KRON
MEDIDORES

USER'S GUIDE

Power Transducer

WA / RA / WR

Review I

Table of Contents

The information herein has the purpose of helping in the correct use and specification of WA, RA and WR Power Transducers.

Due to continued improvement, the information herein is subject to changes without prior notice.

Introduction

WA, RA and WR power transducers have the function of measuring the active (W) or reactive (VAr) power in one-phase or three-phase systems (either balanced or unbalanced).

The power measurement is made with an analog multiplier, that uses the TDM (time division multiplication) method, generating a DC output signal, that may be of voltage (e.g.: 0-10V) or of current (e.g.: 4-20mA), and is directly proportional to the transducer's input. This output signal is galvanically insulated from the transducer's input.

Term of Warranty

Kron Instrumentos Elétricos Ltda ensures that its products are strictly calibrated and tested, committing itself to repair them if possible manufacture faults occur.

One (1) year warranty:
From the product's purchase date upon confirming the purchase invoice.

The warranty does not cover:

- Devices that have been tampered with.
- Disassembled or opened by unauthorized personnel.
- Damaged by overcharge or installation error.
- Used in a negligent or improper manner.
- Damaged by any kind of accident.

Maintenance:

Corrective maintenance, if necessary, should be carried out by **Kron Instrumentos Elétricos'** specialized personnel, upon sending the defective part to our plant. The instrument cleaning, when necessary, should be done only in external parts, using neutral material, and with all electrical connections unplugged.

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Technical Features

Measurement Circuit

Type: Single-phase (F-N), Single-phase (F-F), Wye Three-phase (3 elements, 4 wires) and Delta Three-phase (2 elements, 3 wires).

Frequency: 50 or 60Hz (±10%)

Current Input

Rated: 1Aac or 5Aac
Effective Measurement Range: 10 to 110% of In
Short duration overcharge: 20 x In (1 sec)
Continuous overcharge: 2 x In
Power consumption: < 0,5VA

Voltage Input

Rated: 110Vac – 115Vac – 150Vac – 220Vac – 380Vac – 440Vac
Effective Measurement Range: 80 to 120% of Vn
Short duration overcharge: 1,5 x Vn (1 sec)
Continuous overcharge: 1,2 x Vn
Power consumption: < 0,2VA

Auxiliary (or external) supply

To be defined in the order, between these options:
Alternated: 110 – 220 Vac (± 15%)
Continuous: 12 – 24 – 48 – 125 Vdc (± 20%)

Maximum power consumption: 5VA

Environmental Conditions

Working Temperature: -10 to 60º C
Operating Moisture: 0-95% (no condensing)

Temperature coefficient: 0.01%/°C

Mechanical Features

Fastening: With screws (4) in the panel background.

Housing: Special extruded aluminum case with high mechanical resistance and for high temperatures.

Connections: Through terminal strip with M3 screws.

Protection degree: IP40 for housing and IP00 for terminals.

Electrical Features

Accuracy: 0.25% (under consultation: 0.2%)

Insulation: 2kV (60Hz, 1 minute)

Impulse Test: 5kV – 1.2/50us – 0.5J

Output Ripple: <0.5% (regarding full scale)

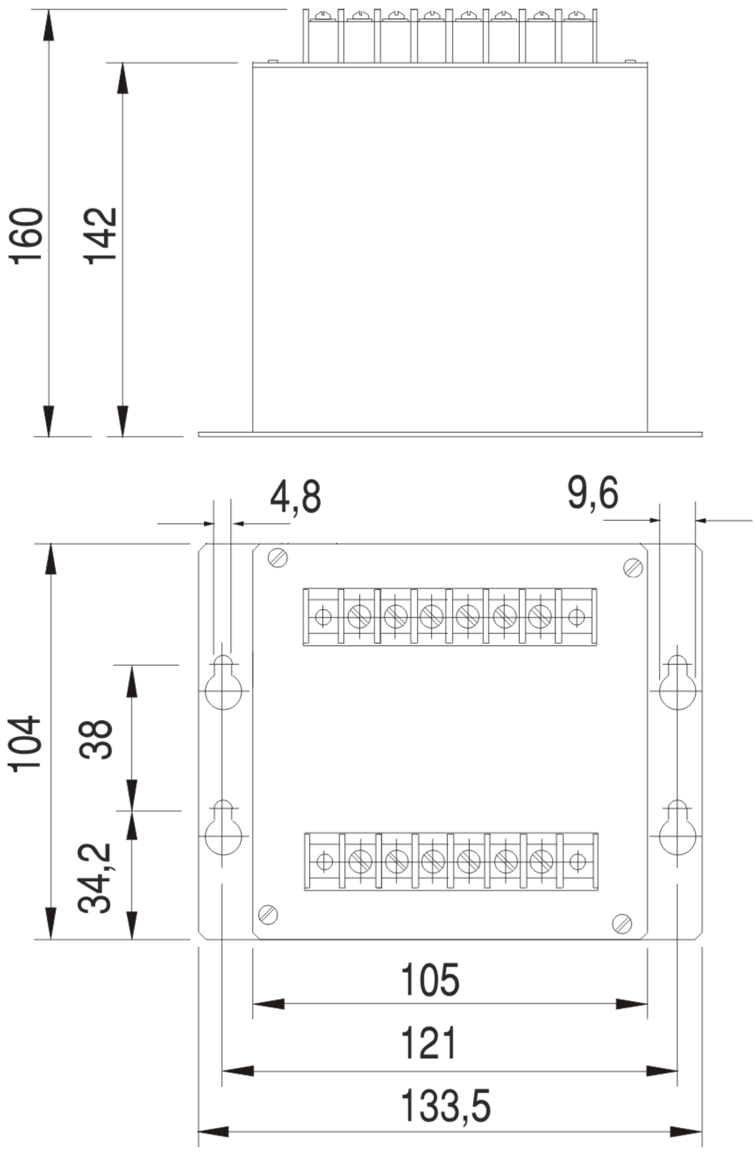
Response Time: < 400ms
(others under consultation)

Standardizing

According to NBR 8145.

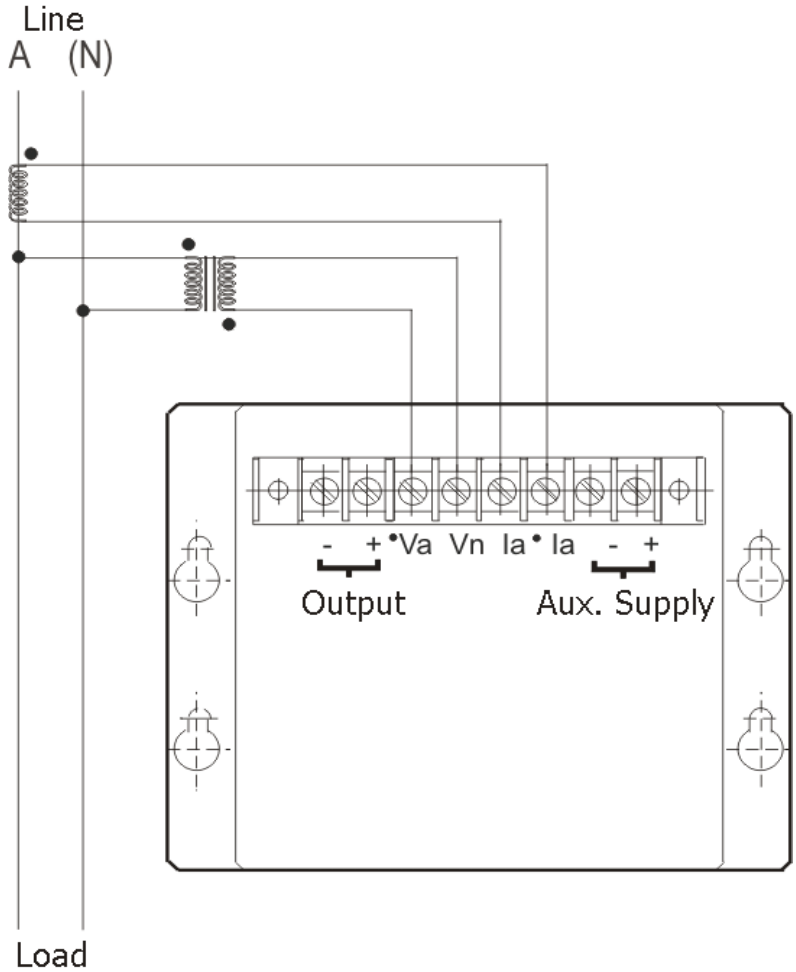
Product's Dimensions

Dimensions in millimeters (mm). Tolerance: ±0.5mm

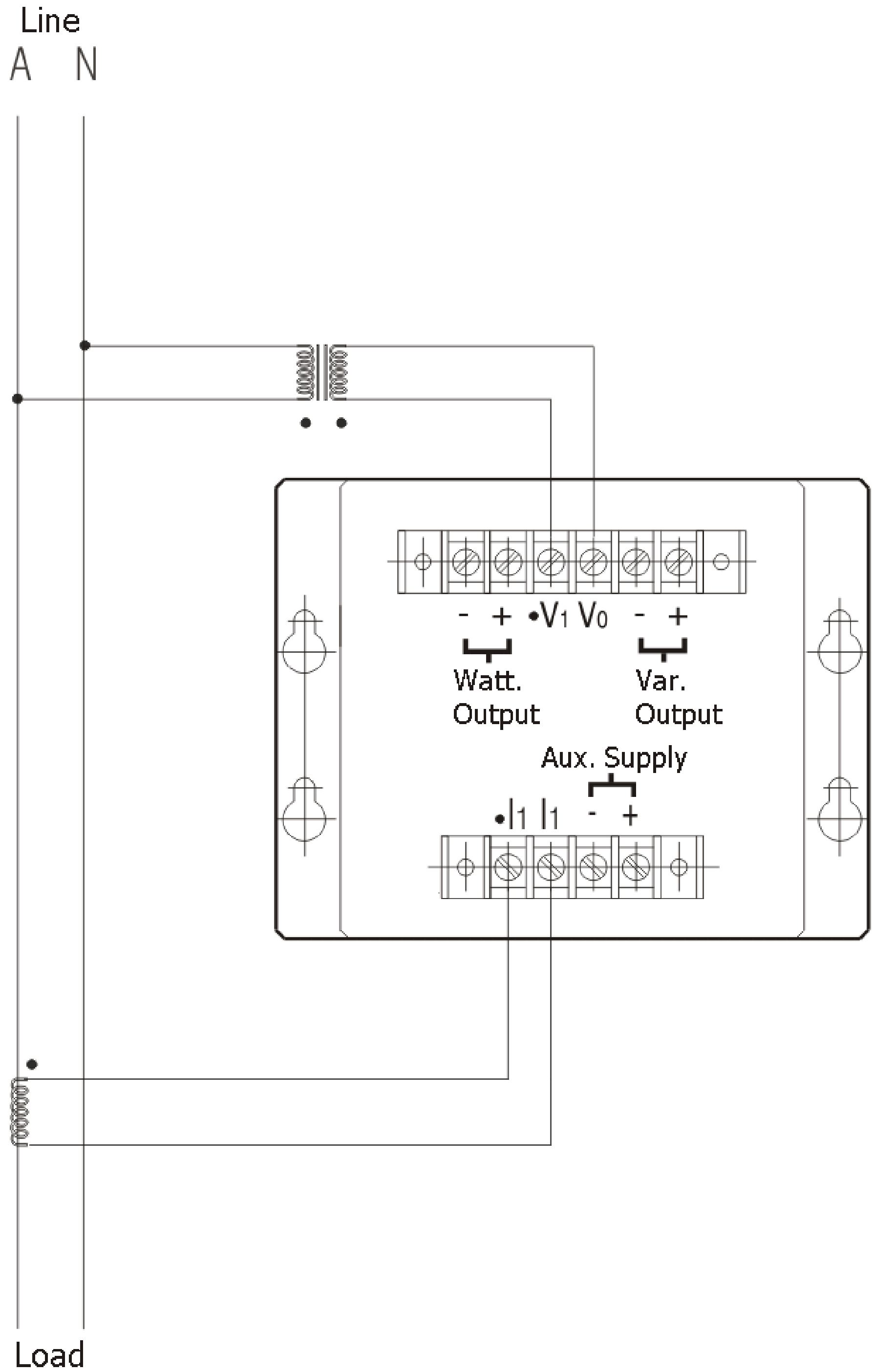


Wiring Diagrams

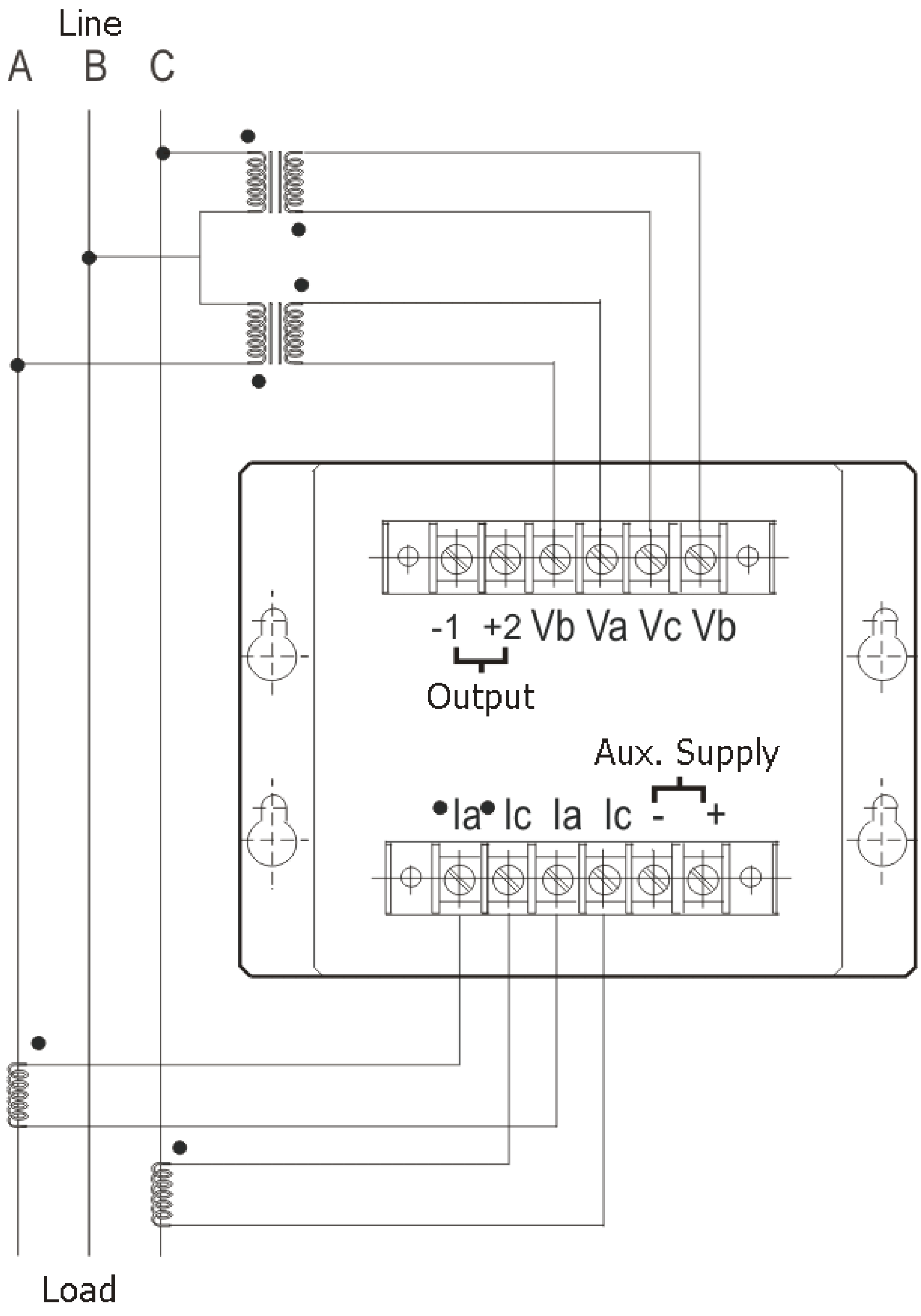
Single element, two-wire transducer
WA or RA models



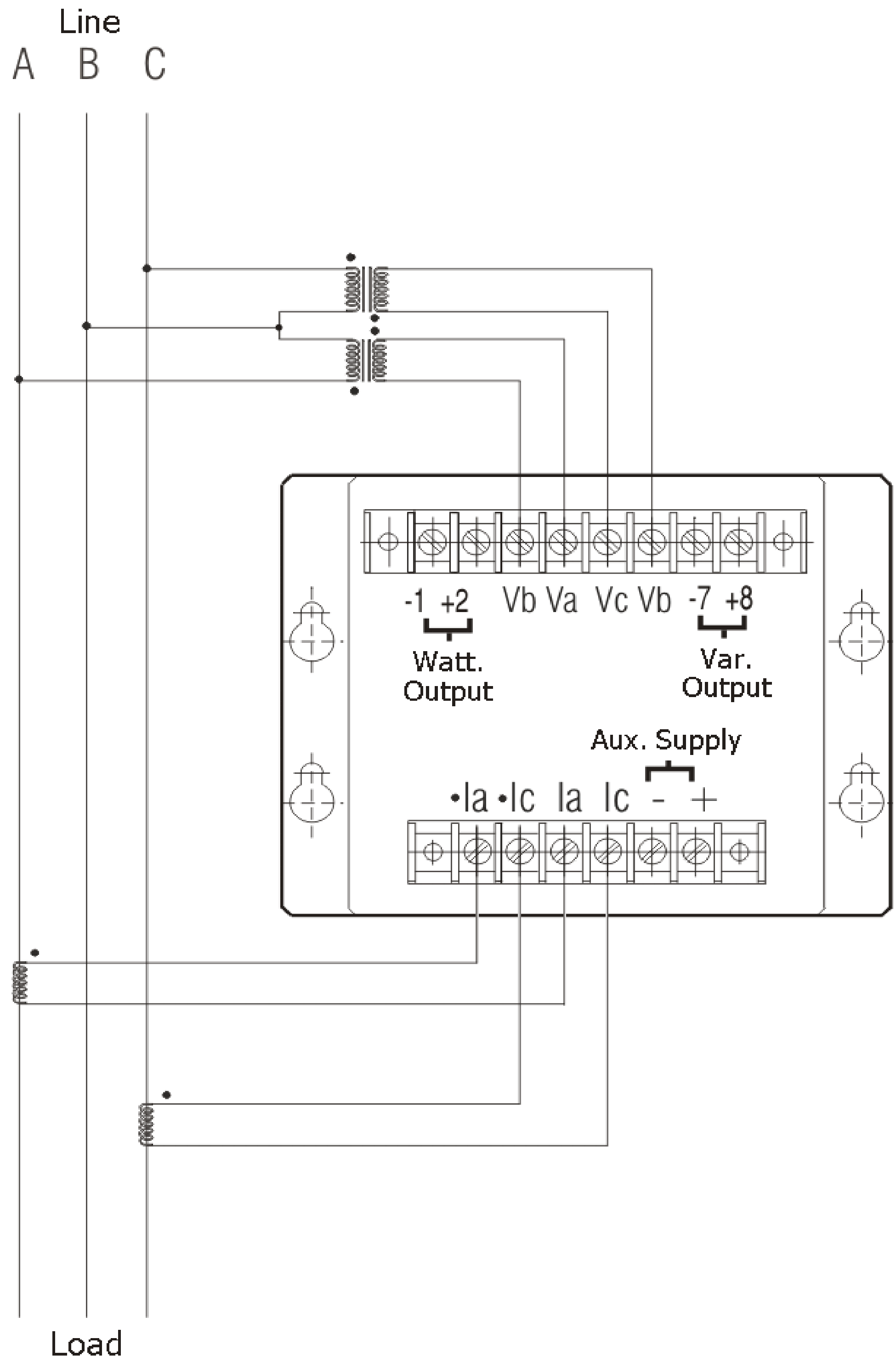
Single element, two-wire transducer
WR model



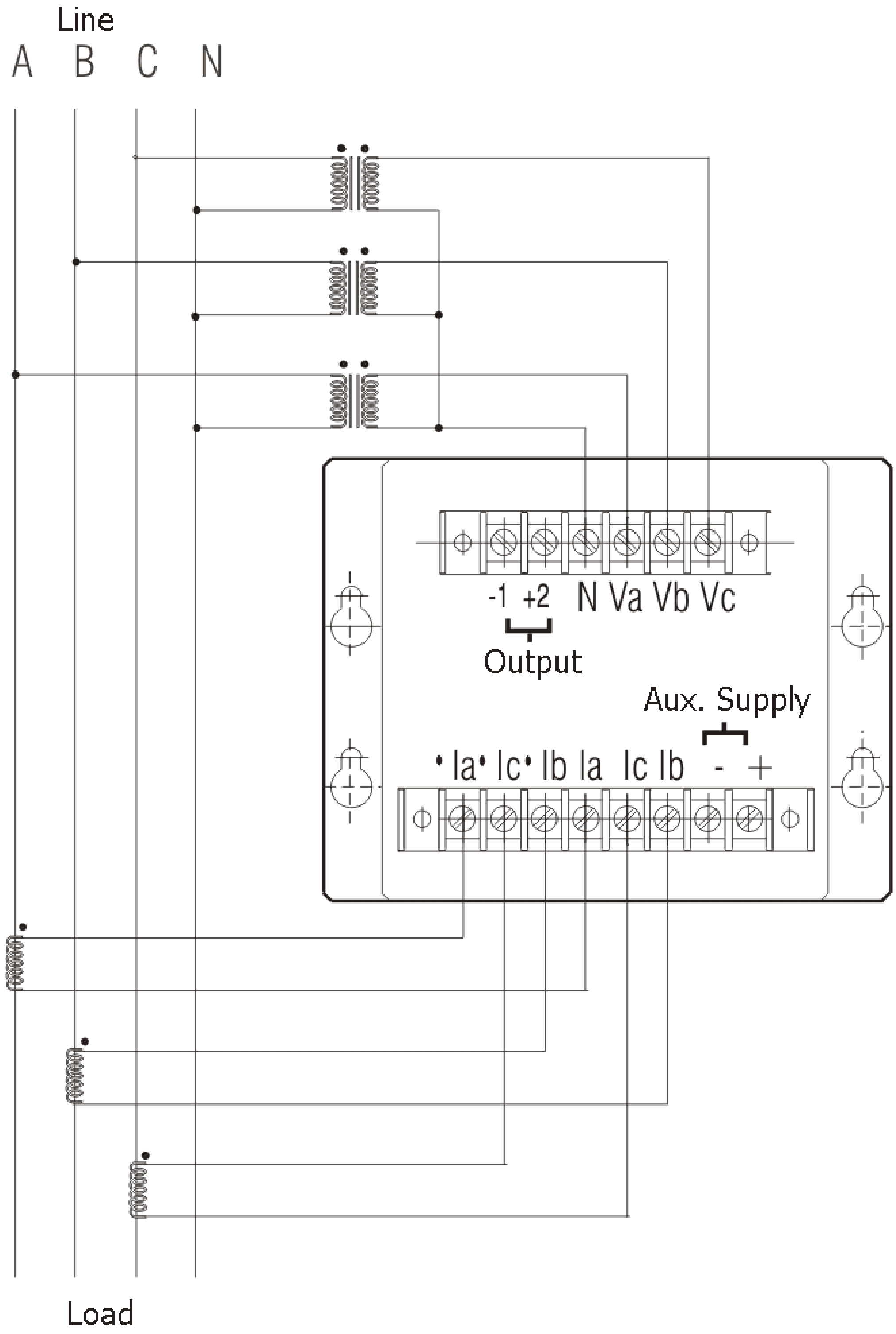
Two elements, three-wire transducer
WA or RA models



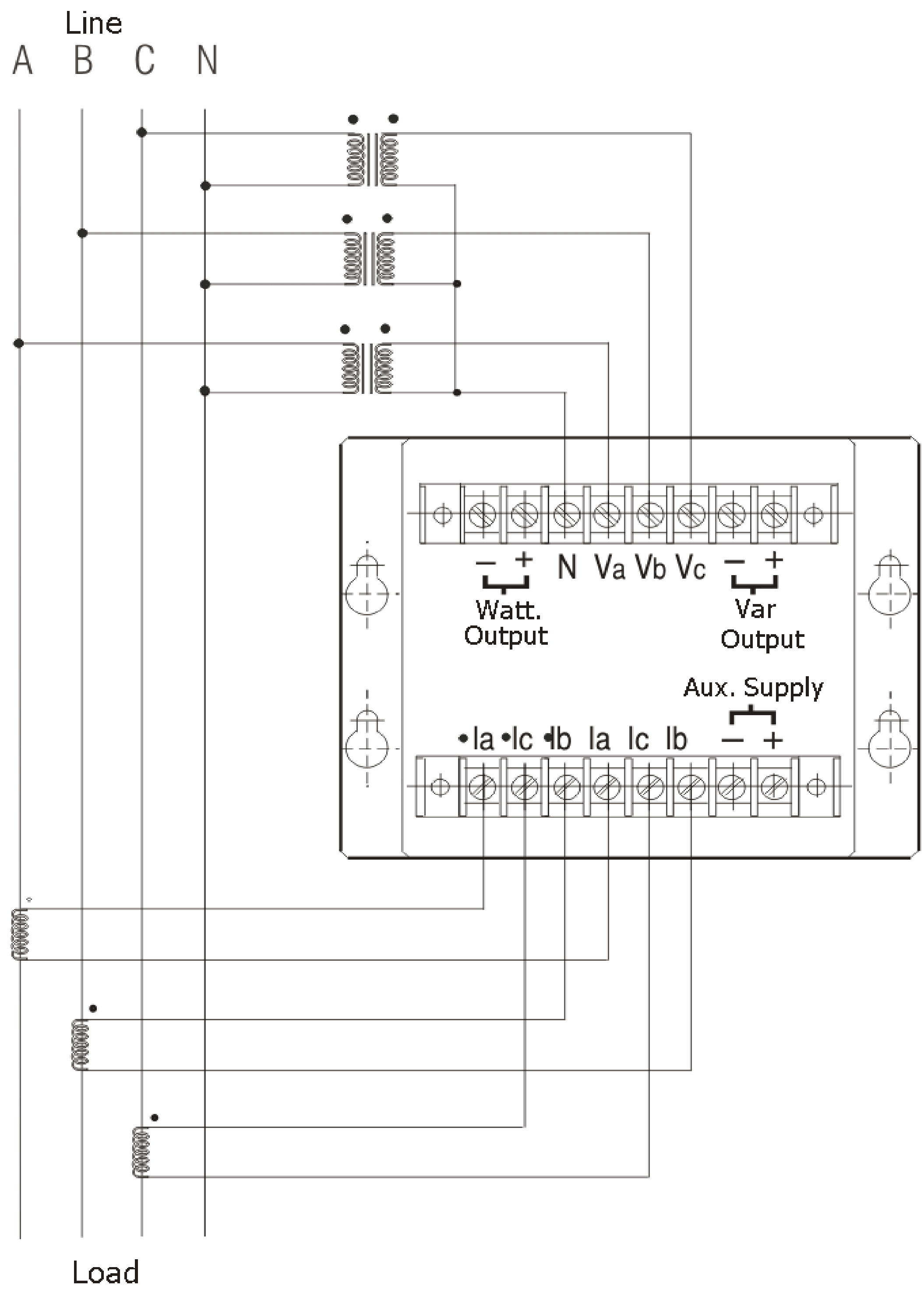
Two elements, three-wire transducer
WR model



Three elements, four-wire transducer
WA or RA models



Three elements, four-wire transducer
WR model



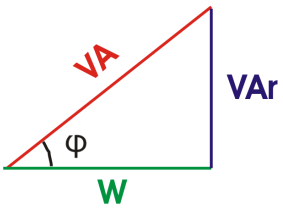
Analog Output

A transducer's principle is supplying a proportional linear output to an input signal. The power transducer is intended to measure active power (W) and/or reactive power (VAr). The output signal is always in direct current (D.C.). Thus:

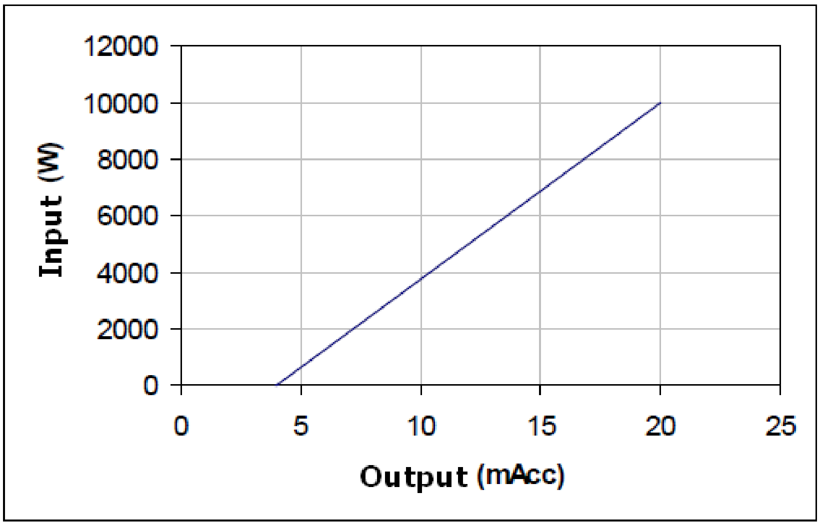
Apparent power = V x I

Active power = V x I x cos φ

Reactive power = V x I x sen φ



And the output signal expresses the power value in a linear manner, as seen below:



Example of input x output graph in a transducer with 12000W as full scale and 4-20mAdc output. Note that under 0W we have 4mAdc in output and under 12000W, we have 20mAdc in output.

Regarding the output types, there are two models:

1. Current type signal

It is a signal in the form of current. This is widely used in systems where the module that will receive the signal is away from the transducer, once the voltage type output transducer signal would suffer attenuation and consequent incorrect reading due to the distance. The 4-20mAdc signal is an interesting manner to check if the transducer is, indeed, working, as even if there is no input or if it equals 0, it should provide a 4mAdc output.

In this type of output, the **maximum burden** supported by the transducer is specified.

Examples: 0-1mAdc, 0-10mAdc, 4-20mAdc, etc.

2. Voltage type signal

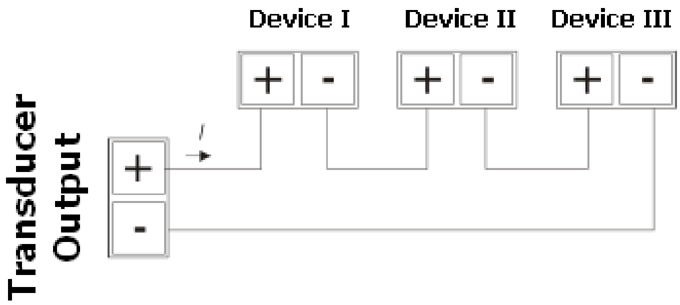
It is a signal in the form of voltage. A **minimum burden** is specified for the transducer, as it is not able to drain high currents in its output.

Examples: 0-1Vdc, 0-10Vdc, etc.

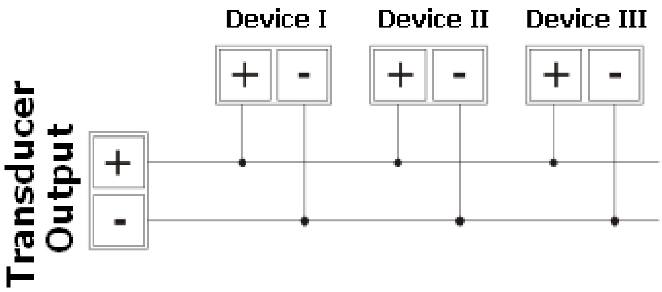
Connecting several devices to a transducer

In many industrial automation processes there is the need of using a single signal in several devices, such as a digital gauge and a PLC.

For **current output** transducers, the instruments should be connected in **series**, according to the illustration below:



On the other hand, for **voltage output** transducers, the instruments should be connected in parallel:



The **equivalent resistance** of the devices to be connected should always be calculated, in order to verify if there will not be output saturation of the transducer, which may lead it to be damaged or present unreal output values. The equivalent resistance should always be within the allowed range for the transducer's output type (the resistance allowed for a 0-1mAdc transducer is different from that allowed for a 0-10mAdc, for such, refer to the table available in the *Output burden limits* topic).

Output burden limits

The burden limits allowed for WA, RA and WR power transducers are:

Output	Allowed range
0-1mAdc	0-10kΩ
0-5mAdc	0-2kΩ
0-10mAdc	0-1kΩ
4-20mAdc	0-750Ω
0-20mAdc	0-750Ω
0-1Vdc	1kΩ Minimum
0-5Vdc	1kΩ Minimum
0-10Vdc	2kΩ Minimum

Full Scale Calculation

As full scale is defined the input value that will cause the transducer to reproduce its maximum output value. It is important to carry out this calculation for correct specification of the value measured in a PLC or in the definition of a digital gauge's scale, for example.

F.S.	**=**	**Rated Voltage**	**x**	**Rated Current**	**x**	**(three-phase) *or* 1 (single-phase)**	**x**	**C.F.**
F.S. = Full Scale		*It is the transducer's input voltage, expressed in its front panel.*		*It is the transducer's input current, expressed in its front panel.*		*Use the factor 1 for single-phase transducers and the (1.732...) factor for three-phase transducers.*		*It is the calibration factor. When not specified by the client, it is defined as 1. It is always a value between 0.5 and 1.2.*

Commonly, current and/or voltage transformers are used in order to adequate the system's voltage with the transducer's measuring voltage. In this case, the value to be used in F.S. calculation is that of the primary between these transformers.

Example I

WA Transducer (Active Power) – 3 elements, 4 wires – Input: 115Vac / 5Aac – Output: 4-20mAdc
Uses VT 13800/115Vac and CT 200/5Aac

F.S. = 13800 x 200 x   [W]
F.S. = 4,780,320 W
F.S. = 4.78 MW

Reading interpretation: 4mAdc = 0W, 20mAdc = 4.78MW

Example II

RA Transducer (Reactive Power) – 1 element, 2 wires – Input: 380Vac / 5Aac – Output: 0-10Vdc
Uses CT 300/5Aac (the voltage is directly connected)

F.S. = 380 x 300 x 1 [VAr]
F.S. = 114,000 VAr
F.S. = 114 kVAr

Reading interpretation: 0Vdc = 0VAr, 10Vdc = 114kVAr

Example III

WR Transducer (Active Power + Reactive Power) – 1 element, 2 wires – Input: 440Vac / 5Aac – Output: 0-10Vdc
Uses CT 1000/5Aac (the voltage is directly connected)

In this case, we'll have two full scales, one of them regarding the active power and the other, the reactive power, but both with the same value.

F.S. = 440 x 1000 x 1 [W]
F.S. = 440,000 W
F.S. = 440 kW
Reading interpretation: 0Vdc = 0W, 10Vdc = 440kW

For reactive output (VAr), the interpretation is the same, changing only the unit (VAr instead of W).

Example IV

WA Transducer (Active Power) – 3 elements, 4 wires – Input: 115Vac / 5Aac – Output: 4-20mAdc – C.F. (Calibration factor) = 0.941
Uses VT 13800/115Vac and CT 200/5Aac

F.S. = 13800 x 200 x   x 0.941 [W]
F.S. = 4,500,000 W
F.S. = 4.50 MW

Reading Interpretation: 4mAdc = 0W, 20mAdc = 4.50MW

Bi-direction transducers

For measurement of co-generation systems, i.e., systems which in part of time supply energy and in part of time consume energy are used transducers with bi-direction output.

In a common transducer, with 4-20mAdc output, when we have an active power whose signal is negative, it will not carry out measurement. The bi-direction model, on the other hand, works with “two scales” in its output, one of them positive and the other negative.

Bi-direction output example: 4..12..20mAdc

12mAdc = 0W
4mAdc = F.S. negative
20mAdc = F.S. positive

For the other signals, without suppressed zero, it is also possible the execution of bi-direction type, however, the operation will be in this manner:

Bi-direction output example: -1..0..1mAdc

0mAdc = 0W
-1mAdc = F.S. negative
1mAdc = F.S. positive

Product Installation

1. Transducer fastening

The first step for the product installation is fastening it to a panel background with four screws in the proper dimensions, as indicated in the product's dimension.

Regarding electrical connections, it is recommended the use of eyelet terminals with proper dimensions for M3 screws.

2. External supply signals connection

The next step is connecting the product's external supply, as indicated in its front panel. For direct current supply, it is important to respect the indicated polarity (+ and -).

It is recommended the use of a 0.250mA external fuse as protection of the transducer's external supply.

It is recommended the use of wire with 1.5mm² minimum rated section.

3. Voltage signals connection

The voltage signals connection (directly or through VT) should be done in the indicated terminals according to the transducer's wiring diagram.

It is recommended the use of a 0.250mA external fuse as protection of the transducer's voltage inputs. It is also recommended the use of terminal blocks, allowing to move the transducer (for a future calibration and/or possible maintenance) without the need of turning the system off.

It is recommended the use of wire with 1.5mm² minimum rated section.

4. Current signals connection

The current signals connection (directly or through CT – current transformer) should be done in the indicated terminals according to the transducer's wiring diagram.

In case of using CTs, they should be for measurement, and never for protection, as these not only send high current to the transducer's input in short circuit conditions, but also have no accuracy class for measuring power.

Protection fuses should never be used in the current input, as in the event of over-current they would trip the CT output circuit, possibly causing damage to it. As well as in the voltage part, the use of terminal blocks is recommended.

The rated section of the wire to be used should consider the transducer's rated current (1Aac or 5Aac), the distance to the CT and the CTs' rated burden. Commonly are used 2.5mm² or 4mm² section cables.

5. Output connection

Depending of the transducer model, it makes available one or two analog outputs (WA and RA – 1 output, WR – 2 outputs) used for measuring the power of the system where the transducer is connected.

More detail on how this output should be interpreted and also on how the choice for voltage and/or current output types should be made are explained in the chapter *Analog Output*.

The choice of cable section to be used should consider information such as the distance between the transducer and the equipment that will receive the signal and the current level and/or voltage to be used.

Voltage type outputs (e.g.: 10Vdc) should never suffer short circuits. There is no problem in keeping current type (e.g: 4-20mAdc) outputs opened.

Annex A: Product Coding

For correct product specification, it is possible to define a 11-characters code that facilitates the product purchase and later interaction with the Technical Support.

Code:	Meaning:
W	*Fixed. Means that the product is a transducer*
☐ ☐	**30 – WA** Active Power Transducer **31 – RA** Reactive Power Transducer **32 – WR** Active + Reactive Power Transducer
☐	*Circuit to be measured:* **1 – Single-phase** 1 element, 2 wires (F-N) **2 – Delta three-phase** 2 elements 3 wires **3 – Wye three-phase** 2.5 elements **4 – Wye three-phase** 3 elements 4 wires **5 – Single-phase** 1 element, 2 wires (F-F)
☐ ☐	*Voltage input:* **11** – 110V **15** – 115V **20** – 150V **38** – 380V **50** – 115/$\sqrt{3}$ **99** – According to order *The voltage to be informed is always phase-phase.*
☐	*Current input:* **1** – 1A **5** – 5A
☐	*Frequency:* **1** – 60Hz **2** – According to order **3** – 50Hz
☐	*Output:* **1** – 0-1mAdc (0-10k) **2** – 0-5mAdc (0-2k) **3** – 0-10mAdc (0-1k) **4** – 0-20mAdc (0-750) **5** – 4-20mAdc (0-750) **6** – 0-1Vdc (1k min) **7** – 0-5Vdc (1k min) **8** – 0-10Vdcc (2k min) **9** – According to order
☐	*External supply:* **1** – 110Vac **2** – 220Vac **3** – 125Vdc **4** – 48Vdc **5** – 24Vdc **6** – 12Vdc **7** – Acc. Order (Vac) **8** – Acc. Order (Vdc)
☐	*Class* **1** – 0.25% (Default) **2** – 0.2% (Option – under consultation)