Introduction to Transformer Rated Meters

Module 141

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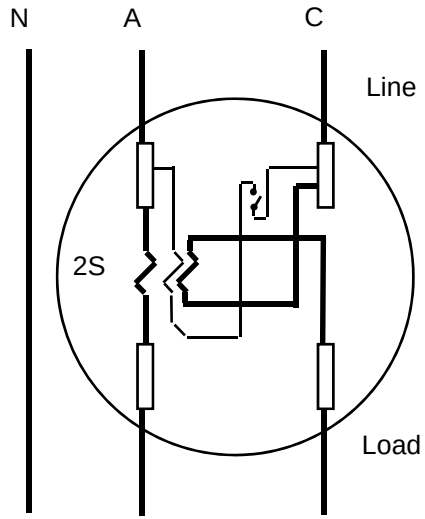
Meter Types

- Self Contained Meters –
  - Usually class 100, 200 or 320 (max. amps)
  - Up to 480 volts (some higher, e.g. Canada)
  - Smaller loads
  - Average homes and small commercial
  - Voltages and currents connect to same terminals; load currents flow through meter
  - The meter multiplier is 1 (typically)

Meter Types

- Self Contained Meters –
  - Voltages and currents connect to same terminals; load currents flow through meter



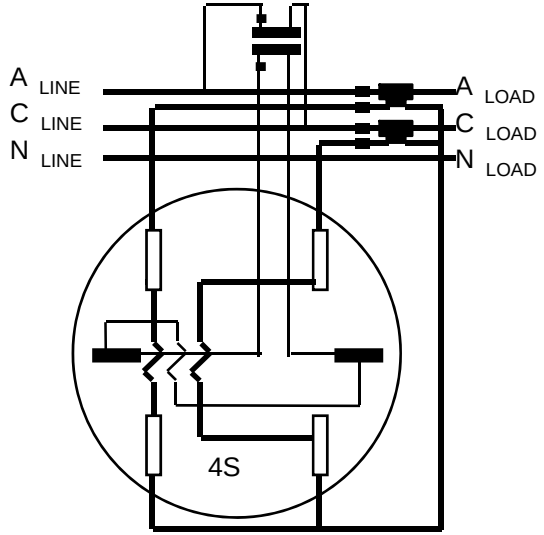
  - The meter multiplier is 1 (typically); may be 10 depending on how “dials” are displayed

Meter Types

- Transformer Rated Meters --
  - Class 10 or 20; generally CL 20 today
  - Load currents above 200 amps and/or voltages above 480v. (typically)
  - Used with voltage transformers and/or current transformers
  - Larger commercial and industrial customers; large homes
  - Voltages and currents connect to separate terminals on meter
  - The meter multiplier is *not* 1 (normally)

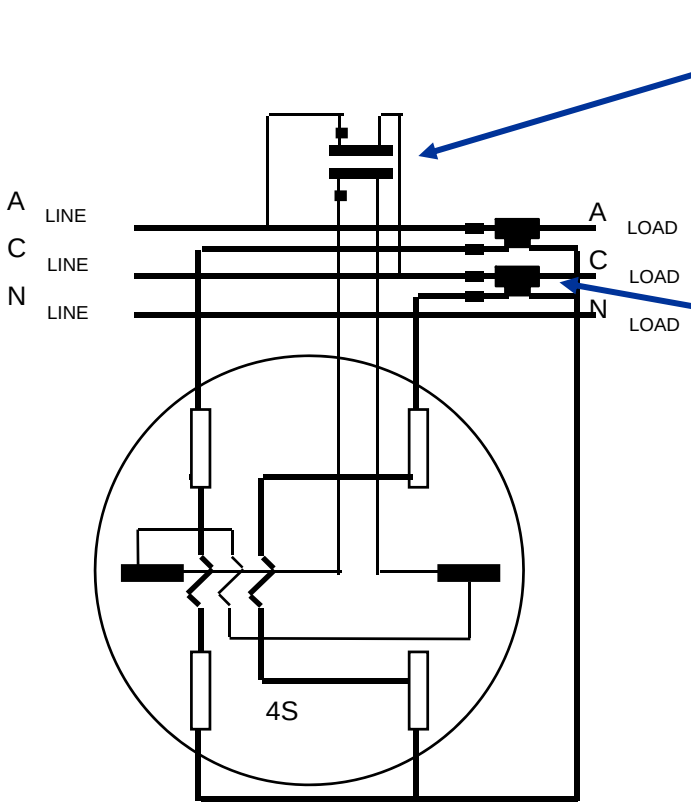
Meter Types

- Transformer Rated Meters --
  - Voltages and currents connect to separate terminals on meter



  - The meter multiplier is not 1 (normally); it is the product of the VT and CT ratios

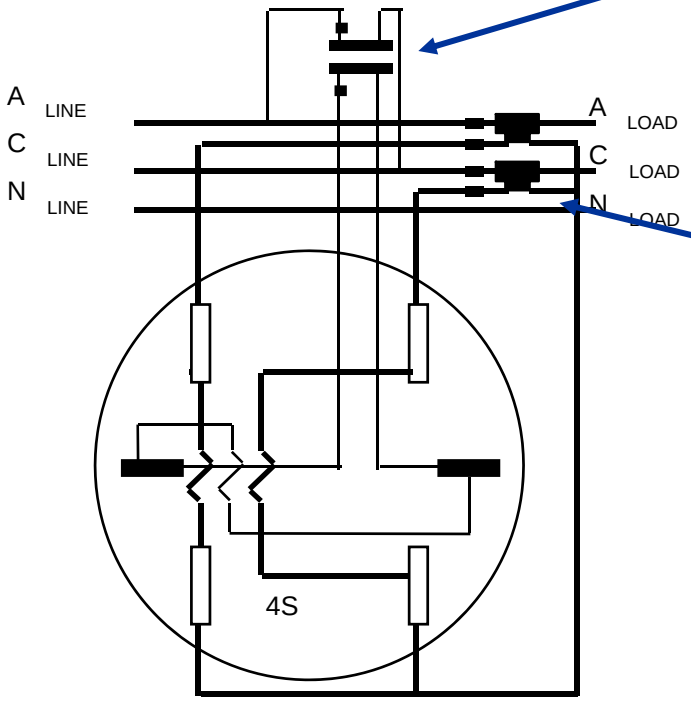
Transformer Rated Meters - Safety



Voltage transformers should never be shorted.

Current transformers must always be shorted when not in use; never “pull” a transformer rated meter unless CT circuits are shorted.

Transformer Rated Meters



Voltage transformer – transforms the voltage; typically to 120 volts from the primary voltage

Current transformer – transforms the current; typically to 5 amps from the primary current

Polarity must be observed for CT's and VT's

The "ratio" is expressed as X to Y (X:Y) and represents the rated primary value as compared to the secondary value.

Meter Multipliers

- Current transformers but no voltage transformers -
  - Example: 400 amp primary (service)
  - 400 amp to 5 amp (400:5) current transformer
  - 80:1 ratio (400/5 = 80)
  - The meter multiplier, then, is 80

Meter Multipliers

- Current transformers and voltage transformers -
  - Example: Service is 12470Y/7200 volts and rated 400 amps
  - VT’s are connected phase to neutral – 7200:120 or 60:1
  - 400 amp to 5 amp (400:5) current transformers – 80:1)
  - The meter multiplier, then, is 60 x 80 or 4800

Meter Multipliers

- “Dial” Multipliers and Primary Reading Registers
  - Meter register must show the actual primary usage values
  - Example: Transformer Factor is 4800
  - Meter multiplies values by 4800 and displays result
  - A dial multiplier may be required to prevent “wrap around”, e.g. x100, x1000, etc.

Blondel's Theorem

Blondel says:

If energy be supplied to any system of conductors through N wires, the total power in the system is given by the algebraic sum of readings of N wattmeters, so arranged that each of the N wires contains one current coil, the corresponding potential coil being connected between that wire and some common point. If this common point is on one of the N wires, the measurement may be made by the use of N-1 wattmeters.

Andre E. Blondel, 1893

- We would use "watthour meters" in place of "watt meters" and "energy" in place of "power".
- We would also consider "ground" as a possible current carrying conductor when counting "N".

What is a meter Form Number?

- A Form designation tells us:
  - The number and arrangement of meter terminals, and
  - The number and ***internal connection*** of meter elements (stators).
- The Form designation describes the meter, not the service.
  - With modern meters, some meter Forms may be used to correctly meter more than one service configuration.
  - More than one meter Form could be used with a particular service depending on the connection of the Instrument Transformers.
- The same Form designation is usually applicable to equivalent meters of all manufacturers.

Basic Meter Forms

Meter Form	S.C./ T.R.	Number of Stators	Number of Current Circuits	Number of External Circuit Wires
1S, 1A	SC	1	1	2
2S, 2A	SC	1	2	3
3S, 3A	TR	1	1	2
4S, 4A	TR	1	2	3
5S, 5A	TR	2	2	3 (or 4)
35S, 35A	TR	2	2	3*
45S, 45A	TR	2	2	3 (or 4)
6S, 6A	TR	2	3	4Y
36S, 36A	TR	2	3	4Y
8S, 8A	TR	2	3	4Δ
9S, 9A	TR	3	3	4Y (or Δ**)
12S, 12A	SC	2	2	3
14S, 14A	SC	2	3	4Y
15S, 15A	SC	2	3	4Δ
16S, 16A	SC	3	3	4Y (or Δ**)

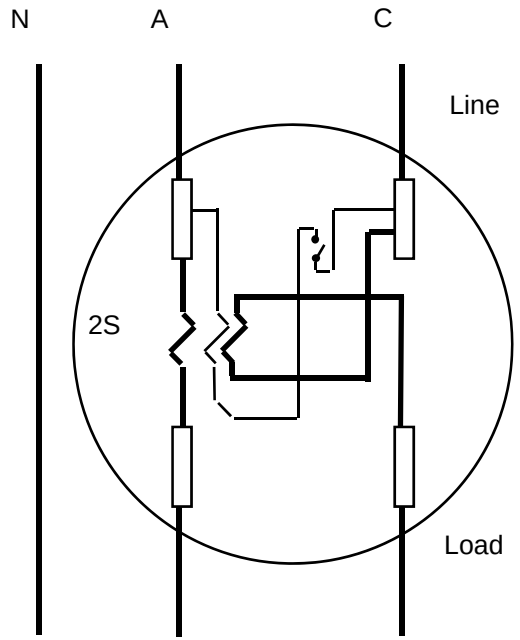
* Not intended for Form 5S equivalent, 4 wire delta connections. ** Some electronic meters may be used in 4wY or 4wΔ circuits.

SC = Self Contained; TR = Transformer Rated
S = Socket Base; A = Bottom Connected

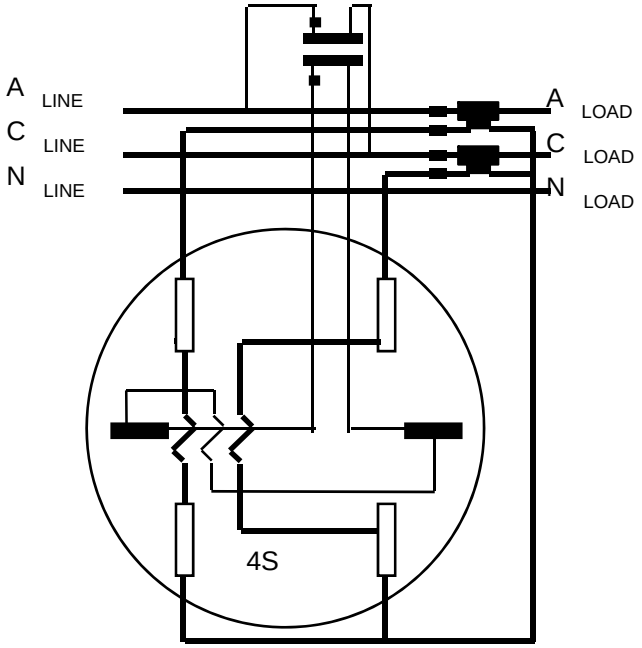
Self Contained vs Transformer Rated

What is one of the key differences . . .

. . . when we look at ANSI forms?

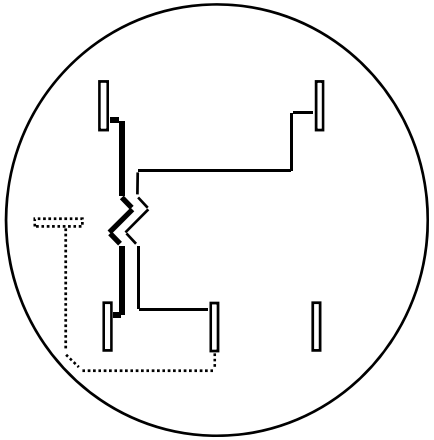


Self-Contained



Transformer-Rated

Applicable ANSI Meter Forms



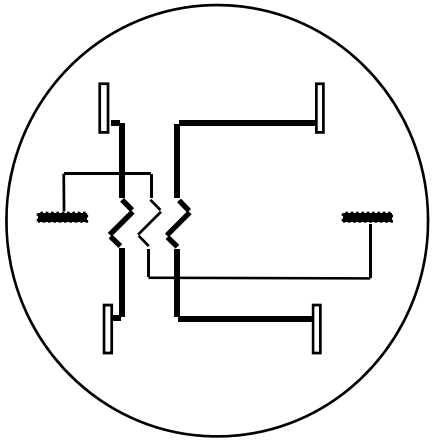
Form 3S*

1 Element,

Transformer Rated

2 wire, single phase,

3 wire, single phase



Form 4S*

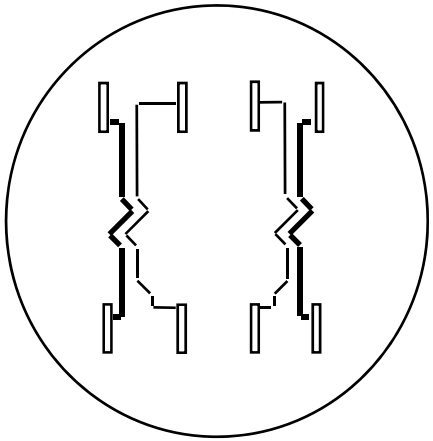
“1-1/2” Element,

Transformer Rated

3 wire, single phase

* ANSI Forms looking from the front of the meter

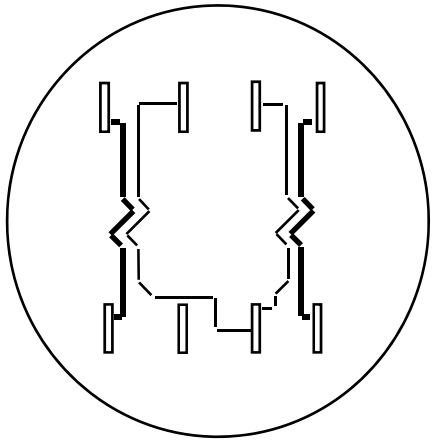
Applicable ANSI Meter Forms



Form 5*

2 Element,

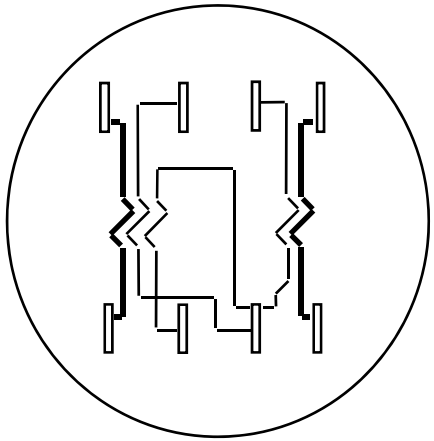
3 wire, network



Form 35*

2 Element,

3 wire, network



Form 45*

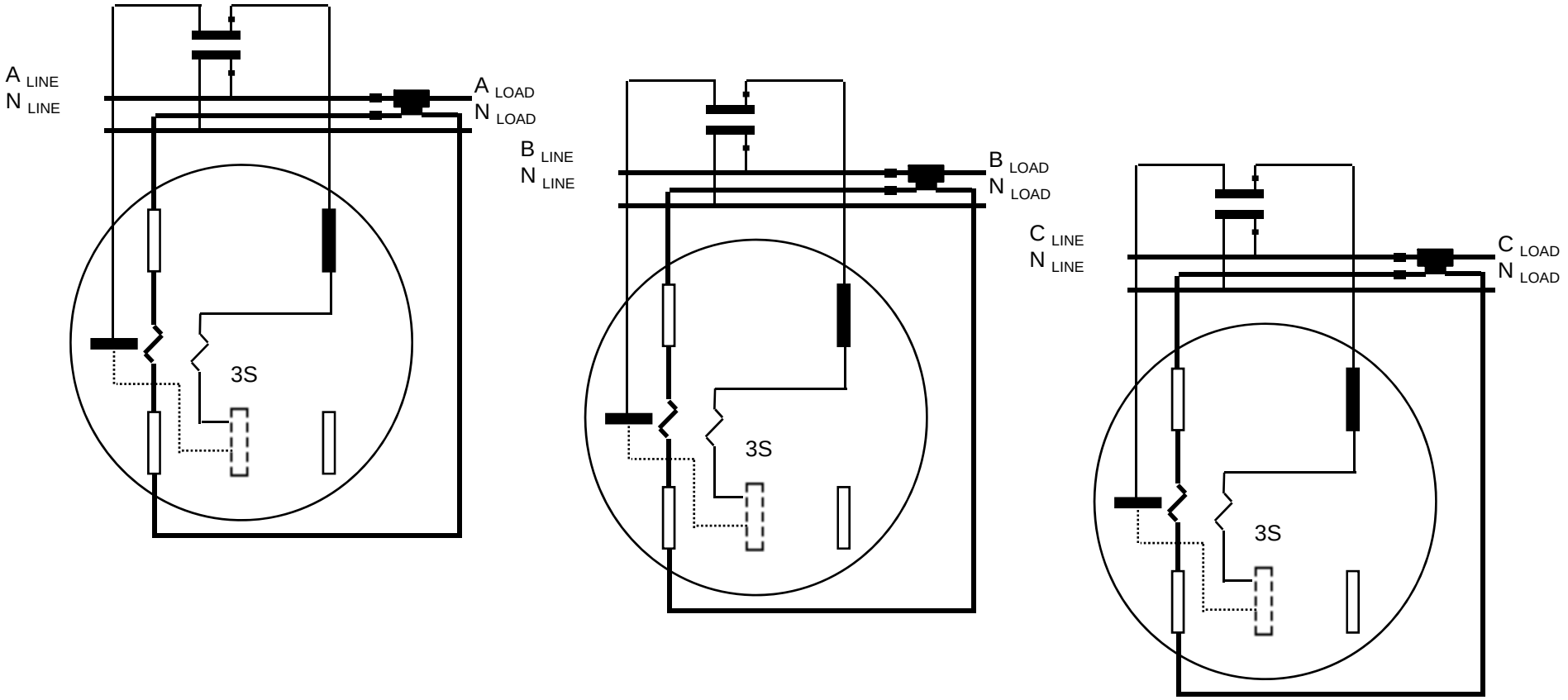
2 Element,

3 wire, network

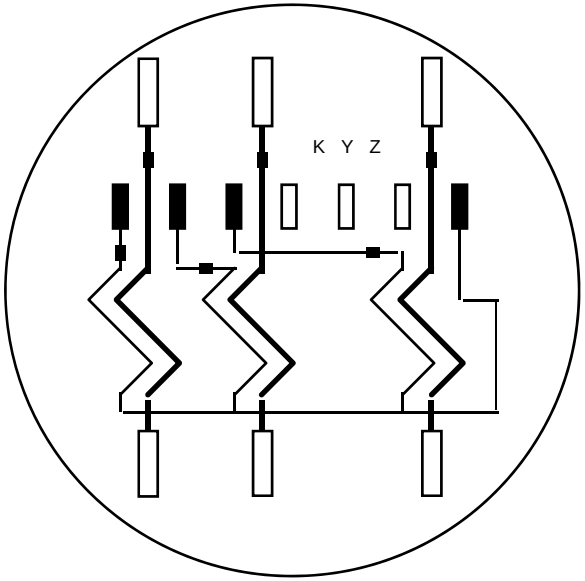
* ANSI Forms looking from the front of the meter

Polyphase Meters

4 Wire Wye Services



4 wire Wye Metering

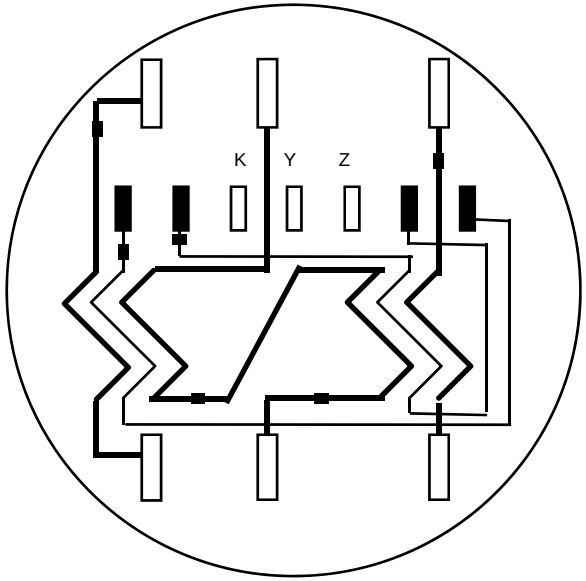


Form 9

3 Element,

4 wire, wye

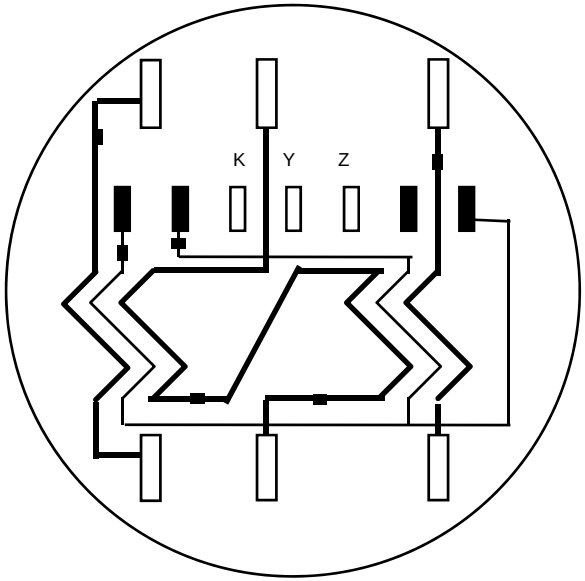
Transformer-rated



Form 6

2½ Element,

4 wire, wye

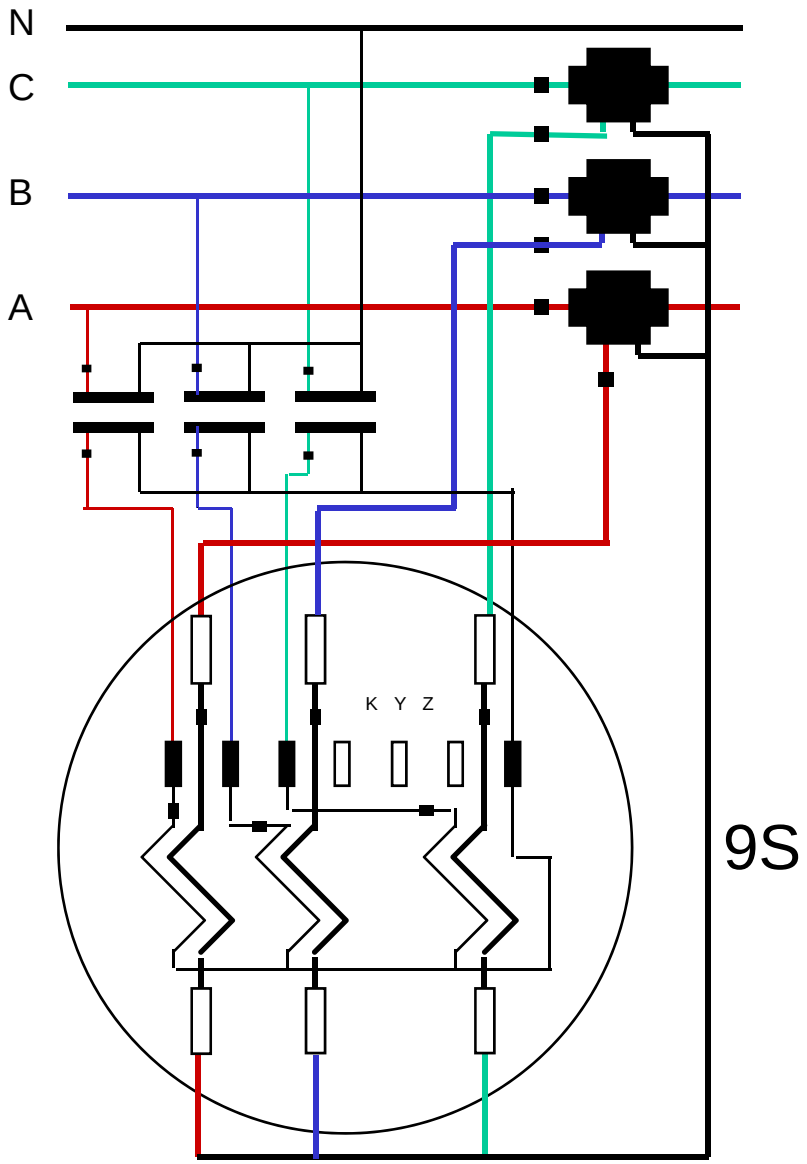


Form 36

2½ Element,

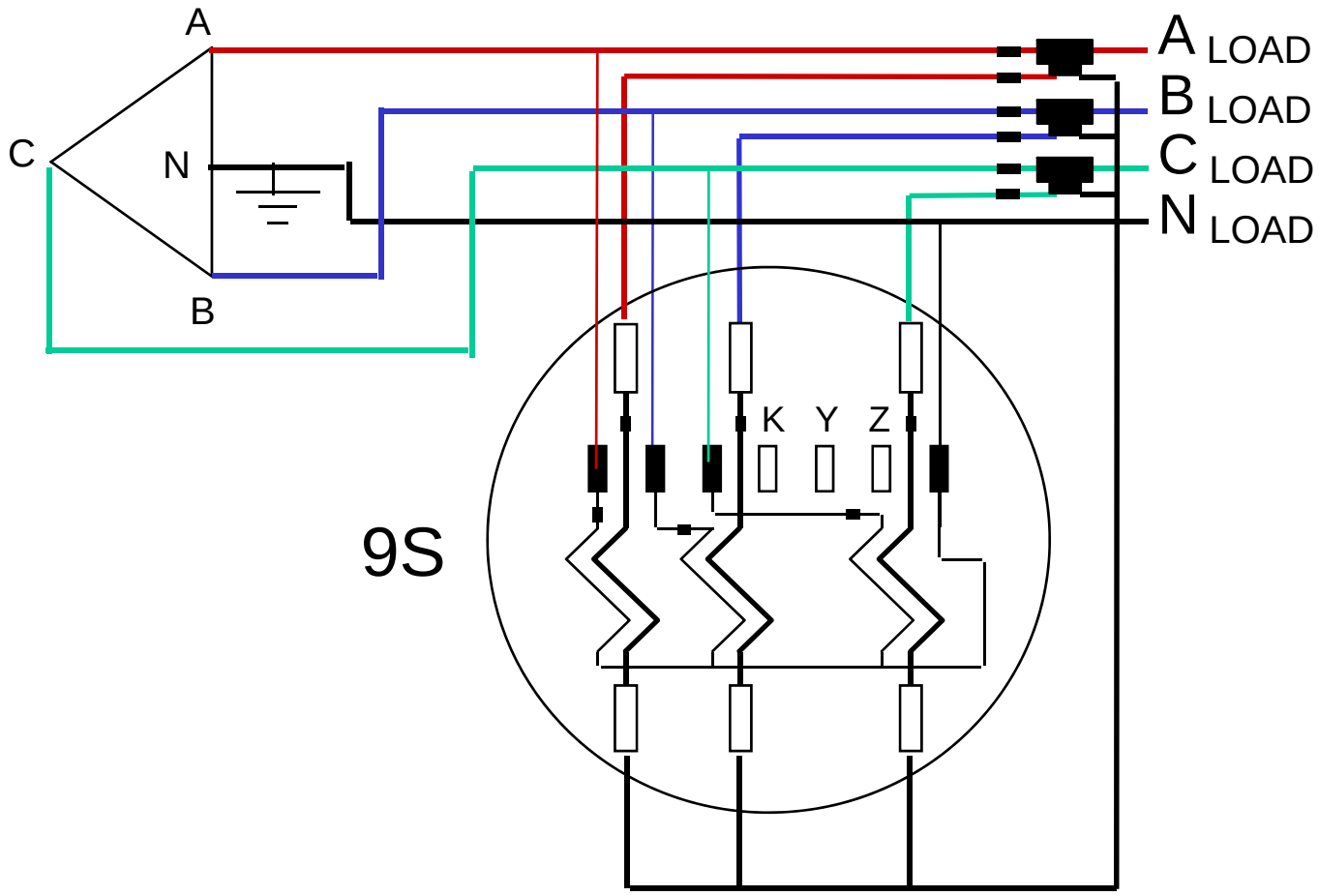
4 wire, wye

4 wire, Wye Metering



Transformer-rated

4 Wire, Delta Metering



Summary

- Transformer rated meters are required when voltages and currents exceed the meter's direct connect capability
- A form designation tells us about the number or terminals, their location and the internal meter wiring
- In CT and VT connections, polarity must be observed for metering to be correct
- CT's must be shorted when not in use; VT's should not be shorted
- Meter multipliers are critical in transformer rated applications