Installation, Operation, and Maintenance

E50 Series
Compact Power and Energy Meter

Modbus E50C2-T2

for use with Split Core and Solid Core CTs

PN: X13690277002

⚠ SAFETY WARNING

Only qualified personnel should install and service the equipment. The installation, starting up, and servicing of heating, ventilating, and air-conditioning equipment can be hazardous and requires specific knowledge and training. Improperly installed, adjusted or altered equipment by an unqualified person could result in death or serious injury. When working on the equipment, observe all precautions in the literature and on the tags, stickers, and labels that are attached to the equipment.

April 2021

BAS-SVX073C-EN

TRANE TECHNOLOGIES

Introduction

The E50 DIN Rail Power Meter provides a solution for measuring energy data with a single device. Inputs include Control Power, CT, and 3-phase voltage. The E50 supports multiple output options, including solid state relay contacts and Modbus. The LCD screen on the faceplate allows instant output viewing. The meter is housed in a plastic enclosure suitable for installation on T35 DIN rail according to EN50022. The E50 can be mounted with any orientation over the entire ambient temperature range, either on a DIN rail or in a panel. The meter is not sensitive to CT orientation to reduce installation errors.

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Warnings, Cautions, and Notices

Safety advisories appear throughout this manual as required. Your personal safety and the proper operation of this machine depend upon the strict observance of these precautions.

The three types of advisories are defined as follows:

⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. It could also be used to alert against unsafe practices.
NOTICE	Indicates a situation that could result in equipment or property-damage only accidents.

Important Environmental Concerns

Scientific research has shown that certain man-made chemicals can affect the earth's naturally occurring stratospheric ozone layer when released to the atmosphere. In particular, several of the identified chemicals that may affect the ozone layer are refrigerants that contain Chlorine, Fluorine and Carbon (CFCs) and those containing Hydrogen, Chlorine, Fluorine and Carbon (HCFCs). Not all refrigerants containing these compounds have the same potential impact to the environment. Trane advocates the responsible handling of all refrigerants-including industry replacements for CFCs and HCFCs such as saturated or unsaturated HFCs and HCFCs.

Important Responsible Refrigerant Practices

Trane believes that responsible refrigerant practices are important to the environment, our customers, and the air conditioning industry. All technicians who handle refrigerants must be certified according to local rules. For the USA, the Federal Clean Air Act (Section 608) sets forth the requirements for handling, reclaiming, recovering and recycling of certain refrigerants and the equipment that is used in these service procedures. In addition, some states or municipalities may have additional requirements that must also be adhered to for responsible management of refrigerants. Know the applicable laws and follow them.

⚠ WARNING

Proper Field Wiring and Grounding Required!

Failure to follow code could result in death or serious injury.

All field wiring MUST be performed by qualified personnel. Improperly installed and grounded field wiring poses FIRE and ELECTROCUTION hazards. To avoid these hazards, you MUST follow requirements for field wiring installation and grounding as described in NEC and your local/state/national electrical codes.

⚠ WARNING

Personal Protective Equipment (PPE) Required!

Failure to wear proper PPE for the job being undertaken could result in death or serious injury.

Technicians, in order to protect themselves from potential electrical, mechanical, and chemical hazards, MUST follow precautions in this manual and on the tags, stickers, and labels, as well as the instructions below:

- **Before installing/servicing this unit, technicians MUST put on all PPE required for the work being undertaken (Examples; cut resistant gloves/sleeves, butyl gloves, safety glasses, hard hat/bump cap, fall protection, electrical PPE and arc flash clothing). ALWAYS refer to appropriate Safety Data Sheets (SDS) and OSHA guidelines for proper PPE.**
- **When working with or around hazardous chemicals, ALWAYS refer to the appropriate SDS and OSHA/GHS (Global Harmonized System of Classification and Labelling of Chemicals) guidelines for information on allowable personal exposure levels, proper respiratory protection and handling instructions.**
- **If there is a risk of energized electrical contact, arc, or flash, technicians MUST put on all PPE in accordance with OSHA, NFPA 70E, or other country-specific requirements for arc flash protection, PRIOR to servicing the unit. NEVER PERFORM ANY SWITCHING, DISCONNECTING, OR VOLTAGE TESTING WITHOUT PROPER ELECTRICAL PPE AND ARC FLASH CLOTHING. ENSURE ELECTRICAL METERS AND EQUIPMENT ARE PROPERLY RATED FOR INTENDED VOLTAGE.**

⚠ WARNING

Follow EHS Policies!

Failure to follow instructions below could result in death or serious injury.

- **All Trane personnel must follow the company's Environmental, Health and Safety (EHS) policies when performing work such as hot work, electrical, fall protection, lockout/tagout, refrigerant handling, etc. Where local regulations are more stringent than these policies, those regulations supersede these policies.**
- **Non-Trane personnel should always follow local regulations.**

Table of Contents

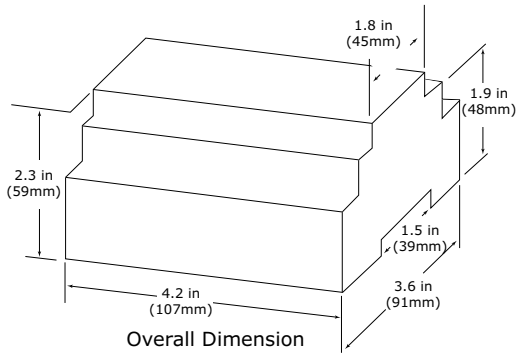
Product Identification, Specifications, and Data Outputs

Product Identification	
Model:	E50C2-T2
Description:	Modbus output, full data set
Output:	Pulse, RS-485, Alarm
Measurement Accuracy	
Real Power and Energy:	IEC 62053-22 Class 0.2S, ANSI C12.20 0.2%
Reactive Power and Energy:	IEC 62053-23 Class 2, 2%
Current:	0.4% (+0.015% per °C deviation from 25°C) from 5% to 100% of range; 0.8% (+0.015% per °C deviation from 25°C) from 1% to 5% of range
Voltage:	0.4% (+0.015% per °C deviation from 25°C) from 90 V_{L-N} to 600 Vac_{L-L}
Sample Rate:	2520 samples per second
Data Update Rate:	1 sec
Type of Measurement:	True RMS up to the 21st harmonic 60 Hz; One to three phase AC system
Input Voltage Characteristics:	
Measured AC Voltage:	• Minimum 90 V_{L-N} (156 V_{L-L}) for stated accuracy • U.L. Maximum: 600 V_{L-L} (347 V_{L-N}) • CE Maximum: 300V_{L-N}
Metering Over Range:	+20%
Impedance:	2.5M Ω_{L-N}/5M Ω_{L-L}
Frequency Range:	45 Hz to 65 Hz
Input Current Characteristics	
CT Scaling:	Primary:adjustable from 5 A to 32,000 A
Measurement Input Range:	0 Vac to 0.333 Vac or 1 Vac to 1.0 Vac (+20% over range), rated for use with Class 1 voltage inputs
Impedance:	10.6kΩ(1/3 V mode) or 32.1kΩ (1 V mode)
Control Power	
AC:	• 5 VA max.; 90 V min. • U.L. Maximum: 600 V_{L-L} (347 V_{L-N}) • CE Maximum: 300V_{L-N}
DC: *External DC current limiting is required.*	• 3 W maximum • U.L and CE: 125 VDC to 300 VDC
Ride-through Time:	100 milliseconds at 120 Vac
Output	
Alarm Contacts:	N.C., static output (30 Vac/DC, 100 mA maximm @ 25°C, derate 0.56 mA per °C above 25°C)
Real Energy Pulse Contacts:	N.O., static output (30 Vac/DC, 100 mA maximum @ 25°C, derate 0.56 mA per °C above 25°C)
RS-485 Port:	2-wire, 1200 to 38400 baud, Modbus RTU

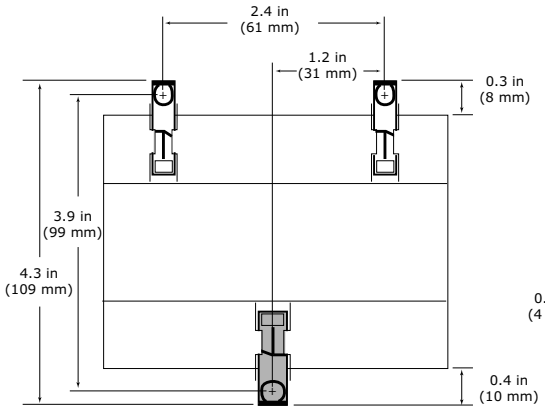
Product Identification, Specifications, and Data Outputs

Mechanical Characteristics:	
Weight:	0.62 LB. (0.28 kg)
IP40 Degree of Protection (IEC60529):	IP40 front display; IP20 Meter
Display Characteristics:	Backlit blue LCD
Terminal Block Screw Torque:	0.37 ft-lb (0.5 N·m) nominal/0.44 ft-lb (0.6 N·m) maximum
Terminal Block Wire Size:	24 AWG to 14 AWG (0.2 to 2.1 mm2)
Rail:	T35 (35 mm) DIN Rail per EN50022
Operating Conditions:	
Operating Temp:	-30°C to 70°C (-22°F to 158°F)
Storage Temp:	-40° to 85°C (-40° to 185°F)
Humidity Range:	<95% RH (non-condensing)
Altitude of Operation:	3000 m
Agency Compliance	
U.S. and Canada:	• CAT III; • Pollution Degree 2 • For distribution systems up to 347 V_{L-N}/600 Vac_{L-L}
CE:	• CAT III; • Pollution Degree 2 • For distribution systems up to 300 V_{L-N}
Dielectric Withstand:	Per U.L. 508, EN61010
Conducted/Radiated Emissions:	FCC part 15 Class B, EN55011/EN61000 Class B (residential and light industrial)
Conducted/Radiated Immunity:	U.L. EN61000 Class A (heavy industrial)
U.S./Canada (cULus)	U.L. 508 (open type device)/CSA 22.2 No. 14-05
Europe (CE):	U.L. EN61010-1
Data Outputs (Modbus Only)	
Full Data Set:	• Power (kW), Energy (kWh) • Configurable for CT & PT ratios, system type, and passwords • Diagnostic alerts • Current/Volts are both 3-phase average • Current by phase and volts by phase Line-Line and Line-Neutral • Power: Real, reactive, and apparent 3-phase total and per phase • Power factor: 3-phase average and per phase • Frequency • Power demand: most recent and peak • Demand configuration: fixed, rolling block, and external sync

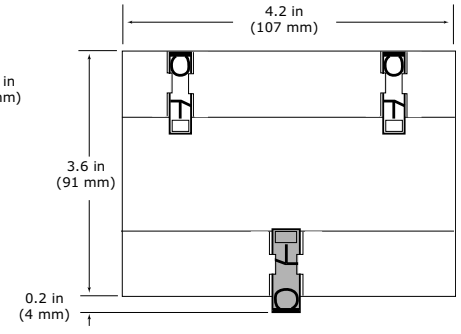
Unit Dimensions



Overall Dimension

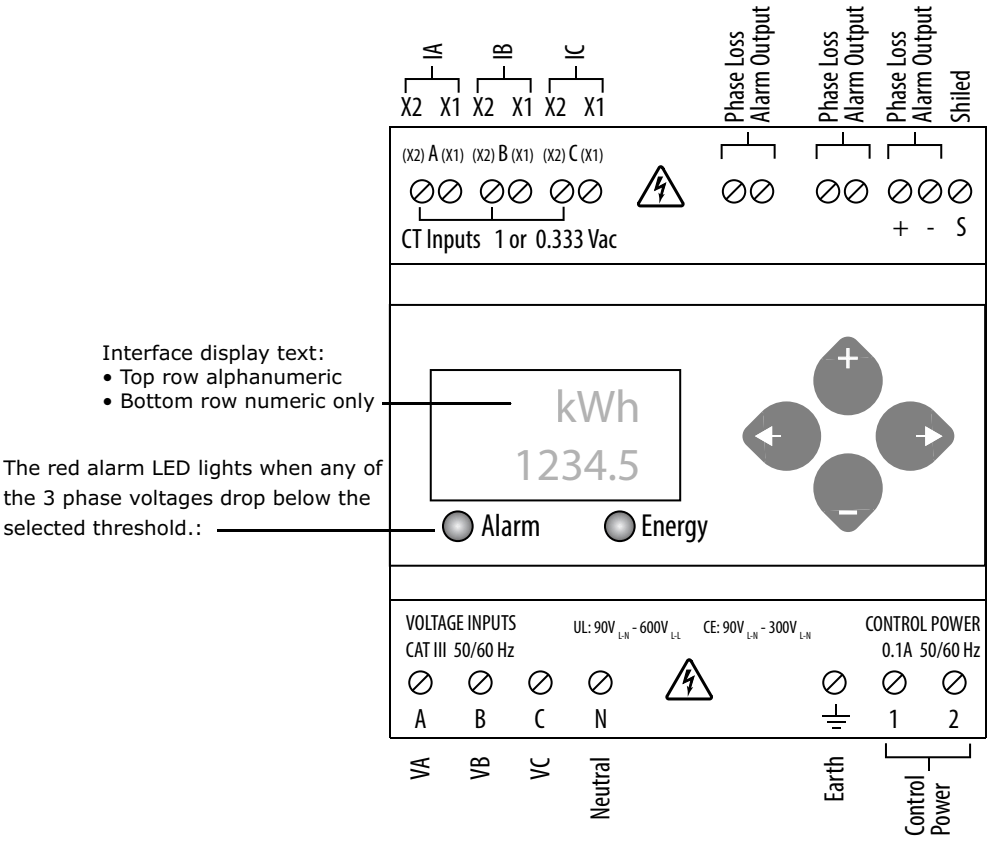


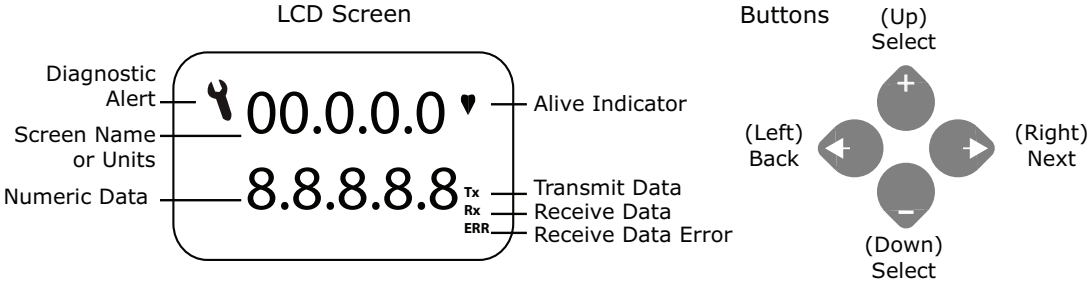
Screw Mount Configuration
(Bottom View)



DIN Rail Mount Configuration
(Bottom View)

Product Diagram and Screen Display





Installation

Read the following guidelines before starting installation.

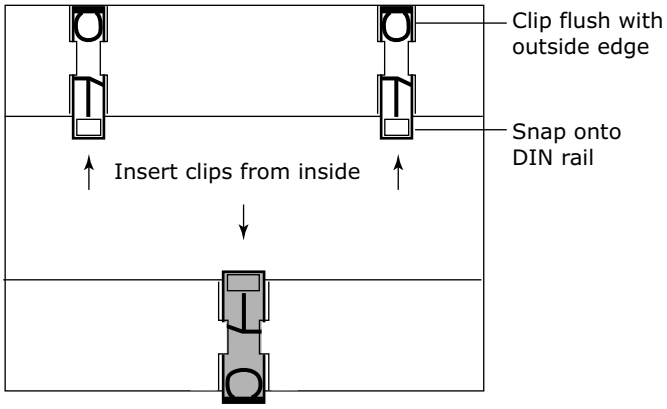
- Disconnect power prior to installation.
- Reinstall any covers displaced during installation before re-powering unit.
- Mount the meter in an appropriate electrical enclosure near equipment to be monitored.
- Do not install the load side of a variable frequency drive (VFD).

Mount the meter using one of the following two methods:

1. DIN Rail Mount
   a. Attach mounting clips to the underside of housing by sliding them into the slots from the inside.

      Note: *The stopping pegs must face the housing and the outside edge of the clip must be flush with the outside edge of the housing.*

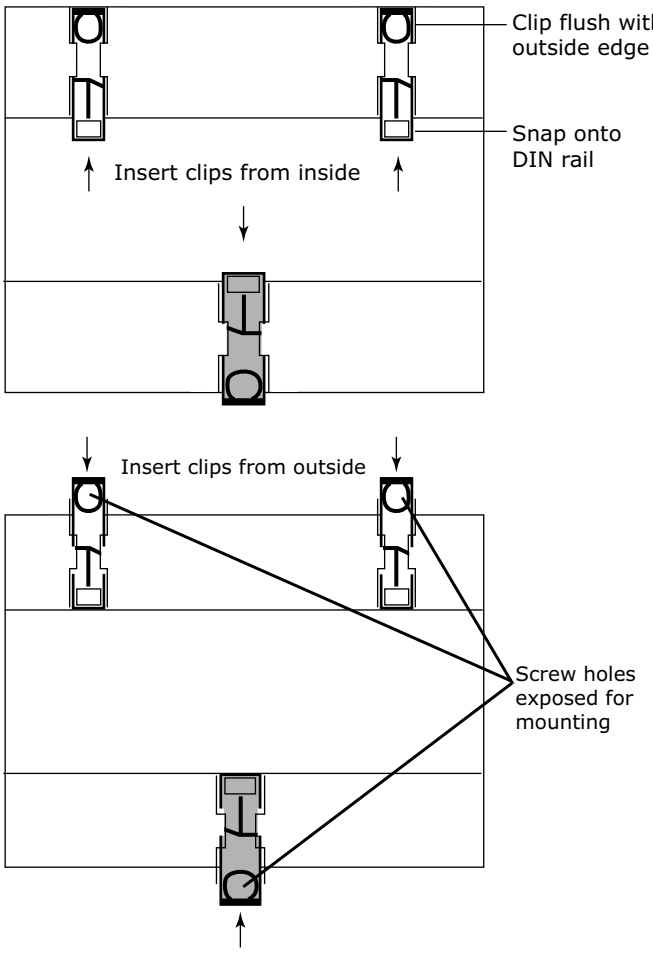
   b. Snap the clips onto the DIN rail.



2. Screw Mount
   a. Attach mounting clips to the underside of housing by sliding them into the slots from the inside.

      Note: *The stopping pegs must face the housing and the outside edge of the clip must be flush with the outside edge of the housing.*

b. Use three (3) #8 screws (not supplied) to mount the meter to the insdie of the enclosure.



Supported Systems

The meter has a number of different possible system wiring configurations (Refer to the table below and next section, Wiring Diagrams). To configure the meter, set the System Type via the User Interface, Modbus register 130. The system type tells the meter which of its current and voltage inputs are valid, which are to be ignored, and if neutral is connected. Setting the correct system type prevents unwanted energy accumulation on unused inputs, selects the formula to calculate the Theoretical Maximum System Power, and determines which phase loss algorithm is to be used. The phase loss algorithm is configured as a percent of the Line-to-Line System Voltage (except when in System Type 10). In addition, it calculates the expected Line-to-Neutral voltages for system types that have Neutral (12 & 40). Values that are not valid in a particular System Type display as —— on the User Interface or as **ǪNAN** in the Modbus registers or BACnet Analog Input objects.

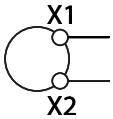
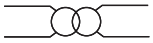
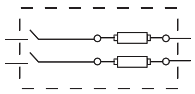
Note: *To avoid distortion, use parallel wires for control power and voltage inputs.*

	CTs		Voltage Connections			System Type		Phase Loss Measurement			Wiring Dia-gram
# Wires	Qty	ID	Qty	ID	Type	Modbus Reg 130/	User Inter-face (SET-UP>S SYS)	VLL	VLN	Bal-ance	Wiring #
Single-Phase Wiring											
2	1	A	2	A, N	L-N	10	1L+1n		AN		1
2	1	A	2	A, B	L-L	11	2L	AB			2
3	2	A,B	3	A, B, N	L-L w/ N	12	2L+1n	AB	AN, AB	AN-AB	3
Three-Phase Wiring											
3	3	A, B, C	3	A, B, C	Delta	31	3L	AB, BC, CA		AB-BC-CA	4
4	3	A, B, C	4	A, B, C, N	Grou-nded Wye	40	3L-1n	AB, BC, CA	AN, BN, CN	AN-BN-CN and AB-BC-CA	5,6

Wiring

Wiring Symbolism

Refer to the following symbols used in the wiring diagrams.

	Voltage Disconnect Switch
	Fuse ***Note:*** *Installer is responsible for ensuring compliance with local requirements.*
	Earth Ground
	Current Transducer
	Potential Transformer
	Protection containing a voltage disconnect switch with a fuse or disconnect circuit breaker. The protection device must be rated for the available short circuit current at the connection point.

Read all Warnings, Cautions, and Notices before proceeding.

NOTICE

Equipment Damage!

Failure to follow instructions below could result in overheating and permanent equipment damage.

This product is designed only for use with 1 Volt or 0.333 Volt current transducers. Do not use current output CTs on this product.

⚠ WARNING

Hazardous Voltage!

Failure to disconnect power before servicing could result in death or serious injury.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a voltmeter.

⚠ WARNING

Hazardous Voltage and Equipment Damage!

Failure to follow instructions below could result in death or serious injury.

CT terminals are referenced to neutral on the meter and may be at elevated voltages. Do not contact meter terminals while the unit is connected. Do not connect or short other circuits to the CT terminals.

Disconnect all electric power, including remote disconnects before servicing. Follow proper lockout/tagout procedures to ensure the power can not be inadvertently energized. Verify that no power is present with a CAT III or IV voltmeter rated per NFPA 70E.

⚠ WARNING

Electrical Shock, Explosion, or Arc Flash Hazard!

Failure to follow these instructions could results in death or serious injury.

Install the product in an appropriate electrical/fire enclosure per local regulations. Do not install the product in hazardous or classified locations.

Do not use the product for life or safety applications.

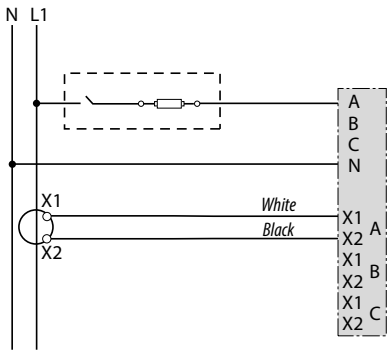
Do not exceed the product ratings or maximum limits. Products rated only for basic insulation must be installed on insulated conductors.

Current transformer secondaries (current mode) must be shorted or connected to a burden at all times.

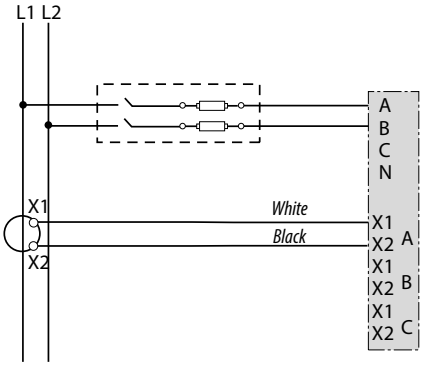
Remove all wire scraps, tools, replace all doors, covers and protective devices before powering the equipment.

Wiring Diagrams

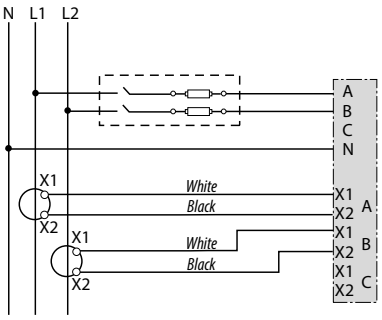
Figure 1. 1–Phase and 3–Phase Diagrams



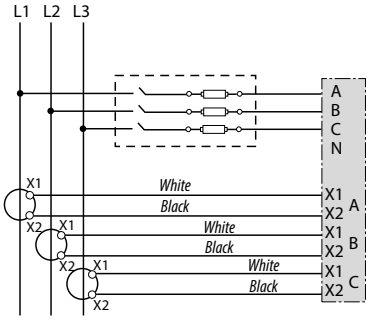
#1: 1-Phase, Line-to-Neutral, 2-Wire System, 1 CT
Use System Type 10 (1L+1n)



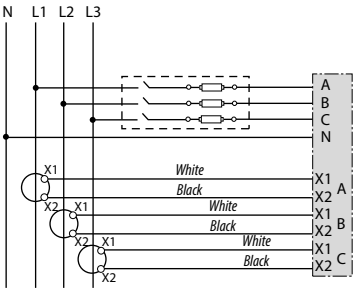
#2: 1-Phase, Line-to-Line, 2-Wire System, 1 CT
Use System Type 11 (2L)



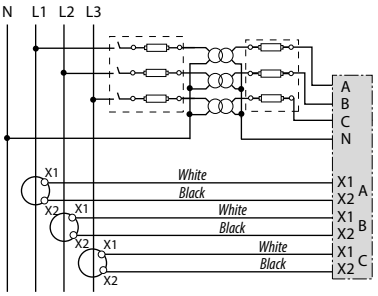
#3: 1-Phase, Direct Voltage Connection, 2 CT
Use System Type 12 (2L+1n)



#4: 3-Phase, 3-Wire System, 3 CT, No PT
Use System Type 31 (3L)

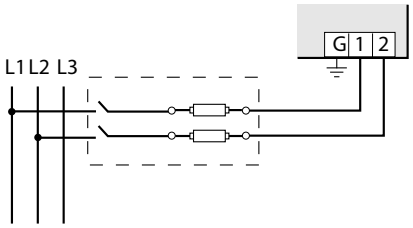


#5: 3-Phase, 4-Wire, Direct Voltage Input Connection, 3 CT
Use System Type 40 (3L+1n)



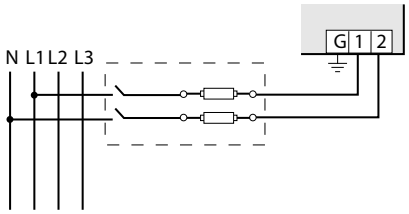
#6: 3-Phase, 4-Wire Wye Connection, 3 CT, 3 PT
Use System Type 40 (3L+1n)

Figure 2. Control Power Diagrams

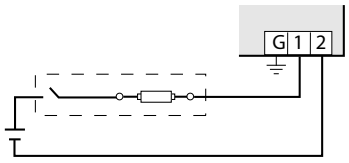


#1: Direct Connect Control Power, Line-to-Line

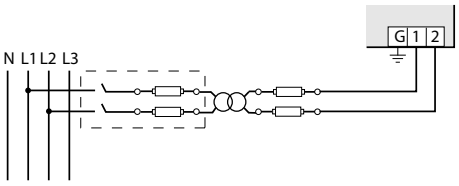
Line-to-Line from 90 Vac to 600 Vac (UL). In UL installations the lines may be floating (such as a delta). If any lines are tied to an earth (such as a corner grounded delta), refer to the Line-to-Neutral installation limits. In CE compliant installations, the lines must be neutral (earth) referenced at less than 300 Vac_{L-N}



#2: Line-to-Neutral from 90 Vac to 347 Vac (UL) or 300 Vac (CE)



#3: DC Control power from 125 VDC to 300 VDC (UL and CE max)



#4: Control power transformer may be wired L-N or L-L. Output to meet meter input requirements

Fuse Recommendations

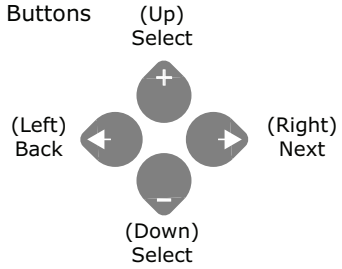
Keep the fuses close to the power source. For selecting fuses and circuit breakers, use the following criteria:.

- Select current interrupt capacity based on the installation category and fault current capability
- Select over-current protection with a time delay.
- Use a voltage rating sufficient for the input voltage applied.
- Provide over-current protection and disconnecting means to protect the wiring.

  Note: *. For AC installations, use Trane AH04 or equivalent. For DC installations, provide external circuit protection. Suggested: 0.5A, time delay fuses rated for DC operation at or above the supply voltage*
- Use the earth connection (G) for electromagnetic compatibility (EMC), not a protective earth ground.

Navigating Screens and Setting Parameters

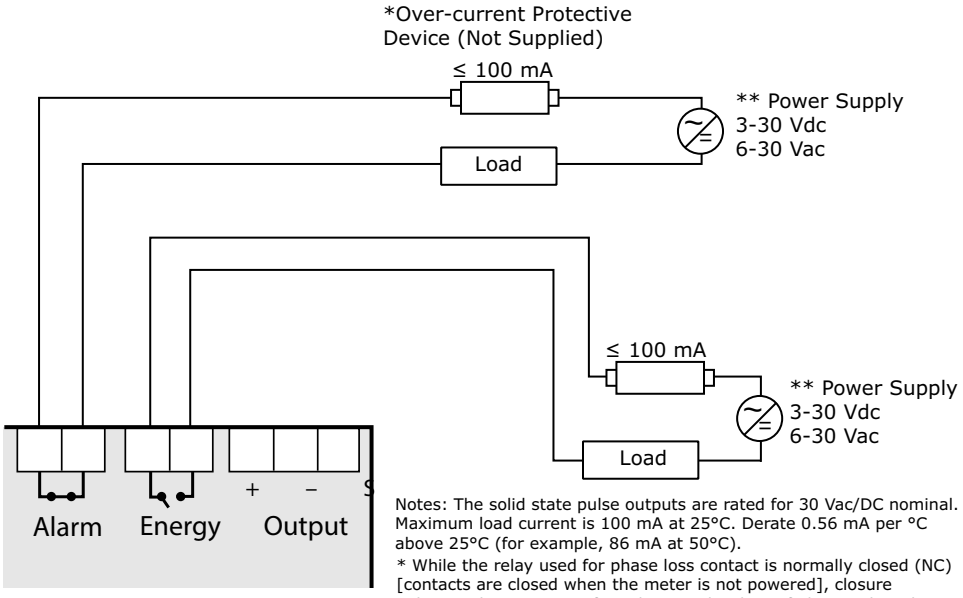
These instructions assume the meter is set to factory defaults. If it has been previously configured, all optional values should be checked.



1. Press the + or – button repeatedly until **SETUP** screen displays.
2. Press –>. to advance to the **PASWD** screen.
3. Press –>. through the digits. Press + or – buttons to select the password (the default is **00000**). Exit the screen to the right.
4. Press + or – buttons to select the parameter to configure settings.
5. Optional: if the unit has an RS-485 interface, the first setup screen is **S COM** (set communications).
   a. Press –>. to advance to the **ADDR** screen and through the address digits. Press + or – buttons to select the Modbus address.
   b. Press –> to advance to the **BAUD** screen. Press + or – buttons to select the baud rate.
   c. Press –> to advance to the **PAR** screen. Press + or – buttons to select the parity.
   d. Press –> to return to the **S COM** screen.
6. Press – to advance to the **S CT** (Set Current Transducer) screen. If this unit does not have an RS-485 port, this is the first screen to displays. .
   a. Press –> to advance to the **CT V** screen and through the digits. Press + or – buttons to select the mode CT output voltage.
   b. Press –> to advance to the **CT SZ** screen and through the digits. Press + or – buttons to select the CT size in amps.
   c. Press –> to return to the **S CT** screen.
7. Press –> to advance to the **S SYS** (Set System) screen.
   a. Press –> to advance to the **SYSTM** screen. Press + or – buttons to select the System Type.
   b. Press –> to return to the **S SYS** screen.
8. Optional: press – to advance to the **S PT** (Set Potential Transformer) screen. If PTs are not used, then skip this step.
   a. Press –> to advance to the **RATIO** screen and through the digits. Press + or – buttons to select the Potential Transformer step down ratio.
   b. Press –> to return to the **S PT** screen.
9. Press – to advance to the **S V** (Set System Voltage) screen.
   a. Press –> to advance to the **VLL** (or VLN if system is 1L-1n) screen and through the digits. Press + or – buttons to select the Line to Line System Voltage.
   b. Press –> to return to the **S V** screen.
10. Press <– to exit the setup screen and then **SETUP**. Verify that the wrench is not displayed on the LCD.
    a. If the wrench is displayed, press + or – buttons to advance to the **ALERT** screen.
    b. Press –> through the screens to see which alert is on.

Solid State Output

The E50C2-T2 have one (1) normally open (NO) KY Form A output and one (1) normally closed (N.C.) output.* One is dedicated to energy (Wh), and the other to Alarm.



Notes: The solid state pulse outputs are rated for 30 Vac/DC nominal. Maximum load current is 100 mA at 25°C. Derate 0.56 mA per °C above 25°C (for example, 86 mA at 50°C).

* While the relay used for phase loss contact is normally closed (NC) [contacts are closed when the meter is not powered], closure indicates the presence of an alarm; either loss of phase, when the meter is power, or loss of power when the meter is not.
The contacts are open when the meter is powered and no phase loss alarm conditions are present.

** All pulse outputs and communication circuits are only intended to be connected to non-hazardous circuits (SELV or Class 2). Do not connect to hazardous voltages.

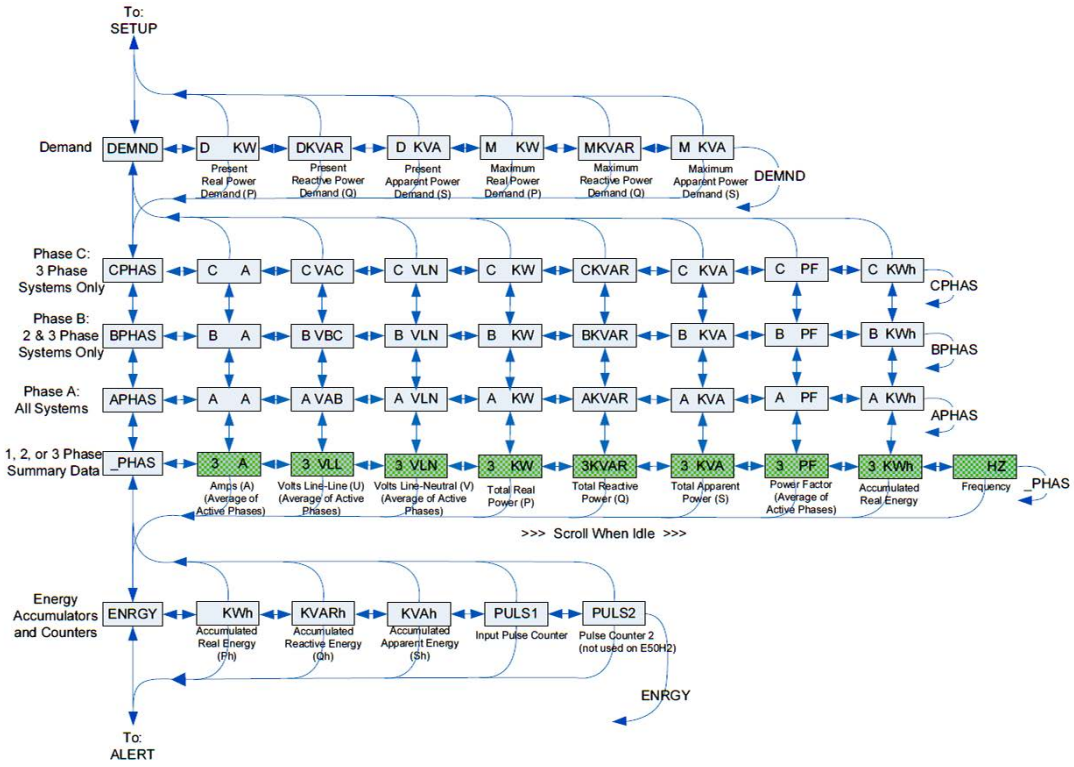
User Interface

The user can set the display mode to either IEC or IEEE notation in the SETUP menu.

Table 1. User Interface Menu Abbreviations

Main Menu			Main Menu		
IEC	IEEE	Description	IEC	IEEE	Description
D	D	Demand	F ERR	F ERR	Frequency Error
MAX	M	Maximum Demand	I OVR	I OVR	Over Current
P	W	Present Real Power	V OVR	V OVR	Over Voltage
Q	VAR	Present Reactive Power	PULSE	PULSE	kWh Pulse Output Overrun (configuration error)
S	VA	Present Apparent Power	_PHASE	_PHASE	Summary Data for 1, 2, or 3 active phases
A	A	Amps	ALERT	ALERT	Diagnostic Alert Status
UAB, UBC, UAC	VAB, VBC, VAC	Voltage Line-to-Line	INFO	INFO	Unit Information
V	VLN	Voltage Line to Neutral	MODEL	MODEL	Model Number
PF	PF	Power Factor	OS	OS	Operating System
U	VLL	Voltage Line-to-Line	RS	RS	Reset System
HZ	HZ	Frequency	SN	SN	Serial Number
KSh	KVAh	Accumulated Apparent	RESET	RESET	Reset Data
KQh	KVARh	Accumulated Reactive	PASWD	PASWD	Enter Reset or Setup Password
KPh	KWh	Accumulated Real Energy	ENERG	ENERG	Reset Energy Accumulators
PLOSS	PLOSS	Phase Loss	DEMND	DEMND	Reset Demand Maximums
LOWPF	LOWPF	Low Power Factor Error			

Figure 3. Data Configuration



The units for all Power and Energy screens change to preserve resolution as the accumulated totals increase. For example, energy starts out as Wh, then switches to kWh, MWh, and eventually GWh as the accumulated value increases.

Figure 4. Alert and Reset Information

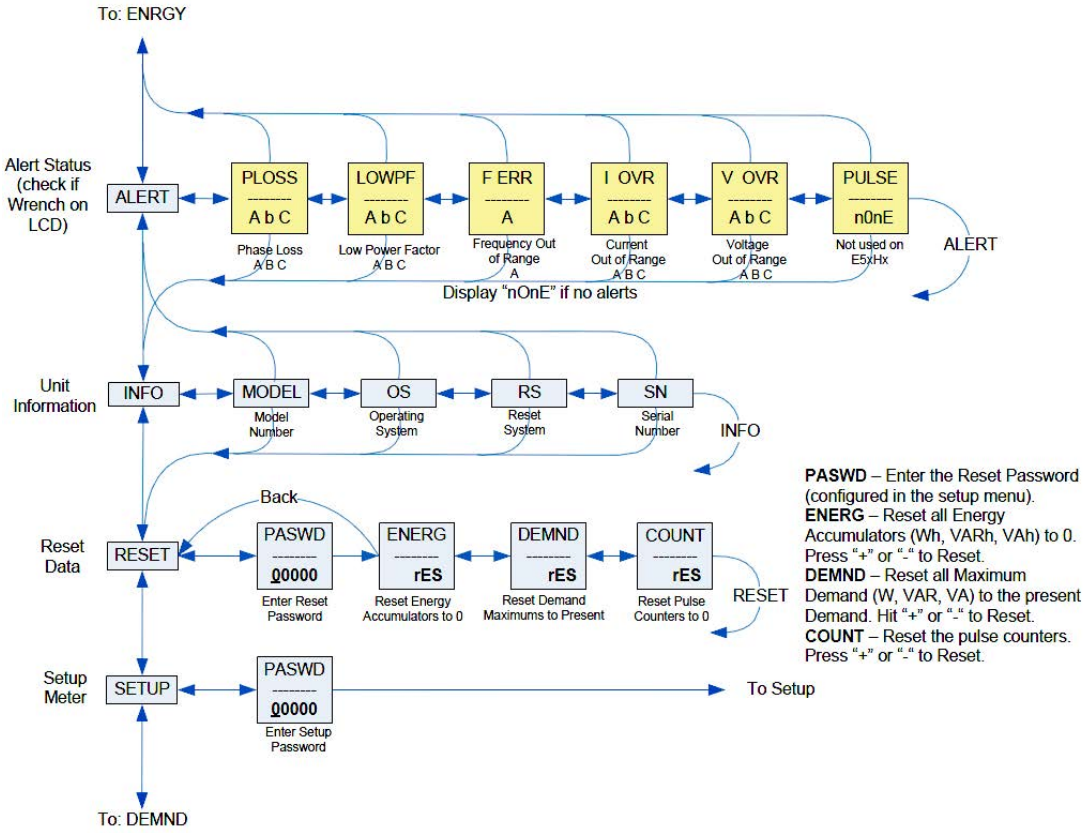
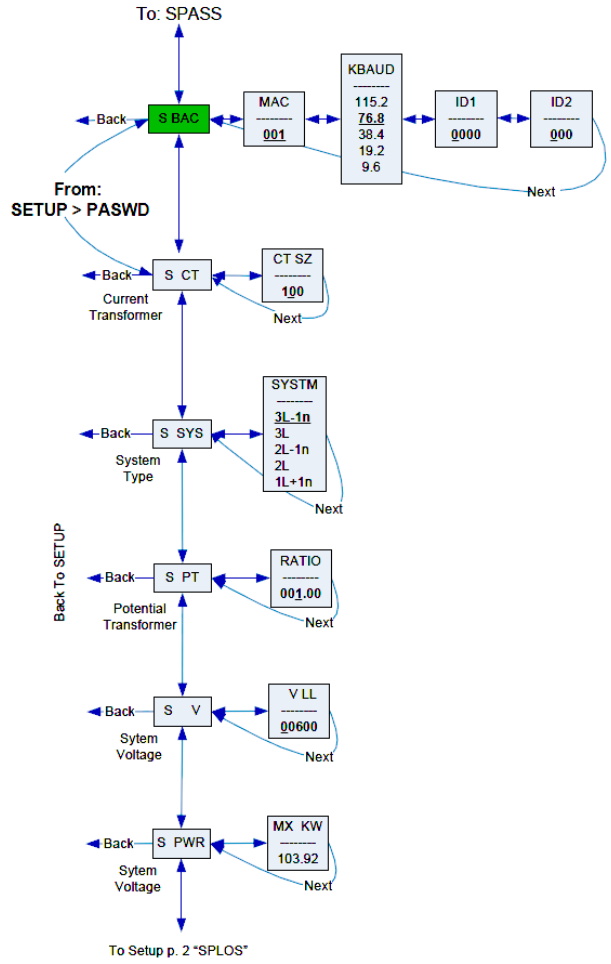


Figure 5. User Interface for Setup



Set Communications Parameters:
ADDR – BACnet MS/TP MAC Address: 0 – 127.
+ increments the selected (blinking) digit.
– selects the digit to the left.
BAUD - Baud Rate: 9600 – 115200 Baud
BACnet ID: These two screens set the 7 digit BACnet device ID. Screen ID1 is the most significant 4 digits and ID2 the least significant three digits. This is in the range of 0 - 4,194,302.

Set Current Transducer:
CT SZ - CT Size: in Amps. Maximum is 5000 Amps.

Set System Configuration:
SYSTM: **+** or **–** to step through the following System Type options:

System	Req 130	CTs	Description
3L-1n	40	3	Wye Three Phase: A, B, & C with Neutral (Default).
3L	31	3	Delta Three Phase: A, B & C; no Neutral
2L-1n	12	2	Single Split Phase: A & B with Neutral
2L	11	1	Single Phase: A & B; no Neutral
1L-1n	10	1	Single Phase: A to Neutral

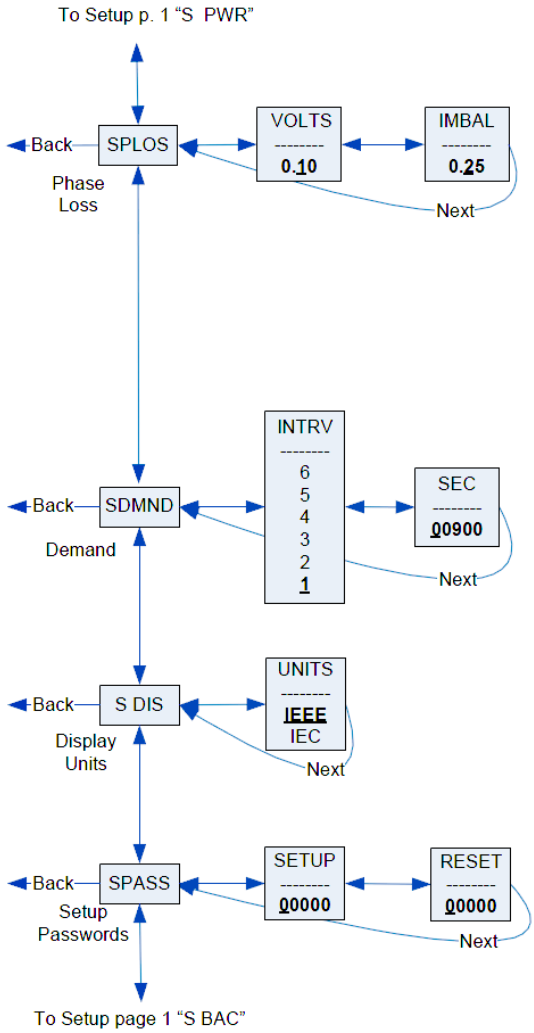
Set Potential Transfomer Ratio:
RATIO – Potential transformer step down is RATIO:1. Default is 1:1 (No PT installed). See Install for wiring diagrams. This value must be set before the System Voltage (if used).

Set System Voltage:
V LL – The nominal Line to Line Voltage for the system. This is used by the meter to calculate the theoretical maximum system power, and as the reference voltage for setting the Phase Loss threshold. Maximum is 32000 Volts. For system type 1+N (10), this is a Line to Neutral Voltage, indicated by "V LN". Note: the meter will reject settings that are not within the meter's operating range when divided by the PT ratio.

System Power:
MX KW – The theoretical Maximum System Power is calculated by the meter from the System Voltage, CT size, and System Type. Power Factor is assumed to be unity. The value of System Power is used to determine which combinations of pulse weight and duration are valid and will keep up with the maximum power the meter will see. This value is read only.

Note: **Bold** is the Default.

Figure 6. User Interface for Setup (continued)



Set Phase Loss:
VOLTS - Phase Loss Voltage: The fraction of the system voltage below which Phase Loss Alarm is on. For system types with neutral, the Line to Neutral voltage is also calculated and tested. If the System Voltage is 600 and the fraction is set to 0.10, then the Phase Loss threshold will be 60 volts.
IMBAL - Phase Loss Imbalance: The fractional difference in Line to Line voltages above which Phase Loss Alarm is on. For system types with neutral, the Line to Neutral voltages are also tested. For system types 1+N (10) and 2 (11) , imbalance is not tested.

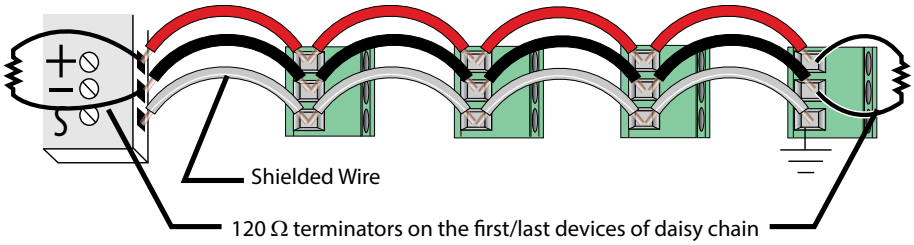
Set Demand Interval:
INTRV - The number of Sub-Intervals (1 to 6) in a Demand Interval. Default is 1 (block demand).
SEC - Sub-Interval length in seconds. Default is 900 (15 minutes). Set to 0 for external sync-to-comms.

Set Display Units: +/- to switch between:
IEEE – VLL VLN W VAR VA Units.
IEC - U V P Q S Units.

Set Passwords:
SETUP - The Password to enter the SETUP menu.
RESET - The Password to enter the RESET menu.

RS-485 Communications

The RS-485 secondary port allows the power meter to be connected in a daisy chain with up to 63, 2–wire devices.



Notes:

- The voltage and current ratings on the terminals are compliant with the requirements of the EIA RS-485 communications standard.
- The RS-485 transceivers are ¼ unit load or less.
- RS-485+ has a 47 kΩ pull up to +5V, and RS-485- has a 47 kΩ pull down to Shield (RS-485 signal ground).
- Wire the RS-485 Bus as a daisy chain from device-to-device, without any stubs. Use 120 Ω termination resistors at each end of the bus (not included).
- Shield is not internally connected to Earth Ground.
- Connect Shield to Earth Ground somewhere on the RS-485 bus (only at one point).

For all terminals on E50 meters:

- When tightening terminals, apply the correct torque: 0.37-0.44 ft·lb (0.5-0.6 N·m).
- Use 14-24 gauge (2.1-0.2 mm^2) wire.

Standard Modbus Default Settings

Setting	Value	Modbus Register
Setup Password	00000	—
Reset Password	00000	—
System Type	40 (3+N) Wye	130
CT Primary Ratio (only if CTs are not included)	100 amp	131
CT Secondary Ratio	1 volt	132
PT Ratio	1:1 (none)	133
System Voltage	600 V L-L	134
Maximum Theoretical Power (Analog Output: Full Scale (20 mA or 5 V)	104 kW	135
Display Mode	1 (IEEE)	137
Phase Loss	10% of system voltage (60 volt), 25% Phase-to-Phase Imbalance`	142, 143
Pulse Energy	1 (kWh/pulse)	144
Demand: Number of Sub-intervals per interval)	1 (block mode)	149
Demand: Sub-interval Length	900 sec (15 min)	150
Modbus Address	001	—
Modbus Baud Rate	19200 baud	—
Modbus Parity	None	—

Modbus Point Mapping

The E50C2-T2 Full Data Set (FDS) features data outputs such as demand calculations, per phase VA and VAR, and VAh VARh accumulators. For security reasons, configuration and resets on all E50 models are protected by a user configurable passcode. The meter supports variable CTs and PTs, allowing a much wider range of operation from 90V x 5A up to 32000V x 5000A. To promote this, the meter permits variable scaling of the 16-bit integer registers via the scale registers. The 32-bit floating point registers do not need to be scaled. Integer registers begin at 001 (0x001). Floats at 257 (0x101). Configuration registers at 129 (0x081). Values not supported in a particular System Type configuration will report QNAN (0x8000 in Integer Registers, 0x7FC00000 in Floating Point Registers).

Table 2. Supported Modbus Commands

Command	Description
0x03	Read Holding Registers
0x04	Preset Input Registers
0x06	Preset; Single Register
0x11	Report ID
	• Return String : #bytes following w/out crc – byte0: address – byte1: 0x11 – byte2: #bytes following 2/out crc – byte3: ID byte = 247 – byte4: status = 0xFF if the operating system is used; status = 0x00 if the reset system is used – bytes5+: ID string = "Veris Industries E50xxA Power Meter Full Data Set" or "Veris Industries E50xxA Power Meter - RESET SYSTEM RUNNING RS Version x.xxx" last 2 bytes: CRC
0x2B	Read Device Identification, BASIC implementation (0x00, 0x01 and 0x02 data), Conformity Level 1.
	• Object Values: – 0x01: "Veris Industries" – 0x02: " E50xxA" – 0x03: "Vxx.yyy", where xx.yyy is the OS version number (reformatted version of the Modbus register #7001, (Firmware Version, Operating System). – If register #7001 == 12345, then the 0x03 data would be "V12.345").

The following table lists the addresses assigned to each data point. For floating point format variables, each data point appears twice because two 16-bit addresses are required to hold a 32-bit float value.

Table 3. Assigned Addresses

R/W	R=read only; R/W=read from either int or float formats, write only to integer format.
NV	Value is stored in non-volatile memory. The value will still be available if the meter experiences a power loss and reset.
Format	UInt: Unsigned 16-bit integer.
	SInt: Signed 16-bit integer.
	ULong: Unsigned 32-bit integer; Upper 16-bits (MSR) in lowest-numbered / first listed register (001/002 = MSR/LSR).
	Float:32-bit floating point; Upper 16-bits (MSR) in lowest-numbered / first listed register (257/258 = MSR/LSR). Encoding is per IEEE standard 754 single precision.
Units	Lists the physical units that a register holds.
Scale Factor	Some Integer values must be multiplied by a constant scale factor (typically a fraction), to be read correctly. This is done to allow integer numbers to represent fractional numbers.
Range	Defines the limit of the values that a register can contain.

Modbus Point Mapping

ESOC2 -T2	ESOC2 -T2 REG.	R/W	NV	Format	Units	Scale	Range	Description	
Integer Data									
•	001	R	NV	ULong	kWh	E	0-0xFFFF	Real Energy Consumption (MSR)	Clear via reset register
•	002						0-0xFFFF	Real Energy Consumption (LSR)	
•	003	R		UInt	kW	W	0-32767	Total Instantaneous Real Power (3 Phase Total)	
•	004	R		UInt	kVAR	W	0-32767	Total Instantaneous Reactive Power (3 Phase Total)	
•	005	R		UInt	kVA	W	0-32767	Total Instantaneous Apparent Power (3 Phase Total)	
•	006	R		UInt	Ratio	0.0001	0-10000	Total Power Factor (Total KW / Total KVA)	
•	007	R		UInt	Volt	V	0-32767	Voltage, L-L, Average of 3 Phases	
•	008	R		UInt	Volt	V	0-32767	Voltage, L-N, Average of 3 Phases	
•	009	R		UInt	Amp	I	0-32767	Current, Average of 3 Phases	
•	010	R		UInt	kW	W	0-32767	Real Power, Phase A	
•	011	R		UInt	kW	W	0-32767	Real Power, Phase B	
•	012	R		UInt	kW	W	0-32767	Real Power, Phase C	
•	013	R		UInt	Ratio	0.0001	0-10000	Power Factor, Phase A	
•	014	R		UInt	Ratio	0.0001	0-10000	Power Factor, Phase B	
•	015	R		UInt	Ratio	0.0001	0-10000	Power Factor, Phase C	
•	016	R		UInt	Volt	V	0-32767	Voltage, Phase A-B	
•	017	R		UInt	Volt	V	0-32767	Voltage, Phase B-C	
•	018	R		UInt	Volt	V	0-32767	Voltage, Phase A-C	
•	019	R		UInt	Volt	V	0-32767	Voltage, Phase A-N	
•	020	R		UInt	Volt	V	0-32767	Voltage, Phase B-N	
•	021	R		UInt	Volt	V	0-32767	Voltage, Phase C-N	
•	022	R		UInt	Amp	I	0-32767	Current, Instantaneous, Phase A	
•	023	R		UInt	Amp	I	0-32767	Current, Instantaneous, Phase B	
•	024	R		UInt	Amp	I	0-32767	Current, Instantaneous, Phase C	
•	025	R		UInt				Reserved; returns 0x8000 (QNAN)	
•	026	R		UInt	Hz	0.01	4500-6500	Frequency (derived from Phase A)	
•	027	R	NV	ULong	KVAh	E	0-0xFFFF	Apparent Energy Consumption (MSR)	Clear via reset register
•	028						0-0xFFFF	Apparent Energy Consumption (LSR)	
•	029	R	NV	ULong	KVARh	E	0-0xFFFF	Reactive Energy Consumption (MSR)	Clear via reset register
•	030						0-0xFFFF	Reactive Energy Consumption (LSR)	
•	031	R		UInt	kVA	W	0-32767	Apparent Power, Phase A	
•	032	R		UInt	kVA	W	0-32767	Apparent Power, Phase B	
•	033	R		UInt	kVA	W	0-32767	Apparent Power, Phase C	
•	034	R		UInt	kVAR	W	0-32767	Reactive Power, Phase A	
•	035	R		UInt	kVAR	W	0-32767	Reactive Power, Phase B	
•	036	R		UInt	kVAR	W	0-32767	Reactive Power, Phase C	
•	037	R		UInt	kW	W	0-32767	Total Real Power Present Demand	
•	038	R		UInt	kVAR	W	0-32767	Total Reactive Power Present Demand	
•	039	R		UInt	kVA	W	0-32767	Total Apparent Power Present Demand	
•	040	R	NV	UInt	kW	W	0-32767	Total Real Power Max Demand	
•	041	R	NV	UInt	kVAR	W	0-32767	Total Reactive Power Max Demand	
•	042	R	NV	UInt	kVA	W	0-32767	Total Apparent Power Max Demand	

E50C2 -T2	E50C2 -T2 REG.	R/W	NV	Format	Units	Scale	Range	Description		
•	043	R	NV	ULong			0-0xFFFF	Pulse Counter 1 (Real Energy)	MSR	Contact Closure Counters. Valid for both Pulse inputs and outputs. E50xx counts are shown in (). See register 144 (Energy per Pulse) for the Wh per pulse count. Clear via register 129. Inputs are user defined.
•	044								LSR	
•	045	R	NV	ULong			0-0xFFFF	Pulse Counter 2 (Reactive Energy)	MSR	
•	046								LSR	
•	047	R	NV	ULong	kWh	E	0-0xFFFF	Real Energy Consumption Phase A	MSR	Clear via reset register
•	048								LSR	
•	049	R	NV	ULong	kWh	E	0-0xFFFF	Real Energy Consumption Phase B	MSR	
•	050								LSR	
•	051	R	NV	ULong	kWh	E	0-0xFFFF	Real Energy Consumption Phase C	MSR	
•	052								LSR	
Configuration										
•	129	R/W		UInt			N/A	Command Register: - Write 30078 (0x757E) to clear all Energy Accumulators to 0. - Write 21211 (0x52DB) to begin new Demand Sub-Interval calculation cycle. Takes effect at the end of the next 1 second calculation cycle. Write no more frequently than every 10 seconds. - Write 21212 (0x52DC) to reset Max Demand values to Present Demand Values. Takes effect at the end of the next 1 second calculation cycle. Write no more frequently than every 10 seconds. - Write 16498 (0x4072) to Clear Pulse Counters to 0. - Read always returns 0.		
•	130	R/W	NV	UInt			10, 11, 12, 31, 40	Single Phase: A + N		System Type (See Manual. Note: only the indicated phases are monitored for Phase Loss)
								Single Phase: A + B		
								Single Split Phase: A + B + N		
								3 phase Δ, A + B + C, no N		
								3 phase Y, A + B + C + N		
•	131	R/W	NV	UInt	Amps		20-5000	CT Ratio – Primary		Current Inputs
•	132	R	NV	UInt			n/a	Reserved, always returns QNAN		
•	133	R/W	NV	UInt		100	0.01-320.00	PT Ratio: The meter scales this value by 100 (i.e. entering 200 yields a potential transformer ratio of 2:1). The default is 100 (1.00:1), which is with no PT attached. Set this value before setting the system voltage (below)		
•	134	R/W	NV	UInt			82-32000	System Voltage: This voltage is line to line, except for system type 10 which is line to neutral. The meter uses this value to calculate the full scale power for the analog outputs and pulse configuration (below), and as full scale for phase loss (register 142). The meter will refuse voltages that are outside the range of 82-660 volts when divided by the PT Ratio (above).		
•	135	R	NV	UInt	kW	W	1-32767	Theoretical Maximum System Power: This read-only value is the theoretical max. power the meter can expect to see on a service. This value is 100% of scale on the analog output (0-5 VDC or 4-20 mA), if equipped. The meter recalculates this value if the user changes the CT size, system type, or system voltage. This integer value has the same scale as other integer power registers (see register 140 for power scaling).		
•	136	R		UInt				Reserved, always returns 0		
•	137	R/W	NV	UInt			0,1	Display Units: 0 = IEC (U, V, P, Q, S), 1 = IEEE (default: VLL, VLN, W, VAR, VA)		

E50C2 -T2	E50C2 -T2 REG.	R/W	NV	Format	Units	Scale	Range	Description	
•	138	R		SInt		-4 0.0001 -3 0.001 -2 0.01 -1 0.1 0 1.0 1 10.0 2 100.0 3 1000.0 4 10000.0		Scale Factor I (Current)	Scale Factors Note: These registers contain a signed integer, which scales the corresponding integer registers. Floating point registers are not scaled. Scaling is recalculated when the meter configuration is changed.
•	139	R		SInt				Scale Factor V (Voltage)	
•	140	R		SInt				Scale Factor W (Power)	
•	141	R		SInt				Scale Factor E (Energy)	
•	142	R/W	NV	UInt	%		1-99	Phase Loss Voltage Threshold in percent of system voltage (register 134). Default is 10 (%). Any phase (as configured in register 130) that drops below this threshold triggers a Phase Loss alert - i.e. if the System voltage is set to 480 V L-L, the L-N voltage for each phase should be 277 V. When the threshold is set to 10%, if any phase drops more than 10% below 277 V, (less than 249 V), or if any L-L voltage drops more than 10% below 480 V (less than 432 V) the corresponding phase loss alarm bit in register 146 will be true.	Phase Loss Output Note: The phases tested are determined by the System Type.
•	143	R/W	NV	UInt	%		1-99	Phase Loss Imbalance Threshold in Percent. Default is 25% phase to phase difference. For a 3-phase Y (3 + N) system type (40 in register 130), both Line to Neutral and Line to Line voltages are tested. In a 3-phase Δ System type (31 in register 130), only Line to Line voltages are examined. In a single split-phase (2 + N) system type (12 in register 130), just the line to neutral voltage are compared.	
•	144	R/W	NV	UInt	Wh		10000, 1000, 100, 10	Wh (& VARh, if equipped with FDS) Energy per Pulse Output Contact Closure. If the meter cannot find a pulse duration that will keep up with the max. system power (register 135), it rejects the new value. Try a larger value.	kWh Pulse Contacts Note: The kWh pulse contact can keep up with a maximum power (Watts) of 1800000 x Wh pulse weight ÷ contact closure duration (in msec)
•	145	R	NV	UInt	ms		500, 250, 100, 50, 25, 10	Pulse Contact Closure Duration in msec. Read-only. Set to the slowest duration that keeps up with the theoretical max. system power (register 135). The open time ≥ the closure time, so the max. pulse rate (pulses per sec) is the inverse of double the pulse time.	

E50C2 -T2	E50C2 -T2 REG.	R/W	NV	Format	Units	Scale	Range	Description	
•	146	R		UInt				Diagnostic Alert Bitmap. 1 = Active: Bit 0: Phase A Voltage out of range Bit 1: Phase B Voltage out of range Bit 2: Phase C Voltage out of range Bit 3: Phase A Current out of range Bit 4: Phase B Current out of range Bit 5: Phase C Current out of range Bit 6: Frequency out of the range of 45 – 65 Hz OR there is insufficient voltage to determine frequency. Bit 7: Reserved for future use Bit 8: Phase Loss A Bit 9: Phase Loss B Bit 10: Phase Loss C Bit 11: Low Power Factor on A with one or more phases having a PF less than 0.5 due to mis-wiring of phases Bit 12: Low Power Factor on B Bit 13: Low Power Factor on C Bit 14: Energy pulse output overrun error. The pulse outputs are unable to keep up with the total real power (registers 3 and 261/262). To fix, increase the pulse energy register (register 144) and reset the energy accumulators (see reset register 129). Bit 15: Energy pulse output configuration error (present pulse energy setting may not keep up with the theoretical max. system power; see register 135). To fix, increase the pulse energy (register 144).	
•	147	R	NV	UInt			0-32767	Count of Energy Accumulator resets	
•	148	R		UInt				Reserved (returns 0)	
•	149	R/W	NV	UInt			1-6	Number of Sub-Intervals per Demand Interval. Sets the number of sub-intervals that make a single demand interval. For block demand, set this to 1.	Demand Calculation
•	150	R/W	NV	UInt	Seconds		0, 10-32767	Sub-Interval Length in seconds. For sync-to-comms, set this to 0 and use the reset register (129) to externally re-start the sub-interval.	
•	151	R/W		UInt			1-32767	Reserved (returns 0)	
•	152	R/W	NV	UInt			0-32767	Power Up Counter.	
•	153	R	NV	UInt			0-32767	Output Configuration. E50C2A-T2 units have a NO (normally open) energy contact and NC (normally closed) (Normally Open - Form A or Normally Closed - Form B) Phase Loss contact. While the relay used for the Phase Loss contact is Normally Closed (contacts are closed when the meter is not powered), closure indicates the presence of an alarm; either loss of phase, when the meter is powered, or loss of power when the meter is not. The contacts are open when the meter is powered and no phase alarm conditions are present. 3rd Output: 0 = RS-485 2 = VAR Pulse	
•	154	R		UInt				Reserved, returns 0	

E50C2 -T2	E50C2 -T2 REG.	R/W	NV	Format	Units	Scale	Range	Description
Floating Point Data								
•	257/258	R	NV	Float	kWh			Real Energy Consumption (clear via reset register)
•	259/260	R	NV	Float	kWh			Real Energy Consumption (clear via reset register)
•	261/262	R		Float	kW			Total Instantaneous Real Power
•	263/264	R		Float	kVAR			Total Instantaneous Reactive Power
•	265/266	R		Float	kVA			Total Instantaneous Apparent Power
•	267/268	R		Float	Ratio		0.0-1.0	Total Power Factor (Total KW / Total KVA)
•	269/270	R		Float	Volt			Voltage, L-L, Average of 3 Phases
•	271/272	R		Float	Volt			Voltage, L-N, Average of 3 Phases
•	273/274	R		Float	Amp			Current, Average of 3 Phases
•	275/276	R		Float	kW			Real Power, Phase A
•	277/278	R		Float	kW			Real Power, Phase B
•	279/280	R		Float	kW			Real Power, Phase C
•	281/282	R		Float	Ratio		0.0-1.0	Power Factor, Phase A
•	283/284	R		Float	Ratio		0.0-1.0	Power Factor, Phase B
•	285/286	R		Float	Ratio		0.0-1.0	Power Factor, Phase C
•	287/288	R		Float	Volt			Voltage, Phase A-B
•	289/290	R		Float	Volt			Voltage, Phase B-C
•	291/292	R		Float	Volt			Voltage, Phase A-C
•	293/294	R		Float	Volt			Voltage, Phase A-N
•	295/296	R		Float	Volt			Voltage, Phase B-N
•	297/298	R		Float	Volt			Voltage, Phase C-N
•	299/300	R		Float	Amp			Current, Instantaneous, Phase A
•	301/302	R		Float	Amp			Current, Instantaneous, Phase B
•	303/304	R		Float	Amp			Current, Instantaneous, Phase C
•	305/306	R		Float				Reserved, returns 0x7FC00000 (QNAN)
•	307/308	R		Float	Hz		45.0-65.0	Frequency (derived from Phase A)
•	309/310	R	NV	Float	kVAh			Apparent Energy Consumption
•	311/312	R	NV	Float	kVARh			Reactive Energy Consumption
•	313/314	R		Float	kVA			Apparent Power, Phase A
•	315/316	R		Float	kVA			Apparent Power, Phase B
•	317/318	R		Float	kVA			Apparent Power, Phase C
•	319/320	R		Float	kVAR			Reactive Power, Phase A
•	321/322	R		Float	kVAR			Reactive Power, Phase B
•	323/324	R		Float	kVAR			Reactive Power, Phase C
•	325/326	R		Float	kW			Total Real Power Present Demand
•	327/328	R		Float	kVAR			Total Reactive Power Present Demand
•	329/330	R	NV	Float	kVA			Total Apparent Power Present Demand
•	331/332	R	NV	Float	kW			Total Real Power Max Demand
•	333/334	R	NV	Float	kVAR			Total Reactive Power Max Demand
•	335/336	R	NV	Float	kVA			Total Apparent Power Max Demand

E50C2 -T2	E50C2 -T2 REG.	R/W	NV	Format	Units	Scale	Range	Description	
-	337/338*	R		Float			0 - 4294967040	Pulse Counter 1 (Real Energy)	Contact Closure Counters. Valid for both Pulse inputs and outputs. E50xxA counts are shown in (). See register 144 (Energy per Pulse) for the Wh per pulse count. Clear via register 129. Inputs are user defined. These values are derived from the 32 bit integer counter and rolls over to 0 when the integer counters do.
-	339/340*	R		Float			0 - 4294967040		
-	341/342*	R	NV	Float	kWh			Real Energy Consumption, Phase A	clear via reset register
-	343/344*	R	NV	Float	kWh			Real Energy Consumption, Phase B	
-	345/346*	R	NV	Float	kWh			Real Energy Consumption, Phase C	

Invalid or Quiet Not A Number (QNAN) conditions are indicated by 0x8000 (negative zero) for 16 bit integers and 0x7FC00000 for 32 bit floating point numbers. Floating point numbers are encoded per the IEEE 754 32-bit specifications.

Troubleshooting

Problem	Cause	Solution
The maintenance wrench icon appears in the power meter display.	There is a problem with the inputs to the power meter.	Refer to the Alert sub-menu or Diagnostic Alert Modbus Register 146.
The display is blank after applying.	The meter is not receiving adequate power.	• Verify that the meter control power are receiving the required voltage. • Verify that the heart icon is blinking.Check the fuse.
The data displayed is inaccurate.	Incorrect setup values.	Verify the values entered for power meter setup parameters (CT and PT ratings, system type, etc.).
	Incorrect voltage inputs.	Check power meter voltage input terminals to verify adequate voltage.
	Power meter is wired improperly.	Check all CTs and PTs to verify correct connection to the same service, PT polarity, and adequate powering.
Cannot communicate with power meter from a remote personal computer.	Power meter address is incorrect.	Verify that the meter is correctly addressed.
	Power meter baud rate is incorrect.	Verify that the baud rate of the meter matches that of all other devices on its communications link.
	Communications lines are improperly connected.	• Verify the terminating resistors are properly installed on both ends of a chain of units. Units in the middle of a chain should not have a terminator. • Verify the power meter communications connections. • Verify the shield ground is connected between all units.

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Hazardous Substances						
Part Name	Pb	Hg	Cd	Cr, VI	PBB	PBDE
Electronic	X[a]	O[b]	O	O	O	O

[a] X indicates that concentration of hazardous substance in at least one of the homogeneous materials used for this part is above the limit as stipulated in GB/T 26572.

[b] O indicates that the concentration of hazardous substance in all of the homogeneous materials for this part is below the limit as stipulated in GB/T 26572.

Additional Resources

- E50 Series Compact Power and Energy Meter, BACnet (E50H2-T2) and **Modbus (E50C2-T2)** for Use With Split Core and Solid Core CTs, Installation Instructions (X39641310001)
- Product Data Sheet Enhanced Power and Energy Meters E50 Series Modelss, Product Data Sheet (BAS-PRD035)
- Quick Installation Guide (Z207411-0A 0217)

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