

# MULTICAL® 401 Thermal Heat Meter

**“Long-life” ultrasonic heat meter**

**Large dynamic range**

**12 years of battery operation,  
24 V or 230 V**

**Calendar, data logger and tariffs**

**Optical data reading**

**RS232, M-Bus, modem and radio**

**2 pulse inputs for water meters**

**Pulse output for energy**

**NOWA compatible verification**

TS 27.01  
145

EN 1434-OIML R75:2002

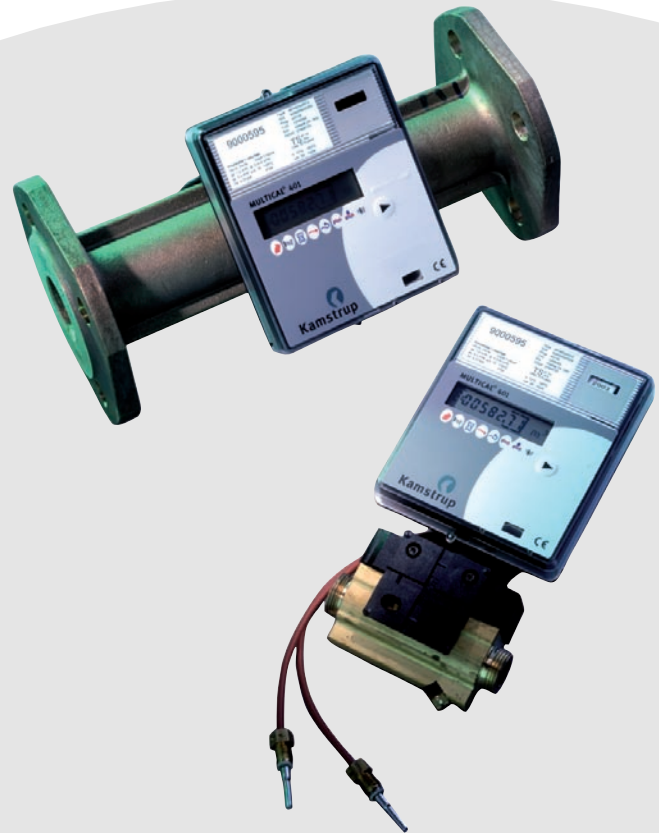
PTB

22.52

04.02

MID-2004/22/EC

CE M07 0200



## Application

MULTICAL® 401 is used for metering heat in small and medium-sized central heating plants and district heating plants, typically in single or multi-family houses and in blocks of flats. The meter is very simple to install, read and verify. In addition, MULTICAL® 401 contributes to keeping the annual operating costs at a minimum with its unique combination of large measuring accuracy and long lifetime.

MULTICAL® 401 calculates the thermal energy based on the measured differential temperature between flow and return flow, the measured water quantity, as well as internal table correction for density and enthalpy.

Flow is measured with ultrasound according to the transit time method, and all measurements, references, display readings, calculations and data communication are controlled by a microprocessor and an ASIC.

In addition, MULTICAL® 401 totalizes the consumption of 2 water meters with pulse output, and thereby a total reading of thermal energy and tap water consumption is obtained.

Via an internal module MULTICAL® 401 can be remotely read by means of RS232, M-Bus, modem or Kamstrup's radio system.

  
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## Description

MULTICAL® 401 is a static, ultrasonic thermal heat meter, designed for measuring energy in all types of heating installations where water is used as the heat-conveying medium.

The design is based on Kamstrup's extensive experience with ULTRAFLOW® ultrasonic heat meters and MULTICAL® calculators.

According to EN 1434 MULTICAL® 401 can be described as a "hybrid instrument" also called a "compact meter". In practice this means, that flow part and calculation unit must not be separated. If flow part and calculation unit have been separated and the seals thereby have been broken, the meter will no longer be valid for billing purposes, and the factory guarantee will no longer apply.

Ultrasonic measuring and microprocessor technology are the foundation of the energy meter. All circuits for calculating, measuring temperature and flow are combined in a single board construction, which not only gives a compact and rational design but also ensures an optimal measuring quality and a high degree of reliability.

Bidirectional, ultrasonic technique is used to measure the volume, based on the transit time method. A method which is widely recognised as being the best measuring principle currently available for this type of application owing to the long-term stability. Two ultrasonic transducers send sound signals both against and with the flow direction.

The ultrasonic signal travelling with the flow reaches the opposite transducer before the signal travelling against the flow. The time difference between receiving the two signals is converted into a flow quantity.

Accurately paired Pt500 or Pt100 sensors (in accordance

with EN 60751) measure the temperature in the flow and return pipes.

The short direct sensor construction is designed in accordance with EN 1434-2 and is, therefore, suitable for installation in a wide range of standard ball valves and fittings. In connection with union meters  $\leq G1 (R^{3/4})$  one temperature sensor can be fitted directly into the flow part, thereby simplifying the installation.

The accumulated thermal energy can be displayed in kWh, MWh or GJ – all shown in seven digits with the measuring unit. The display has been specially designed with a view to longevity and optimal contrast in ambient temperatures ranging from 0–55°C. Other values displayed include accumulated water consumption, operation hour counter, actual temperature measurement and momentary flow and power measurements. MULTICAL® 401 can also be configured to record target date, peak power, information code, actual date and user-defined tariffs.

To maximise safety, all registers are stored at hourly intervals in an EEPROM, which also stores monthly data for the previous two-year period.

MULTICAL® 401 has two ports for data communication. The optical eye on the front panel complies with EN 61107 standard and facilitates reading of consumption data, data logger and on-line serial PC-connection when configuring the energy meter.

A split multiplug is placed beneath the top cover. The top part of this plug is used to verify the meter. The lower part is used when connecting communication modules with M-Bus, modem, RS232 interface or radio.

## Approved meter data

MID designation		Flow sensor types	qp 0.6 m <sup>3</sup> /h...qp 15 m <sup>3</sup> /h
Mechanical environment	Class M1	Temperature range, calculator	$\theta$ : 10°C...160°C and $\Delta\theta$ : 3 K...150 K
Electromagnetic environment	Class E1	Temperature sensor set	Pt500 or Pt100, EN 60751
Climatic class	5...55°C, non condensing, closed location (indoor installation)	Medium temperature in flow part	$\theta_q$ : 15°C...130°C
EN 1434 designation	Accuracy class 2 or 3 Environment class A		

Type No.	Nom. flow [ m <sup>3</sup> /h ]	Max. flow [ m <sup>3</sup> /h ]	Min. flow [ l/h ]	Min. Cut off [ l/h ]	Pressure loss $\Delta p$ @ qp [ bar ]	Connection to flow sensor	Length [ mm ]
66-Wx-xx1-xxx	qp 0.6	qs 1.2	6	3	0.04	G <sup>3/4</sup> B	110
66-Wx-xx4-xxx	qp 1.5	qs 3.0	15	3	0.25	G <sup>3/4</sup> B	110
66-Wx-xx5-xxx	qp 1.5	qs 3.0	15	3	0.25	G <sup>3/4</sup> B	165
66-Wx-xx7-xxx	qp 1.5	qs 3.0	15	3	0.25	G1B	130
66-Wx-xx9-xxx	qp 1.5	qs 3.0	15	3	0.25	G1B	190
66-Wx-xxA-xxx	qp 3.0	qs 6.0	30	6	0.05	G1B	130
66-Wx-xxB-xxx	qp 3.0	qs 6.0	30	6	0.05	G1B	190
66-Wx-xxD-xxx	qp 3.5	qs 7.0	35	7	0.07	G5/4B	260
66-Wx-xxF-xxx	qp 6.0	qs 12	60	12	0.19	G5/4B	260
66-Wx-xxG-xxx	qp 6.0	qs 12	60	12	0.19	DN25	260
66-Wx-xxH-xxx	qp 10	qs 20	100	20	0.06	G2B	300
66-Wx-xxJ-xxx	qp 10	qs 20	100	20	0.06	DN40	300
66-Wx-xxK-xxx	qp 15	qs 30	150	30	0.14	DN50	270

# Technical data

## Electrical data

Supply voltage	3.6 V ±5%
Battery	3.65 VDC, D-cell lithium
Replacement interval	
Mounted on the wall	12 years @ $t_{BAT} < 30^{\circ}\text{C}$
Mounted on flow part	10 years @ $t_{BAT} < 40^{\circ}\text{C}$
Fast mode	4 years @ $t_{BAT} < 30^{\circ}\text{C}$
	3 years @ $t_{BAT} < 40^{\circ}\text{C}$
Mains supply	230 VAC +15/-30%, 50 Hz 24 VAC ±50%
Power absorption	<1W
Backup mains supply	Integral SuperCap eliminates operation stop due to power cuts
EMC data	Meets EN 1434 class A

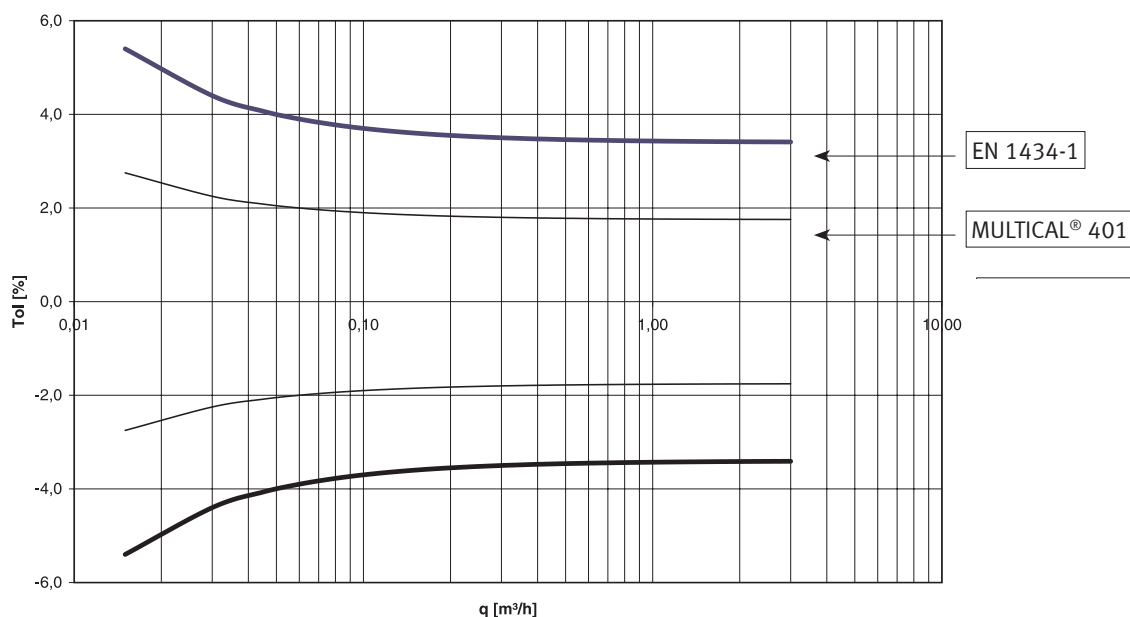
## Mechanical data

Metrology class	2 or 3
Environment class	Meets EN 1434 class A
Ambient temperature	0...55°C (indoor)
Protection class	IP54
Medium temperature	15...130°C At medium temperatures over 90°C in the flow part, we recommend using flange meters and mounting the calculator on the wall.
Storage temperature, empty meter	+25...60°C
Pressure step	
with thread	PN16
with flanges	PN25
Flow sensor cable	1.4 m

## Accuracy

Sub-units of the heat meter	MPE according to EN 1434-1	MULTICAL® 401, typical accuracy
Flow sensor	$\pm(2 + 0.02 \text{ qp}/\text{q})\%$	$\pm(1 + 0.01 \text{ qp}/\text{q})\%$
Calculator	$\pm(0.5 + \Delta\Theta \text{ min}/\Delta\Theta)\%$	$\pm(0.15 + 2/\Delta\Theta)\%$
Sensor set	$\pm(0.5 + 3 \Delta\Theta \text{ min}/\Delta\Theta)\%$	$\pm(0.4 + 4/\Delta\Theta)\%$

MULTICAL® 401  $q_p$  1,5 m³/h @  $\Delta\Theta$  30K



MULTICAL® 401 typical accuracy compared with EN 1434-1.

## Material characteristics

Wetted parts		Calculator casing	
Housing, gland	Enkotal (alpha brass)	Top	PC
Housing, flange	RG5204 (brass)	Bottom	ABS with TPE gaskets (thermoplastic elastomer)
Transducer	AISI 316	Internal cover	PP
Gaskets	EPDM	Flow sensor cable	Silicone cable with internal teflon insulation
Measuring pipe	PES 30% GF		
Reflectors	AISI 304		
Flow sensor housing			
Top/wall brackets	PC + 20% glass		

# Order specifications

MULTICAL® 401		66-	□	-	□	-	□	-	□	-	□	-	□	-	□□□
<b>Sensor connection</b>															
Pt100			V												
Pt500			W												
<b>Modules</b>															
No module															0
M-Bus/pulse inputs (MULTICAL® 401)															P
Data/pulse output															Q
Data/pulse inputs															R
M-Bus pulse inputs															S
Modem															T
Radio/pulse inputs															U
Radio/with external antenna/pulse inputs															W
<b>Supply</b>															
No module															0
Battery, D-cell															2
230 VAC supply module															7
24 VAC supply module															8
<b>Pt500 sensor set</b>															
No sensor set															0
Pocket sensor set with 1.5 m cable															A
Pocket sensor set with 3.0 m cable															B
Short direct sensor set with 1.5 m cable															F
Short direct sensor set with 3.0 m cable															G
<b>Flow part</b>															
<b>qp [m³/h]</b>	<b>Connection</b>														
0.6	G¾B (R½)														1
1.5	G¾B (R½)														4
1.5	G¾B (R½)														5
1.5	G1B (R¾)														7
1.5	G1B (R¾)														9
3.0	G1B (R¾)														A
3.0	G1B (R¾)														B
3.5	G5/4 (R1)														D
6.0	G5/4 (R1)														F
6.0	DN25														G
10	G2B (R1½)														H
10	DN40														J
15	DN50														K
<b>Country code</b>															<b>XXX</b>

The country code is used for:

- Language and approval on type label
- Flow sensor dynamic range (1:50 and 1:100)
- Flow sensor class 2 or 3
- Marking of PN class
- Special verification, if necessary
- Selection of integration period 28 sec. and 4 sec.

Customer labels are integrated in the front label.

# Order specifications

Prog. number

A - B - CCC  
 -  -

Flow sensor installation:  
k-factor table

Flow  
Return

3  
4

Measuring unit, energy:

GJ  
kWh  
MWh

2  
3  
4

Flow sensor code

CCC

## Standard CCC-codes for MULTICAL® 401

CCC No.	Number of decimals on display						qp [m³/h]	Type 66-Wx-xxX-xxx
	kWh	MWh	GJ	m³	l/h	kW		
116	0	3	2	2	0	1	0.6	1
119	0	3	2	2	0	1	1.5	4-5-7-9
136	0	3	2	2	0	1	3.0	A-B
151	-	2	1	1	0	1	3.5	D
137	-	2	1	1	0	1	6.0	F-G
178	-	2	1	1	0	1	10	H-J
120	-	2	1	1	0	1	15	K

## Alternative CCC-codes for MULTICAL® 401

CCC No.	Number of decimals on display						qp [m³/h]	Type 66-Wx-xxX-xxx
	kWh	MWh	GJ	m³	l/h	kW		
107	-	-	3	3	0	1	1.5	4
136	0	3	2	2	0	1	3.5	D
138	0	3	2	2	0	1	6.0	F-G
183	0	3	2	2	0	1	10	H-J
185	0	3	2	2	0	1	15	K

# Configuration

## >DD< Configuration of display – DD-codes primary

Level 1	11	12 (13)	14 (15)	16 (17)	18	19 (20)	21 (22)	23	24	25	26	27	55	57	58	69
Energy	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1
Volume	2	2	2	2	2	2	2	2	2	2	2	2	1	2	2	2
Hour counter	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	8
T1, flow temp.	4	4		4	4	4	4	4	4	4	4	4	4	5	4	4
T2, return temp.	5	5		5	5	5	5	5	5	5	5	5	5	6	5	5
Differential temp.	6	6		6	6	6	6	6	6	6	6	6	6	7	6	6
Actual power	7	7		7	7	7	7	7	7	7	7	7		8	7	7
Peak power (monthly)	8	*8	*	*8	*8	*8		8	*8	8	8	8	*		*8	
Yearly peak power						9										
Actual flow	9	9		9	9	10	8	9	9	9	9	9	7	4	9	3
Peak flow (monthly)	*10						*9	*10		*10	*	*10		*9		
Yearly peak flow						10										
All info	11							11								
All info, however (-2)		10	4	10	10	11	11		10	11	10	11	8	10	10	9

\* Selection of Peak power or Peak flow for monthly data (/#5)

**NB: Info code 128 is automatically controlled in the factory/METERTOOL configuration:**

Type 66-Wx-2xx-xxx ⇒ Info code 128 is **active**.

In connection with other supply modules ⇒ Info code 128 is **not active**.

**NBB: Remember, that rebuilding from battery to mains supply, if any, requires reconfiguration of type number.**

Yearly peak values are updated at the turn of the month.

# Configuration

## >DD< Configuration of display – DD-Codes secondary

Level A	11	12 (13)	14 (15)	16 (17)	18	19 (20)	21 (22)	23	24	25	26	27	55	57	58	69
VA								A	A			A				C
VB								B	B			B				D
Reading date 1	A			A							A				A	
Energy	B			B							B				B	
Volume 1	C			C												
Yearly peak power 1											C				C	
Yearly peak flow 1											D					
Reading date 2	D			D							E				D	
Energi 2	E			E							F				E	
Volumen 2	F			F												
Yearly peak power 2															F	
Yearly peak flow 2																
Monthly data 1-12											I	C			I	A
Energy											J	D			J	B
Volume											K	E			K	
Monthly peak power												F				
Monthly peak flow												G				
TA 2					A	A						H	A	A		
TL 2					B											
TA 3					C	B						I	B	B		
TL 3					D											
Prog No.	G											J				E
Customer No.	H	A	A	G	E	C	A	C	C	A	G	K	C	C	G	F
Actual date	I					D				B	H	L	D	D	H	G
Software edition	J	B	B	H	F	E	B	D	D		11	12	E	E	11	H
Segment test	K	C	C	I	G	F	C	E	E	C	12	13	F	F	12	I

# Configuration

## ›E‹ Configuration of MULTITARIF

E=	TARIFF TYPE	FUNCTION
0	No tariff active	No function
1	Power tariff	Energy is accumulated in TA2 and TA3 based on the power limits in TL2 and TL3
2	Flow tariff	Energy is accumulated in TA2 and TA3 based on the flow limits in TL2 and TL3
3	Cooling tariff	Energy is accumulated in TA2 and TA3 based on the $\Delta t$ -limits in TL2 and TL3
4	$m^3xtF + m^3xtR$	TA2 = $m^3xtF$ and TA3 = $m^3xtR$
5	Return temperature tariff	Energy is accumulated in TA2 and TA3 based on the tR limits in TL2 and TL3

## ›FF‹ Input a, ›GG‹ Input b, Pulse separation ( $f \leq 0,5$ Hz)

Input A, Terminal 65-66		Input B, Terminal 67-68					
FF	Max. input	GG	Max. input	Pre-counter	l/pulses	Measuring unit and decimal point	
00	OFF	00	OFF	-	-	-	-
01	50 m <sup>3</sup> /h	01	50 m <sup>3</sup> /h	1	100	m <sup>3</sup> a - m <sup>3</sup> b	000000.0
02	25 m <sup>3</sup> /h	02	25 m <sup>3</sup> /h	2	50	m <sup>3</sup> a - m <sup>3</sup> b	000000.0
03	12 m <sup>3</sup> /h	03	12 m <sup>3</sup> /h	4	25	m <sup>3</sup> a - m <sup>3</sup> b	000000.0
04	5 m <sup>3</sup> /h	04	5 m <sup>3</sup> /h	10	10	m <sup>3</sup> a - m <sup>3</sup> b	000000.0
05	2.5 m <sup>3</sup> /h	05	2.5 m <sup>3</sup> /h	20	5.0	m <sup>3</sup> a - m <sup>3</sup> b	000000.0
06	1 m <sup>3</sup> /h	06	1 m <sup>3</sup> /h	40	2.5	m <sup>3</sup> a - m <sup>3</sup> b	000000.0
07	0.5 m <sup>3</sup> /h	07	0.5 m <sup>3</sup> /h	100	1.0	m <sup>3</sup> a - m <sup>3</sup> b	000000.0
24	5 m <sup>3</sup> /h	24	5 m <sup>3</sup> /h	1	10	m <sup>3</sup> a - m <sup>3</sup> b	00000.00
25	2.5 m <sup>3</sup> /h	25	2.5 m <sup>3</sup> /h	2	5.0	m <sup>3</sup> a - m <sup>3</sup> b	00000.00
26	1 m <sup>3</sup> /h	26	1 m <sup>3</sup> /h	4	2.5	m <sup>3</sup> a - m <sup>3</sup> b	00000.00
27	0.5 m <sup>3</sup> /h	27	0.5 m <sup>3</sup> /h	10	1.0	m <sup>3</sup> a - m <sup>3</sup> b	00000.00
40	500 m <sup>3</sup> /h	40	500 m <sup>3</sup> /h	1	1000	m <sup>3</sup> a - m <sup>3</sup> b	0000000

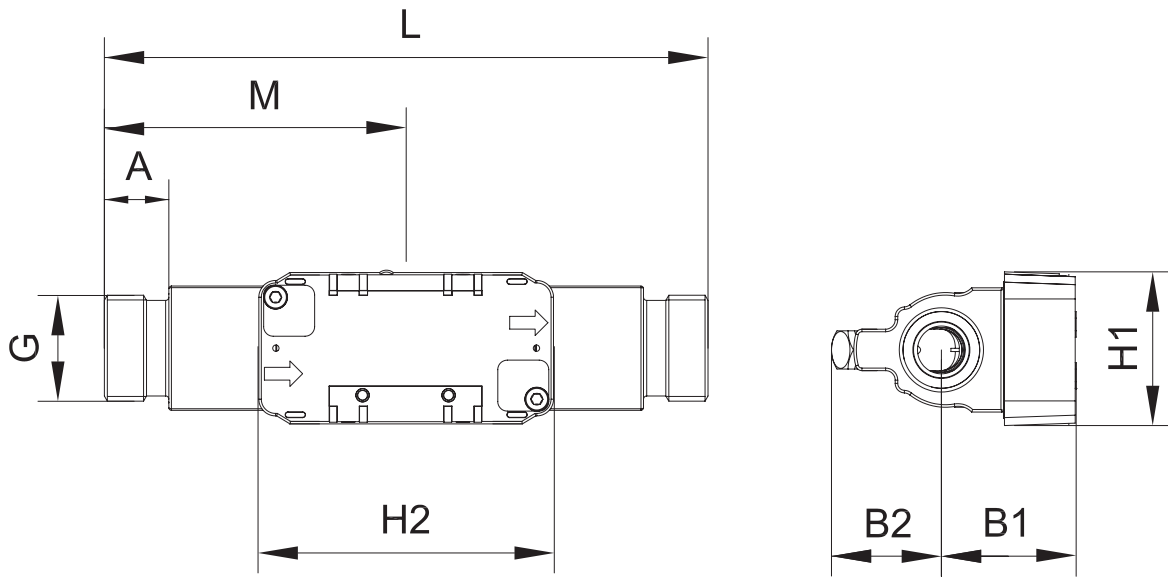
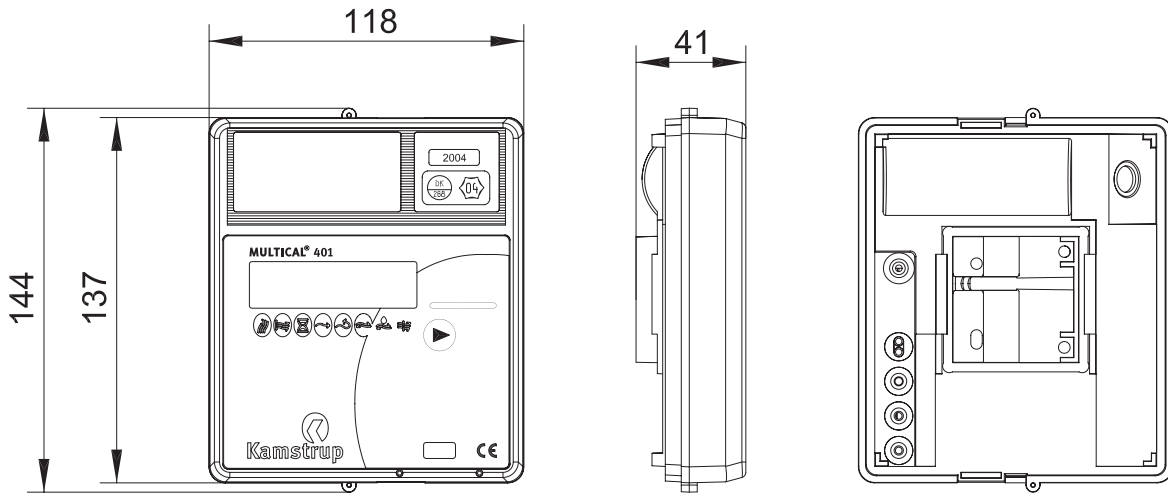
NB: Electricity meters cannot be connected, as minimum 1 sec. of pulse and interval frequency is required.

## ›FF‹ Output A

Output A Energy (CE) Terminal 16-17	
FF	Pulse duration
00	OFF
94	1 msec.
95	30 msec.
96	0.1 sec.



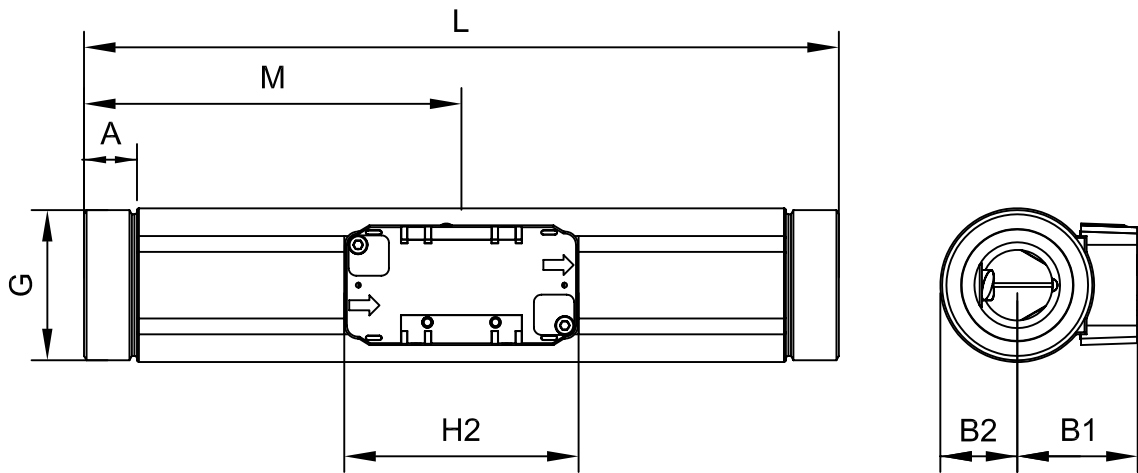
# Dimensional drawings



Thread	L	M	H2	A	B1	B2	H1	Approx. weight [kg]
G <sup>3</sup> / <sub>4</sub>	110	L/2	92.5	10.5	42	35	47.5	1.4
G1 (qp 1.5)	130	L/2	92.5	20.5	42	35	47.5	1.5
G1 (qp 3.0)	130	L/2	92.5	20.5	42	35	47.5	1.4
G <sup>3</sup> / <sub>4</sub>	165	L/2	92.5	20.5	42	35	47.5	1.8
G1 (qp 1.5)	190	L/2	92.5	20.5	42	35	47.5	2.0
G1 (qp 3.0)	190	L/2	92.5	20.5	42	35	47.5	1.9

Weight includes a 3 m sensor set, but is excluding packing.

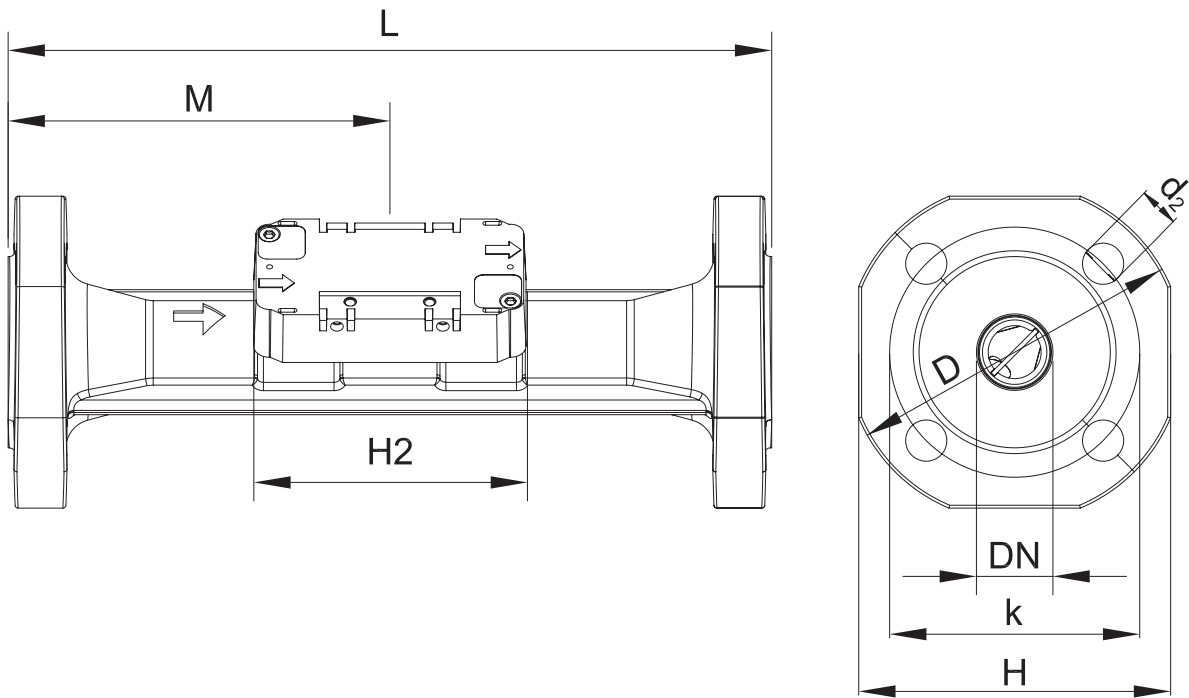
## Dimensional drawings



Thread	L	M	H2	A	B1	B2	Approx. weight [kg]
G5/4	260	L/2	92.5	17	42	22	2.9
G2	300	L/2	92.5	21	48	31	5.1

*Weight includes a 3 m sensor set, but is excluding packing.*

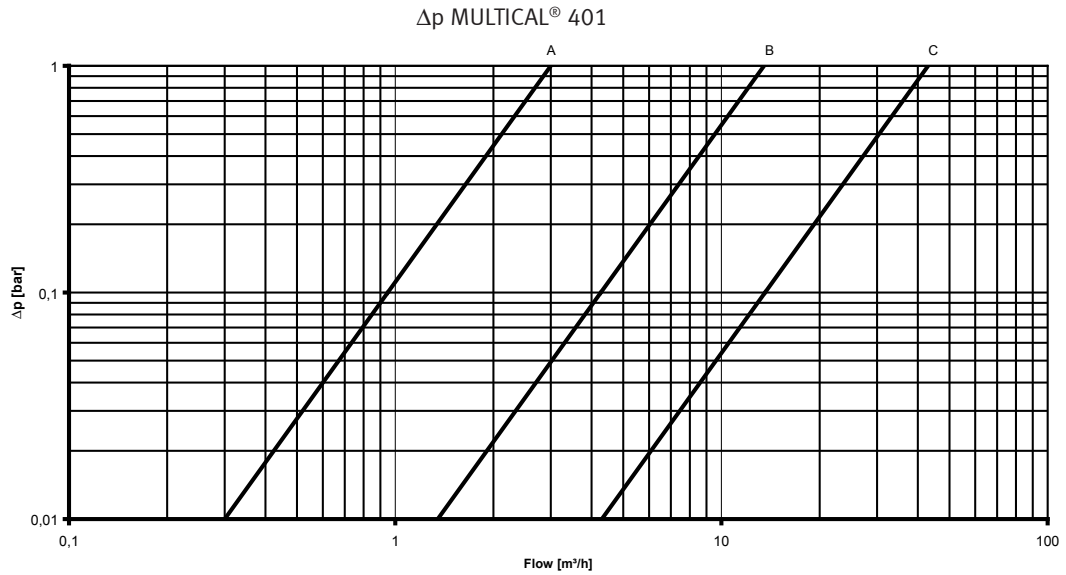
## Dimensional drawings



Nom. diameter	L	M	H2	D	H	k	Bolts			Approx. weight [kg]
							Number	Thread	d <sub>2</sub>	
DN25	260	L/2	92.5	115	106	85	4	M12	14	5.6
DN40	300	L/2	92.5	150	136	110	4	M16	18	8.9
DN50	270	155	92.5	165	145	125	4	M16	18	10.7

Weight includes a 3 m sensor set, but is excluding packing.

## Pressure loss graphs



Graph	$q_p$ [m³/h]	Nom. diameter [mm]	kv	Q@0.25 bar [m³/h]
A	0.6 & 1.5	DN15 & DN20	3	1.5
B	3 & 3.5 & 6	DN20 & DN25	13.5	6.8
C	10 & 15	DN40 & DN50	43	21.7

## Accessories

### Glands including gaskets (PN16)

Size		Type No.	2 pcs.
DN15	(R $\frac{1}{2}$ x G $\frac{3}{4}$ )		65-61-321
DN20	(R $\frac{3}{4}$ x G1)		65-61-322
DN25	(R1 x G $\frac{5}{4}$ )	65-61-313	
DN40	(R1 $\frac{1}{2}$ x G2)	65-61-315	

### Gaskets

For glands		For flange meters	
Size	Type No.	Size	Type No.
G $\frac{3}{4}$	2210-061	DN20	2210-147
G1	2210-062	DN25	2210-133
G $\frac{5}{4}$	2210-063	DN40	2210-132
G2	2210-065	DN50	2210-099

R $\frac{1}{2}$  for M10 x 1 nipple 65-56-491

R $\frac{3}{4}$  for M10 x 1 nipple 65-56-492

Reading head with 9 pole D-Sub plug 66-99-102

Verification Equipment 66-99-385

METER TOOL 66-99-702

METER TOOL LogView 66-99-703