter selected, a set of either Pt100 or Pt500 sensors must be connected (according to IEC 751). The sensors must always be matched and 4-wire screened cable used to connect the sensors to MAXICAL® III, to ensure optimal precision. The cable screen must be connected at the MAXCIAL III and **not** at the sensor housing.

In stand-by mode - i.e. when the supply is disconnected - temperatures will be displayed without 4-wire compensation. Once the supply has been connected, 4-wire compensation will eliminate 99% of the measuring error arising as a result of the length of the cable.

When MAXICAL® III is connected to a pipe with a large diameter, average measuring must be established to reduce the influence of temperature fluctuation in the water. Average measuring can be built up with 5 Pt100 sensors connected in series to a Pt500 input or with 4-sensors connected in parallel/series (Please refer to chapter 4.3.1).

## 2.5. Permanent Memory

MAXICAL® III has an electronic, erasable programmable, read-only memory (EEPROM) which stores data independent of the power supply. All accummulated values are stored in the memory at hourly intervals. At midnight each night, the following data will be stored in a 31-day datalogger:

Date, Energy, Water, TA2, TA3, Alarm
Peak time and Peak power/flow.

## 2.6. Information Codes

During normal operation the information code will be 000. If one or more of the following faults occurs, the letter “E” will be shown in the current display, and the Infocode relay will be deenergized. The information codes, which will be added together if more than one is activated, can be displayed as required.

+2 Check the flow meter connection

Flow pulses have not been registered for a period of 48 hours, whilst Δt has been larger than 20°C.

+4 Check the temperature sensor in the return pipe

The return temperature has been less than 0°C or more than 182°C for 10...20 minutes.

+8 Check the temperature sensor in the flow pipe


The flow temperature has been less than 0°C or more than 182°C for 10...20 minutes.

+256 Check the flow meter code

The meter has registered an excess of water pulses, corresponding to more than 1 integration per second.

Reseting information codes is described in chapter 14.4. If one or more info codes are deselected under section 6.4 >DD<, these codes will not deactivate the alarm relay, nor will “E” appear in the display.

## 2.7. Optical data acquisition

An optical, infrared receiver/transmitter is situated in the bottom left hand corner of MAXICAL® III’s front panel which communicates with serial data in accordance with IEC 1107/EN61107.

A read-out head, type 66-99-102, with a 9-pole D-sub plug is used for data acquistion and when configuring the meter from a computer.

Data acquisition is also possible with Kamstrup Energi's hand-held terminal, MULTITERM III. Kamstrup Energi's software package for MAXICAL® III, type 66-99-210, can be used to configure via a standard computer.

## 2.8. Voltage Supply and Back-up

MAXICAL® III operates on 230 V AC, supplying the integrator and the analogue module via two internal double isolated transformers. Furthermore, an integrated 1 Ah lithium cell ensures that the internal clock (with date) is continuously supplied, should the power be cut off. In the even of a power cut, there is no back-up on the frequency input (terminals 75-76). However there is a 5 minute back-up on the pulse input (terminals 10-11).

## 2.9. Tariff Functions

MAXICAL® III features several tariff functions. Regardless of the tariff type, the total thermal energy will always be accumulated in the primary register. Furthermore, tariff registers TA2 and TA3 accumulate the portion of the energy consumed in connection with a specific condition. This condition, together with the relevant limit values (TL2 and TL3), can be conveniently configured using a Windows software package, type no. 66-99-210, which can easily be installed on your computer.

## 2.10. Plug-in Modules

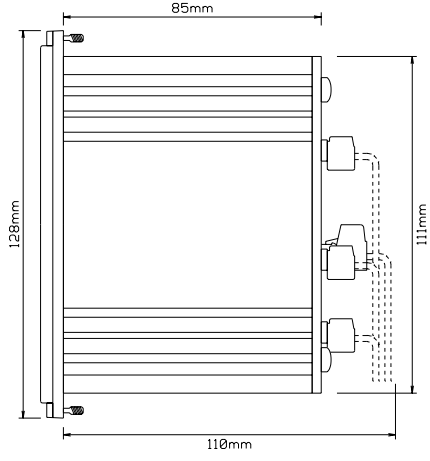
The facilities offered by MAXICAL® III can be extended by means of plug-in modules. There is space for two modules, which can be installed and configured on site.

The uppermost space can be used for 4 active analogue outputs for flow, power, flow temperatures and return/differential temperature. Furthermore, the module has two relay outputs; a programmable limit switch and an information code switch.

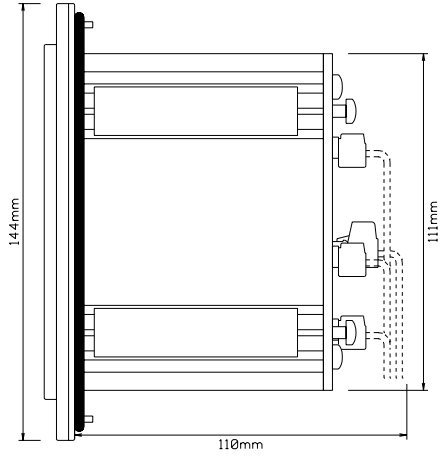
The bottom space is designed for M-Bus, telephone modem or EcheLon modules.

## 3. Panel Installation

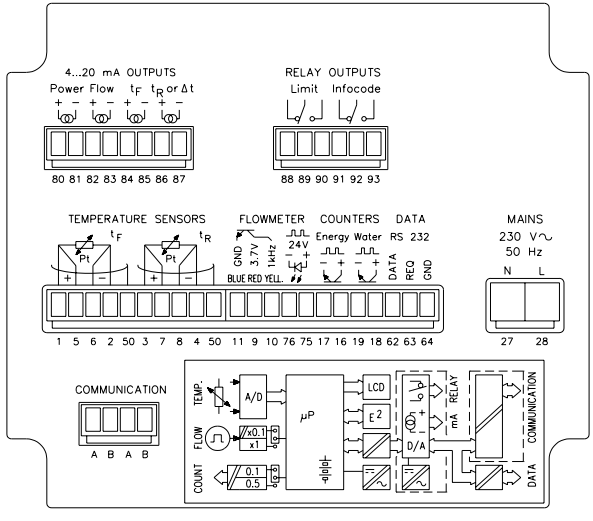
*19" Rack version with front dimensions 142 x 128mm, or 28 TE & 3 HE, corresponding to 1/3 Rack.*




*Q144 version for frontal fitting in control panel. Panel cut-out: 138 x 138 ± 0.5 mm. Brackets and gasket are included in the supply.*




## 4. Electrical Connection




*All MAXICAL® III's connections are accessible from the rear.*

*The analogue and relay module seen at the top, plus the communication module seen at the bottom left are optional and therefore, not included in all versions.*

***NB:***
*MAXICAL® III will display an information code 012 when delivered, as temperature sensors aren't connected. Please refer to chapters 2.6 and 14.4.*

## 4.1 General Installation Requirements

MAXICAL® III must not be installed in an area where the ambient temperature exceeds 0...+55°C. If the average ambient temperature lies above +35°C, the internal lithium back-up cell should be replaced every two years. At lower ambient temperatures, the back-up cell will last for approx. 8 years. Lithium back-up cells are standard spare parts - order no. 1606-047. Chapter 14.2 describes how to replace the battery.

All signal cables must be laid individually, e.g. in cable conduits. They must not be laid parallel to supply or mains current cables. Parallel cabling can only be advised if the cables are kept at least 25 cm apart.

COMBITEMP temperature sensors may only be used in direct installation, when the flow velocity is less than 3m/sec. Sensor pockets must be used if the flow velocity is larger.

**NOTE:**

When delivered MAXICAL® III shows information code 012 as both temperature sensors have been disconnected during transport.

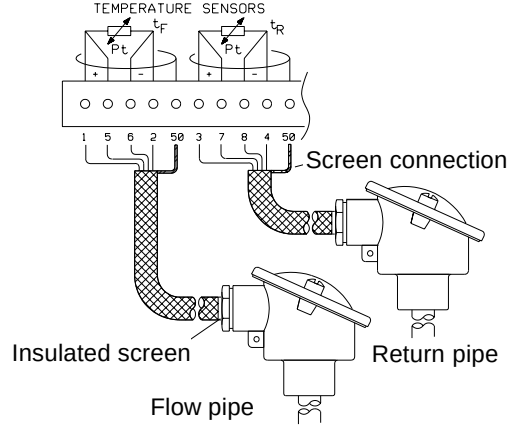
Having installed MAXICAL® III info is reset by activating both front plate buttons for 10 sec. until the display says ”Call”.

## 4.2 Voltage supply (27-28)

MAXICAL® III should be connected to a 230 V AC net supply. Live and neutral connected to terminals 28 and 27. Any earth wire should not be connected, as the instrument contains doubly insulated transformers.

### 4.3 Temperature sensors (1-8)

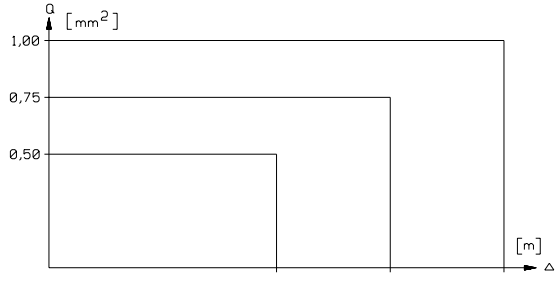
MAXICAL® III is supplied for use with either Pt100 or Pt500 temperature sensors, indicated on the front plate by either 66-F; Pt100 input or 66-G; Pt500 input.




4-wire screened cable should always be used to connect the temperature sensors to MAXICAL® III. Connect the cable screen "pig-tails" - which must be as short as possible and not longer than 25 mm - to terminal 50 on MAXICAL® III. The cable screens must **not** be connected to the temperature sensors.

The cable used should have a cross sectional area of at least 0.5 $mm^2$ when the difference in length between the flow and return sensor cables is up to 10 m for Pt100, or 50 m for Pt500 sensors.

If the difference in length (Δl) between the two sensors is greater, a correspondingly bigger cable cross sectional area (Q) should be used, as indicated in the following diagram:

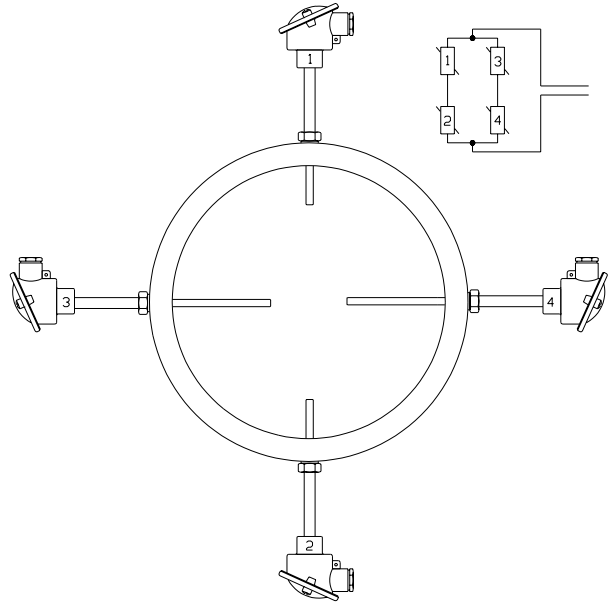



| | | | |
|---|---|---|---|
| Pt100 | 10 | 15 | 20 |
| Pt500 | 50 | 75 | 100 |

Provided the difference in length between the flow and return sensor cables - as shown in the diagram are strictly observed, the error increment on the differential temperature will be less than 0.02 K.

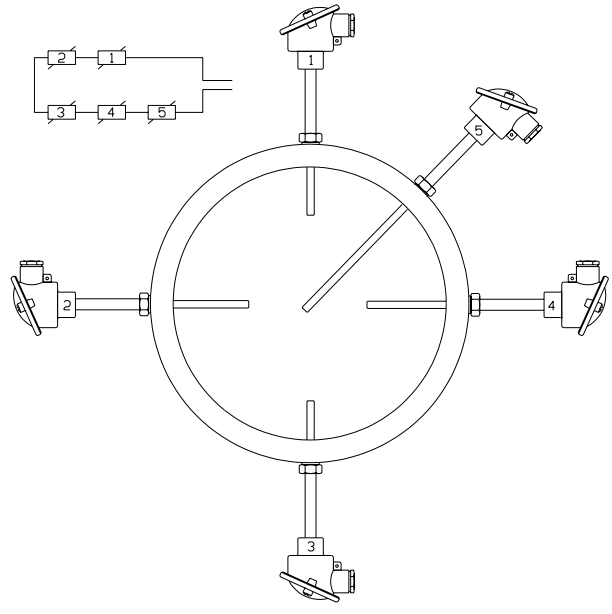
### 4.3.1 Average Measurement

If the pipe dimensions are larger than DN100, stratified water temperatures may occur. If this should happen, average measurements should be ascertained by inserting 4 or 5 sensors in each pipe.




### Example 1

4 sensor sets - with different sensor tube lengths - are installed in both the flow and return lpipes. The four sensors are connected both in series and parallel, so that the original sensor characteristics are maintained. This method can be used with both the Pt100 and Pt500 versions of MAXICAL® III - note, however, that only paired sensors sets must be used for this purpose. The sensor sets used must be connected serial/parallel in the same way both in the flow and return pipes.

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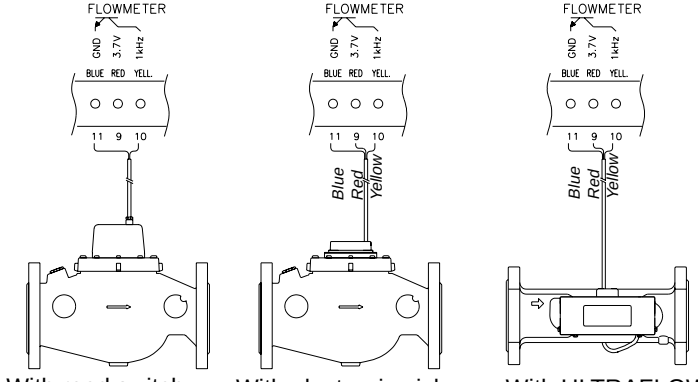
5 Pt100 sensor sets - each with a different sensor tube length - are installed in both the flow and return pipes. The five sensors should be connected in series, thus assuming Pt500 characteristics. This method may only be used with the Pt500 version of MAXICAL® III. As with example 1, only paired sensors sets should be used.

### 4.4 Flow Meter Input (9-11)

This flow meter input can be used by to mechanical meters with Reed-switch output, mechanical meters with electronic pick-ups or Kamstrup Energi's ultrasonic meters: ULTRAFLOW® II.

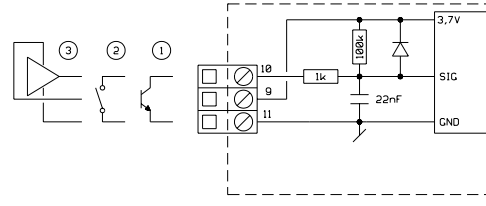
The flow meter connected must use MAXICAL® III's pulse separation (CCC-table). Furthermore, the internal flow switch must be set to 9-11 (please refer to chapter 4.6).




The flow meter input, terminals 9-10-11, is built up as shown below. The pulse duration must be larger than 0.5 msec. and intervals between pulses larger than 10 msec. The input frequency must not exceed the precounter, however <100Hz (please refer to the CCC tables in chapter 6.1).

The input can be connected directly to meters with opto or reed output ① and ② on terminals 10 and 11.

Flow meters with electronic pick-ups ③, and ULTRAFLOW® II are supplied from MAXICAL® III over terminal 9 (3.7 V).



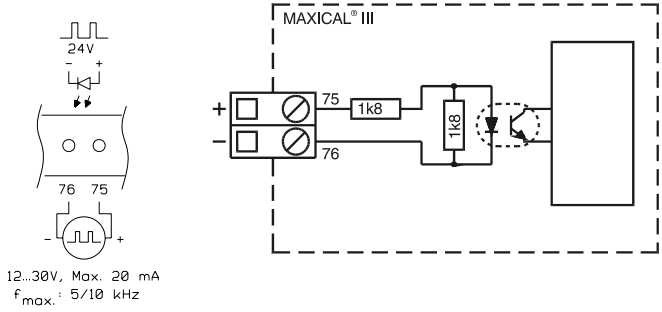

Max. cable length should not exceed 5m.

## 4.5 Flow Meter Input (75-76)

This flow meter input is galvanically separated via an optocoupler and designed for electronic flow meters with active frequency output of max. 5 kHz or 10 kHz. The flow meter's frequency output must have an amplitude of 12...30V. Pulse duration must be at least 30 µsec.

The flow meter connected must use MAXICAL® III's pulse separation (CCC ≥ 300) and preprogrammed Qmax. The internal flow switch must be set at 75-76 - please refer to chapter 4.6.

If the CCC code lies between 300 and 303, the frequency output from the flow meter must be 5 kHz at Qmax.

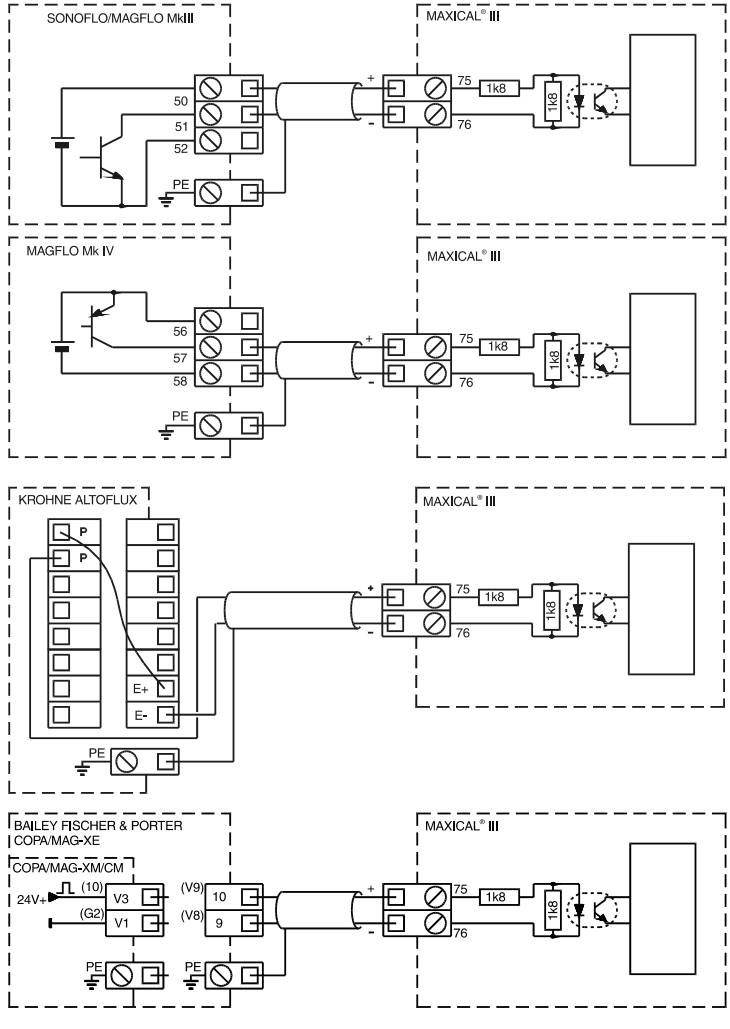



Max. cable length should not exceed 50m.

### 4.5.1 Flow Meter Connection

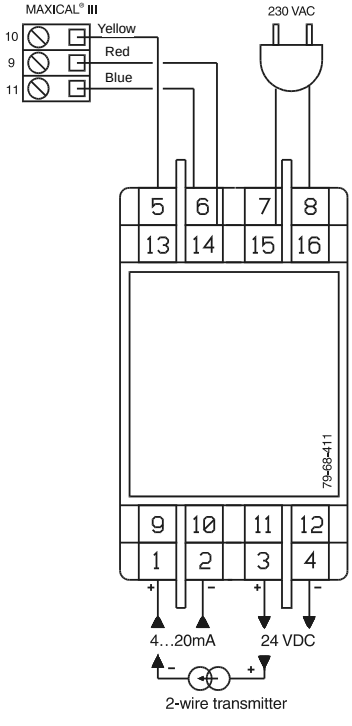
MAXICAL® III connects with almost all flow meters with active pulse output. Below please find various examples of electrical connection.

Please note that the flow meters must be configured correctly as far as $Q_{max.}$ and $f_{max.}$ are concerned, and that some types of meters are to be specially ordered for active output.




**NOTE:**

In case of installation in noisy surroundings we recommend that screened cable is used as shown in the installation drawings.




### 4.5.2 Flow meters with analogue output

Using flow meters with analogue output (4 … 20 mA) an I/F converter is needed to convert the measuring current to flow pulses.

Kamstrup's DIN rail module type 79-68-411 is suitable for this purpose.

In this case flow meter 9-10-11 is to be used together with CCC codes 3xx.

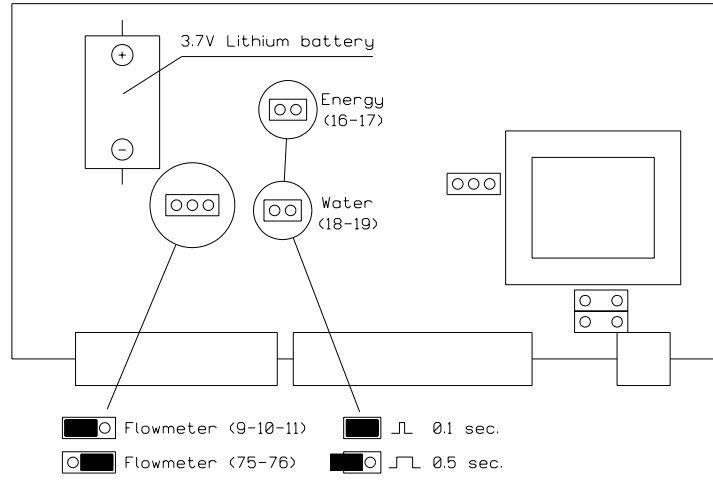
## 4.6 Selecting flow meter inputs and pulse outputs

Before opening the unit, disconnect the supply! Remove the terminals plugs nos. 27 and 28 at the rear.

Remove the four screws that hold the rear plate in position and MAXICAL® III's print switch is accessible on the middle PCB.

***Note:***

*If you remove the PCB, MAXICAL® III's internal clock will loose time. The clock can be set via MULTITERM III hand-terminal or via the computer program, type no. 66-99-210.*




### Selecting Flow Meter Input:

Place the print switch as shown above, to change over between two flow meter inputs (refer to chapters 4.4 and 4.5).

### Selecting Pulse Duration

When you take delivery of MAXICAL® III, pulse outputs for energy and water (16-19) will be set at 0.1 sec. You can increase the pulse duration to 0.5 sec. by moving the print switch to the left as shown above.

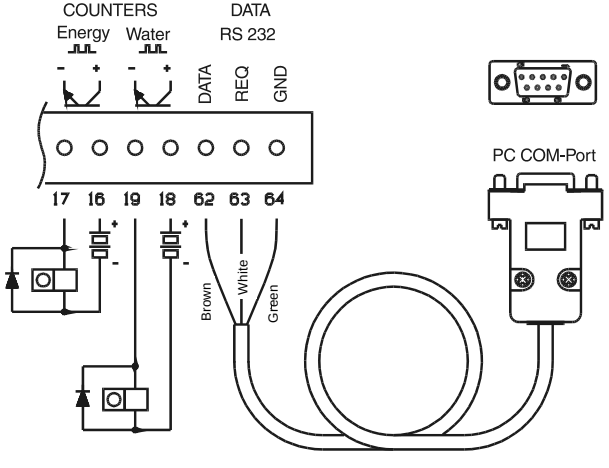
The pulse outputs can bear a load of up to 100 mA.

### 4.7 Pulse and Data Outputs (16-19) (62-64)

The pulse outputs for energy and water, on terminals 16-19, normally emit one pulse for each display count, e.g. 0.01 MWh and 0.1 m³ (please refer to the CCC tables in chapter 6).

Furthermore a 10:1 divider can be programmed (see chapter 6.8)

**N.B:** If an electromechanical meter is used a diode has to be connected in parallel above the coil. We recommend the type 1N4007 or similar.




Data outputs on terminals 62-64 are used for reading days data, target date, verification data etc. The data output can also be used for programming and configuring the meter - in the same way as described for the optical eye.

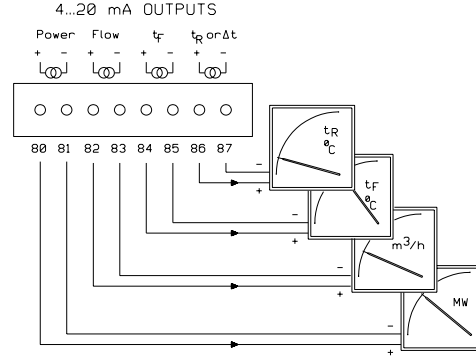
The output communicates passively/in serial with 1200 Baud and can be connected to the COM-port on a computer by means of a data cable (type no. 66-99-106 - which includes the necessary RS-232 adapter).

## 4.8 Analogue Outputs (80-87)

MAXICAL® III can be supplied with a combination analogue and relay module.

The four analogue outputs are active with a 4...20 mA output signal and can bear a load of 0...500Ω. They are typically used for remote display and registration.

When programming MAXICAL® III, select the fourth output (terminal 86-87) as either return line or differential temperature. All outputs have 4 mA, corresponding to zero. However, the measuring range can be programmed using computer software, type no. 66-99-210.

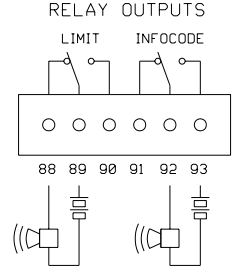



All outputs should - in consideration of EMC - be laid as a complete cable - or couples via isolation amplifiers (please refer to Kamstrup Proces' data sheet P50 749 - Loop Isolator).

### 4.9 Relay Outputs (88-93)

Relay outputs on the combined analogue and relay module are used for monitoring both the process and the integrator.

Infocode is connected between terminals 92 and 93 when the voltage supply is in order and MAXICAL® III has registered no system error - corresponding to info = 000. If an info code of more than 000 has been registered, e.g. if the sensors are faulty or the supply has been interrupted - the relay will switch to terminals 91-92.



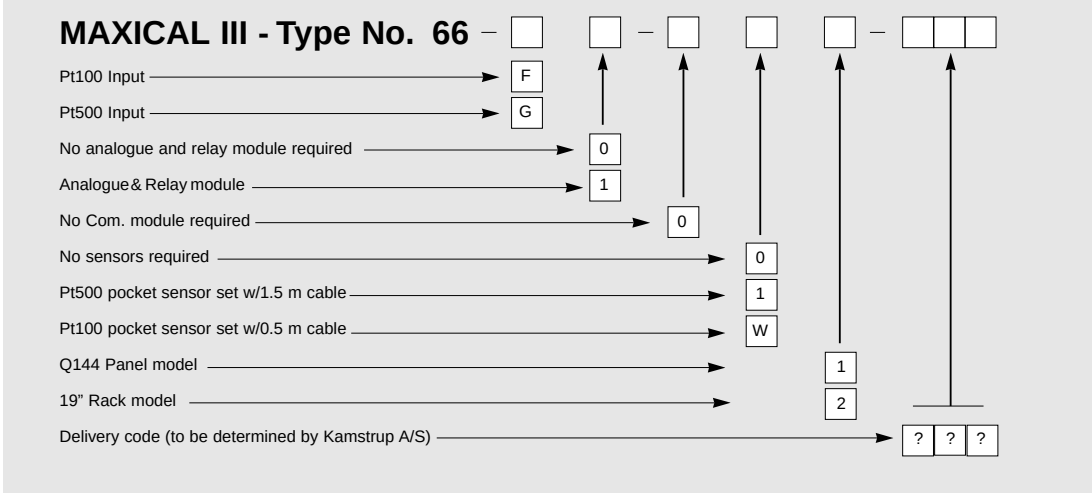

The relay limit is a programmable limit switch. You can select either power, flow rate, flow temperature, return temperature or differential temperature and simply enter the required limit value.

When the actual measured value exceeds the limit value, the relay will be energized and closes the relay contact between terminals 89 and 90.

If you require the opposite function, we would suggest you use terminals 88 and 89.

The load on the relay contacts must not exceed 100 V AC/DC and 500 mA.

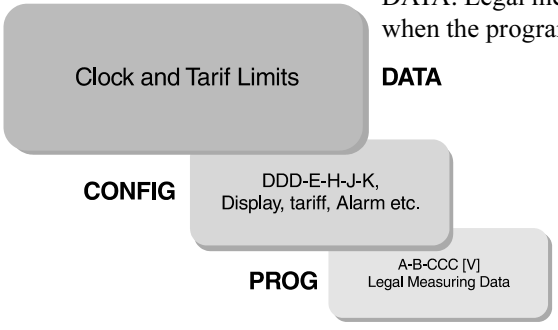
# 5. Compiling the Type Number



# 6. Prog. Config and Data Summary

MAXICAL® III's many functions are determined during programming - which can be done either by Kamstrup A/S, your local distributor, the heat supplier or by a service engineer.

Programming is divided into three groups: PROG, CONFIG and DATA. Legal measuring parameters PROG may only be changed when the program block is V=0.




| | A | B | C C C |
|---|---|---|---|
| **Prog. No.** | | | |
| Flow meter placed in flow pipe | 1 | | |
| Flow meter placed in return pipe | 2 | | |
| Energy calculation in GJ | | 2 | |
| " kWh (Qn ≤ 3m³/h) | | 3 | |
| " MWh | | 4 | |
| Flow meter code | | | |
| Qmax (only at CCC ≥ 300) | | | m³ /h |

| | V |
|---|---|
| **Prog-access denied** | |
| Accessible | 0 |
| Program access denied (can be verified) | 1 |

## 6.1 CCC-Table for MAXICAL® III

| CCC No. | Pre-counter | Flow-factor | No. of Decimals in the Display | | | | | | | | l/Pulse | Pulse/l | Qn | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | kWh | MWh | GJ | m³ | l/h | m³/h | kW | MW | | | | |
| 000 | 10 | 786420 | - | 3 | 2 | 2 | - | 2 | - | 3 | 1 | 1 | 1-3,5 | |
| 001 | 4 | 1966050 | - | 3 | 2 | 2 | - | 2 | - | 3 | 2,5 | 0,4 | 1,5-6 | |
| 002 | 1 | 786420 | - | 3 | 2 | 2 | - | 1 | - | 2 | 10 | 0,1 | 2,5-30 | |
| 003 | 1 | 1966050 | - | 2 | 2 | 1 | - | 1 | - | 2 | 25 | 0,04 | 6-60 | |
| 004 | 10 | 786420 | - | 2 | 1 | 1 | - | 1 | - | 2 | 10 | 0,1 | 2,5-30 | |
| 005 | 10 | 1966050 | - | 1 | 1 | 0 | - | 1 | - | 2 | 25 | 0,04 | 60-600 | |
| 006 | 1 | 786420 | - | 2 | 1 | 1 | - | 0 | - | 1 | 100 | 0,01 | 25-300 | |
| 007 | 1 | 1966050 | - | 1 | 1 | 0 | - | 0 | - | 1 | 250 | 0,004 | 60-600 | |
| 008 | 1 | 7864200 | - | 1 | 0 | 0 | - | 0 | - | 1 | 1000 | 0,001 | 250-3000 | |
| 009 | 28 | 280864 | 0 | 3 | 2 | 2 | - | 2 | - | 3 | 0,3571 | 2,80 | 1,5 | Brunata |
| 108 | 1403 | 56052 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,007128 | 140,3 | 0,6 | GWF |
| 109 | 957 | 82175 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,010449 | 95,7 | 1,0 | GWF |
| 110 | 646 | 121736 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,015479 | 64,6 | 1,5 | GWF |
| 111 | 404 | 194658 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,024752 | 40,4 | 1,5/2,5 | HM/GWF |
| 112 | 502 | 156657 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,01992 | 50,2 | 1,5/2,5* | GWF |
| 113 | 2350 | 334646 | | 2 | 1 | 1 | 0 | - | 1 | - | 0,042553 | 23,5 | 3,5/6* | GWF |
| 114 | 712 | 1104522 | | 2 | 1 | 1 | 0 | - | 1 | - | 0,14044 | 7,12 | 10/15* | GWF |
| 115 | 757 | 103886 | 0 | 3 | 2 | 2 | 0 | - | 1 | | 0,01321 | 75,7 | 1,0* | GWF |
| 116 | 3000 | 26214 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,00333 | 300,0 | 0,6* | GWF |
| 117 | 269 | 292349 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,037174 | 26,9 | 1,5 | Brunata |
| 118 | 665 | 118258 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,015037 | 66,5 | 1,5 | Aquastar |
| 119 | 1000 | 78642 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,01 | 100,0 | 0,6<br>1,5 | HM<br>UF I/UFII |
| 120 | 1000 | 786420 | | 2 | 1 | 1 | 0 | - | 1 | - | 0,1 | 10,0 | 15/25 | UF II |
| 121 | 294 | 267489 | 0 | 3 | 2 | 2 | 0 | | 1 | - | 0,034013 | 29,4 | | |
| 122 | 1668 | 47147 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,005995 | 166,8 | 0,6 | HM |
| 123 | 864 | 91020 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,011574 | 86,4 | 0,75/1* | HM |
| 124 | 522 | 150655 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,019157 | 52,2 | 2,5/1.5* | CG/HM |
| 125 | 607 | 129558 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,016475 | 60,7 | 1,5<br>1*<br>1,5* | HM |
| 126 | 420 | 187242 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,023809 | 42,0 | 1,0<br>2,5* | CG<br>HM |
| 127 | 2982 | 263722 | | 2 | 1 | 1 | 0 | - | 1 | - | 0,033534 | 29,82 | 2,5<br>3,5* | HM |
| 128 | 2424 | 324430 | | 2 | 1 | 1 | 0 | - | 1 | - | 0,041254 | 24,24 | 3,5* | HM |
| 129 | 1854 | 424174 | - | 2 | 1 | 1 | 0 | - | 1 | - | 0,053937 | 18,54 | 6* | HM |
| 130 | 770 | 1021324 | - | 2 | 1 | 1 | 0 | - | 1 | - | 0,12987 | 7,7 | 10* | HM |
| 131 | 700 | 1123457 | - | 2 | 1 | 1 | 0 | - | 1 | - | 0,14285 | 7,0 | 15* | HM |
| 132 | 365 | 215221 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,027322 | 36,54 | 2,5 | Wehrle |
| 133 | 604 | 130051 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,016537 | 60,47 | 1,5 | Wehrle |
| 134 | 1230 | 63910 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,008126 | 123,05 | 0,6 | Wehrle |
| 135 | 1600 | 491512 | | 2 | 1 | 1 | 0 | - | 1 | - | 0,0625 | 16,0 | 10* | HM |
| 136 | 500 | 157284 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,02 | 50 | 2,5<br>3 | UFII<br>UF I |
| 137 | 2500 | 314568 | - | 2 | 1 | 1 | 0 | - | 1 | - | 0,04 | 25 | 6<br>10 | UF I/II<br>UF II |

## 6.2 CCC-Table for MAXICAL® III

| CCC No. | Pre-counter | Flow-factor | No. of Decimals in the Display | | | | | | | | l/Pulses | Pulses/l | Qn | Type |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | kWh | MWh | GJ | m³ | l/h | m³/h | kW | MW | | | | |
| 139 | 256 | 307195 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,03906 | 25,6 | 1,5/2,5 | GWF |
| 140 | 1280 | 614390 | - | 2 | 1 | 1 | 0 | - | 1 | - | 0,078125 | 12,8 | 3,5<br>5,0 | GWF |
| 141 | 1140 | 689842 | - | 2 | 1 | 1 | 0 | - | 1 | - | 0,087719 | 11,4 | 6 | GWF |
| 142 | 400 | 196605 | - | 2 | 1 | 1 | - | 2 | - | 3 | 0,25 | 4 | 10 | GWF |
| 143 | 320 | 245756 | - | 2 | 1 | 1 | - | 2 | - | 3 | 0,3125 | 3,2 | 10<br>15 | GWF |
| 144 | 1280 | 614390 | - | 1 | 0 | 0 | - | 2 | - | 3 | 0,78125 | 1,28 | 25/40 | |
| 145 | 640 | 1228781 | - | 1 | 0 | 0 | - | 2 | - | 3 | 1,5625 | 0,64 | 60 | GWF |
| 146 | 128 | 6143906 | - | 1 | 0 | 0 | - | 2 | - | 3 | 7,8125 | 0,128 | 125 | GWF |
| 147 | 1000 | 786420 | - | 1 | 0 | 0 | - | 2 | - | 3 | 1 | 1 | 18<br>30<br>45<br>75 | Sonocal |
| 148 | 400 | 1966050 | - | 1 | 0 | 0 | - | 2 | - | 3 | 2,5 | 0,4 | 120<br>220<br>300 | Sonocal |
| 149 | 100 | 786420 | - | 1 | 0 | 0 | - | 1 | - | 2 | 10 | 0,1 | 450<br>750<br>1200 | Sonocal |
| 150 | 200 | 3932100 | - | 0 | x10 | x10 | - | 1 | - | 2 | 50 | 0,02 | 1800<br>2400<br>3000 | Sonocal |
| 151 | 5000 | 157284 | - | 2 | 1 | 1 | 0 | - | 1 | - | 0,02 | 50 | 3<br>3,5 | UF II |
| 152 | 1194 | 658643 | - | 2 | 1 | 1 | 0 | - | 1 | - | 0,083752 | 11,94 | 10 | GWF |
| 153 | 1014 | 775562 | - | 2 | 1 | 1 | 0 | - | 1 | - | 0,098619 | 10,14 | 15 | GWF |
| 156 | 594 | 132393 | - | 3 | 2 | 2 | 0 | - | 1 | - | 0,016835 | 59,4 | 1,5 | Metron |
| 157 | 3764 | 208932 | - | 2 | 1 | 1 | 0 | - | 1 | - | 0,0265675 | 37,64 | 2,5 | Metron |
| 158 | 5000 | 157284 | - | 1 | 0 | 0 | - | 2 | 0 | - | 0,2 | 5 | 40 | UF II |
| 163 | 1224 | 64250 | 0 | 3 | | 2 | 20 | - | 1 | - | 0,00817 | 122,4 | 0,6/1,0 | GWF/U2 |
| 164 | 852 | 92260 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,01173 | 85,24 | 1,5 | GWF/U2 |
| 165 | 599 | 131245 | 0 | 3 | 2 | 2 | 0 | - | 1 | - | 0,01669 | 59,92 | 2,5 | GWF/U2 |
| 168 | 449 | 1753054 | - | 2 | 1 | 1 | 0 | - | 1 | 1 | 0,2229 | 4,486 | 15/25 | HM/WS |
| 169 | 1386 | 567403 | - | 1 | 0 | 0 | - | 2 | 0 | - | 0,7215 | 1,386 | 40 | HM/WS |
| 170 | 2500 | 314568 | - | 1 | 0 | 0 | - | 2 | - | 3 | 0,4 | 2,5 | 60-100 | UFII |
| 171 | 4000 | 196605 | - | 0 | x10 | x10 | - | 1 | - | 2 | 2,5 | 0,4 | 400 | UFII |
| 172 | 2500 | 314568 | - | 0 | x10 | x10 | - | 1 | - | 2 | 4 | 0,25 | 600-1000 | UFII |
| 173 | 500 | 157287 | - | 1 | 0 | 0 | - | 1 | - | 2 | 2 | 0,5 | 80 | Westland |

## 6.3 CCC-Table for MAXICAL® III

CCC-codes 300-303 are used for flow meters with active frequency output, programmed to 5 kHz @ Qmax.

| CCC No. | Sep. | Pre-counter | Flow-factor | No. of Decimals in the Display kWh | MWh | GJ | m³ | l/h | m³/h | kW | MW | Pulses/l | Qmax (Qm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 300 | 10 | 18,000/Qm | Qm x 4377 | 0 | 3 | 2 | 2 | | 3 | 1 | | 18,000/Qm | 1.2-14 |
| 301 | 10 | 180,000/Qm | Qm/10 x 4377 | | 2 | 1 | 1 | | 2 | | 3 | 18,000/Qm | 12-140 |
| 302 | 10 | 1.800,000/Qm | Qm/100 x 4377 | | 1 | 0 | 0 | | 1 | | 2 | 18,000/Qm | 120-1400 |
| 303 | 10 | 18,000,000/Qm | Qm/1,000 x 4377 | | 0 | x10 | x10 | | 0 | | 1 | 18,000/Qm | 1200-14000 |

## 6.4 CCC-Table for MAXICAL® III

CCC-codes 310-313 are used for flow meters with active frequency output, programmed to10kHz @ Qmax.

| CCC No. | Sep. | Pre-counter | Flow-factor | No. of Decimals in the Display kWh | MWh | GJ | m³ | l/h | m³/h | kW | MW | Pulses/l | Qmax (Qm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 310 | 10 | 36.000/Qm | Qm x 2188 | 0 | 3 | 2 | 2 | | 3 | 1 | | 36.000/Qm | 1,2-14 |
| 311 | 10 | 360.000/Qm | Qm/10 x 2188 | | 2 | 1 | 1 | | 2 | | 3 | 36.000/Qm | 12-140 |
| 312 | 10 | 3.600.000/Qm | Qm/100 x 2188 | | 1 | 0 | 0 | | 1 | | 2 | 36.000/Qm | 120-1400 |
| 313 | 10 | 36.000.000/Qm | Qm/1.000 x 2188 | | 0 | x10 | x10 | | 0 | | 1 | 36.000/Qm | 1200-14000 |

| CCC No. | Flow signal | Connection | Jumper |
|---|---|---|---|
| 0XX | Slow Pulses | 10-11 |  *) |
| 1XX | Fast Pulses | 9-10-11 |  *) |
| 3XX | Frequency signal | 75-76 |  *) |

*) Please refer to chapter 4.6

Qm can be entered by means of the programming software, type no. 66-99-210.

**Example:**
A flow meter with Qm=40 m³/h - corresponding to 5 kHz is connected. In the software CCC is selected as 301 and Qm as 40 m³/h. With this setting, an integration is performed for every 0.1 m³ water. The accumulated energy in MWh is displayed with 2 decimals.

### 6.4 >DD< Configuration of Display Values

| DD | | 50 | 51 | 52 | 53 |
|---|---|---|---|---|---|
| Energy | ***) | 1 | 1 | 1 | 1 |
| Water | | 2 | 2 | 2 | 2 |
| Hour Counter | | 3 | 3 | - | 3 |
| $t_{FLOW}$ | | 4 | 4 | 3 | 4 |
| $t_{RETURN}$ | | 5 | 5 | 4 | 5 |
| $\Delta t$ | | 6 | 6 | 5 | 6 |
| Power | | 7 | 7 | 6 | 7 |
| Peak Power | *) | 8 | 8 | - | 8 |
| Flow | | 9 | 9 | 7 | 9 |
| Peak Flow | *) | | | 8 | - |
| All Info | | | | - | 10 |
| Info (-2) | **) | 10 | 10 | - | - |
| | | | | | |
| TA 2 | ***) | | A | - | A |
| TL 2 | | | B | - | B |
| TA 3 | ***) | | C | - | C |
| TL 3 | | | D | - | D |
| Alarm limits | | A | E | - | E |
| Customer ID No. | | B | F | A | F |
| Current Date | | C | G | - | G |
| Current Time | | D | H | - | H |
| Quick Sum | | E | I | - | I |
| Segment Test | | F | J | B | J |

*) Either peak power or peak flow can be displayed.

**) Info =128 does not exist in MAXICAL® III. When Info (-2) is selected in the DD-code, the info code 2 alarm relay will not be triggered, nor will “E” appear in the display.

***) Automatic display sequence at 5 s. interval.

**Note:**

Hour counter is running with mains supply only. (Operating hours)

### 6.5 >E< Configuring Multi-Tariff

| E= | Tarif Type | Tariff Limits |
|---|---|---|
| 0 | No active tariff | - |
| 1 | Power controlled tariff | TL2 < TL3 |
| 2 | Flow controlled tariff | TL2 < TL3 |
| 3 | Cooling tariff | TL3 < TL2 |
| | - | - |
| 5 | Return temperature tariff | TL2 < TL3 |
| 6 | Average temperature tariff | - |
| 7 | - | - |
| 8 | Remote controlled tariff | - |
| 9 | Clock controlled tariff | TL2≠TL3 |

### 6.6 >H< Configuring Alarm Output

| H= | Alarm Output | Alarm Limit |
|---|---|---|
| 0 | No active alarm | - |
| 1 | Power controlled alarm | AL |
| 2 | Flow controlled alarm | AL |
| 3 | Cooling alarm | AL |
| 4 | Flow temperature alarm | AL |
| 5 | Return temperature alarm | AL |

### 6.7 >J< Configuring analogue outputs

| J = | Analogue outputs | | | |
|---|---|---|---|---|
| 0 | No set up | | | |
| 1 | A1=Power | A2=Flow | A3=$t_F$ | A4=$t_R$ |
| 2 | A1=Power | A2=Flow | A3=$t_F$ | A4=$\Delta t$ |

### 6.8 >K< Configuration of pulse dividers

| K | Energy | Water |
|---|---|---|
| 0 | 1:1 | 1:1 |
| 1 | 10:1 | 1:1 |
| 2 | 1:1 | 10:1 |
| 3 | 10:1 | 10:1 |

# 7. Tariff Functions

MAXICAL® III has two extra energy registers: TA2 and TA3, which can be used to accummulate energy, determined by the preprogrammed tariff parameters, parallel to the main register. The measuring unit for TA2 and TA3 is always the same as the main register, i.e. either kWh, MWh or GJ. However, the unit field only indicates TA2 and TA3.

The main register must always register accummulated energy consumption as this is considered legal accounting data - regardless of the tariff function selected. Tariff limits TL2 and TL3 are monitored at every integration.

When the tariff parameters occur, the consumed thermal energy is registered in either TA2 or TA3, parallel to the main register.

Every tariff function has a set of two tariff parameters, TL2 and TL3, which are always used for the same tariff type, i.e. the two tariff types cannot be “mixed”.

## Tariff types

**E=0)** **No active tariff**
If the tariff function is not required, select setup E=0.

**E=1)** **Power-controlled tariff**
When the current thermal power (P), in kW or MW, is larger than TL2, but smaller than TL3, thermal energy is counted in TA2 - parallel to the main register. If the actual power becomes larger than TL3, thermal energy is counted in TA3, again parallel to the main register.

| | |
|---|---|
| P < TL2 | Counting in main register only |
| TL3 > P > TL2 | Counting in TA2, plus main register |
| P > TL3 | Counting in TA3, plus main register |

When programming data, make sure that TL3 is larger than TL2.

The power controlled tariff can be used as a basis for calculating the individual consumer’s connection fee.

Additionaly, the tariff provides the works with valuable statistical data, when calculating new plant activities.

**E=2)** **Flow-controlled tarif**

When the actual water flow (Q) - in l/h or m³/h - is larger than TL2, but smaller than TL3, thermal energy is counted in TA2, parallel to the main register. If the actual water flow exceeds TL3, thermal energy will instead be counted in TA3, parallel to the main register.

| | |
|---|---|
| Q < TL2 | Counting in main register only |
| TL3 > Q > TL2 | Counting in TA2, plus main register |
| Q > TL3 | Counting in TA3, plus main register |

When programming data, be sure to enter a value for TL3 that is larger than TL2.

As with the power-controlled tariff, the flow-controlled tariff can be used as a basis for calculating the individual consumer's connection fee.

Additionaly, the tariff provides the works with valuable statistical data, when calculating new plant activities.

**E=3)** **Cooling tariff (Δt)**

When the actual cooling (Δt), in °C, is lower than TL2, but larger than TL3, thermal energy is counted in TA2 parallel to the main register. If the actual cooling falls below the TL3, thermal energy is counted in TA3 parallel to the main register.

| | |
|---|---|
| Δt > TL2 | Counting in main register only |
| TL3 < Δt < TL2 | Counting in TA2, plus main register |
| Δt < TL3 | Counting in TA3, plus main register |

When programming data, be sure to enter a value for TL3 that is smaller than the value for TL2.

The cooling tariff can be used as a basis for differential consumer billing. Minimal cooling (where the difference between the flow and return temperatures is only small) is uneconomical for the heat supplier.

**E=5) Return temperature tariff**

When the actual return temperature ($t_R$), in °C, is larger than TL2 but smaller than TL3, thermal energy is counted in TA2 parallel to the main register. If the actual return temperature rises, exceeding TL3, thermal energy will be counted in TA3 parallel to the main register.

| | |
|---|---|
| $t_R < TL2$ | Counting in main register only |
| $TL3 > t_R > TL2$ | Counting in TA2, plus main register |
| $t_R > TL3$ | Counting in TA3, plus main register |

When programming data, make sure that the value you enter for TL3 is larger than TL2.

The return temperature tariff can be used as a basis for differential consumer billing. A high return temperature is an indication that the heat has been poorly utilized - and is uneconomical for the heat supplier.

**E=6) Average temperature**

This tariff type is not registered in TL2 or TL3. However, for each temperature measurement (integration) the average flow ($t_F$) and return temperature ($t_R$) is determined. These calculations are updated daily, the total average of each day being stored as *daily data*. This information is stored for 31 days.

The display shows the current days average temperature for both $t_F$ and $t_R$ as TA2 and TA3.

| | | |
|---|---|---|
| Average $t_F$ | $\sum t_F/n$ | TA2 |
| Average $t_R$ | $\sum t_R/n$ | TA3 |

**E=8)** **Remote-controlled tariff**

The above tariff types are all internal tariffs, managed by the integrator. MAXICAL® III's tariff registers; TA2 and TA3, can also be controlled remotely via data communication. Three different data commands (TAR0, TAR2 and TAR3) can be used to control the tariffs, e.g. from the heat supplier's computer.

| | |
|---|---|
| TAR0 | Counting in main register only. |
| TAR2 | Counting in TA2, plus main register |
| TAR3 | Counting in TA3, plus main register |

This tariff type is ideal for enforcing tariffing with different time zones. This type of tariff is also particularly suitable if several meters are controlled via an M-Bus, or similar, as it simplifies installation.

**E=9)** **Time controlled tariff**

This tariff type divides the energy consumption between TA2 and TA3, controlled by the actual time. If TL2=0600 and TL3=2200, the energy used between 6 a.m. and $9^{59}$ p.m. will be accumulated in TA2, whereas the energy used from 10 p.m. to $5^{59}$ a.m. will be accumulated in TA3.

# 8. Programming Tariff and Alarm Limits

All tariff limits, alarm limits and analogue outputs measuring values in MAXICAL® III must be programmed as digits and decimals - but without the decimal point. Temperature limits (E=3 and E=5, H=3 and H=5 plus A3 and A4) must always be entered in °C with two decimals. However, power and flow limits (E=1 and E=2, H=1 and H=2 plus A1 and A2) vary both with respect to measuring unit and number of decimals, depending on the flow meter code (CCC no.) selected.

Additionally, please note that:

*TL3 must be* **larger** *than TL2 when you select code E=1. 2 and 5*

*and,*

*TL3 must be* **smaller** *than TL2 if you select code E=3 (Δt tariff).*

**Example 1: Δt tariff (E=3)**
TL2 = 30.00°C and TL3 = 20.00°C means that:
TL2 = 3000 and TL3 = 2000

**Example 2: Power tariff (E=1)**
TL2 = 10.0 kW and TL3 = 15.0 kW means that:
TL2 = 100 and TL3 = 150

| CCC No. | E=1, H=1, A1 Power (TL3 > TL2) | Programming Limits: | E=2, H=2, A2 Flow (TL3 > TL2) | Programming Limits: |
|---|---|---|---|---|
| 000 | 0,001...1,000 MW | 1...1000 | 0,01...5,00 m³/h | 1...500 |
| 001 | 0,001...1,000 MW | 1...1000 | 0,01...9,00 m³/h | 1...900 |
| 002 | 0,01...9,00 MW | 1...900 | 0,1...50,0 m³/h | 1...500 |
| 003 | 0,01...9,00 MW | 1...900 | 0,1...90,0 m³/h | 1...900 |
| 004 | 0,01...9,00 MW | 1...900 | 0,1...50,0 m³/h | 1...500 |
| 005 | 0,01...120,00 MW | 1...12000 | 0,1...900,0 m³/h | 1...9000 |
| 006 | 0,1...90,0 MW | 1...900 | 1...900 m³/h | 1...900 |
| 007 | 0,1...90,0 MW | 1...900 | 1...900 m³/h | 1...900 |
| 008 | 0,1...900,0 MW | 1...9000 | 1...5000 m³/h | 1...5000 |
| 009 | 0,001...0,500 MW | 1...500 | 0,01...3,00 m³/h | 1...300 |
| 108 | 0,1...180,0 kW | 1...1800 | 1...1200 l/h | 1...1200 |
| 109 | 0,1...300,0 kW | 1...3000 | 1...2000 l/h | 1...2000 |
| 110 | 0,1...450,0 kW | 1...4500 | 1...3000 l/h | 1...3000 |
| 111 | 0,1...750,0 kW | 1...7500 | 1...5000 l/h | 1...5000 |
| 112 | 0,1...750,0 kW | 1...7500 | 1...5000 l/h | 1...5000 |
| 113 | 0,1...1800,0 kW | 1...18000 | 1...12000 l/h | 1...12000 |
| 114 | 0,1...4500,0 kW | 1...45000 | 1...30000 l/h | 1...30000 |
| 115 | 0,1...300,0 kW | 1...3000 | 1...2000 l/h | 1...2000 |
| 116 | 0,1...180,0 kW | 1...1800 | 1...1200 l/h | 1...1200 |
| 117 | 0,1...450,0 kW | 1...4500 | 1...3000 l/h | 1...3000 |
| 118 | 0,1...450,0 kW | 1...4500 | 1...3000 l/h | 1...3000 |
| 119 | 0,1...350,0 kW | 1...3500 | 1...2500 l/h | 1...2500 |
| 120 | 0,1...4500,0 kW | 1...45000 | 1...30000 l/h | 1...30000 |
| 121 | 0,1...1000,0 kW | 1...10000 | 1...7000 l/h | 1...7000 |
| 122 | 0,1...180,0 kW | 1...1800 | 1...1200 l/h | 1...1200 |
| 123 | 0,1...300,0 kW | 1...3000 | 1...2000 l/h | 1...2000 |
| 124 | 0,1...750,0 kW | 1...7500 | 1...5000 l/h | 1...5000 |
| 125 | 0,1...450,0 kW | 1...4500 | 1...3000 l/h | 1...3000 |
| 126 | 0,1...750,0 kW | 1...7500 | 1...5000 l/h | 1...5000 |
| 127 | 0,1...1000,0 kW | 1...10000 | 1...7000 l/h | 1...7000 |
| 128 | 0,1...1000,0 kW | 1...10000 | 1...7000 l/h | 1...7000 |
| 129 | 0,1...1800,0 kW | 1...18000 | 1...12000 l/h | 1...12000 |
| 130 | 0,1...3000,0 kW | 1...30000 | 1...20000 l/h | 1...20000 |
| 131 | 0,1...4500,0 kW | 1...45000 | 1...30000 l/h | 1...30000 |
| 132 | 0,1...750,0 kW | 1...7500 | 1...5000 l/h | 1...5000 |
| 133 | 0,1...450,0 kW | 1...4500 | 1...3000 l/h | 1...3000 |
| 134 | 0,1...180,0 kW | 1...1800 | 1...1200 l/h | 1...1200 |
| 135 | 0,1...3000,0 kW | 1...30000 | 1...20000 l/h | 1...20000 |
| 136 | 0,1...500,0 kW | 1...5000 | 1...3500 l/h | 1...3500 |
| 137 | 0,1...2000,0 kW | 1...20000 | 1...15000 l/h | 1...15000 |

| CCCNo | E=1, H=1, A1<br>Power (TL3 > TL2) | Programming<br>Limits: | E=2, H=2, A2<br>Flow (TL3 > TL2) | Programming<br>Limits: |
|---|---|---|---|---|
| 139 | 0,1...750,0 kW | 1...7500 | 1...5000 l/h | 1...5000 |
| 140 | 0,1...1500,0 kW | 1...15000 | 1...10000 l/h | 1...10000 |
| 141 | 0,1...1800,0 kW | 1...18000 | 1...12000 l/h | 1...12000 |
| 142 | 0,001...3,000 MW | 1...3000 | 0,01...20,00 m³/h | 1...2000 |
| 143 | 0,001...5,000 MW | 1...5000 | 0,01...30,00 m³/h | 1...3000 |
| 144 | 0,001...12,000 MW | 1...12000 | 0,01...80,00 m³/h | 1...8000 |
| 145 | 0,001...30,000 MW | 1...30000 | 0,01...120,00 m³/h | 1...12000 |
| 146 | 0,001...40,000 MW | 1...40000 | 0,01...250,00 m³/h | 1...25000 |
| 147 | 0,001...30,000 MW | 1...30000 | 0,01...150,00 m³/h | 1...15000 |
| 148 | 0,001...90,000 MW | 1...90000 | 0,01...600,00 m³/h | 1...60000 |
| 149 | 0,01...360,00 MW | 1...36000 | 0,1...2400,0 m³/h | 1...24000 |
| 150 | 0,01...900,00 MW | 1...90000 | 0,1...6000,0 m³/h | 1...60000 |
| 151 | 0,1...800,0 kW | 1...8000 | 1...5000 l/h | 1...5000 |
| 152 | 0,1...3000,0 kW | 1...30000 | 1...20000 l/h | 1...20000 |
| 153 | 0,1...4500,0 kW | 1...45000 | 1...30000 l/h | 1...30000 |
| 156 | 0,1...450,0 kW | 1...4500 | 1...3000 l/h | 1...3000 |
| 157 | 0,1...750,0 kW | 1...7500 | 1...5000 l/h | 1...5000 |
| 158 | 1...1000 kW | 1...1000 | 0,01...60,00 m³/h | 1...6000 |
| 163 | 0,1...300,0 kW | 1...3000 | 1...2000 l/h | 1...2000 |
| 164 | 0,1...450,0 kW | 1...4500 | 1...3000 l/h | 1...3000 |
| 165 | 0,1...750,0 kW | 1...7500 | 1...5000 l/h | 1...5000 |
| 168 | 0,1...4500,0 kW | 1...45000 | 1...30000 l/h | 1...30000 |
| 169 | 1...1000 kW | 1...1000 | 0,01...60,00 m³/h | 1...6000 |
| 170 | 0,001…20,000 MW | 1…20000 | 0,01…150,00 m³/h | 1…15000 |
| 171 | 0,01…80,00 MW | 1…8000 | 0,1…600,0 m³/h | 1…6000 |
| 172 | 0,01…200,00 MW | 1…20000 | 0,1…1500,0 m³/h | 1…15000 |
| 173 | 0,01…15,00 MW | 1…1500 | 0,1…120,0 m³/h | 1…1200 |
| 300 | 0,1...3000,0 kW | 1...30000 | 0,001...14,000 m³/h | 1...14000 |
| 301 | 0,001...30,000 MW | 1...30000 | 0,01...140,00 m³/h | 1...14000 |
| 302 | 0,01...300,00 MW | 1...30000 | 0,1...1400,0 m³/h | 1...14000 |
| 303 | 0,1...3000,0 MW | 1...30000 | 1...14000 m³/h | 1...14000 |
| 310 | 0,1...3000,0 kW | 1...30000 | 0,001...14,000 m³/h | 1...14000 |
| 311 | 0,001...30,000 MW | 1...30000 | 0,01...140,00 m³/h | 1...14000 |
| 312 | 0,01...300,00 MW | 1...30000 | 0,1...1400,0 m³/h | 1...14000 |
| 313 | 0,1...3000,0 MW | 1...30000 | 1...14000 m³/h | 1...14000 |

| CCC No.. | E=3. H=3. A4<br>$\Delta$t (TL3 < TL2) | Programming<br>Limits: | E=5. H=5. A3<br>Return temp. (TL3 > TL2) | Programming<br>Limits: |
|---|---|---|---|---|
| All | 3.00...175.00 °C | 300...17500 | 3.00...175.00°C | 300...17500 |

# 9. Data Setup

Using the programming software, type no. 66-99-210.

**1) Current Date YY.MM.DD**
The current date is programmed from the internal clock in the computer. 10th February, 1997 is written as 97.02.10. The data can also be changed via Kamstrup's hand-held terminal, MULTITERM III.

**2) Current Time HH.MM.SS**
The current time is programmed from the internal clock in the computer. MAXICAL® III always displays seconds as "00"

This too can be changed via Kamstrup's hand-held terminal, MULTITERM III.

**3) Read-out Date MM.DD**
The default is 1st June (06.01). However this can be changed using MULTITERM III.

Programming limits: MM: 01...12

DD: 01...28

Data is read at midnight (2400 hrs) on the programmed date. If you require data up to and including 31st March (03.31), the read-out date should be programmed to 1st April (04.01).

**4) Customer ID No. Variable**
The Customer ID No. can comprise of max 11 digits.

**5) Average time**
Average time for calculating peak power or peak flow (in the EEPROM) can vary from 1 - 120 minutes.

**6) Tariff Limits, TL2/TL3** (Please read previous chapter)

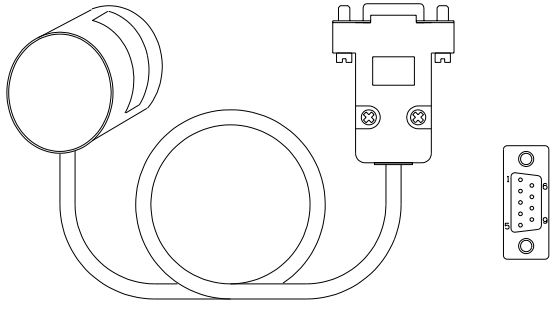
**7) Alarm Limits, AL** (Please read previous chapter)

**8) Analogue outputs** (Please read previous chapter)

# 10. Data Communication

An optical, infra-red eye is placed at the bottom left of MAXICAL® III's front panel. This sends and receives data in accordance with the IEC 1107/EN61107 standard.

A standard optical read-out head with a permanent magnet is used for data acquisition and programming MAXICAL® III.




| | | |
|---|---|---|
| 2 | RXD | Recieve Data |
| 3 | TXD | Transmit Data |
| 4 | DTR | Data Terminal Ready |
| 5 | SG | Signal Ground |

Pulse count, location of flow meter and measuring unit for accumulated energy can be programmed via the optical read-out head. As this data (A-B-CCC) is considered to be legal data, changes can only be made if the program for MAXICAL® III can be accessed (V=0).

Kamstrup's read-out head, type no. 66-99-102, can be connected to a standard PC (IBM compatible) with Windows 3.1 - or a more recent version. Use Kamstrup's programming software (66-99-210) for programming - please read chapter 11 for further information on the programming software.

## 10.1 Data Strings and Functions

When the computer connected sends a recognisable request string, MAXICAL® III responds by sending a data string 1-2 seconds after the request has been received.

MAXICAL® III's data acquisition uses the following communication set-up:

| | | | | |
|---|---|---|---|---|
| 300/1200 Baud | 1 Startbit | 7 Databits | Equal parity | 1 Stopbit |

The following data strings can be read via optical data acquisition:

**Key**

| | |
|---|---|
| UNIT1 | kWh, MWh, GJ or none |
| UNIT2 | $m^3$ or none |
| STX | Start of Text |
| ETX | End of Text |
| BCC | Block Check Character |
| LF | Line Feed |
| CR | Carriage Return |
| Dn | ASCII Characters |
| * | Separate value and unit |
| -> | Data string *to* MAXICAL® III |
| <- | Data string *from* MAXICAL® III |

**Data string for "EN 61107" Request**

a) EN61107 data acquisition (via the optical eye only)

-> / ? ! CR LF [300 BAUD]

<- / K A M 0 M C CR LF [300 BAUD]

-> ACK 0 0 0 CR LF [300 BAUD]

<- STX 0 . 0 ( D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 ) [300 BAUD]

<- 6.8 ( D7 D6 D5 D4 D3 D2 D1 * UNIT1 ) [300 BAUD]

<- 6.26 ( D7 D6 D5 D4 D3 D2 D1 * UNIT2 ) [300BAUD]

<- 6.31( D7 D6 D5 D4 D3 D2 D1 * h ) ! CR LF ETX BCC [300 BAUD]

## 10.2 Data Strings

(The following data can be read either by the optical read head or via data terminals 62-63-64)

**b) Normal data 1:**

-> / # 1 [300 BAUD]

<- Energy, Water, Hour Counter, $t_F$, $t_K$, $\Delta t$, Power, Flow, Peak Power/Flow, Info

— [1200 BAUD]

**c) Normal data 2:**

-> / # 2 [300 BAUD]

<- Customer No., TA2, TL2, TA3, TL3, Alarm Limit, 0, Prog. No., Config. No., Date

— [1200 BAUD]

**d) Read-out data:**

-> / # 3 [300 BAUD]

<- Customer No., Target Date, Energy, Water, TA2, TA3, AL, 0, 0

— [1200 BAUD]

**e) Data read-out of verification data:**

-> / # 4 [300 BAUD]

<- Energy, Quick sum, Δt x k-factor, Water, Water remainder 1, Water remainder 2, $t_F$ ,$t_R$ , Prog.No.

— [1200 BAUD]

**f) Data read-out of daily data:**

-> / # 5 [300 BAUD]

<- Customer No., Read-out date, Energy, Water, TA2, TA3, Alarm Limit, Peak time, Peak Power/flow — (hourly data)

[1200 BAUD]

<- Read-out date, Energy, Water, TA2, TA3, Alarm Limit, Peak time, Peak Power/flow — (1 previous day)

.

.

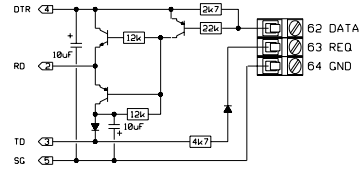
<- Read-out date, Energy, Water, TA2, TA3, Alarm Limit, Peak time, Peak Power/flow — (the previous 30 days)

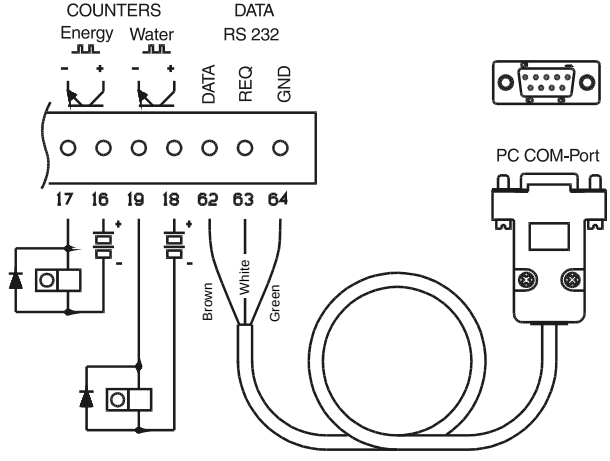
<- Read-out date, Energy, Water, TA2, TA3, Alarm Limit, Peak time, Peak Power/flow — (the previous 31 days)

## 10.3 Data Acquisition via Connection Terminals

Serial data communication - with the same function as the optical read out head - can be connected to the right of MAXICAL® III, where all the connection terminals are placed. This means that both programming and data acquisition is possible via this data port. The data section is galvanically separated by means of opto-couplers.

As MAXICAL® III's data port is passively isolated, a circuit with direction connection to a computer must be created. The following drawing can be used as an example:




The RS-232 adapter, shown above, is integrated in the data cable shown - type no. 66-99-106, making computer connection possible.

# 11. Programming (Windows) software 66-99-210

MAXICAL® III is 100% based on micro-processor technique, which means that all integration functions can be programmed.

The software package, 66-99-210, has been developed with a view to providing distributors and service technicians with simple, but effective, access to programming and configuring MAXICAL® III.

## 11.1 Computer and Printer Requirements

The program can be installed and run on an IBM-compatible 486 or Pentium computer, with at least 8 MB RAM - although we would recommend 16 MB RAM as the program runs somewhat faster.

To install the program, there must be at least 10 MB free on the hard disk and a 3½" (1.44 MB) floppy drive. The program can not run directly from the disks. The computer must also have mouse and a free serial COM port for programming, plus a free parallel port for the lable printer.

Windows 3.1 or 3.11 must be installed on the computer. The program can also be used with Windows 95.

The monitor must be min. VGA, as the program is always shown in VGA format. If a monitor with a better resolution is connected, the program will not fill the whole screen.

When programming MAXICAL® III, all that is required is a serial data connection between MAXICAL® III and the computer. This connection can be established via the optical read-out head, type no. 66-99-102 - or by means of a data cable with built-in RS-232 adapter, type no. 66-99-106.

Regardless of the method you prefer, the program can be set up to use either the COM1 or COM2 port in the computer.

The program can also be used to print the label - which can be seen in the window to the right of MAXICAL® III's front foil. The printer used for this purpose must be connected to the computer's parallel port, LTP1. The printer must be suitable for Windows and for printing small labels.

Kamstrup A/S recommend OKI 610ex, OKI 410ex or HP4 laser printer.

The original labels for MAXICAL® III can be ordered from Kamstrup A/S - product No. 2008-259.

### 11.2 Installing the Software

Use Windows File Manager to check that there is at least 10 MB free space on the hard disk.

Close any other Windows programs that may be running, before proceeding to install.

Start Windows Program Manager, select File and click with the left hand mouse button on *run*.

Insert disk #1 into the floppy drive - probably drive A.

Write “A:\Setup” and press “Enter”

The program will then lead you through the installation. Insert disk #2 and #3, when requested to do so.

When the installation is complete, close Windows before starting the program. The installation process creates an icon - called *MaxCal III*. Start the program by double clicking this icon.

Windows 95 users should note that the program cannot start unless a printer driver has been installed!

### 11.3 Connecting MAXICAL® III to the Computer

MAXICAL® III is programmed solely by means of serial data transmission between MAXICAL® III and the computer. The connection can be either the optical read-out head, type no. 66-99-102, or a data cable with built in RS-232 adaptor, type no. 66-99-106, connected to the screw terminals 62-63-64 at the rear of MAXICAL® III.

## 11.4 Reading MAXICAL® III's Set-up

Start the program by double-clicking with the left-hand button of the mouse on the MAXICAL® III icon. Establish serial data communication, as described, and click on *Read Meter*.

After a short wait the data transmitted will be displayed on the computer monitor.

Once the meter has been read, the status field at the bottom right of the menu will indicate the extent to which the meter can be programmed.

## 11.5 Partial Programming

MAXICAL® III is supplied with a block so that only partial programming is possible. (V=1). In practice, this means that all legal measuring data A-B-CCC, the meter's serial number and any Qmax are not accessible.

This block is used for all type-approved meters that are to be verified.

## 11.6 Total Programming

When MAXICAL® III is supplied without the program block (V=0), all the meter's measuring parameters can be programmed via the programming software.

**Note**: MAXICAL® III's daily data and accumulated counter status are **not** affected by total programming!

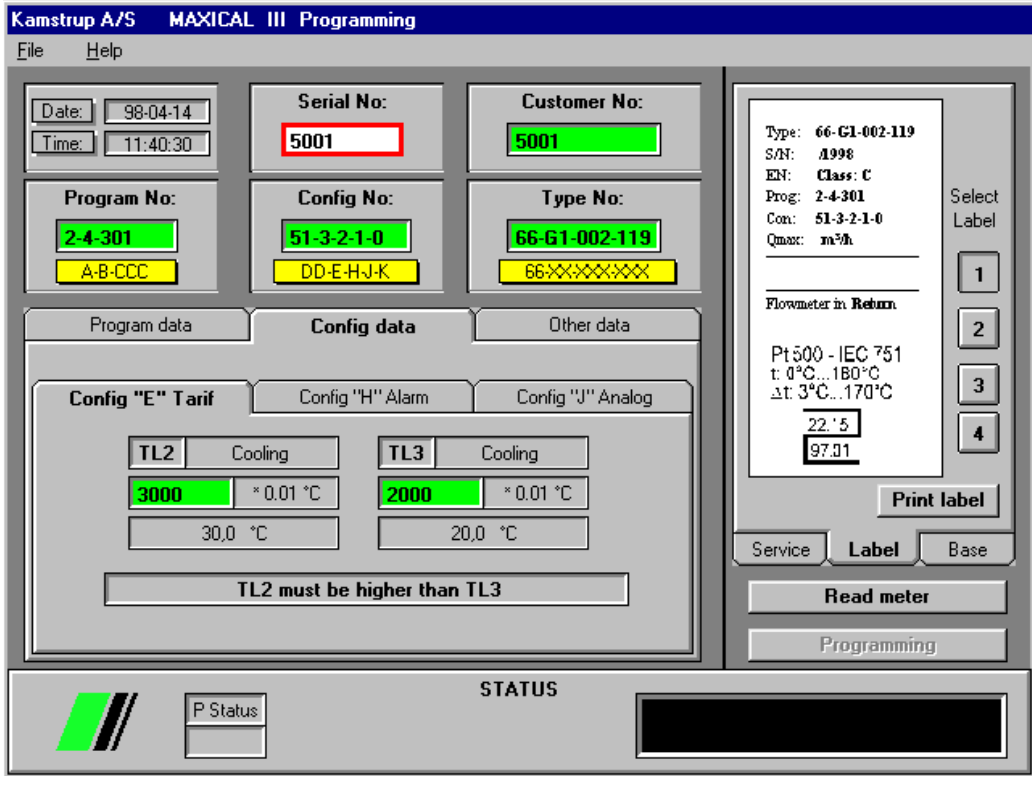
## 11.7 Entering Data

You should be totally familiar with MAXICAL® III's functions before programming. This manual contains all the information you require - pay particular attention to chapters 5 and 6.

**Your computer's system clock must be correctly set - the date and time stated here will be transmitted to the meter during programming.**

**MAXICAL® III must be supplied by the mains when programming.**

## 11.8 Screen Menu




**NOTE:**

If MAXICAL® III is in operation during programming, the actual displays and analogue outputs for power and flow will show excessively high values for a few seconds.

Analogue measured values may have a slightly lower value with *Read meter* than with *Programming* due to the integrator's internal resolution, i.e. a programmed temperature of 160.00°C will be shown as 159.98°C when *Read meter* is selected.

# 12. Sealing

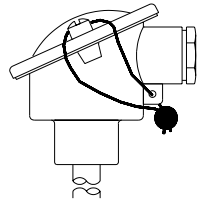
All verified meters are sealed subsequent to installation. Meters may also be sealed for other reasons. The integrator, flow part and temperature sensors are all sealed independently to ensure that legal measuring data is not tampered with.

Place MAXICAL® III in a separate panel section, so that the front lid can be locked and sealed with thread and a plastic seal.

Panel doors with both sealable snap locks and sealing screws can be used.

MAXICAL® III's front panel has a void-label - placed by Kamstrup A/S - which prevents tampering.

Temperature sensors with DIN-heads, shape B, can be sealed as shown below. The seal ensures that the top cannot be removed.



If sensor pockets are used in addition to sensor tubes, these too must be sealed.

The flow meter should be sealed as prescribed for the type in question.

# 13. Verification

**Quick-figure**
The Quick-figure is used when verifying MAXICAL® III. The meter's highest resolution is defined as the Quick-figure. The Quick-figure can be read in two ways:

**1) In MAXICAL® III's display**
Select the next but last display - using the key on the left of MAXICAL® III's front panel. The *measuring unit* is displayed as *T-M*, and the Quick-figure can be seen in the display for 8 minutes.

**2) Data Output**
Both the optical data output on the front of MAXICAL® III and the data output on terminals 62-63-64 can be used for reading the Quick-figure. Please refer to chapter 10.2.

**Reseting the Quick-figure**
It is not possible to reset the Quick-figure.

The Quick-figure is calculated to be the difference between the Quick-figure before and after verification.

**Quick-sum**
When verifying ULTRAFLOW® II, Qn 1.5 m³/h, there will normally be 10.000 pulses, corresponding to 10 energy integrations or 100 litres. The total Quick-figure is of most interest in connection with verifying.

## 13.1 Energy Calculation

The *true* energy - measured by MAXICAL® III during verification must be calculated with greatest care as this value is the basis for calculating the meter's verification deviation. Energy can be calculated as follows:

| | | |
|---|---|---|
| $E_{MJ}$= | $m^3 \times \Delta t \times k_{STUCK}$ | [MJ] |
| $E_{GJ}$ = | $\frac{EMJ}{1000}$ | [GJ] |
| $E_{kWh}$ = | $\frac{EMJ}{3,6}$ | [kWh] |
| $E_{MWh}$ = | $\frac{EMJ}{3600}$ | [MW] |

$m^3$ is the water quantity recorded (or simulated) during verification. E.g., if MAXICAL® III has a Qn 1.5 m³/h flow meter and a CCC code of 119, the integrator will be programmed to receive 100.0 volume pulses pr. litre.

If 10,000 volume pulses are registered during verification, this would correspond to 10,000/100.0 = 100 litres - or 0.1 m³.

$\Delta t$ is the difference between flow and return temperatures ($t_F$ - $t_R$). Regardless of whether the verification is performed with sensors in a liquid bath or with precision resistors, the temperatures must be entered accurately.

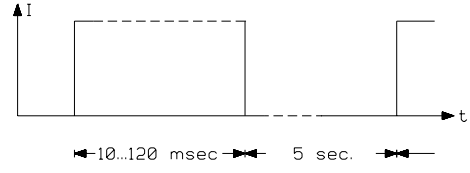
$k_{STUCK}$ is the water's thermal coefficient - which can be seen in "Tabellen von Wärmekoeffizienten für Wasser als Wärmeträgermedium", published in 1986 by Wirtschaftverlag NW.

Note that to use this reference book, the following information is required:

- Flow temperature, $t_F$
- Return temperature, $t_R$
- Flow meter location: flow or return
- Plant pressure 16 bar

The k-factor stated in the table, is the basis for energy calculation in MJ, and must, therefore, be converted - using the formulae stated earlier, when the energy is required in other units.

**NB.:**
*Precision resistors can be used for testing and verifying MAXICAL® III. An electronic resistance simulator, e.g. based on voltage-controlled FET, is not suitable as MAXICAL's measuring current is intermittant (pulsing).*




*The measuring current (I) is approx. 2.5 mA for the Pt100 version and approx 0.5 mA for the Pt500 version. The measuring sequence will, depending on the flow and return temperatures, take from 10 to 120 msec. The Measurements will be repeated at 5 second intervals.*

## 13.2 Σ Quick-figure

The sum of the Quick-figure, e.g. determined during verification, is called Σ Quick-figure. The figure can be up to 999999 starting again at 0 for 1.000.000. The Quick-figure can be read over the data output and on the display - described in chapter 13.

The calculated total Quick-figure, which MAXICAL® III ideally should note during verification, can be calculated from the *true* energy multiplied by the high-resolution Quick-factor:

Quickfigure = $E_{GJ}$ x $Q_{GJ}$ or $E_{MWh}$ x $Q_{MWh}$,

where $Q_{GJ}$ and $Q_{MWh}$ can be seen in the following Quick table:

| CCC-code (read chapter 6.1 - 6.3) | $Q_{GJ}$ | $Q_{MWh}$ | Decimals with [m³] display |
|---|---|---|---|
| 000, 001, 002, 108, 109, 110, 111, 112, 115, 116, 117, 118, 119, 121, 122, 123, 124, 125, 126, 132, 133, 134, 136, 139, 156, 164, 165, 165, 300, 310 | 2.388.900 | 8.600.000 | x 0,01 m³ |
| 003 | 955.200 | 3.440.000 | x 0,1 m³ |
| 004, 006, 113, 114, 120, 127, 128, 129, 130, 131, 135, 137, 140, 141, 142, 143, 151, 152, 153, 157, 168, 301, 311 | 238.890 | 860.000 | x 0,1 m³ |
| 005, 007 | 95.520 | 344.000 | x 1 m³ |
| 008, 144, 145, 146, 147, 148, 149, 158, 169, 170, 302, 312 | 23.889 | 86.000 | x 1 m³ |
| 171, 172, 303, 313 | 2.388,9 | 8.600 | x 10 m³ |

**Example of *true* Quick-figure calculation:**

* MAXICAL® III
* Programmed for Qn 1.5 m³/h flow meter (CCC=119)
* Fitted in flow pipe
* 10,000 volume pulses, corresponding to 0.1 m³ registered
* The temperature is simulated to: $t_F$ = 49.00°C and $t_R$ = 40.00°C.

$E_{MJ} = m^3 \times \Delta t \times k_{STUCK} = 0.1 \times 9 \times 4.1316 = 3.71844$ [MJ]

$$\text{Quick} = \frac{EMJ \times QGJ}{1000} = \frac{3.71844 \times 2{,}388.900}{1000} = 8883$$

### 13.3 Nominal quick-figure

The nominal quick-figure for verification of MAXICAL® III can be calculated using the formula stated on page 50, provided *ideal* conditions prevail. Nominal quick-figures can naturally only be used as a guideline or for testing functions - the quick-figure must be corrected for actual temperature deviations etc. prior to final verification.

**Table 1, Nominal Quick-figure**

* ULTRAFLOW® II, Qn 1.5 $m^3/h$, CCC=119

* Fitted in flow pipe

| Qn [$m^3/h$] | $t_F$ [°C] | $t_R$ [°C] | $\Delta t$ (°C] | Flow meter | Imp/10 Int. | $Quick_{NOM}$ |
|---|---|---|---|---|---|---|
| 1.5 | 43.00 | 40.00 | 3.00 | flow line | 10,000 | 2,966 |
| 1.5 | 49.00 | 40.00 | 9.00 | flow line | 10,000 | 8,883 |
| 1.5 | 61.00 | 40.00 | 21.00 | flow line | 10,000 | 20,602 |
| 1.5 | 80.00 | 40.00 | 40.00 | flow line | 10,000 | 38,843 |
| 1.5 | 160.00 | 10.00 | 150.00 | flow line | 10,000 | 137,122 |

**Table 2, Nominal Quick-figure**

* ULTRAFLOW® II, Qn 1.5 $m^3/h$, CCC=119

* Fitted in return pipe

| Qn [$m^3/h$] | $t_F$ [°C] | $t_R$ [°C] | $\Delta t$ [°C] | Flow meter | Pulse/10 Int. | $Quick_{NOM}$ |
|---|---|---|---|---|---|---|
| 1.5 | 43.00 | 40.00 | 3.00 | return line | 10,000 | 2,970 |
| 1.5 | 49.00 | 40.00 | 9.00 | return line | 10,000 | 8,912 |
| 1.5 | 61.00 | 40.00 | 21.00 | return line | 10,000 | 20,803 |
| 1.5 | 80.00 | 40.00 | 40.00 | return line | 10,000 | 39,667 |
| 1.5 | 160.00 | 10.00 | 150.00 | return line | 10,000 | 151,117 |

# 14. Service

## 14.1 Trouble Shooting

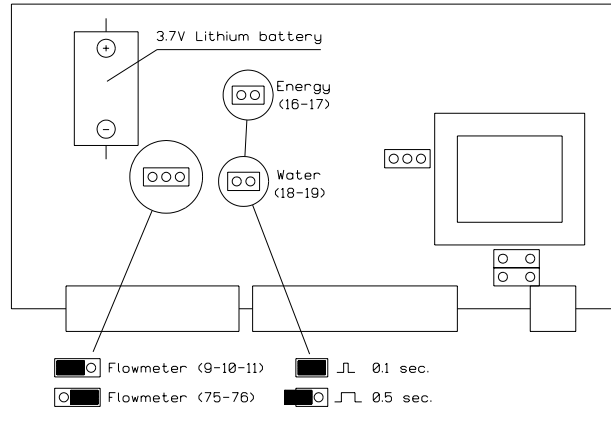
| Symptom | Possible Cause | Suggested Remedy |
|---|---|---|
| No function displayed when supply cut-off<br>(blank display) | Internal battery supply missing | Replace Lithium back-up cell<br>(Spare part no. 1606-047) |
| Background lighting off<br>Displayed temp. too high | Voltage supply cut-off<br>4-wire circuit out of order | Check mains supply<br>Check mains supply |
| No energy accumulation (e.g. MWh) and $m^3$ | Read “info” on display<br>If “info” = 000<br>If “info” > 000 | Check both flow meter and temperature sensors<br>Check fault indicated by info code |
| Accumulation of $m^3$, but not energy (e.g. MWh) | Flow and return sensors switched over, either in installation or connection | Fit sensors correctly ($t_F$ must be higher than $t_R$) |
| No accumulation of $m^3$ | No volume pulses | Check flow meter connection<br>Check flow meter direction<br>Check flow meter setting<br>(read chapter 4.6) |
| Incorrect accumulation of $m^3$ | Flow meter faulty<br>Flow meter installed wrong way<br>Incorrect programming | Send meter to repair<br>Re-install correctly<br>Reprogram MAXICAL® III or send to Kamstrup for checking<br>Check flow meter setting |
| Incorrect temperature display | Faulty temperature sensor<br>Poor cable joints | Replace sensor pair<br>Check joints |
| Temperature display a little too low/ accumulated energy a little too low (e.g. MWh) | Poor thermal sensor switch | Place sensors in the bottom of sensor pockets |
| | Heat loss | Insulate sensor pocket |
| | Sensor pocket too short | Replace with longer pocket |
| Analogue outputs give insufficient current | Voltage supply too low | Supply should be >210VAC |
| | Excessive load | $R_{LOAD} < 500\Omega$ |
| | Outputs scaled incorrectly | Reprogram MAXICAL® III |

## 14.2 Replacing Back-up Cell

The internal back-up cell should be replaced after 8 years operation, when MAXICAL® III is used in applications where the correct time is essential.

Cut off the 230 V supply and remove all the plug in terminals on MAXICAL® III's back plate. Remove the back plate by unscrewing the four screws (use a Torxbit no. T-20).

Draw the middle PCB approx 2 cm out and loosen the display light plug (to the left of the transformer). The print can now be drawn completely out of the cabinet.




Use a soldering iron to remove the lithium cell and solder a new one in place. Only original lithium cells (spare part no. 1606-047) may be used.

Replace the PCB and reconnect the supply cable to the display light.

Replace the back plate and MAXICAL® III is once again ready for operation.

**NB.:**
Remember to reset MAXICAL® III's internal clock subsequent to replacing the back-up cell. The clock can be set via the programming software, 66-99-210 or by means of Kamstrup's hand-held terminal, MULTITERM III.

### 14.3 Inserting Analogue and Relay Module

An analogue and relay module (66-x0) can easily be fitted into an existing MAXICAL® III. The module has 4 active analogue outputs (4...20 mA) and two relay outputs for info code alarm and limit switches respectively.

Order type no. 66-99-600 for a separate analogue and relay module.

To fit the module, remove the back panel as described on the previous page. Fit the module in the top section of the integrator, so that the plug and socket mesh.

Use a stanley knife - or something similar - to cut the connection holes free at terminal no. 80-93.

Replace the back panel and MAXICAL® III is ready for operation.

**NB.:**
Remember to reprogram MAXICAL® III subsequent to fitting a new analogue and relay module, as the module is not programmed on delivery. Use the programming software, 66-99-210. MAXICAL® III must be supplied with 230 V AC during programming.

### 14.4 Reseting MAXICAL® III

MAXICAL® III information codes can be reset via the optical read out head or via data terminals 62-63-64. Data instruction “M3” must be sent to the meter. The function is also available in the programming software, 66-99-210. Select *service* and click on *reset infocode*.

Furthermore, the information code can be reset by activating both front plate buttons for approx. 10 s. until the display says ”Call”.

The hour counter can not be reset independently.

The meter can be totally reset by removing the back plate and taking the main PCB out. Replace the PCB, simultaneously pressing both keys on the front panel whilst you do so. This will activate a total reset (energy, water, hour counter and info codes will be cancelled).

# 15. Disposing of Energy Meters

Kamstrup's energy meters are designed for many years reliable operation. But all good things must come to an end - and a worn-out energy meter should be disposed of with as much consideration to the environment as possible.

**The supplier can dispose of the meter**
If agreed to beforehand, Kamstrup can dispose of worn-out MAXICAL® III meters in a correct and environmentally sound manner, at no cost to the customer. However, the customer must cover transport expenses involved in sending the meter back to Kamstrup A/S.

**The customer can dispose of the meter**
The lithium battery **must** be removed and sent independently for destruction in an approved manner. There should be no risk of battery cables shorting during transport.

- A small number of meters - without batteries - can be sent for industrial destruction - or combustion. Metals will be recycled.
- If a large number of meters are involved, they should be taken apart, sorted and sent individually to destruction or recycling as described below:

| Item | Substance | Recommended disposal |
|---|---|---|
| Lithium battery in MULTICAL® III | New quantity: 1 g lithium >UN 3091< | Approved destruction of lithium cells |
| PCB in MAXICAL® III | Coppered epoxy laminate, soldered components | Print scrap for break-down to i.a. noble metals |
| Alu-sheath | Anodized aluminium | Aluminium recycling |
| Plastic, moulded | Noryl and ABS | Plastic recycling |
| Packing | Environmental cardboard | Cardboard recycling |

*Any questions pertaining to environmental concerns, can be sent by fax to:*
KAMSTRUP A/S
Att.: Quality Management
Fax.: 89 93 10 01

For further information and coding data please contact Kamstrup A/S by telephone, or send an e-mail to: support.heat@kamstrup.dk