Overview

KW350 3 Channel Power Meter, 0.5 Class Accuracy, Serial Communication Protocols

The KW350 meter combines high performance with ease of integration to provide a cost-effective power and energy monitoring solution. The meter comes standard to be mounted DIN rail mounted but is also available in a panel upgrade version that comes with NEMA 4X panel enclosure, pre-wired and labeled terminal for CT's, terminal blocks for voltage input, and industrial grade fuses (see ordering table). The meter can monitor both uni-directional and bi-directional current and features a built-in LCD display designed to simplify setup and local reading of all measurements of meter data. The UI enables access to configure the meter set-up options. Many of the advanced meter functions connect with the Utility Software which requires an RS-485 to USB converter to connect to a PC or laptop - See Accessory Ordering Grid. The meter supports user selectable Modbus-RTU and BACnet MS/TP communication protocols, and pulse output communication which allows seamless integration with data acquisition systems. Meters also feature a built-in relay that can be used to trigger an alarm. The KW350 provides demand measurement of Current, Active Power, Reactive Power and Apparent Power. It also provides demand forecasting as well as the peak demand. Meters can record the time and event regarding important parameter events such as the run time of the meter and alarm functions. The Auto Phase-check function automatically checks for common wiring mistakes, such as current transformer direction, voltage, and current phase alignment. The tamper-proof design is approved for revenue applications. Model selection is determined by which style of current transformer is required-333mV or Rogowski coil (see ordering table). Current Transformers are sold separately as shown on the Hinged, Split Core, Solid Core, or Rogowski Coils CT product data sheets.

Applications: Sub-Metering Electrical Panel, Equipment Load Monitoring, Industrial Applications, Predicted Maintenance, Renewable Energy, Overhead Cost Reduction, "NET ZERO" Buildings, LEED Buildings, Green Buildings, and Refrigeration

The KW350 Power Meters are covered by a Five (5) Year Limited Warranty.

Part Numbers

N2-KW350-P1-D-S-RC-A
N2-KW350-P1-D-S-SC-A
N2-KW350-P1-D-S-RC-PC-A
N2-KW350-P1-D-S-SC-PC-A
N2-KW350-ENC-A
N2-USB-RS485
N2-AK-03

Specifications

Service Type:	Single Phase, 3 Phase – Four Wire (WYE), Three Phase – Three Wire (Delta)
Power[1]:	100 - 415Vac, 50/60Hz, 100 - 300Vdc on terminals L and N.
Power Consumption:	<2W or 10VA
AC Fuse Protection:	External 1A/600VAC Fuse
Rated Voltage:	100-400VAC Line to Neutral (L-N) or 100-690VAC Line to Line (L-L)
Number of CT Inputs:	3
Revenue Grade Accuracy:	IEC 62053-22 0.5s Class / ANSI C12.20 0.5 Class
Voltage Channels:	400 Volts AC (L-N), 690 VAC (L-L), 50/60 Hz

Current Channels:	3 Channels, 0.4 VAC max, 333 mV CT's or 0 to 6000 Amps with Rogowski Coils
Maximum Current Input:	150% of current sensor rating (mV CT's) to maintain accuracy. Up to 6000 Amps w/ Rogowski Coils
Measurement Type:	Real-time, True RMS measurement of instantaneous Voltage, Current, Power, Frequency and Power Factor
Line Frequency:	50/60 Hz
Measurement Data Parameters:	See Table 1
Meter Sampling Rate:	3.84kHz @ 60 Hz; 3.2kHz @ 50 Hz
Real Time Parameter Update Rate:	200 mS
Accumulated Parameter Update Rate:	1 Sec
LCD Display:	3 Display Modes (Important Parameter's, All Parameter's, Settings Display Modes)
Energy Pulse Output:	Two-wire pulse train, Isolation Voltage 2500 VAC, 5~60 VDC Load Voltage, 10 mA Max Load Current, Pulse Width 20~100ms, Pulse Constant 1~60,000
Energy Pulse Power Supply:	External 24 VDC Power Supply (Required) Note: 1K Ohm External Current Limiting Resistor (Recommended)
Communication Protocols:	Serial RS-485 Modbus RTU (SunSpec IEEE-754 Single Precision Floating Point Format) or BACnet MS/TP
Maximum Distance:	1200 meters (3,937 Feet) with data range of 100K bits/second or less
Termination Resistor:	120 Ohm to 300 Ohm 1/4W Resistor (Not Included); (Installed at end of RS-485 Comm Bus)
Supported Baud Rates:	BACnet MS/TP Protocol: 9600, 19200, 38400, 76800, 115200 Baud Rate (38400 BACnet Default) Modbus RTU Protocol: 1200, 2400, 4800, 9600, 19200, 38400, 115200 Baud Rate (19200 Modbus Default)
Max Station:	127 MS/TP Masters (MAC Addresses is 0 to 127)
BACnet Device Instance Number:	1 (Default); Field adjustable from 1 to 4194303
Modbus Data Bits / Parity / Stop Bit	8 | None, Even, Odd | 2, 1
Enclosure Material / Flammability Rating:	Polycarbonate | UL 94V-0
Operating Temperature Range:	-13 to 158^{O}F (-25 to 70^{O}C)
Storage Temperature Range:	-40 to 185^{O}F (-40 to 85^{O}C)
Operating / Storage Humidity Range:	5 to 95%, non-condensing
Wiring Connections:	Screw Connections
Wire Size:	14-22 AWG (2.5 to 0.34 mm^2)
Relay Output	
Load Voltage:	250VAC, 30VDC
Max Load Current:	5A (Resistant Load)
Isolation Voltage:	2000VAC (1 min)
Action Time (MAX):	10 milliseconds
Mechanical Life:	20,000,000 cycles
Electrical Life:	Above 50,000 cycles (5A, 250VAC Resistant Load)
Mounting:	IEC 35mm DIN Rail (Standard)
Utility Software:	AcuRev 1310 Utility Software, Windows Based; (USB-RS485 converter is required to connect to computer)
Security:	Password Protected to access Settings. Sealed and Tamper Proof Cover.
Agency Approvals:	BTL Certified, CE, UKCA, RoHS2, cULus Listed (File # E359521)
Product Dimensions (L x W x H):	4.25" (108 mm) x 3.54" (90 mm) x 2.46" (62.5 mm)
Power Meter Weight:	0.82 lbs. (0.372 kg)
Ingress Protection (EN 60529):	IP67
Electrical Insulation:	Totally Insulated

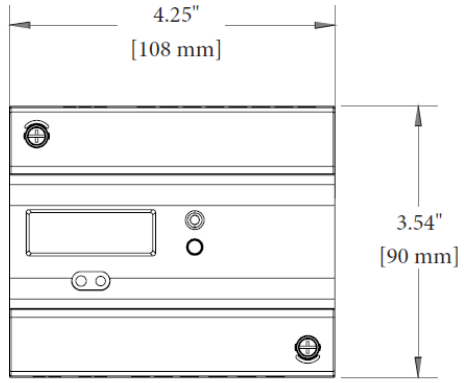
Halogen free (DIN/VDE 0472, Part 815):	0	
UV Resistance and Flammability Rating:	UL 508	
Glow Wire Test (IEC 695-2-1) °C:	960	
	NEMA Rating:	UL Type 4, 4X, 6, 6P, 12 and 13
KW350-ENC Enclosure Only (Accessory):	Dimensions (L x W x H):	8.24" (209.3 mm) x 8.24" (209.3 mm) x 4.96" (126 mm)
	Enclosure Product Weight:	3.8 lbs. (1.724 kg)
	NEMA Rating	NEMA 4X
	Enclosure Material:	Polycarbonate
	Fuse:	600 VAC/2A
KW350 Panel Upgrade (Optional):	Wiring:	DIN rail mounted pre-labeled terminal blocks for voltage and CT connections pre-installed
	Dimensions (L x W x H):	11.81” (300 mm) x 11.81” (300 mm) x 7.01” (178 mm)
	Enclosure Product Weight:	8 lbs. (3.63 kg)

NOTE 1 A power supply can be an independent power supply and a fuse (typical 1A/600 Vac) is suggested to be used when connecting the power supply to the meter

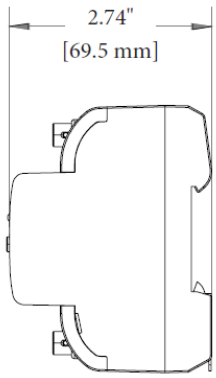
Table 1

Parameter	Accuracy	Resolution	Range
Active Energy	0.5%	1Wh	0-999999999
Reactive Energy	0.5%	1varh	0-999999999
Apparent Energy	0.5%	1VAh	0-999999999
Voltage	0.5%	0.1V	10V-1000KV
Current	0.5%	0.001A	5mA-50000A
Active Power	0.5%	1W	-99-99MW
Reactive Power	0.5%	1var	-99-99Mvar
Apparent Power	0.5%	1VA	-99-99MVA
Power Factor	0.5%	0.001	-1.00-1.000
Frequency	0.2%	0.01Hz	50/60
Power Demand	0.5%	1W/var/VA	99MW/Mvar/MVA
Current Demand	0.5%	0.001A	5mA-50000A

Dimensional Drawing

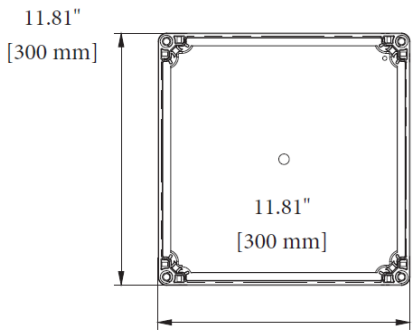


FRONT VIEW

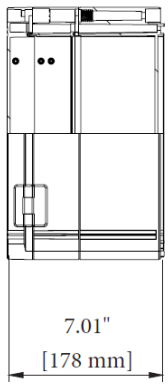


SIDE VIEW

Power Meter Panel Upgrade



FRONT VIEW



SIDE VIEW

Ordering

Standard

Model #	Description
KW350-P1-D-S-RC-A	3 Circuit, 0.5 Class Accuracy, Power Meter Rogowski Coil Input w/LCD
KW350-P1-D-S-SC-A	3 Circuit, 0.5 Class Accuracy, Power Meter 333mV CT Input w/LCD
KW350-P1-D-S-RC-PC-A	Panel Upgrade, same as KW350-P1-D-S-RC installed in NEMA 4X Enclosure w/ labeled and prewired supply voltage and CT connections
KW350-P1-D-S-SC-PC-A	Panel Upgrade, same as KW350-P1-D-S-SC installed in NEMA 4X Enclosure w/ labeled and prewired supply voltage and CT connections

Accessories

Model #	Description
KW350-ENC-A	NEMA 4X/IP66 Wall Mount Enclosure, includes: Din Rail Mounting Hardware, Swing Panel Kit, Tamper Proof Locking Options
USB-RS485	RS485 to USB Converter
AK-03	Three Fuse Pack; Inline Fuse Kit; 600V, 2A; Slow Blow

Mounting Instructions

Environmental

Before installation, please check the environment, temperature, and humidity to ensure the KW350 series meter is being placed in an environment that are within temperature and humidity specifications.

Temperature

KW350 operating temperature is -25 to 70° C (-13 to 158° F). Exceeding this temperature range will cause damage to the meter and will affect the accuracy and functionality. Please note this can influence the meters life negatively if the meter operates in extremely high or extremely low temperatures. KW350 storage temperature range is 40~85° C (-40 ~ 185° F).

Humidity

5% to 95% non-condensing.

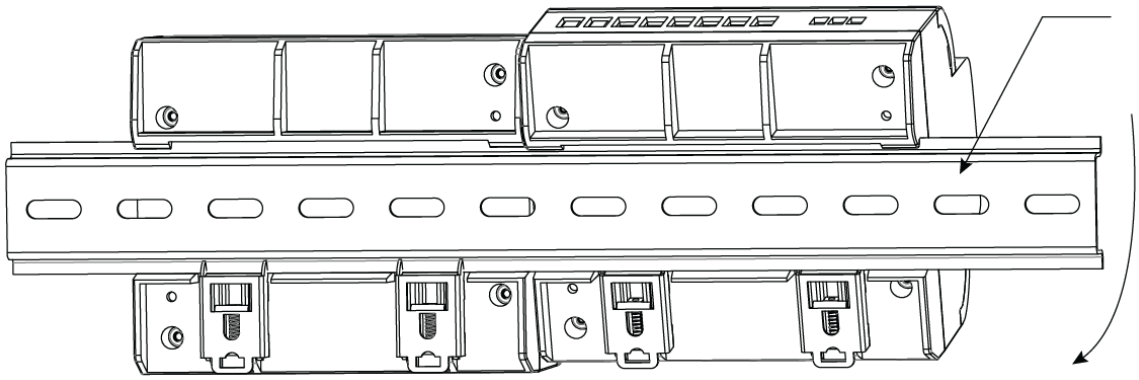
Location

KW350 series meter should be installed in a dry and dust free environment. Avoid exposing the meter to excessive heat, radiation and high electrical noise sources.

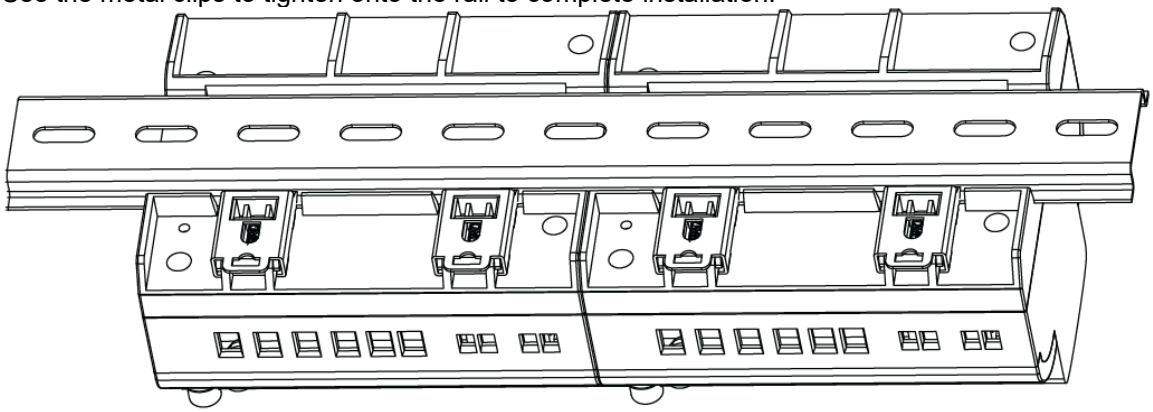
Installation Steps

This product is DIN railed mounted and fits on a standard 35mm rail.

1. To install the meter on the rail insert the top of the rail into the groove on the back of the meter. Pull the metal clips back and slide the rail across the groove of the meter.



2. Use the metal clips to tighten onto the rail to complete installation.

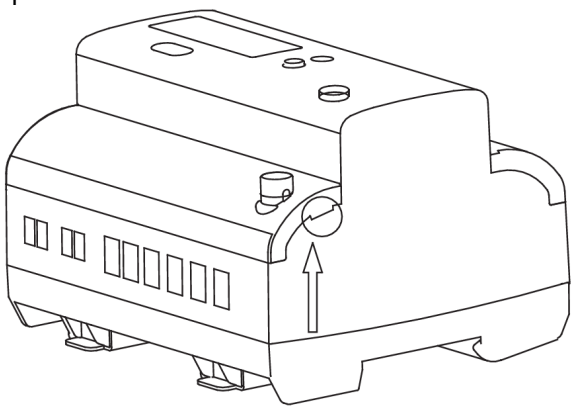


Wiring Instructions

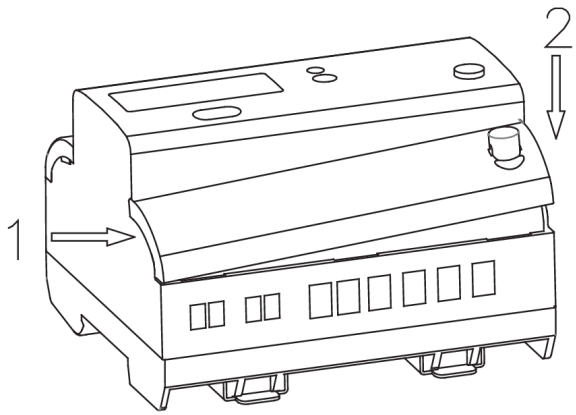
Warning	The installation must be performed by qualified, competent accredited professionals who has received formal training and has experience with high voltage and current devices. Appropriate safety wear (gloves, glasses, arc flush suit, etc.) is mandatory to ensure safe installation. During normal meter operation, caution should be used when handling the following as high voltage may be present: • Terminal Blocks • Current/Potential Transformer leads and the related circuits • All primary and secondary circuits may contain lethal current and voltage. • Contact with current channels must be avoided. ✓ The power meter cannot be installed on the primary side of transformers or where VA has limitations. The power meter can be only installed on the secondary side. Avoid contact with meter terminals after the completion of installation. ✓ Do not supply input voltage above the rated maximum limit of the power meter and devices connected to it. Before energizing the meter, please refer to the meters label and specifications.

The terminals of the KW350 series can be accessed by first removing the terminal covers on the meter.

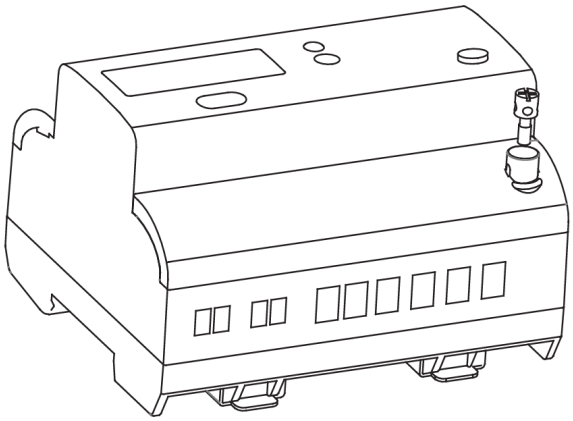
1. To open the terminal cover, remove the seal if applicable, and then unscrew the sealing screws and lift the cover upwards to remove.



2. To attach the bottom terminal cover back onto the meter, place the left side of the cover down into the groove first and then press down onto the right side, see figure below. When installed correctly, you will hear a clicking sound. To attach the top cover place the right side of the cover down into the groove and press down onto the left side.



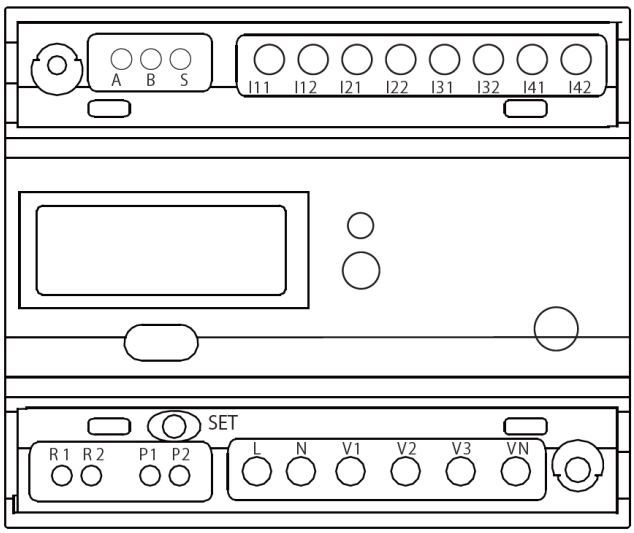
3. After inserting the cover, tighten the sealing screws and place the seal.



Terminals:

This manual uses V1, V2, V3 to represent three-phase conductors, which would be the same as Va, Vb, Vc in other manuals.

- Communications Terminal: A, B, S
- Pulse Output: P1, P2
- Auxiliary Power: L, N
- Voltage Inputs: V1, V2, V3, VN
- Current Inputs: I11, I12, I21 I22, I31, I32, I41, I42
- Relay Output: R1, R2

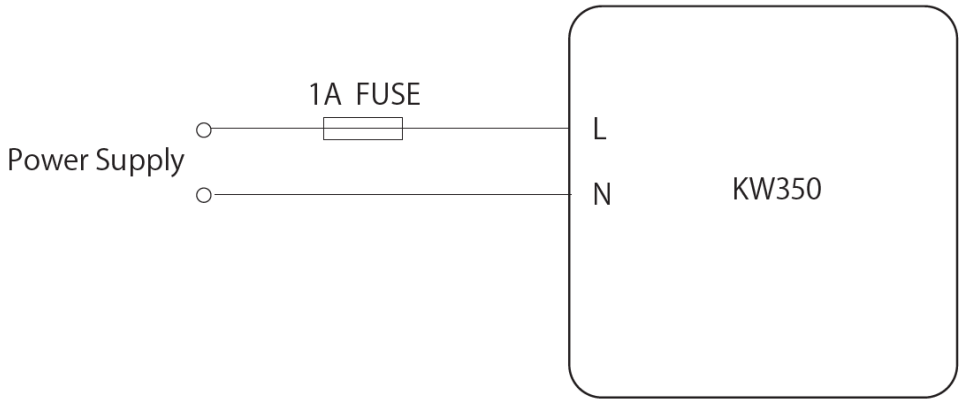


Auxiliary Power Supply:

The KW350 series meter requires a power supply of 100 ~ 415 Vac at 50/60 Hz. For use of other power supply voltage selections please contact the manufacturer. The meter typically has small power consumption (less than 1W) so the power supply can be an independent power supply, or can be obtained from the circuit under test.

It is suggested that under the condition that the power voltage fluctuation is large, to use a voltage stabilizer. The power supply terminals respectively are: L, N.

The typical auxiliary power wiring is as follows:



The meter requires AWG22-16 as the wires to connect the power supply.

A fuse (typical 1A/250Vac) is suggested to be used when connecting the power supply to the meter.

NOTE Check the power supply rating before wiring. Please confirm by reading the Power Supply information on the silver sticker at the side of the meter.

Voltage Input

The maximum input voltage for the KW350 series meter cannot exceed 400LN/690LL VAC RMS for three phase or 400LN VAC rms for single phase. The voltage input requires a 1A fuse.

Potential Transformer (PT) must be used for high voltage systems that are greater than the meters rated voltage. The rated secondary output from the PT is typically 100-120V. Please make sure to select an appropriate PT to maintain the measurement accuracy of the KW350 series meter. When connecting using the WYE configuration wiring method, the PT's rated input or primary side rated voltage should be equal to or close to the phase voltage of the system to utilize the full range of the PT being used. When connecting using the Delta configuration wiring method, the PT's rated input or primary side rated voltage should be equal to or close to the line voltage of the system.

A fuse rated for 1A/600V should be used when connecting the voltage inputs to the meter. The meter requires the wire size to be AWG22-14.

NOTE Under no circumstances should the secondary of the PT be shorted. The secondary of the PT should be grounded at one end. Please refer to the wiring diagram section for further details.

Current Input

Current Transformers (CTs) are required in most applications. The KW350 series meter supports two CT input types: 333mV or Rogowski coil (RCT). Meter model selection is determined by which style of current transformer input being used. The CT should be selected to maintain revenue grade accuracy of the system. The distance between CT and the meter should be as short as possible as the length of the CT leads will have an effect on the accuracy.

The meter requires AWG22-14 as the wire size to the current input terminals.

NOTE The secondary side of the CT should not be open circuit in any circumstance when the power is on. There should not be any fuse or switch in the CT loop.

When using mV and RCT CT's the secondary leads must not be grounded.

Confirm CT polarity is correct prior to powering on the meter. Failure to do so will effect meter accuracy and operation.

Assure that the flow of current matches the direction of the arrow located on the CT. The arrow must face the same direction as the load.

333mV Split Core CTs:	RCT Rogowski Coil CTs:
• Arrow to represent direction of current flow • White wire (+), Black wire (-) • CT leads are not grounded	• Arrow to represent direction of current flow • White wire (+), brown wire (-) • Shield wire not grounded

V_n Connection

V_n is the reference point of the KW350 series meter voltage input. Low wire resistance helps improve the measurement accuracy. Different system wiring modes require different V_n connection methods. Please refer to the wiring diagram section for more details.

KW350 series meter supports different wiring configurations for both three phase and single phase systems. Please read this section carefully before choosing the suitable wiring method for your power system.

In the KW350 series meter please make sure that the wiring connection mode and the corresponding practical application in engineering are correct to ensure the measurement accuracy of meter. Here are some of the common installation methods, their respective diagrams and meter configurations for the KW350 series meter.

1. Three Phase: 4 wire-connection: (Three Phase with a neutral) Wiring mode 3LN. Three CT's needed for this connection.
   Common voltages for this connection: 120V LN/208V LL, 240V LN/415V LL

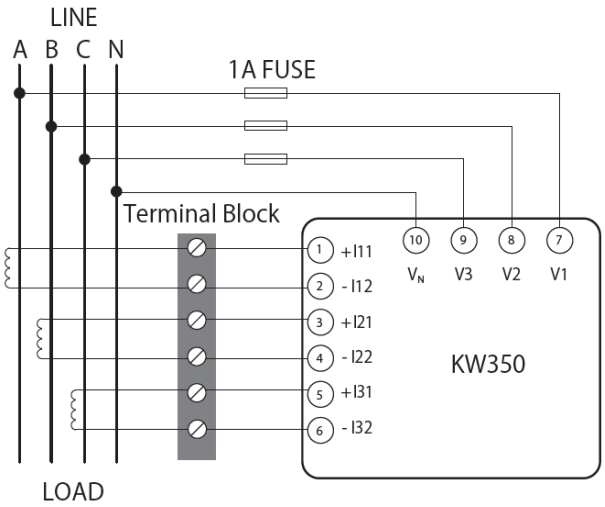


Figure 1: 3LN using 333mV and Rogowski Coil CTs

2. Three Phase: 3 wire-connection (Three phase without a neutral) Wiring mode 3LN. Three CT's needed for this connection.
   Common voltages for this connection: 208V LL, 415V LL, and 690 LL

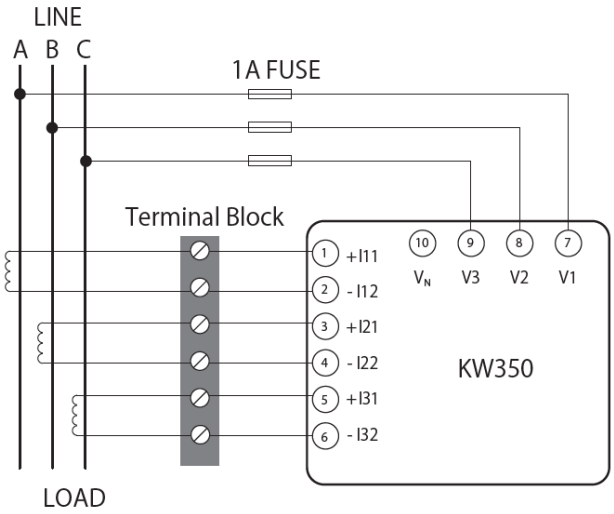


Figure 2: 3LN– 3 phase no neutral wiring diagram using 333mV and Rogowski Coil CTs.

3. Three Phase: 3 wire-connection (Three phase without a neutral and Potential Transformers) The wiring mode is set to 2LL. Three CT's needed for this connection. With Potential Transformers (PTs) - PTs are required if the system voltage is higher than 690V LL. Instead of connecting the voltage lines directly to the meter, the voltage lines are connected to the meter using PTs. The PTs should be connected as shown below.

   NOTE Only two PTs are needed for this connection.

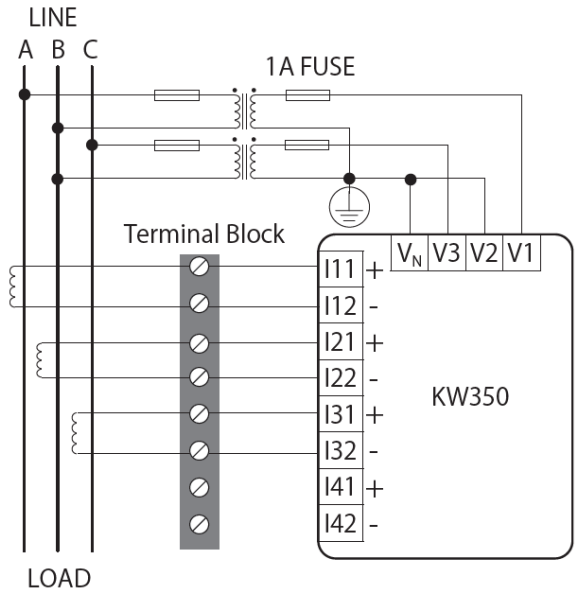


Figure 3: 2LL using 333mV, mA and Rogowski Coil CTs

4. Single Phase: 3 Lines (Single phase with 2 lines and a neutral) The wiring mode is set to 1LL. Two CT's needed for this connection.
   Common Voltage: 120V LN/240V LL

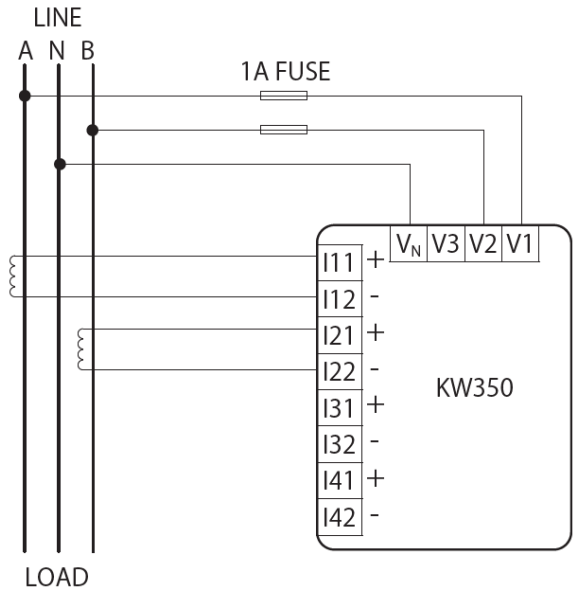


Figure 4: 1LL Using 333mV and Rogowski Coil CTs

5. Single Phase: 2 Lines (Single phase with 2 lines without a neutral) The wiring mode is set to 1LN. One CT needed for this connection.

NOTE It is optional to tie the other phases to neutral. When the meter is configured for 1LN the other phases are disregarded and do not appear on the meter.
Common Voltage for this connection: 208/240V LL (2 hot legs, where 1 hot will be used as the neutral reference-see wiring diagram)

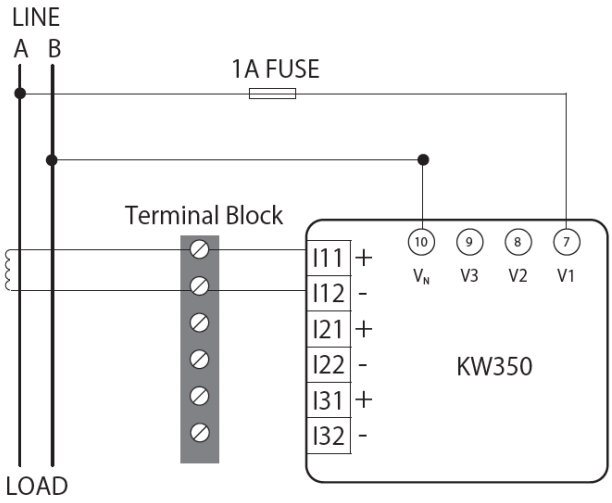


Figure 5: 1LN using 333mV and Rogowski Coil CT

6. Single Phase: 2 Lines (Single phase with one line and a neutral) The wiring mode is set to 1LN. One CT needed for this connection.

NOTE It is optional to tie the other phases to neutral. When the meter is configured for 1LN the other phases are disregarded and do not appear on the meter.
Common Voltage for this connection: 120V

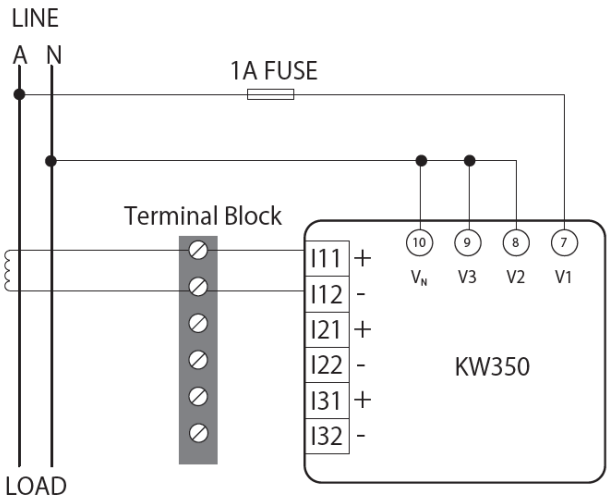
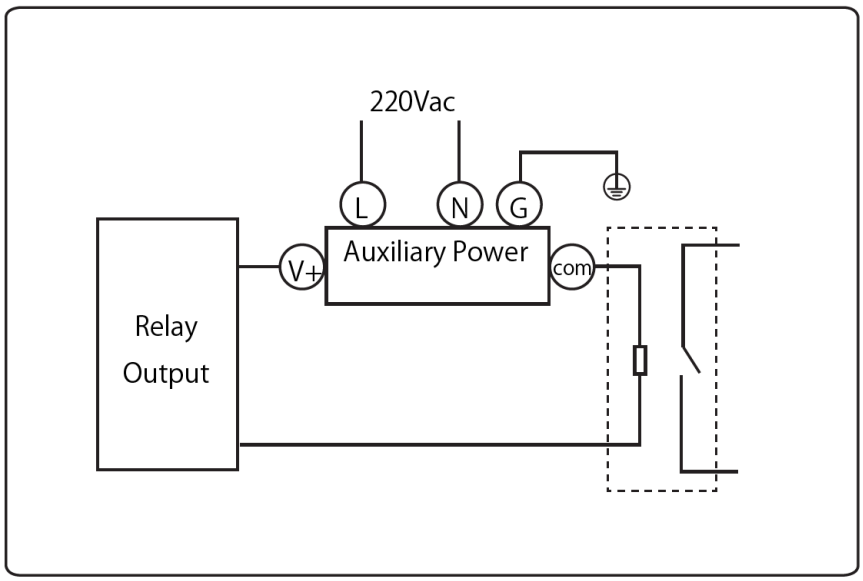


Figure 6: 1LN using 333mV and Rogowski Coil CT

Relay Output Wiring Diagram



Communication

The KW350 supports two different, user-selectable , communication protocols: Modbus-RTU and BACnet MS/TP. Modbus RTU is the factory default setting on the meter. Both protocols utilize the built-in RS485 port, which is located under the terminal cover on the front of the meter. The RS485 terminals are denoted as “A”, “B,” and “S”. “A” is the positive differential terminal, 'B' is the negative differential terminal, and 'S' is for connecting the shield of the shielded twisted pair cable.

The maximum distance of the cable should not exceed 1200m. This distance should be shorter if more devices are connected to the same communication link or if using a higher baud rate.

If the master device is equipped with an RS232 port instead of an RS485 port, an RS232-to- RS485 converter should be utilized.

In order to improve communication quality, note the following:

- A high-quality Shielded Twisted Pair cable is very important; AWG22 (0.6mm) or lower is recommended.
- Pay attention to "single-point earthing.” This means that there is only one side for the shield to be connected to the ground in a communication link.
- Every A (+) should be connected to A (+) and every B (-) should be connected to B (-). Failure to make the proper connections can influence the network or even damage the communication interface.
- “T” type connection topology should be avoided. This means no new branches except from the starting point.
- Keep communication cables as far away as possible from sources of electrical noise.
- When several devices are connected in daisy chain to the same long communication line, a resistor (typical value 120- 300 Ohm, 0.25W) should be used at the end of the circuit (the last device of the chain).
- Only use RS232-to-RS485 or USB-to-RS485 converters with an optically isolated output and surge protection

Appendix – Symbols Key

Warning	Potential for death, serious injury, or permanent damage to a system.
Caution	Potential for injury, damage to a system, or system failure.
Tip	Useful information not related to injury or system damage.

W.E.E.E. DIRECTIVE

At the end of their useful life the packaging and product should be disposed of via a suitable recycling center. Do not dispose of with household waste. Do not burn.