HPAC series - 301 electromagnetic energy meter

Description

HPAC series electromagnetic energy meter is based on standard requirement for chilled and hot water energy audit design, it includes high accuracy electromagnetic energy meter, temperature sensors and integrated energy calculator to perform the data collection and processing function, making the measured data available for statistical, monitoring or control purposes.
The energy meter and integrated energy calculator for measurement of energy & volume, monitor in heating or cooling system.

Featuring

The measurement of energy is in a close circuit with water using an electromagnetic principle with higher accuracy compared to ultrasonic series. Important properties are:

- ⌘ **Non-wearing due to non-moving parts**
- ⌘ **Measuring range of flow 1:100**
- ⌘ **Mounting in flow or return, no settling sections or flow strengtheners**
- ⌘ **Large liquid-crystal screen, humanization interface operation, easy to use**
- ⌘ **Abundance intuitionistic records**
- ⌘ **Demand measurements with maximum values**
- ⌘ **Permanent EEPROM to keep configured parameters and measured data**
- ⌘ **Support MODBUS communication protocol**
- ⌘ **Combined heating/ cooling system application**
- ⌘ **Also operable as a flow meter or cold meter or heat/cold meter**
- ⌘ **Self-diagnostics**

Application

HPAC series energy meters are used to measure heat consumption in district heating networks and residential development. It can be used for cold water measurement at the same time (solely or together with heat measurement) and for flow measurement in systems using water as medium.

Heat meter design

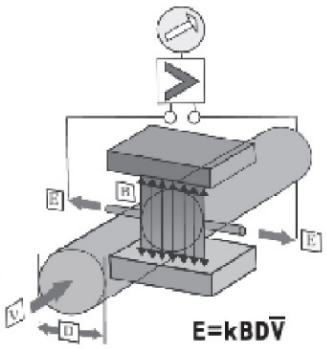
The heat meter comprises a calculator, a flow measuring part and two temperature sensors.

Method of operation

The thermal energy transferred from the water to the heat consumer over a defined period of time is proportional to the temperature difference between the flow and return and the volume of water that has flowed through.

The water volume measurement principle is law of Faraday's Electromagnetic Induction:

When the conductive liquid passes the measuring pipe surrounded in the magnetic field, induction electromotive force (E) will be produced in the direction vertical to the flow direction and the magnetic field, which is in proportion to the average flow rate (V). Magnetic field strength B is a constant (by the coil current control),the distance D between the detect electrodes is fixed, so the liquid flow rate (V) is the only variable of induction electromotive force(E), and it is Linear relationship between the output signal of the flow sensor and the flow. The water volume is then calculated using these relationships.



The flow and return temperatures are determined using platinum resistors. Water volume and the difference in temperature between the flow and return are multiplied and its product integrated. The result which is the consumed quantity of thermal energy or cold is registered and displayed in the physical units **KWh** / **MWh**, or **MJ** / **GJ**, the quantity of flow in $\mathbf{m^3}$ / **L**.

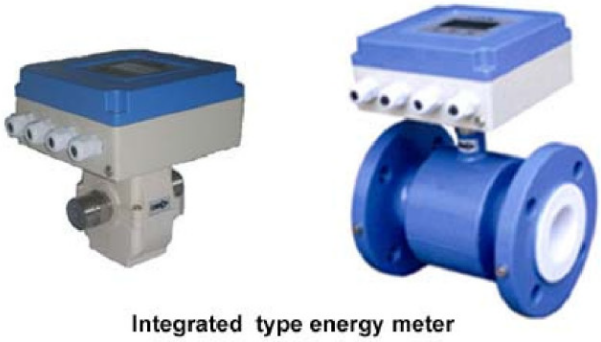
Calculator

A standard calculator is used for all flow rate values with identical operation and an integrated service unit.

Technical data

Display	LCD display with at most 9 digits, directly display real time clock various flow data and energy measurement.
Product structure	In-line type design, Integrated or separate type
Application range	Hot water or chilled water, combined heating / cooling system
Temperature range	0~95℃, maximum 180℃ on request
Differential temp.	Δt:3~60k for heating system, Δt:2~20k for cooling system
Compensation	Temperature compensation is allowed
Input	Pt1000 for temperature of supply and return
Output	4~20mA for instantaneous flow or power optional 0~5Hz pulse for cumulate flow or energy optional
Communication	RS485, support MODBUS protocol
Connection	Screw type connection for size from DN15~DN25 Flange type connection for size from DN32~DN600
Product standard	Along with EN1434-1 requirement
Certificate of CE	According to LVD 2006/95/EC and EMC 2004/108/EC EN61000-3-2:2006 Limits for Harmonic Current Emissions EN 61326-1:2006, Emission (Conformity to EN61000-6-4:2001) EN 61326-1:2006, Immunity (Conformity to EN61000-6-1:2001) EN 61010-1:2001, Safety – Part 1:General requirements
Protection class	IP65 for integrated type, IP67 or IP68 optional for separate type
Power supply	220VAC±10% 50Hz or 24VDC max.15VA
Ambient conditions	Temperature: 5~55℃, Humidity <85 % r.h. (non-condensing)

Electromagnetic flow sensor



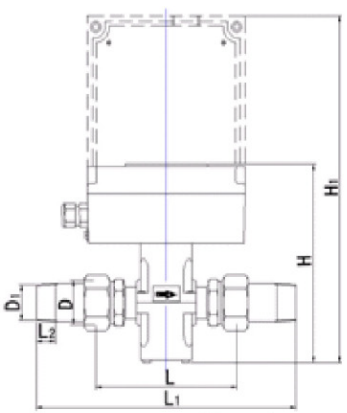
Integrated type energy meter

The shell of the flow sensor is welded from carbon steel. Only the electrode and lining is contacted with the media. The flow sensor is matched with the calculator to form one set of integrated type energy meter or separate type energy meter.

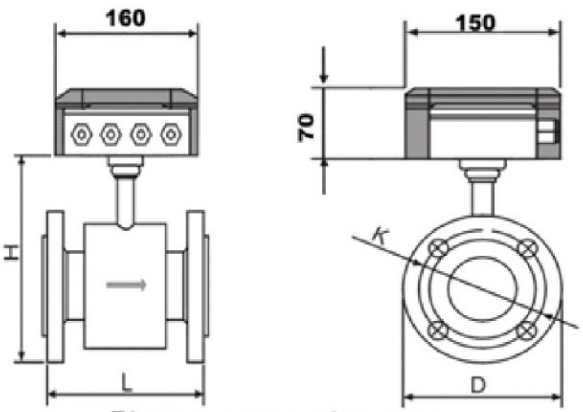
Technical data of flow sensor

Application range	Including all conductive liquid such as HVAC cold and hot water, fresh water, various corrosive media.
Measuring accuracy	The accuracy is ±0.5% for any measured velocity in full scale range, Measuring range is 0.1 m/s~10 m/s optional
Diameter (mm)	15 ~ 600 mm
Nominal pressure	PN10, PN16, PN25 or PN40 optional
Electrode material	Stainless steel 316L, others on request (e.g. Ti,Hc,Hb,Ta,W)
Lining material	Ne ,FEP or PTFE optional
Media temperature	0~95℃, maximum 180℃ on request (note: it is limited by the thermal resistance features of the lining materials)
Shell material	Carbon steel for flow sensor DN15~DN600, others on request (e.g. stainless steel) ABS engineering plastic shell for screw type flow sensor below DN25.
Protection class	IP67 or IP68 optional for flow sensor
Connection standard	The screw connection is complied with BS21 or ISO7-1 standard Flange type connection adapt to pipeline flange of various standards (e.g. BS EN1092-2 , ISO 7005-2, BS4504, HG20593-199, GB9119)

Dimensions



Screw connection type



Flange connection type

Technical data of screw type meter

DN (mm)	Lining materials			Flow range selection Flow volume (m^3/h)			Connection dimensions (mm)				
	Ne	FEP	PTFE	Norm. flow	Min. flow	Max. flow	L	L1	D	D1	H
15		•		1.5	0.03	3	110	220	G3/4B	R 1/2	275
20		•		2.5	0.05	5	130	240	G1B	R 3/4	275
25		•	•	3.5	0.07	7	130	250	G1 1/4B	R 1	275

Technical data of flange type meter

DN (mm)	Lining materials			Flow range selection Flow volume (m^3/h)			Overall dimensions(mm)			Connection dimensions (mm)		
	Ne	FEP	PTFE	Norm. flow	Min. flow	Max. flow	L	D	H	K	n	MA
32		•	•	6	0.12	12	150	140	361	100	4	M16
40		•	•	10	0.2	20		150	371	110	4	M16
50	•	•	•	15	0.3	30	200	165	384	125	4	M16
65	•	•	•	25	0.5	50		185	404	145	8	M16
80	•	•	•	40	0.8	80		200	416	160	8	M16
100	•	•	•	60	1.2	120	250	220	445	180	8	M16
125	•	•	•	100	2	200		250	472	210	8	M16
150	•	•	•	150	3	300	300	285	503	240	8	M20
200	•	•	•	250	5	500	350	340	554	295	12	M20
250	•	•	•	400	8	800	400	405	610	355	12	M24
300	•	•	•	600	12	1200	450	460	663	410	12	M24
350	•		•	750	15	1500		520	721	470	16	M24
400	•		•	900	18	1800	500	580	774	525	16	M27
450	•		•	1200	24	2400	600	640	829	585	20	M27
500	•		•	1500	30	3000		715	892	650	20	M30
600	•		•	2500	50	5000		840	1004	770	20	M33

K = Bolt circle diameter, n = Number of holes, MA = Size of bolt

Remark 1) "•" in the a.m. table means optional lining various diameter's flow sensor, Ne lining materials can be chose for DN50~DN600, FEP lining materials only for DN15~300, PTFE lining materials can be chose for DN25~DN600.

2) When the normal diameter of the flow meter is below DN80, the pressure grade of the flow sensor standard chosen as PN40.DN100~150 standard chosen as PN16.When above DN200, PN10 or PN16 is optional.

3) Please place special order, if the pressure in the measured pipeline is higher than the nominal pressure of the sensor.

Ccalculator

The energy calculator is programmed according to the size of electromagnetic energy meter that will be connected to it. If energy measurement is required then standard Pt1000 sensor pairs must be ordered also.

The calculator receives the flow analogue signal from meter and makes the instantaneous flow rate available at the LCD display. The meter also record the accumulative energy and instantaneous energy upon the temperature sensors are connected, a calculation is made base on the flow rate (Volume), the differential temperature and the coefficient for the medium used for the energy transfer.

Calculation of energy is based on the following formula:

$$\textbf{Energy} = \textbf{Volume} \times (T_{Hot} - T_{Cold}) \times K_{factor} (Ti)$$

Note:

Volume: Volume [m^3] of a given amount of water

T_{Hot}: Measured temperature in the flow T_{Cold}:
Measured temperature in the return

K_{factor} (Ti): Thermal coefficient of water based on the polynomial associated with Dr. Stuck's tables of enthalpy and heat content

Permanent memory

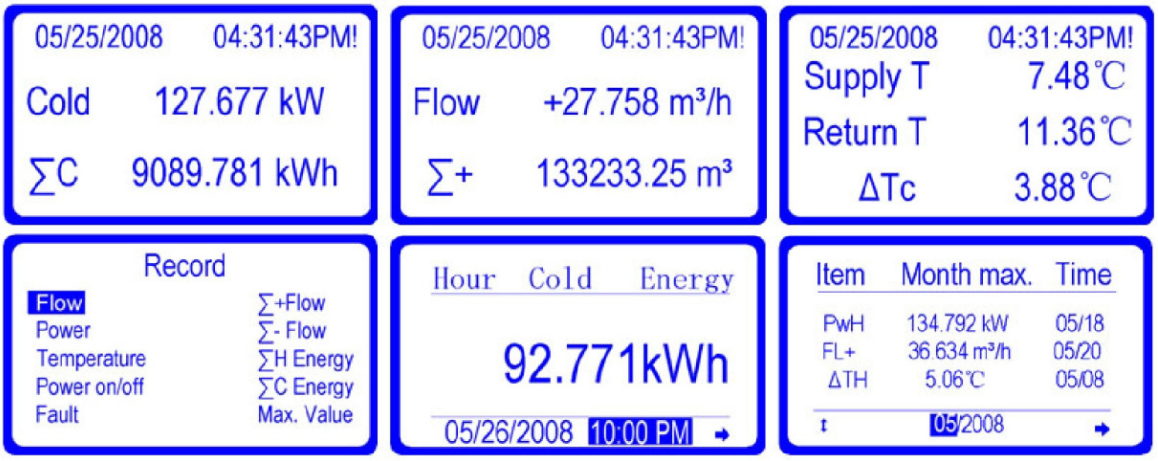
The LOG of the calculator records the following values: instantaneous flow, power, temperature (supply, return and differential), power on/ power off information, fault information, hour/day/month/year data of ∑+Flow, ∑-Flow, ∑H Energy, ∑C Energy, and max. values.

The above data are stored to enable output to a selected date in the year. All data are stored for a further 1080 hours (hourly), and 365 days (daily), and 36 months (monthly), and 15 years (yearly) in a record for possible subsequent study of operating conditions in the system.

Display description

The calculator has an easily-read at most 9 digits LCD display with associated pictograms for the various functions.

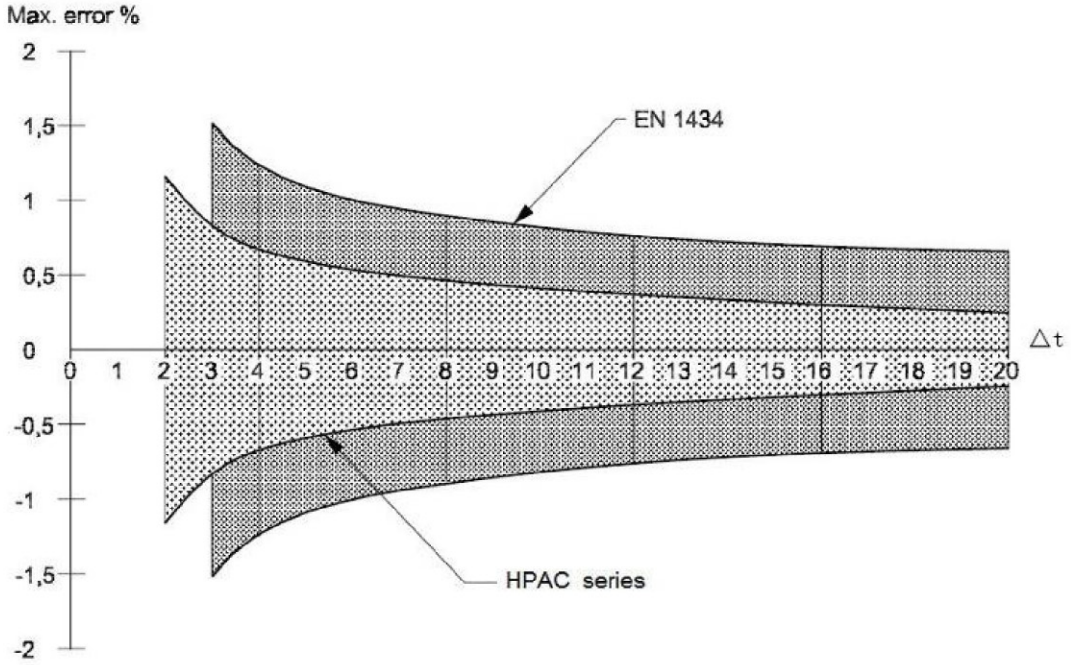
Can display the following data: instantaneous flow, power, cumulative energy, cumulative flow, and temperature of the supply water, temperature of the return water, the differential temperature, All the permanent memory data can be displayed too.



Communication

RS485 communication mode, baud rate optional for 1200, 2400, 4800, 9600, 19200, 38400.
Protocol: open MODBUS communication protocol.
You can read all the permanent memory data and other information in this mode such as instantaneous flow, power, accumulated energy, accumulated flow, supply water temperature, and return water temperature.

Measuring accuracy



The diagram shows tolerances of energy calculator relative to the requirements of

$$EN\ 1434 = \pm(0.5 + \frac{3K}{\Delta t})\ [\%]$$

Technical data of calculator

Standard in accordance with	Heat meter EN1434	Chilled water EN1434 pr.A1
Temperature range	0~95℃ maximum 180℃ on request	2~30℃
Differential temperature	Δt: 3~60K	Δt: 2~20K
Δt measurement error without sensor	± (0.5+3K /Δt) [%]	± (0.1+2K /Δt) [%]
Measuring accuracy	Θ≤1.5%	
Flow range	Max. flow≤20000 m^3/h	
Compensation	Temperature compensation is allowed	
Temperature Input	Pt1000 2-wire, measurement resolution:0.01℃	
Current output	4~20mA , resistance≤750Ω	
Pulse output	0~5Hz passive(OC gate) output, max.24VDC, ≤200mA , pulse width 150ms	
Display	LCD display at most 9 digits with backlight	
Communication	RS485, support MODBUS protocol	
Power supply	220VAC±10% 50Hz or 24VDC, max.15VA	
EMC emission	EN 61326-1:2006, Emission (Conformity to BS EN61000-6-4:2001)	
EMC immunity	EN 61326-1:2006, Immunity (Conformity to BS EN61000-6-1:2001)	
Limits for Harmonic Current Emissions	Compliance to EN 61000-3-2:2006	
CE product safety	EN 61010-1:2001, Safety – Part 1:General requirements	
Protection class	IP65 for calculator	
Ambient temperature	5~55℃	
Ambient humidity	<85 % r.h. (non-condensing)	

Temperature sensor

The Pt1000 temperature sensor is designed for applications with HPAC series energy meter for energy measurement for cold and hot water application.

Technical data of temperature sensor

Temperature sensors in the following two-wire versions are recommended:

Sensing element	Pt1000 (3850)
Temperature range	0~105℃
Operation R.H.	<95 % r.h. (non-condensing)
Nominal pressure	PN25
Protection class	IP67
Sheath well material	Stainless steel 316L
Sheath O.D. (D)	5~12 mm
Immersion type	Direct immersion with ball valve for DN25 or below, Direct immersion with protection pocket for DN32 or above
Immersion length (EL)	35 mm direct sensor for DN25 or below flow sensor 50 mm pocket sensor for DN32 to 50 100 mm pocket sensor for DN65 to 100 150 mm pocket sensor for DN125 to 200 200 mm pocket sensor for DN250 or above
Mounting fittings(M)	M10×1.0×5 for DN25 or below G1/4 for DN32 to 100 G1/2 for DN125 to 200 G3/4 for DN250 or above
Sensor connection	2 wire
Sensing cable (AI)	1.5 meters or 5 meters cable optional ,10 meters for separate type

Optional offer of sensing cable can be provided upon request

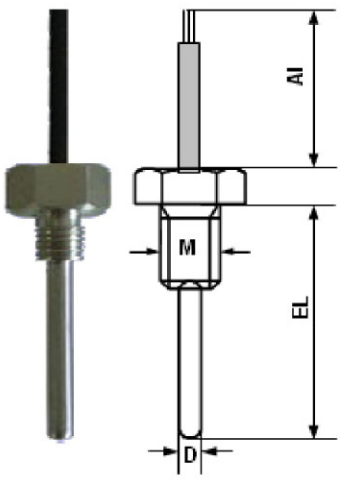


Fig.T-type temperature sensor

Note: EL= Immersion length, AI= cable length, M= Mounting fitting, D= Sheath O.D.

Product selection

Diameter selection

When the normal velocity of flow of the measured pipeline is more than 0.5 m/s, select the meter with diameter same to that of the process pipeline.

Select the meter with diameter smaller than that of the process pipeline in following conditions: The velocity of flow in the pipeline is somewhat slow, which can not meet the requirement of velocity limit of the energy meter or the measurement precision is not satisfying under this velocity (the velocity limit to obtain relatively high precision is more than 1m/s).

Application type selection

Considering the actual application situation, we make the design directions as follows to avoid miss measurement and over measurement:

Application type	Supply water temperature(℃)	Differential temperature(℃)	Install position
Chilled water application	---	≥1	Return water pipe
Hot water application	---	≥2	Supply water pipe
Combined cooling/heating	Cooling ≤18 Heating ≥30	1,2,3 optional(same value for cooling/heating)	Return water pipe

Lining materials selection

Lining materials	Corrosive resistance	Working temp.	Range of application
Ne	Neoprene It can resist low concentration acid alkali salt.	0~70℃	It can be used in Industrial water, sewage, low concentration acid alkali salt solution. Maximum 95℃ on request Ne lining materials can only be chose for DN50~DN600.
FEP	Fluorinated ethylene propylene It has heat resistance and corrosive resistance. It has high mechanical strength, abrasiveness resistance and when cleaning the surface the lining is seldom broken.	-20~120℃	All fluid except high abrasive medium like mortar. It can be used where has sanitary requirement like drink. Maximum 180℃ on request FEP lining materials can only be chose for DN15~DN300
PTFE	Polytetrafluoro ethylene It can resist almost all chemical medium's corrosion. It has low wear resistance.	-40~180℃	Can't be applied for pipe at negative pressure or high abrasive medium. PTFE lining materials can be chose for DN25~DN600

Temperature grade of flow sensor selection

Four type of working temperature grades of flow sensor are 70℃ ,95℃ (be the same with high temperature liquid) and 120℃, maximum 180℃ on request.

Select the temperature grade that mostly near the actual working temperature of the medium to make the energy meter working under ideal condition. For example, if the highest working temperature of the medium is 50℃ , select the sensor with temperature grade 70℃.

Output signal selection

4~20mA or frequency for instantaneous flow or power optional.

0~5Hz pulse (non-active frequency) for cumulate flow or energy optional.

May be select two output signal at the same time, eg. 4~20mA and 0~5Hz pulse.

Protection class selection

Select the protection class according to above requirement and the working environment of the flow sensor.

Select IP65 for integrated type, Select IP67 or IP68 separate type for those whose medium is frozen water to avoid frosting or moisture condensation inside the sensor.

Structure selection

Consider from the aspect of convenient installation and use, selection priority is given to IP65 integrated type energy meter.

When the energy meter is installed underground or places that is easily to be flooded by water, select IP 67 or IP 68 separate type energy meter.

Note: when the energy meter is installed in the high temperature pipeline or high corrosive environment, to suggest select separate type energy meter for those whose medium is frozen water to avoid frosting or moisture condensation inside the sensor.

Temperature sensor selection

Direct immersion with ball valve for DN25 or below, immersion length 35 mm.

Direct immersion with protection pocket for DN32 or above, immersion length 50~200 mm optional.

Note: sensing cable 1.5 meters or 5 meters optional, 10 meters or above for separate type.

Power supply selection

Can use 220V AC or 24V DC power supply. Consider from the aspect of convenient installation and use, selection priority is given to 220V AC.

Examples of model code

e.g. HPAC301-(50)-31050C21

Description:

HPAC301 series energy meter for cooling/heating application, consists of energy calculator and DN50 flange type flow sensor. Ne is used as lining materials. Its temperature grade is 0~70℃, output signal is 4~20mA and 0~5Hz pulse, protection class is IP65 for integrated type, include pairs Pt1000 2-wire pocket sensor, operation power supply is 220V AC.

Ordering code

HPAC301- { } - □ □ □ □ □ □ □ □

Operation power supply

0 24 Vdc
1 220 Vac

Temperature sensor type (Note 4)

0 No sensors include
1 Pt1000 2-wire direct sensor
2 Pt1000 2-wire pocket sensor
3 Other

Structure

C Integrated type
S Separate type

Protection class (Note 3)

0 IP65
1 IP67
2 IP68

Output signal

0 no need
1 4~20mA
2 active frequency
3 non-active frequency
4 4~20mA + active frequency
5 4~20mA + non-active frequency

Temperature grade of flow sensor

0 0℃ ~70℃
1 0℃ ~95℃
2 -20℃~120℃
3 -40℃~180℃

Lining materials (Note 2)

1 Ne
2 FEP
3 PTFE

Application type (Note 1)

1 Chilled water application
2 Hot water application
3 Combined cooling/heating

Energy meter diameter

e.g. 15,20…500,600

Note 1: Install the flow sensor on the return pipe for chilled water application or combined cooling/heating application,and on the supply pipe for hot water application,

Note 2: Ne lining materials can be chose for DN50~DN600,FEP lining materials only for DN15~DN300,PTFE lining materials can be chose for DN25~DN600.

Note 3:IP65 for integrated type, IP67 or IP68 optional for separate type.

Note 4: Direct immersion with ball valve for DN25 or below, Direct immersion with protection pocket for DN32 or above.
Sensing cable 1.5 meters or 5 meters optional, 10 meters or above for separate type.