

# EM24 W1 Kamstrup special version

MID energy analyzer for 3-phase and 1-phase systems, wireless M-Bus communication

## Structure

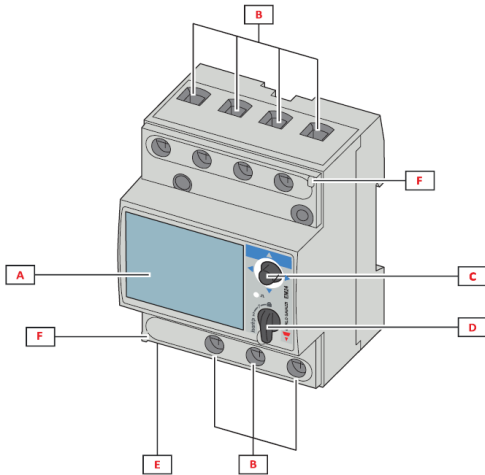


Fig. 1 Direct connection (AV2)

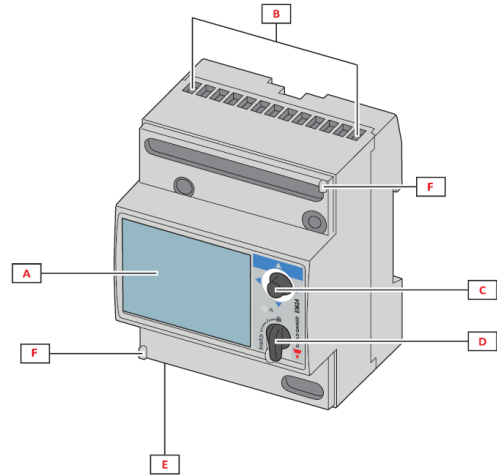


Fig. 2 CT connection (AV5)

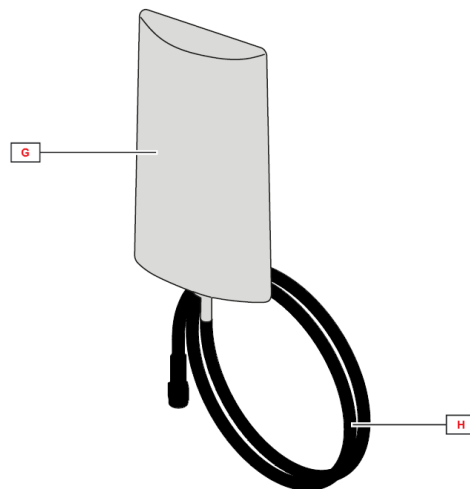


Fig. 3 External antenna

Area	Description
A	LCD display
B	Voltage/current connections
C	Joystick
D	Selector with MID seal (programming block)
E	SMA connector (only in the version with external antenna)
F	Pins for MID seal (protection covers included)
G	External antenna for wireless M-Bus communication
H	SMA connector cable (2 m)

## Features

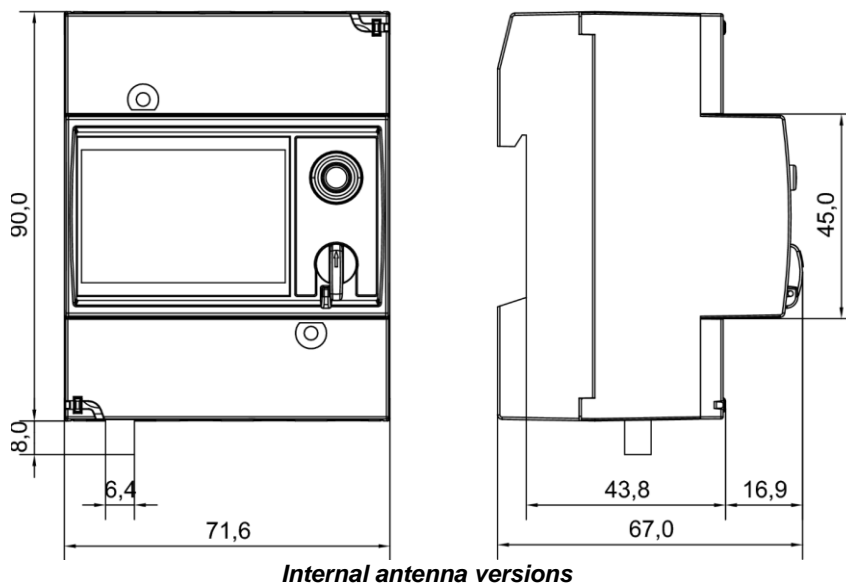
### General

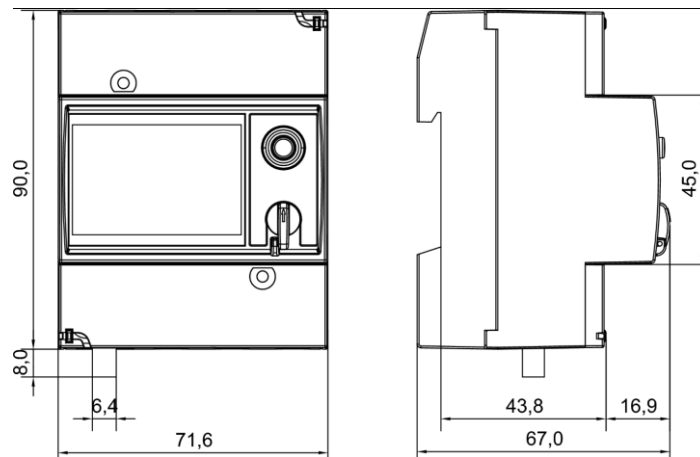
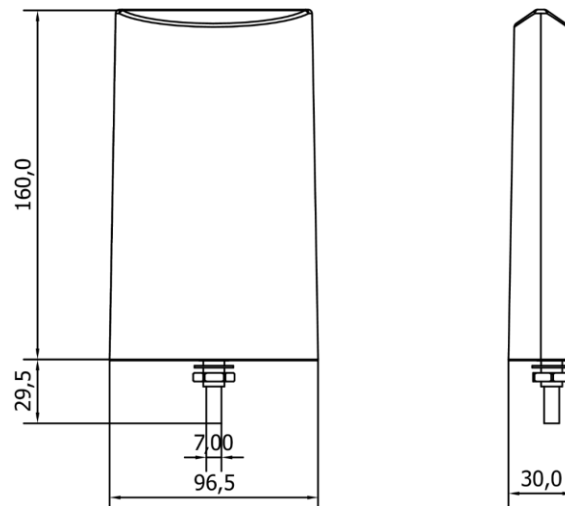
<b>Protection degree</b>	Front: IP50. Terminals: IP20
<b>Terminals</b>	Screw terminals <b>AV2:</b> Max.: 16 mm <sup>2</sup> , min.: 2.5 mm <sup>2</sup> (by cable lug) <b>AV5:</b> Max.: 1.5 mm <sup>2</sup>
<b>Overvoltage category</b>	Cat. III
<b>Pollution degree</b>	2
<b>Mounting</b>	DIN rail
<b>Weight</b>	Internal antenna versions: 400 g (packaging included) External antenna versions: 800 g (packaging included)

### Environmental specifications

<b>Operating temperature</b>	From -25 to +55 °C/from -13 to +131 °F
<b>Storage temperature</b>	From -30 to +70 °C/from -22 to +158 °F

NOTE: R.H. < 90 % non-condensing @ 40 °C / 104 °F.



**External antenna versions****Antenna****Compatibility and conformity**

<b>Directives</b>	2011/65/EU (RoHs) 2014/53/EU (RED)
<b>Standards</b>	Electromagnetic compatibility (EMC) - emissions and immunity: EN 62052-11 Electrical safety: EN 50470-1 (MID) Accuracy: EN 62053-23, EN 50470-3 (MID)  ETSI EN 300 220-1 ETSI EN 300 220-2 ETSI EN 301 489 EN 62311
<b>Approvals</b>	<b>CE</b>  MID  RED

## Electrical specifications

Voltage		
Voltage inputs	AV2	AV5
Voltage connection	Direct	
Rated voltage L-N	230 V	230 V
Rated voltage L-L	400 V (3-phase only)	400 V
Voltage tolerance	-20%, +15%	
Overload	Continuous: 1.15 Un max	
Input impedance	Refer to "Power supply"	
Frequency	50/60 Hz	

Current		
Current inputs	AV2	AV5
Current connection	Direct	Via CT
Rated current (I <sub>n</sub> )	-	5 A
Base current (I <sub>b</sub> )	10 A	-
Minimum current (I <sub>min</sub> )	0.5 A	0.05 A
Maximum current (I <sub>max</sub> )	65 A	10 A
Start-up current (I <sub>st</sub> )	0.04 A	0.01 A
Overload	Continuous: 65 A @50 Hz For 10 ms: 1950 A, @ 50 Hz	Continuous: 10 A @50 Hz For 500 ms: 200 A @ 50 Hz
Input impedance	< 1.7 VA	< 0.7 VA
Crest factor	4 (I <sub>max</sub> peak 92 A)	3 (I <sub>max</sub> peak 15 A)

## Power supply

Power supply		
	AV2	AV5
Type	Self power supply	



## Measurements

Method	TRMS
Sampling	1600 samples/s @50 Hz 1900 samples/s @60 Hz

### Available measurements on display

Active energy	Unit	System	Phase
Imported (+) Total	kWh+	•	-
Exported (-) Total	kWh-	•	-
Imported (+) Partial	kWh+	•	-

Reactive energy	Unit	System	Phase
Imported (+) Total	kvarh+	•	-
Exported (-) Total	kvarh-	•	-
Imported (+) Partial	kvarh+	•	-

Electrical variable	Unit	System	Phase
Voltage L-N	V	•	•
Voltage L-L	V	•	•
Current	A	-	•
DMD MAX	A	•	-
Active power	kW	•	•
DMD	kW	•	-
DMD MAX	kW	•	-
Apparent power	kVA	•	•
DMD	kVA	•	-
DMD MAX	kVA	•	-
Reactive power	kvar	•	•
Power factor	PF	•	•
Frequency	Hz	•	-
Run hour meter	h	•	-

Note: DMD integration interval is equal to the transmission interval.

### Available measurements on wireless M-Bus communication

Active energy	Unit	System	Phase
Imported (+) Total	kWh+	•	-
Exported (-) Total	kWh-	•	-

Reactive energy	Unit	System	Phase
Imported (+) Total	kvarh+	•	-
Exported (-) Total	kvarh-	•	-

## Measurement accuracy

Current	AV2	AV5
From 0.5 A to 2 A	$\pm(0.5\% \text{ rdg} + 3\text{dgt})$	-
From 2 A to 65 A	$\pm(0.5\% \text{ rdg} + 1\text{dgt})$	-
From 0.05 A to 1 A	-	$\pm(0.5\% \text{ rdg} + 3\text{dgt})$
From 1 A to 10 A	-	$\pm(0.5\% \text{ rdg} + 1\text{dgt})$

Phase-phase voltage	AV2	AV5
In the range $U_n$	$\pm(1\% \text{ rdg} + 1\text{dgt})$	

Phase-neutral voltage	AV2	AV5
In the range $U_n$	$\pm(0.5\% \text{ rdg} + 1\text{dgt})$	

Active and apparent power	AV2	AV5
From 1.0 A to 65.0 A (PF=0.5L, 1, 0.8C)	$\pm(1\% \text{ rdg} + 1\text{dgt})$	-
From 0.5 A to 1.0 A (PF=1)	$\pm(1.5\% \text{ rdg} + 1\text{dgt})$	-
From 0.25 A to 10 A (PF=0.5L, 1, 0.8C)	-	$\pm(1\% \text{ rdg} + 1\text{dgt})$
From 0.05 A to 0.25 A (PF=1)	-	$\pm(1.5\% \text{ rdg} + 1\text{dgt})$

Reactive power	AV2	AV5
From 1.0 A to 2.0 A ( $\sin\phi=0.5L$ , 0.5C) From 0.5 A to 1.0 A ( $\sin\phi=1$ )	$\pm(2.5\% \text{ rdg} + 1 \text{ dgt})$	-
From 2.0 A to 65.0 A ( $\sin\phi=0.5L$ , 0.5C) From 1.0 A to 65.0 A ( $\sin\phi=1$ )	$\pm(2\% \text{ rdg} + 1 \text{ dgt})$	-
From 0.25 A to 0.5 A ( $\sin\phi=0.5L$ , 0.5C) From 0.1 A to 0.25 A ( $\sin\phi=1$ )	-	$\pm(2.5\% \text{ rdg} + 1 \text{ dgt})$
From 0.5 A to 10 A ( $\sin\phi=0.5L$ , 0.5C) From 0.25 A to 10 A ( $\sin\phi=1$ )	-	$\pm(2\% \text{ rdg} + 1 \text{ dgt})$

Active energy	Class B (EN50470-3) (MID)
Reactive energy	Class 2 (EN62053-23)

Frequency	
From 45 to 65 Hz	$\pm 0.1 \text{ Hz}$

## LED and display

### Display

<b>Type</b>	LCD
<b>Refresh time</b>	< 750 ms
<b>Description</b>	3 rows: 1 <sup>st</sup> : 8 digits (7 mm) 2 <sup>nd</sup> : 4 digits (7 mm) 3 <sup>rd</sup> : 4 digits (7 mm)
<b>Variable readout</b>	Instantaneous: 4 digits, min: 0.000, max: 9999 Energy: 8 digits (imported), 7 digits (exported), min: 0.00, max: 99 999 999

### LED

Model	CT	Weight (kWh per pulse)
AV5	$\leq 7$	0.001
	$> 7 \leq 70.0$	0.01
	$> 70 \leq 700.0$	0.1
	$> 700$	1
AV2	N/A	0.001

# Communication

## Wireless M-Bus

<b>Protocol</b>	wireless M-Bus according to EN13757-3, EN13757-4, EN13757-7
<b>Frame format</b>	B (not OMS compliant)
<b>Frequency</b>	868,950 MHz (as per C1 requirement)
<b>Mode</b>	C1
<b>Encryption</b>	AES-128 Counter Mode
<b>Transmission interval</b>	96 s
<b>Antenna</b>	Version W1 I: Internal antenna Version W1 E: External antenna for SMA connector (included as accessory, cable length: 2 m )
<b>Transmission power</b>	<25 mW
<b>Configuration parameters</b>	-
<b>Configuration mode</b>	-
<b>Note</b>	<p>After power on, the first frame is sent in a random moment within the first time interval in order to avoid collisions when a great number of meters is powered on at the same time.</p> <p>Both solutions (internal and external antenna) will be tested according to RED requirements and documentation will be available.</p>

# Wireless M-Bus frame

## Extended Link layer

Reference standard: IS EN13757-4

CI-field	CC-field	ACC-field	SN-field	Payload CRC-field
8D <sub>h</sub>	1 byte	1 byte	4 bytes	2 bytes

CI-field: 0x8D: ELL\_2

CC-field:

B-field	D-field	S-field	H-field	P-field	A-field	R-field	(RFU)
Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

Figure 9 — Communication Control Field

B-field: always 0

D-field: always 0

S-field: always 1 (instrument cannot transmit any asynchronous frame)

H-field: always 0

P-field: always 0

A-field: always 0

R-field: always 0

**ACC-field** is always increased by 1 at every frame transmission (every transmitted frame is synchronous)

SN-field:

ENC-field	Time-field	Session-field
Bit 31 – Bit 29	Bit 28 – Bit 4	Bit 3 – Bit 0

Figure 10 — Session Number Field

ENC-field: always 001b to define AES-128 Counter mode encryption

Note: SN-field is stored at power down of instrument in order to have a session number that is never reused during the lifetime of the meter for optimized encryption purposes



### Transport layer

Reference standard: IS EN13757-7

**Table 10 — General structure of TPL**

CI-Field	TPL Header	APL data	TPL Trailer (optional)
1 byte	None header Short header Long header	Variable number	Variable number

**CI-Field:** always 0x78 (Application layer without Transport layer, none header)

### Application layer

Reference standard: IS EN13757-3

EM24 ELECTRIC MEASUREMENT	DATA FORMAT	ENGINEERING UNIT	DIF [hex]	VIF [hex]	VIFE#1 [hex]	VIFE#2 [hex]	VIFE#3 [hex]
kWh(+) TOT	32 bit integer	Wh*100	04	05			
kvarh(+) TOT	32 bit integer	kVarh*0.1	04	FB	82	75	
kWh(-) TOT	32 bit integer	kWh*0.1	04	85	3C		
kvarh(-) TOT	32 bit integer	kVarh*0.1	04	FB	82	F5	3C
Error flag	8 bit integer		01	FD	17		

### Error flag

**Note: Error flag** is used to manage overflow conditions on electric measurements measured by measuring module. The meaning of the bits are shown in the table below:

Bit								Meaning	
8 [MSb]	7	6	5	4	3	2	1 [LSb]	1P system	3Pn system
0	0	0	0	0	0	0	0	No error	
0	0	0	0	0	0	0	1	V 1-N overflow	
0	0	0	0	0	0	1	0	N.A.	V 2-N overflow
0	0	0	0	0	1	0	0	N.A.	V 3-N overflow
0	0	0	0	1	0	0	0	I1 overflow	
0	0	0	1	0	0	0	0	N.A.	I2 overflow
0	0	1	0	0	0	0	0	N.A.	I3 overflow
0	1	0	0	0	0	0	0	Frequency out of range	

N.A. means that the bit cannot be set because the relevant measurement is not defined. So this bit is always "0". Frequency out of range is set when occurs an overflow or an underflow of the frequency measured by measuring module.

## Connection Diagrams

### Three-phase with neutral (4-wire)

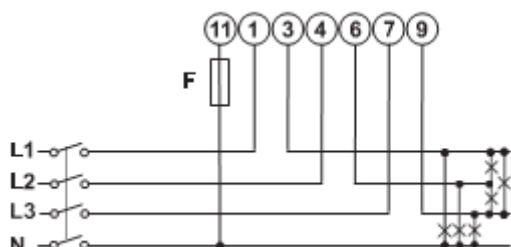


Fig. 3 AV2 3X

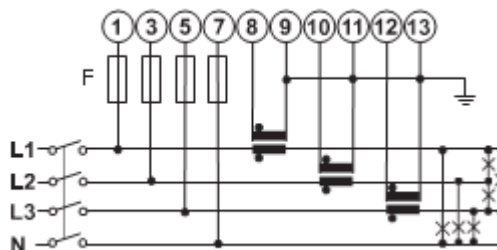


Fig. 4 AV5

### Three-phase without neutral (3-wire)

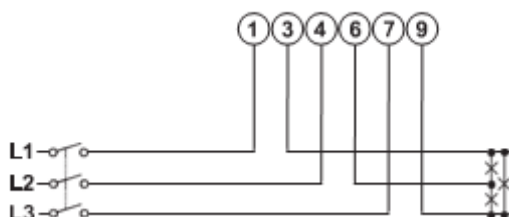


Fig. 5 AV2 3X

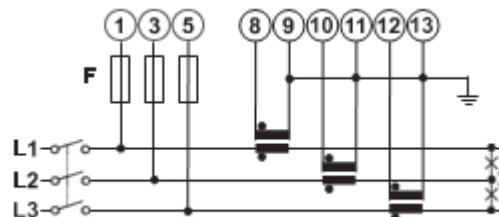


Fig. 6 AV5

### Single-phase (2-wire)

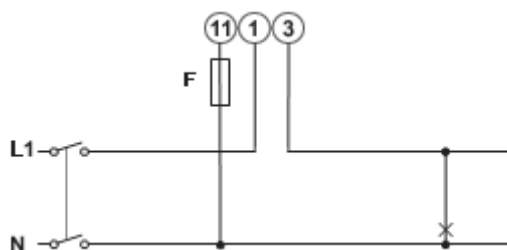


Fig. 7 AV2 1X

*Note: Energy meters cannot be reset.*

*Note: in case of 3-phase meter (AV2 3X or AV5) and 3-phase connection without neutral, L-N voltages are shown on display, referred to a "virtual" neutral.*

## References

Order code

### MID models

Component name/part number	I/O communication	Voltage inputs	Current inputs	Power	System
EM24DIN AV2 1X W1 I PFB 01	wireless M-Bus, INTERNAL antenna	230V L-N 400V L-L	10 (65) A	Self power supply	1-phase
EM24DIN AV2 1X W1 E PFB 01	wireless M-Bus, EXTERNAL antenna	230V L-N 400V L-L	10 (65) A	Self power supply	1-phase
EM24DIN AV2 3X W1 I PFB 01	wireless M-Bus, INTERNAL antenna	230V L-N 400V L-L	10 (65) A	Self power supply	3-phase
EM24DIN AV2 3X W1 E PFB 01	wireless M-Bus, EXTERNAL antenna	230V L-N 400V L-L	10 (65) A	Self power supply	3-phase
EM24DIN AV5 3X W1 I PFB 01	wireless M-Bus, INTERNAL antenna	230V L-N 400V L-L	5(10) A via CT	Self power supply	3-phase
EM24DIN AV5 3X W1 E PFB 01	wireless M-Bus, EXTERNAL antenna	230V L-N 400V L-L	5(10) A via CT	Self power supply	3-phase

**Note: Both imported (kWh+) and exported (kWh-) energies are measured, shown on the display and transmitted via wireless M-Bus. Only kWh+ is MID certified.**

## Additional information by ITEM code

Component name/part number	Item number (TOP number)	Kamstrup name	EAN Code
EM24DIN AV2 1X W1 I PFB 01	6696041	CGEM24 1ph DIN wM-Bus int	8030956087253
EM24DIN AV2 1X W1 E PFB 01	6696042	CGEM24 1ph DIN wM-Bus ext	8030956087260
EM24DIN AV2 3X W1 I PFB 01	6696043	CGEM24 3ph DIN wM-Bus int	8030956087277
EM24DIN AV2 3X W1 E PFB 01	6696044	CGEM24 3ph DIN wM-Bus ext	8030956087284
EM24DIN AV5 3X W1 I PFB 01	6696045	CGEM24 CT DIN wM-Bus int	8030956087291
EM24DIN AV5 3X W1 E PFB 01	6696046	CGEM24 CT DIN wM-Bus ext	8030956087307

Component name/part number	Manufacturer	Version (HEX)	Media (HEX)
EM24DIN AV2 1X W1 I PFB 01	KAM	31	02 (electricity)
EM24DIN AV2 1X W1 E PFB 01	KAM	32	02 (electricity)
EM24DIN AV2 3X W1 I PFB 01	KAM	33	02 (electricity)
EM24DIN AV2 3X W1 E PFB 01	KAM	34	02 (electricity)
EM24DIN AV5 3X W1 I PFB 01	KAM	35	02 (electricity)
EM24DIN AV5 3X W1 E PFB 01	KAM	36	02 (electricity)

## Labels and packaging

### Box



Standard Carlo Gavazzi box as per the attached picture.

### Box label

<b>EM24DIN AV2 1X W1 I PFB 01</b>	<p>EM24-DIN.AV2.3.X.W1.I.P/FB01</p>  <p>8 030956 087253</p> <p>Input: 230V 0,5-10(65)A 50Hz Output: wireless M-Bus</p>   <p>MADE IN ITALY</p> <p>27316138 1 QTY *X*</p>	<p>6641302</p> <p><input type="checkbox"/> VERIFIED</p>
<b>EM24DIN AV2 1X W1 E PFB 01</b>	<p>EM24-DIN.AV2.1.X.W1.E.P/FB01</p>  <p>8 030956 087260</p> <p>Input: 230V 0,5-10(65)A 50Hz Output: wireless M-Bus</p>   <p>MADE IN ITALY</p> <p>27316138 1 QTY *X*</p>	<p>6641303</p> <p><input type="checkbox"/> VERIFIED</p>
<b>EM24DIN AV2 3X W1 I PFB 01</b>	<p>EM24-DIN.AV2.3.X.W1.I.P/FB01</p>  <p>8 030956 087277</p> <p>Input: 3x230(400)V 0,5-10(65)A 50Hz Output: wireless M-Bus</p>   <p>MADE IN ITALY</p> <p>27316138 1 QTY *X*</p>	<p>6641304</p> <p><input type="checkbox"/> VERIFIED</p>
<b>EM24DIN AV2 3X W1 E PFB 01</b>	<p>EM24-DIN.AV2.3.X.W1.E.P/FB01</p>  <p>8 030956 087284</p> <p>Input: 3x230(400)V 0,5-10(65)A 50Hz Output: wireless M-Bus</p>   <p>MADE IN ITALY</p> <p>27316138 1 QTY *X*</p>	<p>6641305</p> <p><input type="checkbox"/> VERIFIED</p>
<b>EM24DIN AV5 3X W1 I PFB 01</b>	<p>EM24-DIN.AV5.3.X.W1.I.P/FB01</p>  <p>8 030956 087291</p> <p>Input: 3x230(400)V 0,05-5(10)A 50Hz Output: wireless M-Bus</p>   <p>MADE IN ITALY</p> <p>27316138 1 QTY *X*</p>	<p>6641306</p> <p><input type="checkbox"/> VERIFIED</p>



**EM24DIN AV5 3X W1 E PFB 01**



\*X\* is the revision. For example in case of revision 1 it is \*1\*.

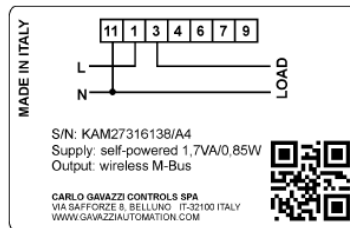
**Bottom of the box label, (production process identification for internal use)**



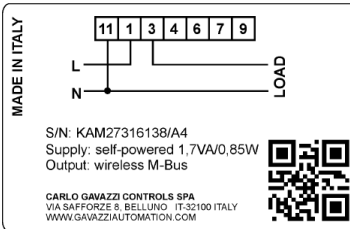
Note: process identification number depends on the meter. 0262755H022 has been used as example.

**Connection label and product label**

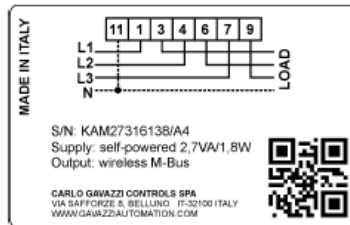
**EM24DIN AV2 1X W1 I PFB 01**



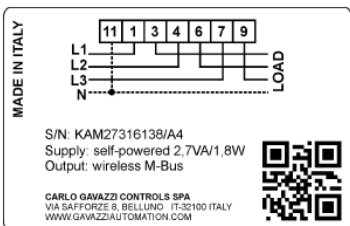
**EM24DIN AV2 1X W1 E PFB 01**



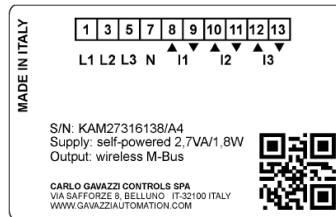
**EM24DIN AV2 3X W1 I PFB 01**



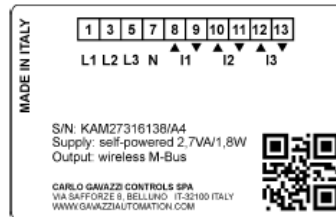
**EM24DIN AV2 3X W1 E PFB 01**



## EM24DIN AV5 3X W1 I PFB 01



## EM24DIN AV5 3X W1 E PFB 01



## Notes:

- KAM27316138/A4 has been used as example
- QN: xxxxxxxxxxxxxx is the Carlo Gavazzi quality number, identifying production date and lot
- M 19: identifies the production year (MID requirement, in the example 19 means 2019)

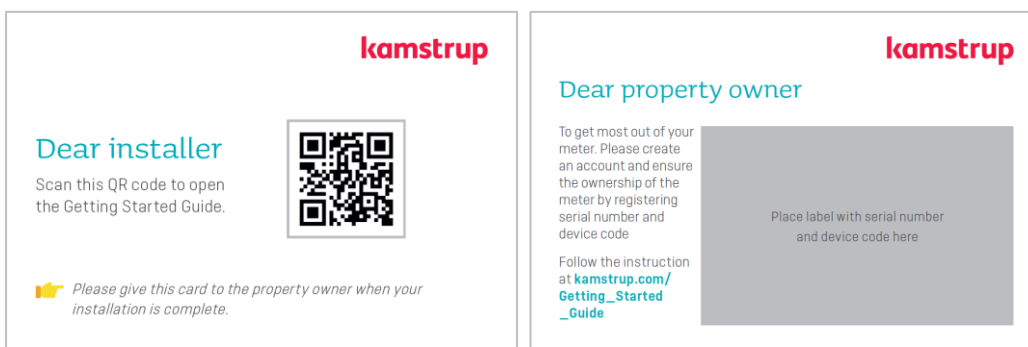
## Serial number label



Note: barcode and number depends on serial number. 27316138 has been used as example.

## Additional card

An additional card 90x60 mm, including the serial number is included in the packaging. The same information is also written in the instruction manual, without the serial number.





## Customer approval

Revision	Date	Signed by	Signature	Note