

MiniCloset-5c

— Installation Manual —



Table of Contents

Contact Information	1
Warning	1
Disclaimer	1
Symbols	1
Chapter 1	
Introduction	
Overview	3
Power Line Communications (PLC)	3
Scan Transponder-5 (PLC Data Collector and Communicator)	3
Quadlogic Metering System	4
Chapter 2	
About the MiniCloset-5c	
The MiniCloset-5c	6
Specifications	7
Chapter 3	
Parts and Options	
Parts	9
Options	9
Chapter 4	
Installation	
Overview	13
Installation Cautions and Warning	13
Protective Conductor Terminal	13
Installation Instructions for Meter, MCI, and CTs	14
Wiring Overview	18
3-Phase, 4-Wire Wye Wiring	18
1-Phase, 3-Wire 120/208V Wiring (Network)	25
3-Phase, 3-Wire Delta Wiring	31
3-Phase, 4-Wire 1EL Wiring	37
1-Phase, 3-Wire 240V 1EL Wiring	43
1-Phase, 3-Wire 240V 2EL Wiring	49
Chapter 5	
Using the Meter	
Display Navigation	55
Verifying Meter Functionality	58
Resetting Demand Values (For Commercial Applications only)	60
Chapter 6	
Applying Multipliers	
Reading the Display	61
How CT multipliers are calculated	62

Chapter 7

Communications

Overview.....	63
HyperTerminal Private Edition Setup.....	63
Security Hierarch.....	65
Logging In To the Meter	65
Basic Meter Data	66
Advanced Meter Programming	69

Chapter 8

Troubleshooting

Resolving Meter Issues.....	71
-----------------------------	----

Chapter 9

Repair and Spare Parts

Repair or Replacement	73
Spare Parts.....	73

Chapter 10

Miscellaneous

Preventive Maintenance.....	75
Warranty Information.....	75
Release Dates	75
Revision History	75

Appendix

The Communications Module	76
RS-485 Overview.....	79
Guidelines for Proper Wiring of a RS-485 Network	79
The Pulse Datalogger Module.....	85

Thank you for purchasing a MiniCloset-5c multi-channel electric power meter manufactured by Quadlogic Controls Corporation. Quadlogic has been designing, manufacturing, and selling digital electric metering systems for over 25 years. We appreciate your business.

CONTACT INFORMATION

For sales and technical support, please contact Quadlogic Controls Corporation as indicated below.

Quadlogic Controls Corporation

Telephone: (212) 930-9300
Fax: (212) 930-9394
Email: support@quadlogic.com
Homepage: www.quadlogic.com

WARNING

This manual is for persons who have received training and are qualified to work with electricity and electrical metering equipment. All applicable national and local electrical codes and standards must be followed. Failure to follow proper procedures may result in damage to the equipment and/or serious bodily harm including death.

DISCLAIMER

The information in this manual has been compiled with care, however, Quadlogic Controls Corporation makes no warranty as to the accuracy or completeness of this material. Furthermore, the product(s) described herein may be changed or enhanced from time to time. This information does not constitute commitments or representations by Quadlogic Controls Corporation, and is subject to change without notice.

SYMBOLS

	WARNING
	NOTE
	CAUTION

CHAPTER 1

INTRODUCTION

OVERVIEW

Quadlogic Controls Corporation manufactures a line of revenue-grade electricity meters and metering systems that utilize our patented, two-way Power Line Communications technology. For over 25 years, Quadlogic systems have used this patented technology to transmit advanced meter data over the existing power lines in a building or service territory. No additional communication wiring is required to transmit metered data to the Scan Transponder (Quadlogic's data collector). Because the system is read remotely via various public or private communication means, meter readers are also not required. Building and facility owners, property managers, and utility companies depend on Quadlogic meters to provide all the data needed to bill customers, allocate energy costs, manage loads, and make smart energy decisions.

POWER LINE COMMUNICATIONS (PLC)

Power Line Communications, or PLC, is a method of transferring meter data via the existing electric power wires that serve each tenant in a building or customer on a utility grid. Quadlogic employs a patented method of PLC to move large amounts of metered data for residential and commercial and industrial (C&I) customers to a central collection point. This robust technology dynamically responds to the varying electrical noise conditions normally found on power lines or electrical distribution grids by changing frequency, phase etc. and is therefore able to maintain highly reliable data communication, including passing through distribution transformers. (Consult Quadlogic or local representative for project layout assistance.) The MiniCloset-5c includes PLC communications as a standard feature. In most installations, the meter data from the MiniCloset-5c is read remotely via PLC.

SCAN TRANSPONDER-5 (PLC DATA COLLECTOR AND COMMUNICATOR)

When the MiniCloset-5c is read via PLC, one or more Scan Transponder-5's are required. The Scan Transponder-5 is the central data collector for Quadlogic metering systems. It communicates with Quadlogic meters over the existing electric wires that serve each tenant in a building or customer on a utility grid.

The Scan Transponder-5 collects a data block from each meter in the system. The block contains all previously uncollected meter readings, interval readings and event logs. This data is stored in a non-volatile memory buffer. At regular intervals, the billing system communicates with the Scan Transponder-5 and uploads all of the information for billing or analysis purposes.

The Scan Transponder-5 is a separate product and requires its own installation.



Figure 1-1. Quadlogic Scan Transponder-5.

QUADLOGIC METERING SYSTEM

The MiniCloset-5c is typically part of a comprehensive metering system within residential, commercial, industrial or mixed-use sites. (See Figure 1-2 for a typical Quadlogic PLC metering system.) This metering system measures electrical usage for each tenant (customer), cost center, or common area space, and communicates this metering data over the power distribution wires. A metering system is comprised of two or more Quadlogic electricity meters and at least one Quadlogic Scan Transponder-5 (ST-5), which is Quadlogic's data collector and concentrator. The ST-5 collects metering data for up to 240 metering points via the power lines. Large sites may require additional ST-5s. Multiple ST-5's are typically interconnected via a data link network using RS-485 or via a wireless network.

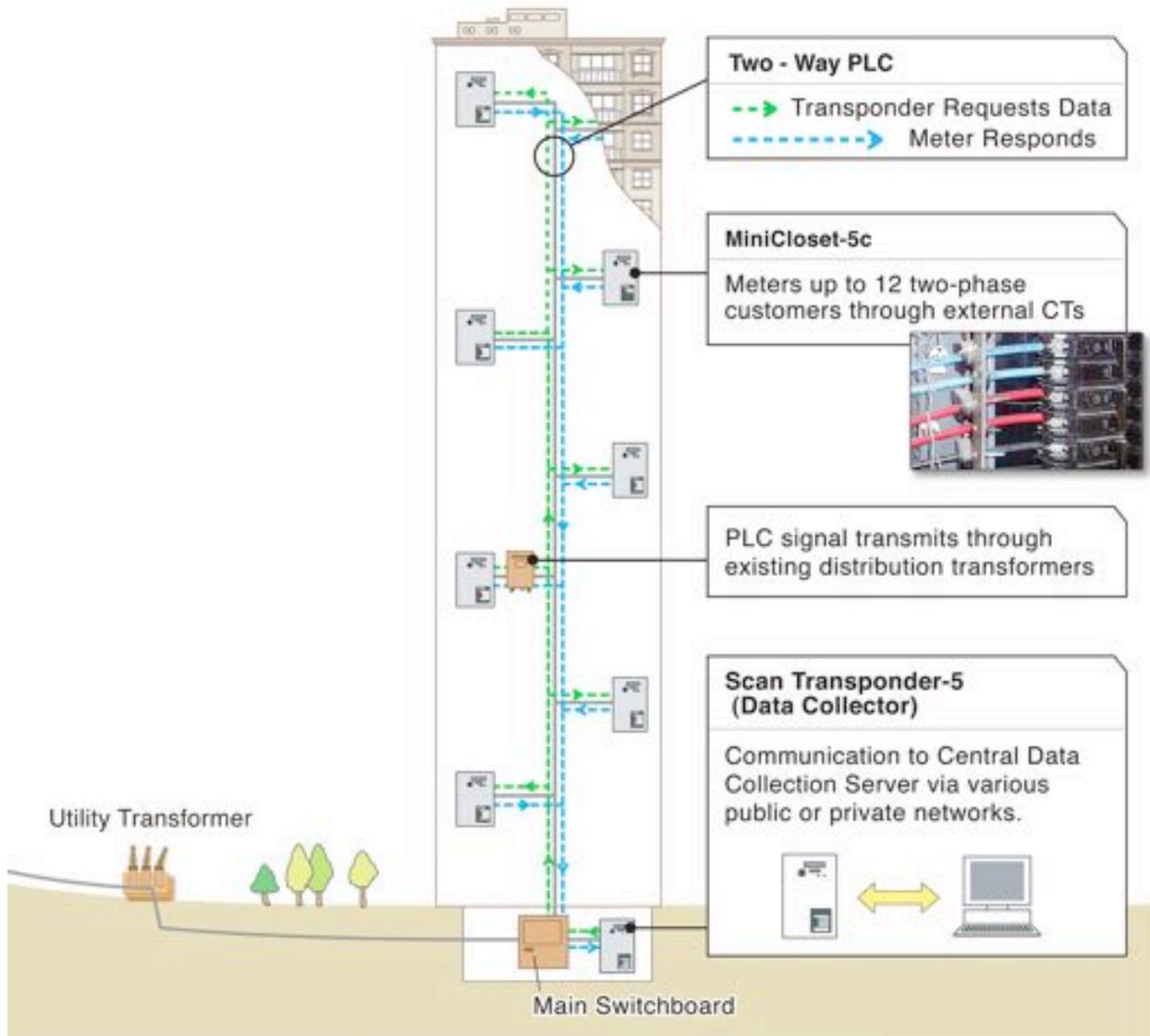


Figure 1-2. Typical Quadlogic metering system.

CHAPTER 2

ABOUT THE MINICLOSET-5C

THE MINICLOSET-5C

The MiniCloset-5c, or MC-5c, is a multi-tenant digital electric meter used for commercial, residential or industrial applications. It meters up to 24 circuits or channels, which can be configured as 24 single-phase/circuit loads, 12 two-phase/circuit loads, 8 three-phase/circuit loads, or any equivalent combination. It records interval data, including hourly and 15 minute intervals, down to 5 minutes which allows flexible load profiling and Time-of-Use (TOU) billing options. It also measures four-quadrant energy, power-down events, frequency, etc. enabling the user to analyze power quality.



Figure 2-1. The MiniCloset-5c.

The MC-5c utilizes flash memory which enables reliable data storage and integrity without battery reliance. In addition to metering data, it stores power quality data and a comprehensive list of relevant events. The recorded events include: power consumption, demand resets, power ups and power downs, time changes, and tampers. In addition to remote reading, the consumption readings, power quality and event data are also accessible by reading the built-in Liquid Crystal Display (LCD) or using a computer and optical probe. (See chapter 5 for more information on the meter display.)

Using a Pulse Datalogger Module (PDM), the MC-5c is capable of collecting pulse data from any device capable of a dry contact outputs, such as water, gas, or BTU meters. Each PDM can count pulses for up to 12 discrete meters, and four PDMs can be daisy-chained together. Therefore up to 48 different meters, (4x12) can be assigned to one MC-5c. Note; This data can be recorded at different intervals than those set for the electricity readings.

SPECIFICATIONS

Metering Specifications

Metered Voltage:	120, 208, 220, 230, 240, 277, 347, 380, 400, 416, 480, 600 VAC
	Delta or Wye, 50/60 Hz
Secondary Current Input:	0.1 Amp or 5 Amp CT inputs available
Programmable:	
Four Quadrant Consumption & Delivered and received	(8) 3-phase meters, (12) network meters, or (24) single-phase meters (number of meter points available will vary by model)
Demand for each of the 24 channels:	Delivered and received: kW, kVARLeading, kVARLagging, kVA, Volts-squared hours, and amp-squared hours
Programmable Interval Data & Data and Peak Demand:	5 minutes to hourly time window (longer time intervals also available) Meter total and/or by phase Programmable to user-determined specific time blocks or rolling time block demand
Demand Reset:	Allows local reset of peak demand (kW) register
Real-time data per Phase:	Voltage, current, phase angle, power factor, THD, watts, VARs, VA, and frequency
Time-of-Use:	Up to 16 blocks per day available for all metering parameters (Exception: Pulse input data)
Data Collection Options:	IQ Software MV-90 TIM Module
Pulse Datalogger Module (PDM-12):	ASCII-based, open-data protocol Open-source data conversion program Collects data from up to 12 water, gas, or BTU meters Form A Dry Contact Inputs PDM connects to MiniCloset-5c via CAT5 Maximum 4 PDM units to a MC-5c (daisy chain) Total of 48 discrete inputs total Pulses will count during a power outage Pulses can be logged in programmable intervals
Distance:	Power supplied by MiniCloset-5c Pulse meter to PDM - 300' max.(18 gauge min.)
Interrogating Signal Specifications:	All 4 PDM's to MC-5c - 300' CAT5 cable Min. Pulse Width: Power on - 50 msec. Power off - 500 msec.* Max. Pulse Rate: Power on - 10 pulses/sec max Power off - 1 pulse/sec max Peak voltage: 5.5V Peak current: not applicable Isolation: The interrogating signal is completely isolated from the AC line, with isolation barriers rated for at least 2.5 kV. Max. signal debounce tolerance: 20 msec.



The pulses that are counted by the PDM consist of a 'closed' state on the external contact, followed by an 'open' state. In order to be reliably registered, the time that the contact is 'open' must be at least the Min Pulse Width, and the time that the contact is 'closed' must also be at least the Min Pulse Width.

* When the MC-5c loses power or is disconnected from the PDM, the PDM has the capability to record pulses using its onboard battery for power. In this situation, the sample rate of the PDM is reduced to decrease current drain and extend battery life.

Accuracy:	±0.5% at unity power factor at any measured load between 1% and 100% of full-scale (excluding external CT error) ±0.75% at 0.5 power factor (lead or lag)
Liquid Crystal Display:	Push button scroll 32-digit liquid crystal display (16 digits x 2 rows) 6 whole digit consumption register Data digit height: 0.31" Programmable display scroll & decimal place display
Operating Range:	Rated Voltage: 90% to 110% Temperature: -20°C to +60°C
Memory:	512 Kbytes non-volatile flash memory During power outage: Flash memory retains daily and interval data Long-life lithium battery maintains time, logs incoming pulses and retains data acquired within the uncompleted interval at the time of the outage
Shipping Weight and Dimensions:	Enclosure: 18.2" H X 10.70" W X 6.1" D Shipping weight: 1 meter assembly: 34 lbs
Environment:	Enclosure: NEMA 1 rated for indoor use only. Temperature: -20°C to +60°C Humidity: 0-95% relative humidity (non-condensing) Pollution Degree: 2 Maximum Altitude: 2000 meters
Type Tests:	Transient/surge suppression: ANSI C37.90.1-1989 Installation Category: III. This product falls under Installation Category III because of its distribution level, fixed installation, and because it has a smaller transient over-voltage rating than an Installation Category IV.
Metering Industry Standards:	Meets ANSI: C12.1 UL and CUL: Recognized under E204142 Industry Canada: MC# AE-1148

Communications Options

Although a MiniCloset-5c is typically part of an AMR (Automatic Meter Reading) System whereby metering data is collected by a Scan Transponder using PLC, in some cases a user may need to communicate with the meter directly. In addition to the Power Line Communications capability that is a standard feature of the MiniCloset-5c, the following communications options are available:

- Local LCD (register values and certain diagnostic data are available via local LCD)
- IEC Optical Communications Interface (optical port is standard feature; optical probe is sold separately)
- 19.2k Internal Modem/RS232/RS485 (Option)
- Network Data Link (4-wire RS-485) (Option)

CHAPTER 3

PARTS AND OPTIONS

PARTS

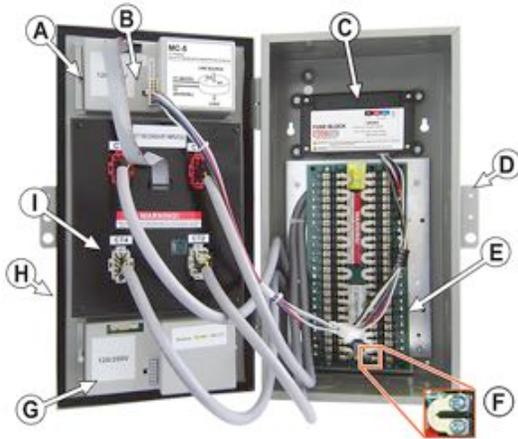


Figure 3-1. MiniCloset-5c, Parts and Assembly

- A. Meter Head – Main component of the MiniCloset-5c. The Meter Head contains the Meter Module, through which all signals transmit, events are recorded and meter data is stored.
- B. Voltage Connector – A 14-pin connector that connects the Fuse Block (C) and the Meter Head (A).
- C. Fuse Block – Provides termination for the voltage taps. It supplies power and fuse protection to the Meter Head.
- D. MC-5c Back Box – Metal box housing the metering device and the MCI board.
- E. MCI – MiniCloset Interface, provides termination for the current transformers (CT).
- F. Shorting Links – Provide termination for CTs when the Current Connectors are disconnected from the meter head.
- G. Communications Module (option).
- H. Front Door of MC-5c.
- I. Current Connectors – A 15-pin connector that connects the MCI and the Meter Head together. Each MC-5c has 4 Current Connectors.

OPTIONS

The following options are available with the MC-5c. A suffix on the meterhead catalog number will indicate which option or options are included with that model as indicated below.

Options	Description	Suffix for Meterhead	Need to order separate part?
Modem	Modem, RS-485, RS-232	M	No. Modem/RS-232/RS-485 is included in "M" model meterhead.
RS-485	RS-485 only	RS	No. RS-485 is included in "RS" model meterhead.
PDM	Pulse Data Module for Form A dry contact inputs	P	Yes. "P" model meterheads do not include the PDM devices. PDMs need to be ordered separately. (Up to 4 PDMs can be used on one MC-5c. 12 inputs x 4 PDMs collects 48 discrete inputs.)
Probe	Abacus Electrics Optical Probe to download meter data locally	Not applicable	Yes.

I. Modem (Modem, RS-485, RS-232)

The Modem module is an optional accessory that can be ordered with the MC-5c. It includes a modem, RS-485 connection and RS-232 connection. The modem module connects to a dedicated telephone line allowing remote data access directly to the device. Users can download data or troubleshoot the system from any remote computer system.

II. RS-485

The Data Link External Communications or RS-485 module allows multiple Quadlogic meters to be connected together in cases where PLC is not being utilized. RS-485 utilizes two (2) shielded, twisted pairs of #16 AWG stranded wires.

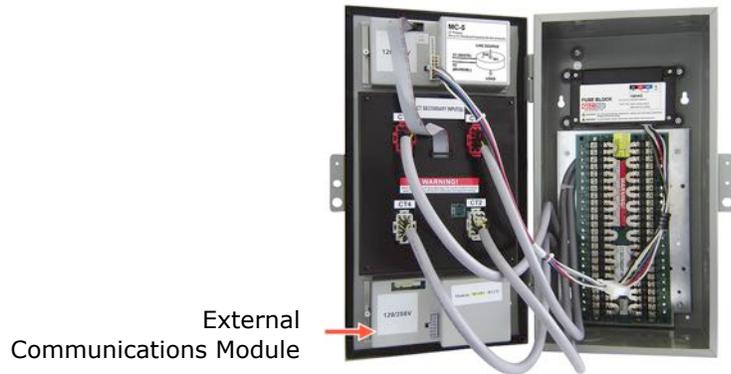


Figure 3-2. MiniCloset-5c with Modem and Data Link External Communications Module.

III. Pulse Datalogger Module

(See Appendix)

IV. Abacus Electrics Optical Probe

The Abacus Electrics optical probes (Model F6Z) are bi-directional interface devices utilizing infra-red light. By connecting to the serial port of a computer or hand-held terminal, they permit galvanically isolated communication with the MC-5c.



Figure 3-3. The Abacus Optical Probe.

Probes are available for use with laptop or desktop computers, as well as with many of the hand-held computers commonly used for field data collection. The probes are fitted with a standard 9-pin 'D' connector. The optical probe is convenient to use, as no battery or power supply connection is needed.

V. Interface with Quadlogic Software (IQ)

The Interface with Quadlogic (IQ) Program allows for easy access to all metering information necessary for basic bill generation, daily load profiling and certain customer service functions such as acquiring as needed reads for customers moving into or out of a designated location. Various metering parameters (Voltage, Amps, Watts, kWh, kVARh, kVAh, Power Factor and Phase Angle for one, two or three phases) can be viewed individually or in combination. Meters can be logically clustered, and the group totals for most metering parameters can be viewed as well.

Color graphs can be produced for Consumption and Daily Peak Demand, as well as Demand Logs. The program is both easy to use and provides professional presentation material.

IQ is available for purchase from Quadlogic Controls Corporation.

IQ requires the following minimum hardware and software:

Hardware:

- 486 or Pentium based PC
- 32 MB RAM minimum (64 MB RAM recommended)
- CD-ROM Drive
- 5 MB free space on the hard drive (for the program only)
- SVGA 800x600 Resolution
- Config.sys: files 50/buffers 15 minimum
- Color monitor
- Mouse
- Keyboard
- At least 2400 baud or compatible modem (for remote connections only)
- Telephone line (for remote connections only)
- Printer (recommended)

Operating System Software:

- Windows 98, Windows NT, Windows XP
- (Note: IQ is not compatible with Windows Vista)

CHAPTER 4

INSTALLATION

OVERVIEW

This chapter contains installation instructions and wiring diagrams for all MiniCloset-5c meter models. The installation instructions start with a general procedure which applies to all meter models, then continues with specific wiring and CT installation information for each particular MC-5c configuration. When installing the meter, it is critical that you use the correct wiring instructions. See pages 18 to identify the correct instructions for your meter model.

INSTALLATION CAUTIONS AND WARNING

- This manual is for persons who have received training and are qualified to work with electricity and electrical metering equipment. All applicable national and local electrical codes and standards must be followed. Failure to follow proper procedures may result in damage to the equipment and/or serious bodily harm including death.
- Do not install if the device is damaged. Inspect the meter box for obvious defects such as dents or cracks in the housing.
- If the device is installed or used in a manner not specified by the accompanying documents, the safety of the device may be impaired.
- If the device functions abnormally, proceed with caution. The safety of the device may be impaired.
- Do not install the meter in the presence of explosive or combustible gas or gas vapor.
- Do not install the meter on an electrical service with current or voltage outside of the specified limits of the device.
- Do not operate the meter with the cover removed.
- To avoid electric shock, disconnect mains before replacing fuses.
- Beware of working around this meter when the voltage is live. There is a risk of electric shock.
- To avoid electrical shock always install CT shorting links before removing meter head if system is live.
- For protection against fire, replace only with fuses of the specified voltage and current rating.
- See instructions for connection diagrams.

PROTECTIVE CONDUCTOR TERMINAL

Securely fasten one end of the grounding wire so that the grounding screw cuts the paint on the back box. Securely fasten other end of the wire to true ground connection. When grounding to the electrical conduit, use continuous metallic pipes, bending when necessary instead of using couplers.



Figure 4-1. Grounding Screw.

INSTALLATION INSTRUCTIONS FOR METER, MCI, AND CTs



The use of the following procedure is mandatory both for safety and meter certification purposes. Certification requires a visual inspection of the current transformers and the voltage taps on the incoming feeder phase wires.

The MiniCloset-5c installation procedure consists of the following steps:

1. Install metal box
2. Optional communication module is installed, run communications wiring
3. Connect the meter's voltage inputs to supply voltage
4. Install Current Transformers (CT) in distribution panel and connect to the meter's current inputs
5. Install meter head and optional communications unit, plug in to wiring harness

The installer needs to understand the following:

In order for the meter to be certified after installation, it must be possible to identify the phase to which each voltage tap and CT is connected. Therefore, it is a requirement that all wires be properly color-coded. Failure to color-code the wires will make it impossible to certify the meter, and may require the entire installation to be re-done. In this document, we use the following color code:

Black – Phase A, or Line 1 for 240V installations

Red – Phase B, or Line 2 for 240V installations

Blue – Phase C

White – Neutral (In wye installations only)

Local codes may require a different color code. If so, the installer must use the required color code consistently for each wire connecting the meter to the distribution panel.

Step 1: Install the back box and conduit

The MC-5c back box is the enclosure for the MCI and fuse block. The MC-5c back box is supplied with the fuse block pre-installed. If the optional communication module is ordered, it is pre-mounted to the MC-5c front cover. The MCI board contains the 48 screw terminal connections for the current transformers. It is supplied with the MCI and current connector wiring harness installed, with the CT shorting links in place.

1. Locate a section of wall to mount the meter. This should be as close as possible to the distribution panel (preferably within 24").
2. Mount the MC-5c back box to the wall. Connect the distribution panel box to the MC-5c back box with a metal conduit. This conduit will be used for the voltage taps. (Note: The installer should use caution in creating punch outs other than those provided as this may prevent the proper installation of the meter head). There will be between 2 and 4 #12AWG wires in this conduit, connected to the hot line(s) and neutral (if present). The conduit should be sized to accommodate this. Also, a fused disconnect for the hot wires may be required. If so, the conduit should run through the fused disconnect.

3. Run a second metal conduit from the distribution panel box to the MC-5c back box. This conduit will be used for the CT secondary wires. In a 24-channel installation, there will be 48 #16AWG wires. The conduit should be sized to accommodate this.
4. The metal box must be grounded. Either a ground wire may be run and attached to one of the box mounting screws, or the box may be grounded by the conduit. Securely fasten one end of the grounding wire so that the screw cuts the paint on the back box. Securely fasten the other end of the wire to true earth ground connection. When grounding to the electrical conduit, use continuous pipes, bending when necessary instead of using couplers.

Step 2: Connect optional communications wiring

1. If using the optional communications module, you must arrange for the proper type of communication line to be brought to the communications module box. This could be a telephone line, an RS-232 connection, or an RS-485 connection. This communication line will connect to other equipment on-site. The details of this connection depend on the particular installation.
2. Refer to detailed information for optional communication in the Appendix, page 76).

Step 3: Connect voltage taps



WARNING:

Power must be off when connecting these wires!

1. Locate the incoming feeder phase (hot) wires in the distribution panel. If color coded wiring is not being used, tape the incoming feeder wires with colored electrical tape according to phase, for identification purposes.
2. Tap the feeder connections with #12 AWG stranded wires. These voltage connections can be made in any way that meets local codes and requirements. It is recommended that some means be provided to disconnect these voltage lines to facilitate servicing of the meter (fused disconnect, breaker, etc). Note: If fused, then no less than a 15A 'Fast Acting' fuses must be used. The color of the insulation on these wires must match the color of the feeder connections to which they are attached. If neutral is required, tap the neutral connection with a #12 AWG stranded wire with white insulation.
3. Run the #12 AWG feeder phase tap wires through the conduit to the MC-5c back box. Connect the wires to the MiniCloset-5c Fuse Block.

Step 4: Install and connect Current Transformers (CTs)



WARNING:

Power must be off when connecting these wires!

DANGER:

Un-terminated CT secondary wires will produce hazardous electrical potentials if any current is flowing through the CT. While connecting the CTs, POWER MUST BE OFF until the CTs have all been connected to the MCI. Before power can be turned on, either the shorting links must be in place, or the 4 CT connectors must be plugged in to the meter head. Turning the power on with the meter unplugged and the shorting links removed will result in a condition that is hazardous to equipment and personnel.



This is the general procedure for connecting the current transformers. For specific wiring instructions, refer to page 18 to identify the current instructions for your meter model.

1. Make sure shorting links are installed on the MCI.
2. Each CT is supplied with two secondary wires. One of these wires is colored either black, red, or blue, and the other wire is white. These 2 wires must pass through the conduit to the MC-5c back box, and connect to screw terminals on the MCI.
3. If the wires that are supplied with the CTs are too short to reach the MCI screw terminals, they may be extended to different length depending upon the gauge of the wire as shown in the table 4-2. (For the file runs over 50' use a shielded twisted pair.) The wire extensions should be black, red, or blue wire to match the existing CT wire. Extend the white wire of each CT with a white wire. It is very important to maintain the association of particular CT's secondary wires. You must keep track of which white wire goes with each individual colored wire. It may be helpful to tape them together before being pulling them through the conduit.

Wire Size (AWG)	Length (feet)	
	0.1A CT	5A CT
#16	223	21
#14	355	34
#12	562	53
#10	893	85

Table 4-2: CT wire extension length



Wire color coding may vary depending on local codes and regulatory standards within certain jurisdictions.



Refer to the Phase Association tables later in this chapter when wiring the MCI. Failure to observe proper phase association will result in incorrect metering data.

4. Locate the branch load hot wires that supply current from the distribution panel to the metered loads. Disconnect these wires one (or two) at a time and properly run each wire (or pair of wires) through a CT. The colors of the CT leads must correspond to the color of the tape on the phase feeder wires that supply this load. The correct way to run the load wires through the CT is different for different installations.
5. Run the CT secondary wires through the conduit to the MC-5c back box. Connect each CT to its proper pair of screw terminals. It is very important the 2 wires from a particular CT go to the corresponding pair of screw terminals on the MCI. For example, if the black wire from a CT goes to terminal "I1", then the white wire from that same CT

must go to terminal "N1". The actual arrangement of the CT connections depends on the installation configuration.

6. Repeat items 4 and 5 (above) for each CT until all CTs have been installed and connected to the MCI screw terminals.
7. Step 4 is complete if the shorting links are in place, the power can now be turned on. However, if you are installing the meter head immediately, leave the power off until the meter head has been installed.

Step 5: Install equipment and covers



It is much better to do this step with the power off. However, if it is not possible to turn the power off, this step can be done with power on. If power is on and meter head is unplugged, SHORTING LINKS MUST BE IN PLACE.

1. Plug the 4 Current connectors, labeled CT1, CT2, CT3, and CT4 into the corresponding connectors in the back of the meter head. The connectors are color-coded and polarized. Make sure that the color of the plugs matches the color of the connectors on the meter head. There are 2 connectors of each color, but they will only plug in one way because one of the connectors has male pins, and the other has female pins. If a connector does not mate easily, try the other same-colored connector.
2. If the optional Communications Module is installed, there will be a 4-pin connector on the end of a wire coming out of the MC-5c meter head. Plug this connector into its mate connector which is on the end of a wire that goes into the Communications Module housing.
3. Plug the voltage connector from the fuse block (see figure 3-1) into the back of the meter head.
4. Make certain that the current connectors voltage connectors and ribbon cable on the meter head are all plugged in securely and correctly.
5. Remove the shorting links from the MCI.
6. Close cover and secure with provided screw.
7. If power was off, turn it on.
8. Installation is complete. The LCD on the MC-5c meter head should be displaying letters and numbers. The meter is ready for testing and certification.

CAUTION:



When reading the meter display, all consumption and demand values must be multiplied by the correct multiplier to calculate true value.

Please refer to Chapter 6: Applying Multipliers.

WIRING OVERVIEW

Review the following wiring types and select the one that matches your installation requirements and catalog number using the following table.

Section	Catalog No.	Manufacturer's Description	Page Reference
3-Phase, 4-Wire Wye Wiring	MC5c120V L 06C	3EL/6M 120/208V 3P4W	18
	MC5c120V L 08C	3EL/8M 120/208V 3P4W	
	MC5c277V L 06C	3EL/6M 277/480V 3P4W	
	MC5c277V L 08C	3EL/8M 277/480V 3P4W	
	MC5c120V H 06C	3EL/6M 120/208V 3P4W	
	MC5c120V H 08C	3EL/8M 120/208V 3P4W	
	MC5c277V H 06C	3EL/6M 277/480V 3P4W	
	MC5c277V H 08C	3EL/8M 277/480V 3P4W	
1-Phase, 3-Wire 120/208V Wiring (Network)	MC5c120V L 03R	2EL/3M 120/208V 3P4W	25
	MC5c120V L 06R	2EL/6M 120/208V 3P4W	
	MC5c120V L 09R	2EL/9M 120/208V 3P4W	
	MC5c120V L 12R	2EL/12M 120/208V 3P4W	
	MC5c120V H 03R	2EL/3M 120/208V 3P4W	
	MC5c120V H 06R	2EL/6M 120/208V 3P4W	
	MC5c120V H 09R	2EL/9M 120/208V 3P4W	
	MC5c120V H 12R	2EL/12M 120/208V 3P4W	
3-Phase, 3-Wire Delta Wiring	MC5c208V L 12C	2EL/12M 208VDELTA3P3W	31
	MC5c208V H 12C	2EL/12M 208VDELTA3P3W	
	MC5c480V L 12C	2EL/12M 480VDELTA3P3W	
	MC5c480V H 12C	2EL/12M 480VDELTA3P3W	
3-Phase, 4-Wire 1 EL Wiring	MC5c120V L 24R1	1EL/24M 120/208V 3P4W	37
	MC5c277V L 24R1	1EL/24M 277/480 3P4W	
1-Phase, 3-Wire 240V 1EL Wiring	MC5c240V L 24R1	1EL/24M 240V 1P3W	43
	MC5c240V H 24R1	1EL/24M 240V 1P3W	
1-Phase, 3-Wire 240V 2EL Wiring	MC5c240V L 12R	2EL/12M 240V 1P3W	49
	MC5c240V H 12R	2EL/12M 240V 1P3W	

Table 4-3: Wiring Diagram / Model Reference

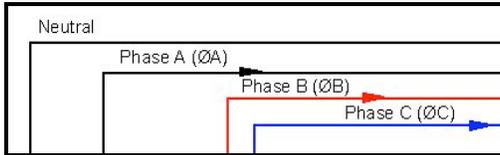
3-PHASE, 4-WIRE WYE WIRING



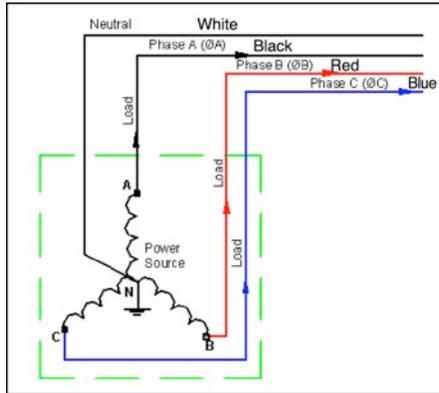
The phase association and polarity of the current transformers must be followed or the meter will not be correctly installed.

Detailed wiring instructions

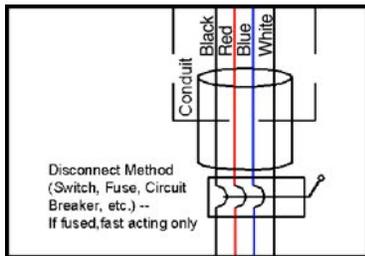
- A) Voltage taps
 - i. Follow voltage tap installation procedure on page 15.
 - ii. Color-code the main feeder wires as follows: Black – phase A; Red – Phase B; Blue – phase C; White – Neutral.



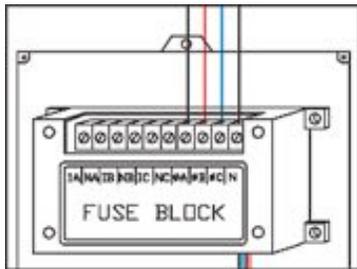
- iii. Connect #12 AWG wires to phase A, phase B, phase C, and Neutral. Wires must be Black (phase A), Red (phase B), Blue (phase C), and White (Neutral)



- iv. If required, run the hot wires through a disconnect switch (if fused, use 15A 'Fast Acting' fuses.)



- v. Run wires through conduit to MC-5c back box. Connect to screw terminals on fuse block. Black - VA; Red - VB; Blue - VC; White - N



B) CT installation

- i. Follow CT installation procedure on page 15.
- ii. For each load, determine which voltage phase supplies the power. Then use a CT with the corresponding color code for that load (Black, Red, or Blue).
- iii. Route the load wire through the CT as shown in the diagram
- iv. Connect the CT secondary wires to the MCI according to the following procedure:

1. Every CT MUST be connected to an MCI input which is referenced to the correct phase (see Figure 4-4).
2. The meter can be configured in two ways:
 - a. Commercial: (6) 3-phase meters or (8) 3-phase meters

For these installations, the meter measures (6) or (8) 3-phase loads. The 3 CTs from each load (one for each phase) must be connected to 3 adjacent inputs, as shown in Figures 4-4.

Installation Notes

CRITICAL:

The Phase Association and Polarity of the current transformers must be followed or meter will not be installed correctly.

Current transformers (CTs) are used to measure the current drawn by the loads to be metered. Within the meter, the current reading from the CT is combined with the voltage reading for the correct voltage phase to calculate the energy reading. CTs must be in phase with reference voltage. The MCI inputs are each associated with a particular voltage phase in an A-B-C order. Input 1 is a phase A CT, input 2 is a phase B CT, input 3 is a phase C CT, input 4 is a phase A CT, and so on in A-B-C-A-B-C order.

Meter	MCI Board CT	Voltage Phase	Meter	MCI Board CT	Voltage Phase
1	1	A	5	13	A
	2	B		14	B
	3	C		15	C
2	4	A	6	16	A
	5	B		17	B
	6	C		18	C
3	7	A	7	19	A
	8	B		20	B
	9	C		21	C
4	10	A	8	22	A
	11	B		23	B
	12	C		24	C

Figure 4-4. CT phase association for 3-phase, 4-wire loads

For example, a current transformer which measures a load supplied by phase A must be installed on CT1, CT4, CT7, etc. Current transformers which measure a load supplied by phase B must be installed on CT2, CT5, CT8, etc. Lastly, current transformers which measure a load supplied by phase C must be installed on CT3, CT6, CT9, etc.

1. For Commercial (designated with "C") 3-phase/4-wire model, each A-B-C combination is a single meter point:
 - Meter #1 (M#1) is CT1, CT2, and CT3
 - Meter #2 (M#2) is CT4, CT5, and CT6
 - Repeat for M#3 to M#8

2. Follow local codes for installation requirement, e.g. conduit, fused disconnect, distance, and wiring.
3. For six (6) 3-phase metering points, model numbers:
 - a) MC5c 120V L 06C
 - b) MC5c 277V L 06C
 - c) MC5c 120V H 06C
 - d) MC5c 277V H 06C

Use meter points M#1-M#6. M#7 and M#8 are not configured for operation.



CAUTION:

If breakers are energized, shorting links must be installed before:

- a) Disconnecting the CT headers or
- b) Replacing or installing meter heads on the panel.



WARNING:

Bodily injury or damage may result if shorting links are not installed.

INSTALLATION NOTES
 Applicable for the following catalog numbers¹:
 MCS5120V * 06C (DEL6M 120/208V 3P4W)
 MCS5120V * 06C (DEL8M 120/208V 3P4W)
 MCS5277V * 06C (DEL6M 277/480V 3P4W)
 MCS5277V * 06C (DEL8M 277/480V 3P4W)
 MCS5230V * 06C (DEL6M 230/400V 3P4W)
 * = "L" for 0.1 Amp inputs or "H" for CL10 (5 Amp) inputs

¹Also applicable when the same meter model number has the suffix: M, RS, or P.

CRITICAL: The installation of the current transformer must be correct or the meter will not read properly. The load-current carrying wires must pass through the CT in the correct orientation, and the CT wires must be connected to the proper MCI screw terminals. Please see wiring diagram for reference.

Current transformers (CTs) are used to measure the current drawn by the loads to be metered. CTs must be at 0.1A or 5A and cannot be mixed on the same meterhead. Within the meter, the current reading from the CT is combined with the voltage reading for the correct voltage phase to calculate the energy reading. CTs must be in phase with the reference voltage. The MCI inputs are each associated with a particular voltage phase in an A-B-C order. Input 1 is a phase A CT, input 2 is a phase B CT, input 3 is a phase C CT, input 4 is a phase A CT, and so on in A-B-C-A-B-C order.

For example, a CT which measures a load supplied by phase A must be installed on CT1, CT4, CT7, etc. Current transformers which measure a load supplied by phase B must be installed on CT2, CT5, CT8, etc. Lastly, current transformers which measure a load supplied by phase C must be installed on CT3, CT6, CT9, etc.

1. For the catalog numbers specified above, each A-B-C combination is a single meter point (see Table 1 for full listing):
 - Meter #1 (M#1) is CT1, CT2, and CT3
 - Meter #2 (M#2) is CT4, CT5, and CT6
 - repeat for M#3 to M#6

2. After completing all CT terminations, connect the four (4) current connectors from the MCI board to the meterhead and then remove shunting links for all meter points that are in use.

3. Follow local codes for installation requirement, e.g. conduit, fused disconnect, distance, and wiring

4. Installation of 0.1A ("L") inputs and CL10 or 5A ("H") inputs are the same.

5. For six (6) 3-phase metering points, catalog numbers:
 - MCS5120V * 06C
 - MCS5277V * 06C
 Use meter points M#1-M#6. M#7 and M#8 are not functional.

CAUTION: If breakers are energized, shunting links must be installed before:
 a) disconnecting the CT heads or
 b) replacing or installing meter heads on the panel.

WARNING: Bodily injury or damage may result if shunting links are not installed.

Meter # (M#)	MCI Board CT #	Reference Voltage Phase
1	1	A
	2	B
	3	C
2	4	A
	5	B
	6	C
3	7	A
	8	B
	9	C
4	10	A
	11	B
	12	C
5	13	A
	14	B
	15	C
6	16	A
	17	B
	18	C
7	19	A
	20	B
	21	C
8	22	A
	23	B
	24	C

Table 1. Phase Association Table

		TITLE 3-PHASE, 4-WIRE WYE WIRING DIAGRAM	
SIGNATURE _____ DATE _____	JUREA JUREA	DATE _____	REV 1.1R
M#1 M#2 M#3	M#4 M#5 M#6	M#7 M#8	M#9 M#10
PART 17-MCS5C3P-4WCDM1		SCALE 1:1	SHEET 1 OF 2

Figure 4-5. 3-phase, 4-wire wye wiring

BEFORE READING THE DISPLAY FOR ANY MC-5c PRODUCT

CAUTION: When reading the meter display, all consumption and demand values must be multiplied by the correct multiplier to calculate true value. This includes all register values (kWh, kW, KVARHLG, KVARHLD, etc.) and Phase Diagnostic values (real time Amps, Watts, etc.)

Volts, phase angle, frequency and power factor are displayed on the LCD as their true values and should not be multiplied.

The multiplier value is dependent upon the ratio of the external Current Transformers (CTs) and can be different for different meter points. Please consult Table 1 CT Multipliers for the appropriate value dependent upon the rating (or size) of the CT.

HOW CT MULTIPLIERS ARE CALCULATED:

0.1AMP CTs

The multiplier values for CTs with 0.1A secondary ratings are derived by dividing the primary side rating by 100. For example, a 50:0.1A-rated CT will have a multiplier of 50 ÷ 100, which is 0.50. A 100:0.1A rated CT will have a multiplier of 100 ÷ 100 which is 1.

5AMP CTs

For CTs with 5A secondary ratings, the multipliers are derived by dividing the primary side rating by 5. For example, a 200:5A-rated CT will have a multiplier of 200 ÷ 5, which is 40.

EXAMPLE:

Meter point with 400:0.1A CT
 LCD reading for meter is 3422.119kWh
 The correct cumulative consumption (kWh) for this meter is **13688.476 kWh**.
 (400 ÷ 100 = 4. Multiply face value for consumption and demand values by 4. 3422.119 x 4 = 13688.476)

NOTE: Failure to use the appropriate multiplier will result in an incorrect diagnosis of the meter's functionality and incorrect revenue billing.

Meter Voltage Ratings	CT Rating	Multiplier for 0.1A CT	Multiplier for 5.0A CT
FOR 120V, 208V, 240V (Wye), 277V, 347V, 416V, 480V, 600V	50A	x0.5	x10.0
	100A	x1.0	x20.0
	200A	x2.0	x40.0
	400A	x4.0	x80.0
	600A	x6.0	x120.0
	800A	x8.0	x160.0
	1200A	x12.0	x240.0
	1500A	x15.0	x300.0
	1600A	x16.0	x320.0
	2000A	x20.0	x400.0
3000A	x30.0	x600.0	
3200A	x32.0	x640.0	
4000A	x40.0	x800.0	

FOR 240V (Split-Phase)	100A	x0.5	x20.0
	200A	x1.0	x40.0

Table 1. CT Multipliers

REVISED		
REV	DESCRIPTION	DATE

	DATE	
	ISSUED BY	
	APPROVED BY	
	SCALE	

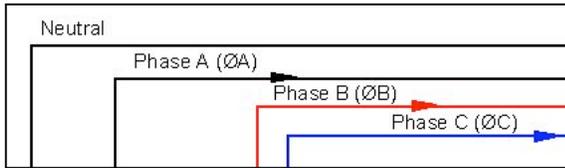
TITLE	3-PHASE, 4-WIRE WYE WIRING DIAGRAM
REV	

1-PHASE, 3-WIRE 120/208V WIRING (NETWORK)

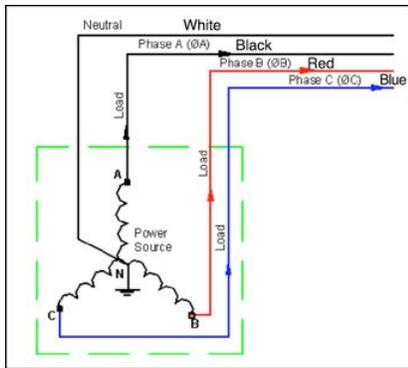
The phase association and polarity of the current transformers must be followed or the meter will not be correctly installed.

Detailed Wiring Instructions

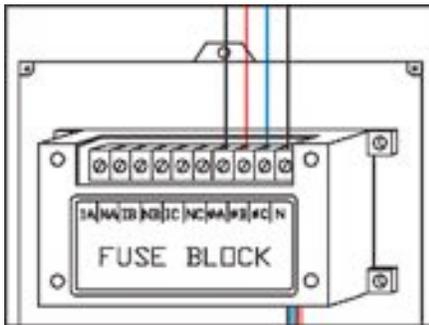
- A) Voltage taps
 - i. Follow voltage tap installation procedure on page 15.
 - ii. Color-code the main feeder wires as follows: Black – phase A; Red – phase B; Blue – phase C; White – Neutral.



- iii. Connect #12 AWG wires to phase A, phase B, phase C, and Neutral. Wires must be Black (phase A), Red (phase B), Blue (phase C), and White (Neutral)



- iv. If required, run the hot wires through a disconnect switch (if fused, use 15A 'Fast Acting' fuses.)
- v. Run wires through conduit to MC-5c back box. Connect to screw terminals on fuse block. Black – VA; Red – VB; Blue – VC; White – N



- B) CT installation
- i. Follow CT installation procedure on page 13.
 - ii. For each load, determine which voltage phase supplies the power. Then use a CT with the corresponding color code for that load (Black, Red, or Blue).
 - iii. Route the load wire through the CT as shown in the diagram
 - iv. Connect the CT secondary wires to the MCI according to the following procedure:
 - v. Every CT MUST be connected to an MCI input which is referenced to the correct phase (See Figure 4-6.)
 - vi. This type of meter is configured as a Residential 2-phase meter. For these installations, the meter measures (12) 2-phase loads. Each metered load has 2 CTs. The 2 CTs from a particular metered load must be connected to adjacent inputs as shown in the chart. Note that meter 1 uses phases A and B, meter 2 uses phases C and A, meter 3 uses phases B and C, and so on.

Installation Notes

CRITICAL:

The Phase Association and Polarity of the current transformers must be followed or meter will not be installed correctly.

1. Current transformers must be in phase with Reference Voltage. The MCI runs in an A-B-C phase rotation and each three CT connections repeat an A-B, C-A, and B-C order.

Meter	MCI Board CT	Voltage Phase	Meter	MCI Board CT	Voltage Phase
1	1	A	7	13	A
	2	B		14	B
2	3	C	8	15	C
	4	A		16	A
3	5	B	9	17	B
	6	C		18	C
4	7	A	10	19	A
	8	B		20	B
5	9	C	11	21	C
	10	A		22	A
6	11	B	12	23	B
	12	C		24	C

Figure 4-6. CT phase association for 1-phase, 3-wire 120/208V loads.

For example, current transformers installed in phase with A reference voltage must be installed on CT1, CT4, CT7, etc. Current transformers installed in phase with B reference voltage must be installed on CT2, CT5, CT8, etc. Current transformers installed in phase with C reference voltage must be installed on CT3, CT6, CT9, etc.

2. Each A-B, C-A, and B-C combination is a single meter point (separated by yellow and white in the above chart):
 - Meter #1 (M#1) is measuring CT1 and CT2
 - Meter #2 (M#2) is measuring CT3 and CT4
 - repeat for M#3 to M#12

3. After completing all current transformer terminations, connect the four (4) current connectors and then remove the twenty-four (24) shorting links.
4. Follow local codes for installation requirement, e.g. conduit, fused disconnect, distance, and wiring.
5. Installation of 0.1A inputs and CL10 or 5A inputs are the same. For 3R, 6R, and 9R 3-phase metering points use meter points M#1-M#3, M#1-M#6, and M#1-M#9, respectively. M#4-M#12, M#7-M#12, and M#10-M#12 are not functional for three (3), six (6), and nine (9) 3-phase metering points, respectively.



CAUTION:

If breakers are energized, shorting links must be installed before:

- a) Disconnecting the CT headers or
- b) Replacing or installing meter heads on the panel.



WARNING:

Bodily injury or damage may result if shorting links are not installed.

BEFORE READING THE DISPLAY FOR ANY MC-5c PRODUCT

CAUTION: When reading the meter display, all consumption and demand values must be multiplied by the correct multiplier to calculate true value. This includes all register values (KWh, kW, kVARH, kVARS, etc.) and Phase Diagnostic values (real time Amps, Volts, etc.).

Volts, phase angle, frequency and power factor are displayed on the LCD as their true values and should not be multiplied.

The multiplier value is dependent upon the ratio of the external Current Transformers (CTs) and can be different for different meter points. Please consult Table 1 CT Multipliers for the appropriate value dependent upon the rating (or size) of the CT.

HOW CT MULTIPLIERS ARE CALCULATED:

0.1AMP CTs

The multiplier values for CTs with 0.1A secondary ratings are derived by dividing the primary side rating by 100. For example, a 50.0 1A-rated CT will have a multiplier of 50 ÷ 100, which is 0.50. A 100.0 1A rated CT will have a multiplier of 100 ÷ 100 which is 1.

5AMP CTs

For CTs with 5A secondary ratings, the multipliers are derived by dividing the primary side rating by 5. For example, a 200.5A-rated CT will have a multiplier of 200 ÷ 5, which is 40.

EXAMPLE:

Meter point with 400.0 1A CT
 LCD reading for meter is 3422.119kWh
 The correct cumulative consumption (kWh) for this meter is **13688.476 kWh**.
 (400 × 100 = 4. Multiply face value for consumption and demand values by 4. 3422.119 × 4 = 13688.476)

NOTE: Failure to use the appropriate multiplier will result in an incorrect diagnosis of the meter's functionality and incorrect revenue billing.

Meter Voltage Ratings	CT Rating	Multiplier for 0.1A CT	Multiplier for 5.0A CT
FOR 120V, 208V, 240V (Wye), 277V, 347V, 415V, 480V, 600V	50A	x0.5	x10.0
	100A	x1.0	x20.0
	200A	x2.0	x40.0
	400A	x4.0	x80.0
	600A	x6.0	x120.0
	800A	x8.0	x160.0
	1200A	x12.0	x240.0
	1500A	x15.0	x300.0
	1600A	x16.0	x320.0
	2000A	x20.0	x400.0
FOR 248V (Split-Phase)	100A	x0.5	x20.0
	200A	x1.0	x40.0

Table 1. CT Multipliers

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

ELC <small>Energy Logic Controls</small>		TITLE	
DESIGNER	DATE	1-PHASE, 3-WIRE 120/208V WIRING NETWORK DIAGRAM	
DRAWN	BY	SCALE	REV
APPROVED	DATE	1:1	1:1
PROJECT	SCALE	17-MC-5c120RES2ELR1	REV

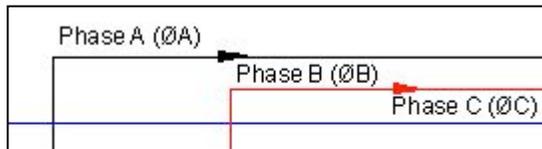
3-PHASE, 3-WIRE DELTA WIRING



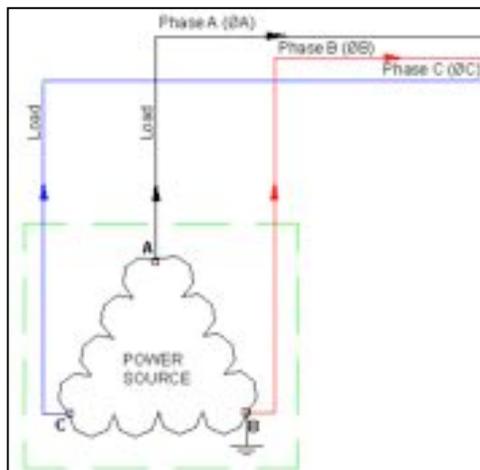
The phase association and polarity of the current transformers must be followed or the meter will not be correctly installed.

Detailed wiring instructions

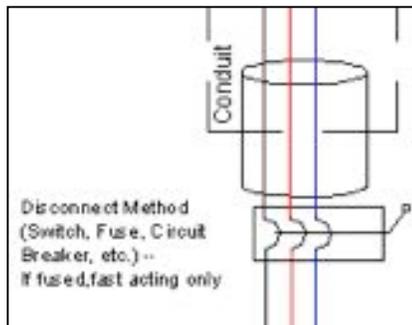
- A) Voltage taps
 - i. Follow voltage tap installation procedure on page 15.
 - ii. Color-code the main feeder wires as follows: Black – phase A; Red – phase B; Blue – phase C.



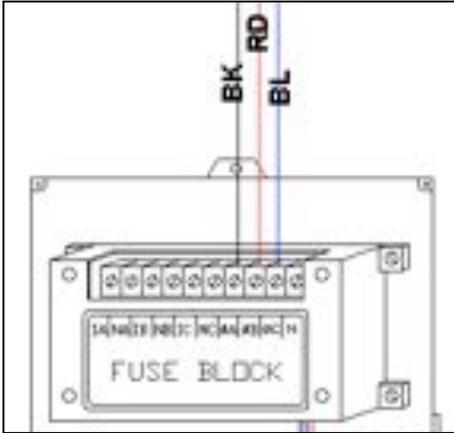
- iii. Connect #12 AWG wires to phase A, phase B, and phase C. Wires must be Black (phase A), Red (phase B), and Blue (phase C).



- iv. If required, run the hot wires through a disconnect switch (if fused, use 15A 'Fast Acting' fuses.)



- v. Run wires through conduit to MC5 back box. Connect to screw terminals on fuse block. Black – VA; Red – VB; Blue – VC.



- B) CT installation
 - i. Follow CT installation procedure on page 15.
 - ii. For each load, determine which voltage phase supplies the power. Then use a CT with the corresponding color code for that load (Black or Blue). Note: The Red phase is not directly measured with a CT.
 - iii. Route the load wire through the CT as shown in the diagram
 - iv. Connect the CT secondary wires to the MCI according to the following procedure:
 - v. Every CT MUST be connected to an MCI input which is referenced to the correct phase (See Figure 4-8).

This type of meter is configured as a Commercial meter with (12) 2-phase meters. For these installations, the meter measures (12) 2-phase loads. Each metered load has 2 CTs. The 2 CTs from a particular metered load must be connected to adjacent inputs as shown in the chart. Note that meter 1 uses phases A and C, meter 2 uses phases A and C, meter 3 uses phases A and C, and so on.

Installation Notes

CRITICAL:

The Phase Association and Polarity of the current transformers must be followed or meter will not be installed correctly.

- 1. Current transformers must be in phase with Reference Voltage. The MCI runs in an A-C phase rotation (See Figure 4-8) and each two CT connections repeat an A-C, A-C, A-C pattern

Meter	MCI Board CT	Voltage Phase	Meter	MCI Board CT	Voltage Phase
1	1	A	7	13	A
	2	C		14	C
2	3	A	8	15	A
	4	C		16	C
3	5	A	9	17	A
	6	C		18	C
4	7	A	10	19	A
	8	C		20	C
5	9	A	11	21	A
	10	C		22	C
6	11	A	12	23	A
	12	C		24	C

Figure 4-8. CT phase association for 3-phase, 3-wire delta loads.

For example, Current transformer installed in phase with A reference voltage must be installed on CT1, CT3, CT5, etc. Current transformers installed in phase with C reference voltage must be installed on CT2, CT4, CT6, etc.

2. Each A-C combination is a single meter point (see Table 1 for full listing):
 - Meter #1 (M#1) is measuring CT1 and CT2
 - Meter #2 (M#2) is measuring CT3 and CT4
 - repeat for M#3 to M#12
3. After completing all current transformer terminations, connect four (4) current connectors and then remove the twenty-four (24) shorting links.
4. Follow local codes for installation requirement, e.g. conduit, fused disconnect, distance, and wiring.
5. Installation of 0.1A inputs and CL10 (or 5A inputs) are the same.



CAUTION:

If breakers are energized, shorting links must be installed before:

- a) Disconnecting the CT headers or
- b) Replacing or installing meter heads on the panel.



WARNING:

Bodily injury or damage may result if shorting links are not installed.

INSTALLATION NOTES

Applicable for the following catalog numbers *:

MC5c208V * 12C (2ELJ12M 208VDELTA3P3W)
 MC5c480V * 12C (2ELJ12M 480VDELTA3P3W)

* = "L" for 0.1 Amp inputs or "H" for CL10 (5 Amp) inputs.

* Also applicable when the same meter model number has the suffix: M, RS, or P.

CRITICAL: The installation of the current transformer must be correct or the meter will not read properly. The load-current carrying wires must pass through the CT in the correct orientation, and the CT wires must be connected to the proper MCI screw terminals. Please see wiring diagram for reference.

Current transformers (CTs) are used to measure the current drawn by the loads to be metered. CTs must be all 0.1A or 5A and cannot be mixed on the same meterhead. Within the meter, the current reading from the CT is combined with the voltage reading for the correct voltage phase to calculate the energy reading. CTs must be in phase with the reference voltage. The MCI inputs are each associated with a particular voltage phase in an A-C order. Input 1 is a phase A CT, input 2 is a phase C CT, input 3 is a phase A CT, input 4 is a phase C CT, and so on in A-C-A-C order.

For example, a CT which measures a load supplied by phase A must be installed on CT1, CT3, CT5, etc. Current transformers which measure a load supplied by phase C must be installed on CT2, CT4, CT6, etc.

1. For the catalog numbers specified above, each A-C combination is a single meter point (see Table 1 for full listing)

- Meter #1 (M#1) is CT1 and CT2
- Meter #2 (M#2) is CT3 and CT4
- repeat for M#3 to M#12

2. After completing all CT terminations, connect the four (4) current connectors from the MCI board to the meterhead and then remove shorting links for all meter points that are in use.

3. Follow local codes for installation requirement, e.g. conduit, fused disconnect, distance, and wiring.

4. Installation of 0.1A ("L") inputs and CL10 or 5A ("H") inputs are the same.

CAUTION: If breakers are energized, shorting links must be installed before

- a) disconnecting the CT headers or
- b) replacing or installing meter heads on the panel.

WARNING: Bodily injury or damage may result if shorting links are not installed.

Motor # (M#)	MCI Board CT #	Reference Voltage	Phase
1	1	A	A
	2	C	C
2	3	A	A
	4	C	C
3	5	A	A
	6	C	C
4	7	A	A
	8	C	C
5	9	A	A
	10	C	C
6	11	A	A
	12	C	C
7	13	A	A
	14	C	C
8	15	A	A
	16	C	C
9	17	A	A
	18	C	C
10	19	A	A
	20	C	C
11	21	A	A
	22	C	C
12	23	A	A
	24	C	C

Table 1. Phase Association Table

ELC	ELECTRIC LOGGING	Building Controls Corporation	TITLE	3-PHASE, 3-WIRE DELTA WIRING DIAGRAM
REVISED	DATE	BY	SCALE	
REVISED	DATE	BY	SCALE	
REVISED	DATE	BY	SCALE	
REVISED	DATE	BY	SCALE	

Figure 4-9. 3-phase, 3-wire delta wiring

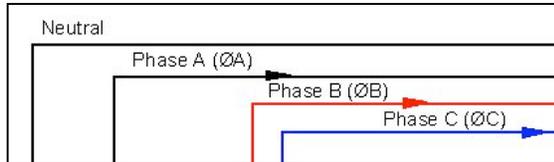
3-PHASE, 4-WIRE 1EL WIRING

The phase association and polarity of the current transformers must be followed or the meter will not be correctly installed.

Detailed wiring instructions

A) Voltage taps

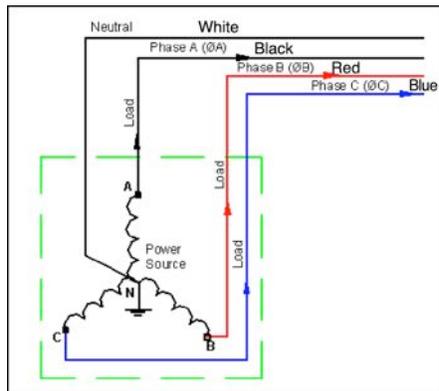
- i. Follow voltage tap installation procedure on page 15.
- ii. Color-code the main feeder wires as follows: Black – phase A; Red – phase B; Blue – phase C; White - Neutral.



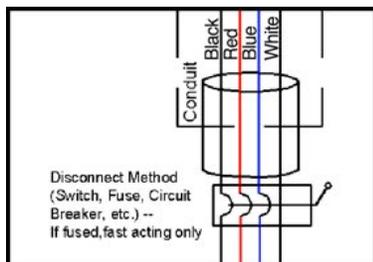
- iii. Connect #12 AWG wires to phase A, phase B, and phase C. Wires must be Black (phase A), Red (phase B), Blue (phase C) and White (Neutral).
- iv. If required, run the hot wires through a disconnect switch (if fused, use 15A 'Fast Acting' fuses.)
- v. Run wires through conduit to MC5 back box. Connect to screw terminals on fuse block. Black – VA; Red – VB; Blue – VC; White - N.

B) CT installation

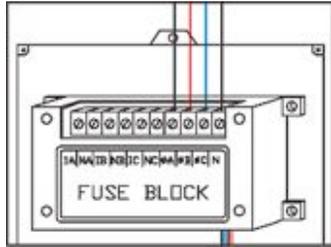
- i. Follow CT installation procedure on page 15.
- ii. For each load, determine which voltage phase supplies the power. Then use a CT with the corresponding color code for that load (Black, Red, or Blue).
- iii. Route the load wire through the CT as shown in the diagram



- iv. Connect the CT secondary wires to the MCI according to the following procedure:



- v. Every CT MUST be connected to an MCI input which is referenced to the correct phase (see Figure 4-8.)



- vi. This type of meter is configured as a Residential meter with (24) single-phase meters. For these installations, the meter measures (24) single-phase loads. Each metered load has one CT. The CT from a particular metered load must be connected to adjacent inputs as shown in the chart. Note that Meter 1 uses phase A, Meter 2 uses phases B, Meter 3 uses phases C, and so on.

Installation Notes

CRITICAL:

The Phase Association and Polarity of the current transformers must be followed or meter will not be installed correctly.

1. Current transformers must be in phase with Reference Voltage. The MCI runs in an A-B-C phase rotation and each CT connections repeat an A, B, C pattern.

Meter	MCI Board CT	Voltage Phase	Meter	MCI Board CT	Voltage Phase
1	1	A	13	13	A
2	2	B	14	14	B
3	3	C	15	15	C
4	4	A	16	16	A
5	5	B	17	17	B
6	6	C	18	18	C
7	7	A	19	19	A
8	8	B	20	20	B
9	9	C	21	21	C
10	10	A	22	22	A
11	11	B	23	23	B
12	12	C	24	24	C

Figure 4-10. CT phase association for single-phase, 2-wire loads.

For example, Current transformer installed in phase with A reference voltage must be installed on CT1, CT4, CT7, etc. Current transformers installed in phase with B reference voltage must be installed on CT2, CT5, CT8, etc. Current transformers installed in phase with C reference voltage must be installed on CT3, CT6, CT9, etc.

2. Each phase is a single meter point (see Figure 4-10 for full listing):
 - Meter #1 (M#1) is measuring CT1
 - Meter #2 (M#2) is measuring CT2
 - Meter #3 (M#3) is measuring CT3
 - repeat for M#4 to M#24
3. After completing all current transformer terminations, connect four (4) current connectors and then remove the twenty-four (24) shorting links.
4. Follow local codes for installation requirement, e.g. conduit, fused disconnect, distance, and wiring.
5. Installation of 0.1A inputs and CL10 (or 5A inputs) are the same.



CAUTION:

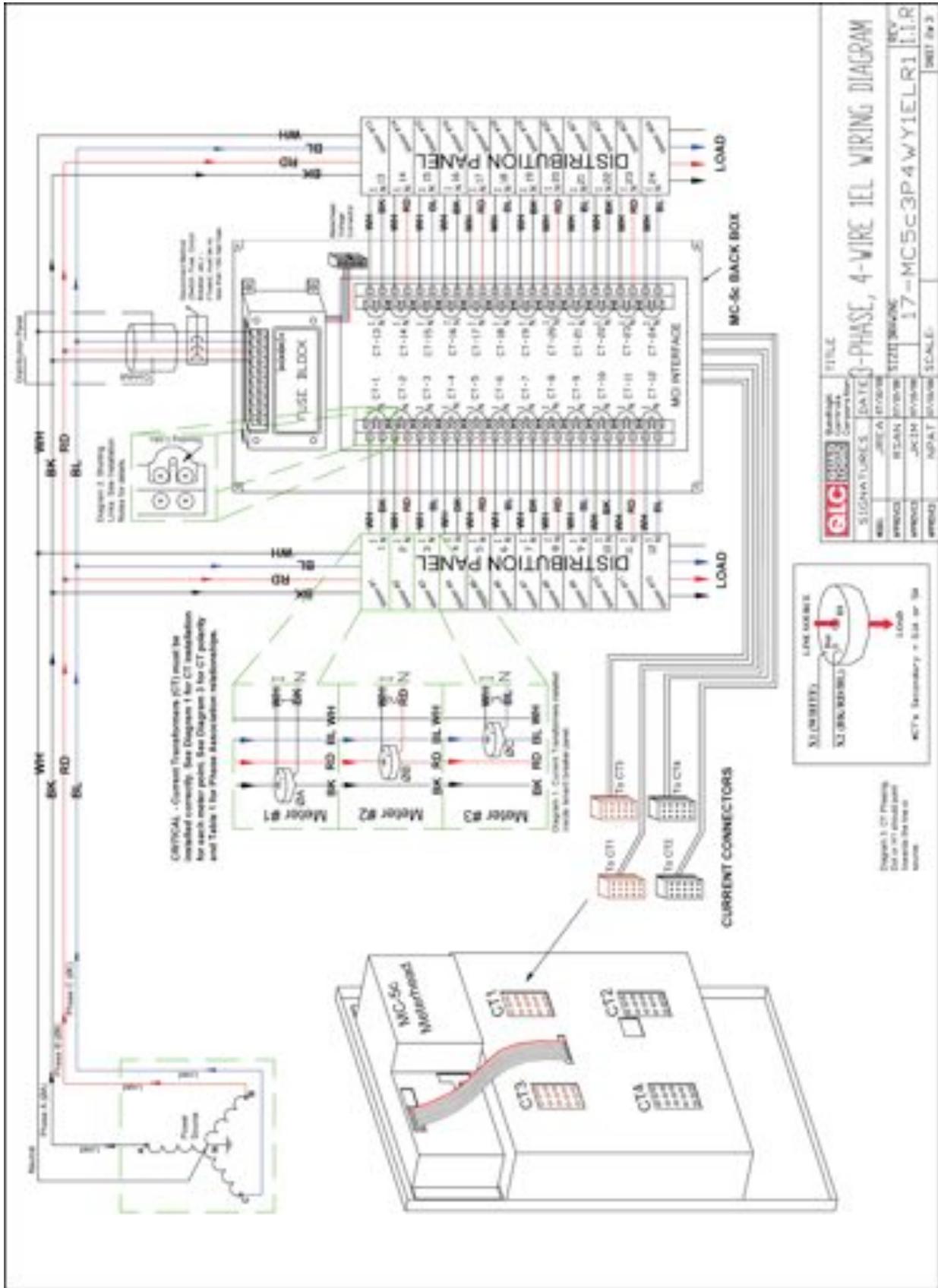
If breakers are energized, shorting links must be installed before:

- a) Disconnecting the CT headers or
- b) Replacing or installing meter heads on the panel.



WARNING:

Bodily injury or damage may result if shorting links are not installed.



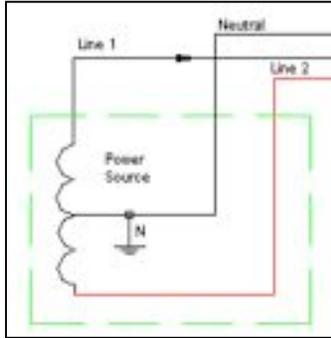
1-PHASE, 3-WIRE 240V 1EL WIRING

The phase association and polarity of the current transformers must be followed or the meter will not be correctly installed.

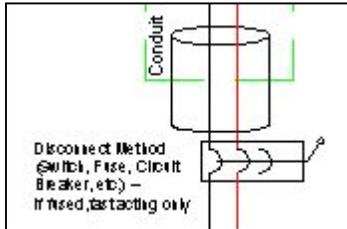
Detailed wiring instructions

A) Voltage taps

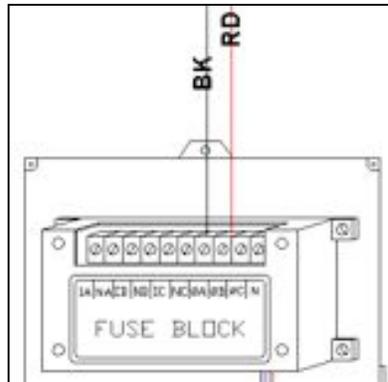
- i. Follow voltage tap installation procedure on page 15.
- ii. Color-code the main feeder wires as follows: Black – Line 1; Red – Line 2.
- iii. Connect #12 AWG wires to Line 1 and Line 2. Wires must be Black (Line 1) and Red (Line 2).



- iv. If required, run the hot wires through a disconnect switch (if fused, use no less than 15A 'Fast Acting' fuses.)



- v. Run wires through conduit to MC5 back box. Connect to screw terminals on fuse block. Black – VA; Red – VB.



B) CT installation

- i. Follow CT installation procedure on page 15.
- ii. For each load, determine which voltage phase supplies the power. Then use a CT with the corresponding color code for that load (Black or Red).
- iii. Route the load wire through the CT as shown in the diagram
- iv. Connect the CT secondary wires to the MCI according to the following procedure:
- v. Every CT MUST be connected to an MCI input which is referenced to the correct phase (see chart).
- vi. This type of meter is configured as a Residential meter with (24) 1-phase meters. For these installations, the meter measures (24) 1-phase loads. Each metered load has 1 CT. The single CT from a particular metered load must be connected to adjacent inputs as shown in the chart. Note that ALL meter points use Line 1 and Line 2.

Installation Notes

CRITICAL:

The Phase Association and Polarity of the current transformers must be followed or meter will not be installed correctly.

1. Each CT has a white side, small white dot, or "H1" marking on only one side of its exterior moulding. Locate this marking since it is critical that the wires are passed through the CT in the correct direction, assuring the correct polarity.

Two wires coming from the line side are passed through each current transformer (CT).

Line 1 (Wire 1): Line 1 should be passed through the CT from the side with the white side, dot/H1 marking.

Line 2 (Wire 2): Line 2 should be passed through the CT from the side WITHOUT the white side, dot/H1 marking. Note that these are opposite polarities.

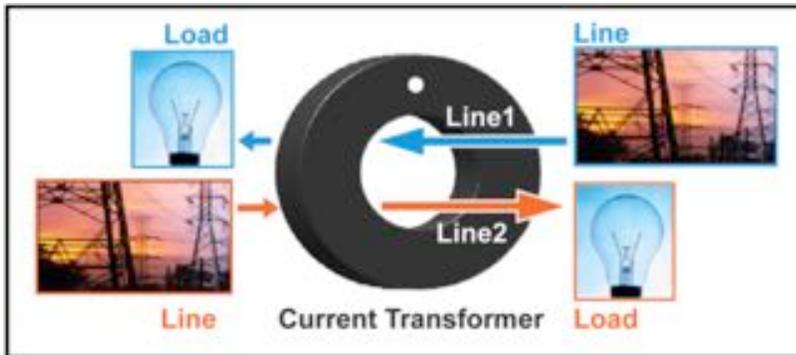


Figure 4-12. Line 1 and Line 2 passed through a current transformer.

2. The MCI runs CT terminals CT#1 to CT#24 with each terminal connected to Meter #1 (M#1) to Meter #24 (M#24). The number of CT terminal and meter connections will depend on the number of suites available. For example:
 - M#1 connects to CT#1
 - M#2 connects to CT#2
 - Repeat for M#3 to M#24

Meter	MCI Board CT	Reference Voltage Line	Meter	MCI Board CT	Reference Voltage Line
1	1	L01(+) and L02(-)	13	13	L01(+) and L02(-)
2	2	L01(+) and L02(-)	14	14	L01(+) and L02(-)
3	3	L01(+) and L02(-)	15	15	L01(+) and L02(-)
4	4	L01(+) and L02(-)	16	16	L01(+) and L02(-)
5	5	L01(+) and L02(-)	17	17	L01(+) and L02(-)
6	6	L01(+) and L02(-)	18	18	L01(+) and L02(-)
7	7	L01(+) and L02(-)	19	19	L01(+) and L02(-)
8	8	L01(+) and L02(-)	20	20	L01(+) and L02(-)
9	9	L01(+) and L02(-)	21	21	L01(+) and L02(-)
10	10	L01(+) and L02(-)	22	22	L01(+) and L02(-)
11	11	L01(+) and L02(-)	23	23	L01(+) and L02(-)
12	12	L01(+) and L02(-)	24	24	L01(+) and L02(-)

3. After completing all current transformer terminations, connect four (4) current connectors and then remove the twenty-four (24) shorting links.
4. Follow local codes for installation requirement, e.g. conduit, fused disconnect, distance, and wiring.
5. Installation of 0.1A inputs and CL10 or 5A inputs are the same. For 12R and 24R use meter points M#1-M#12 and M#1-M#24, respectively. M#13-M#24 is not functional for Model 12R.



CAUTION:

If breakers are energized, shorting links must be installed before:

- a) Disconnecting the CT headers or
- b) Replacing or installing meter heads on the panel.

Bodily injury or damage may result if shorting links are not installed.

INSTALLATION NOTES

Applicable for the following catalog numbers:

MC5C240V * 24R1 (1EL/24M 240V 1P3W)

* = "L" for 0.1 Amp inputs or "H" for CL10 (5 Amp) inputs.

* Also applicable when the same meter model number has the suffix M, RS or P.

CRITICAL: The line association and polarity of the current transformers must be followed or meter will not be installed correctly.

CTs must be all 0.1A or 5A and cannot be mixed on the same meterhead.

1. Each CT has a white side, small white dot, or "H1" marking on only one side of its exterior moulding. Locate this marking since it is critical that the wires are passed through the CT in the correct direction, assuring the correct polarity.

Two wires coming from the line side are passed through each CT.

Line 1 (Wire 1): Line 1 should be passed through the CT from the side with the white side, dot, or H1 marking.

Line 2 (Wire 2): Line 2 should be passed through the CT from the side WITHOUT the white side, dot, or H1 marking. Note that these are opposite polarities.

2. The MCI runs CT terminals CT#1 to CT#24 with each terminal connected to Meter #1 (M#1) to Meter #24 (M#24). The number of CT terminal and meter connections will depend on the number of suites available. For example:

- M#1 connects to CT#1
- M#2 connects to CT#2
- repeat for M#3 to M#24

3. After completing all CT terminations, connect the four (4) current connectors from the MCI board to the meterhead and then remove shorting links for all meter points that are in use.

4. Follow local codes for installation requirement, e.g. conduit, fused disconnect, distance, and wiring.

5. Installation of 0.1A ("L") inputs and CL10 or 5A ("H") inputs are the same.

CAUTION: If breakers are energized, shorting links must be installed before:

- a) disconnecting the CT headers or
- b) replacing or installing meter heads on the panel.

WARNING: Bodily injury or damage may result if shorting links are not installed.

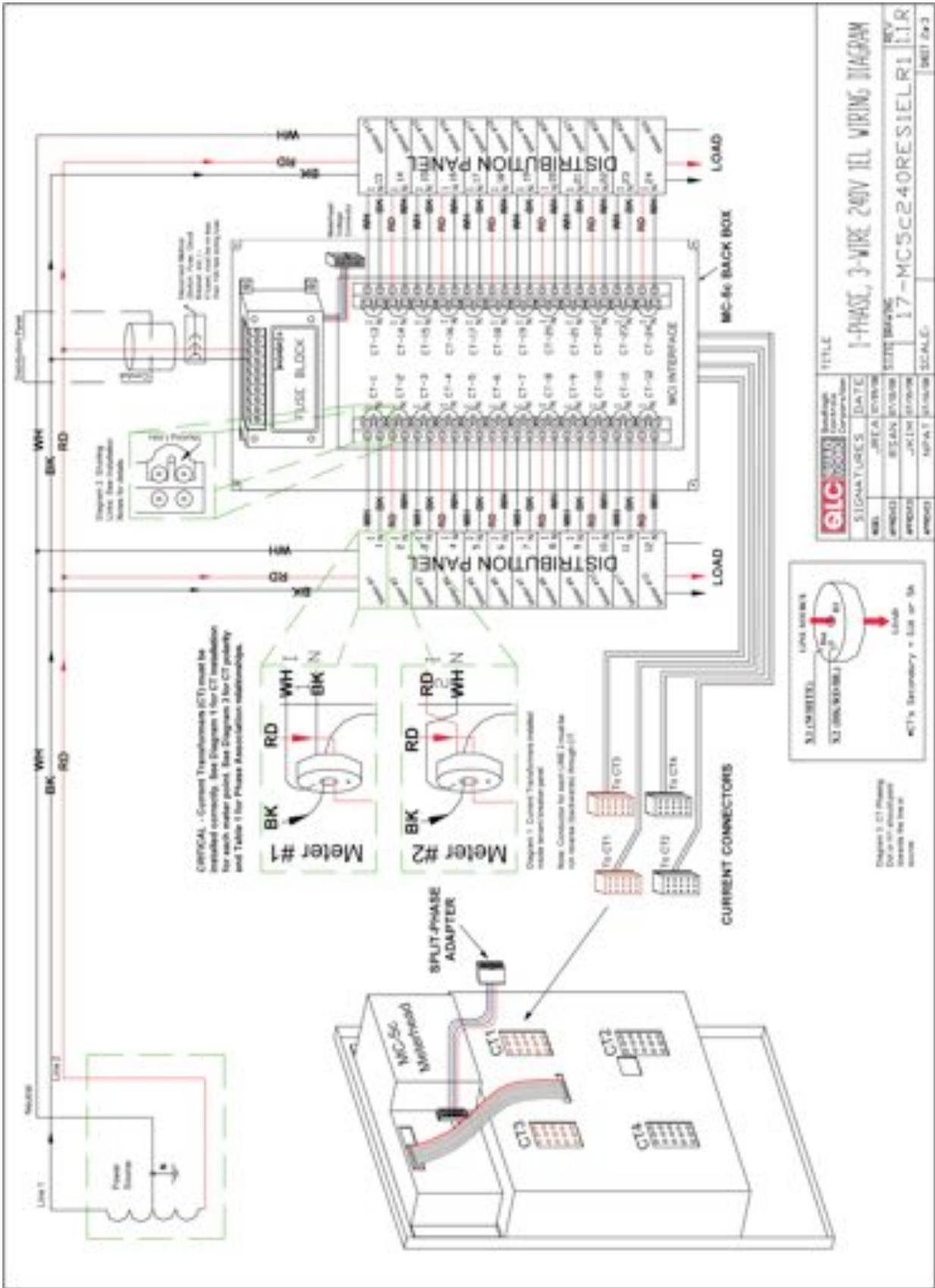
Meter # (M#)	MCI Board CT #	Reference Voltage Line*
1	1	L#1 (+) & L#2 (-)
2	2	L#1 (+) & L#2 (-)
3	3	L#1 (+) & L#2 (-)
4	4	L#1 (+) & L#2 (-)
5	5	L#1 (+) & L#2 (-)
6	6	L#1 (+) & L#2 (-)
7	7	L#1 (+) & L#2 (-)
8	8	L#1 (+) & L#2 (-)
9	9	L#1 (+) & L#2 (-)
10	10	L#1 (+) & L#2 (-)
11	11	L#1 (+) & L#2 (-)
12	12	L#1 (+) & L#2 (-)
13	13	L#1 (+) & L#2 (-)
14	14	L#1 (+) & L#2 (-)
15	15	L#1 (+) & L#2 (-)
16	16	L#1 (+) & L#2 (-)
17	17	L#1 (+) & L#2 (-)
18	18	L#1 (+) & L#2 (-)
19	19	L#1 (+) & L#2 (-)
20	20	L#1 (+) & L#2 (-)
21	21	L#1 (+) & L#2 (-)
22	22	L#1 (+) & L#2 (-)
23	23	L#1 (+) & L#2 (-)
24	24	L#1 (+) & L#2 (-)

Note: L#1 (+) = Line #1 points toward DOIT or H1 of CT
L#2 (-) = Line #2 points away from DOIT or H1 of CT

Table 1. Line Association Table

BLC	Building Construction	DATE	TITLE
REV	DATE	DATE	1-PHASE, 3-WIRE 240V 1EL WIRING DIAGRAM
REV	DATE	DATE	17-MC5C240RES1ELR1 L1R
REV	DATE	DATE	SCALE
REV	DATE	DATE	SHEET 1 OF 2

Figure 4-13. 1-phase, 3-wire 1EL wiring



BEFORE READING THE DISPLAY FOR ANY MC-5c PRODUCT

CAUTION: When reading the meter display, all consumption and demand values must be multiplied by the correct multiplier to calculate true value. This includes all register values (kWh, kW, kVARh,lg, kVARhLd, etc.) and Phase Diagnostic values (real time Amps, Watts, etc.).

Volts, phase angle, frequency and power factor are displayed on the LCD as their true values and should not be multiplied.

The multiplier value is dependent upon the ratio of the external Current Transformers (CTs) and can be different for different meter points. Please consult Table 1 CT Multipliers for the appropriate value dependent upon the rating (or size) of the CT.

HOW CT MULTIPLIERS ARE CALCULATED:

0.1AMP CTs

The multiplier values for CTs with 0.1A secondary ratings are derived by dividing the primary side rating by 100. For example, a 50.0.1A-rated CT will have a multiplier of 50 ÷ 100, which is 0.50. A 100.0.1A rated CT will have a multiplier of 100 ÷ 100 which is 1.

5AMP CTs

For CTs with 5A secondary ratings, the multipliers are derived by dividing the primary side rating by 5. For example, a 200.5A-rated CT will have a multiplier of 200 ÷ 5, which is 40.

EXAMPLE:

Meter point with 400.0.1A CT

LCD reading for meter is 3422.119kWh

The correct cumulative consumption (kWh) for this meter is **13688.476 kWh**.

(400 ÷ 100 = 4. Multiply face value for consumption and demand values by 4. 3422.119 x 4 =13688.476)

NOTE: Failure to use the appropriate multiplier will result in an incorrect diagnosis of the meter's functionality and incorrect revenue billing.

Meter Voltage Ratings	CT Rating	Multiplier for 0.1A CT	Multiplier for 5.0A CT
FOR 120V, 208V, 240V (Wye), 277V, 347V, 415V, 480V, 600V	50A	x0.5	x10.0
	100A	x1.0	x20.0
	200A	x2.0	x40.0
	400A	x4.0	x80.0
	600A	x6.0	x120.0
	800A	x8.0	x160.0
	1200A	x12.0	x240.0
	1500A	x15.0	x300.0
	1800A	x18.0	x320.0
	2000A	x20.0	x400.0
	3000A	x30.0	x600.0
	3200A	x32.0	x640.0
4000A	x40.0	x800.0	

FOR 240V (Split-Phase)	100A	x0.5	x20.0
	200A	x1.0	x40.0

Table 1. CT Multipliers

REV	DESCRIPTION	DATE	APPROVED

ELC	REVISED	TITLE
5500VA TUBES	DATE	1-PHASE, 3-WIRE 240V IEL WIRING DIAGRAM
REV	AREA	STATION
PROJECT	DATE	17-MC5c240RESIELR1
PROJECT	SCALE	REV
PROJECT	SCALE	1:1
PROJECT	SCALE	1:1

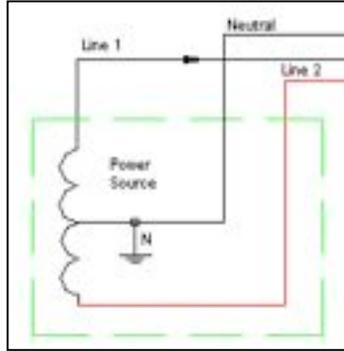
1-PHASE, 3-WIRE 240V 2EL WIRING

The phase association and polarity of the current transformers must be followed or the meter will not be correctly installed.

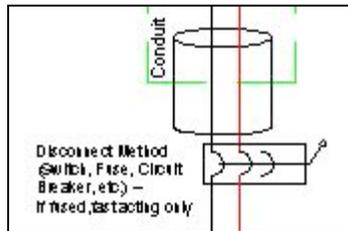
Detailed wiring instructions

A) Voltage taps

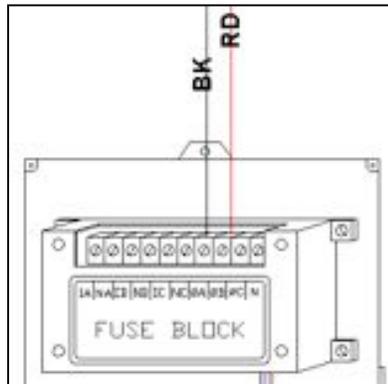
- i. Follow voltage tap installation procedure on page 15.
- ii. Color-code the main feeder wires as follows: Black – Line 1; Red – Line 2.
- iii. Connect #12 AWG wires to Line 1 and Line 2. Wires must be Black (Line 1) and Red (Line 2).



- iv. If required, run the hot wires through a disconnect switch (if fused, use no less than 15A 'Fast Acting' fuses.)



- v. Run wires through conduit to MC-5c back box. Connect to screw terminals on fuse block. Black – VA; Red – VB.



- B) CT installation
- i. Follow CT installation procedure on page 15.
 - ii. For each load, determine which voltage phase supplies the power. Then use a CT with the corresponding color code for that load (Black or Red).
 - iii. Route the load wire through the CT as shown in the diagram
 - iv. Connect the CT secondary wires to the MCI according to the following procedure:
 - v. Every CT MUST be connected to an MCI input which is referenced to the correct phase (see chart).
 - vi. This type of meter is configured as a Residential meter with (12) 1-phase meters. For these installations, the meter measures (12) 1-phase loads. Each metered load has 2 CT. The two CTs from a particular metered load must be connected to adjacent inputs as shown in the chart. Note that ALL meter points use Line 1 and Line 2.

Installation Notes

CRITICAL:

The Phase Association and Polarity of the current transformers must be followed or meter will not be installed correctly.

1. Each CT has a white side, small white dot, or "H1" marking on only one side of its exterior. Locate this marking as it is critical that the wires are passed through the CT in the correct direction, assuring the correct polarity.

Two wires coming from the line side are passed through each current transformer (CT).

Line 1 (Wire 1): Line 1 should be passed through the CT from the side with the dot/H1 marking.

Line 2 (Wire 2): Line 2 should be passed through the CT from the side WITHOUT the dot/H1 marking. Note that these are opposite polarities (see Figure 4-14).

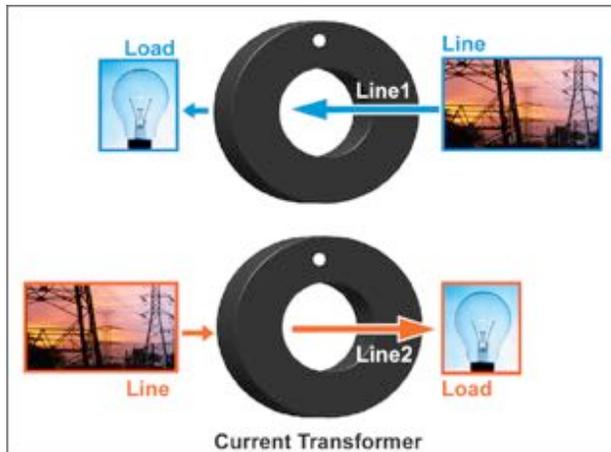


Figure 4-14. Line 1 and Line 2 passed through two different current transformers.

2. The MCI runs CT terminals CT#1 to CT#24 with two terminals connected to Meter #1 (M#1) to Meter #12 (M#12). The number of CT terminal and meter connections will depend on the number of suites available. For example,

- M#1 connects to CT#1 and CT#2
- M#2 connects to CT#3 and CT#4
- repeat for M#3 to M#1

Meter	MCI Board CT	Reference Voltage Line	Meter	MCI Board CT	Reference Voltage Line
1	1	L#1(+) and L#2(-)	7	13	L#1(+) and L#2(-)
	2	L#1(+) and L#2(-)		14	L#1(+) and L#2(-)
2	3	L#1(+) and L#2(-)	8	15	L#1(+) and L#2(-)
	4	L#1(+) and L#2(-)		16	L#1(+) and L#2(-)
3	5	L#1(+) and L#2(-)	9	17	L#1(+) and L#2(-)
	6	L#1(+) and L#2(-)		18	L#1(+) and L#2(-)
4	7	L#1(+) and L#2(-)	10	19	L#1(+) and L#2(-)
	8	L#1(+) and L#2(-)		20	L#1(+) and L#2(-)
5	9	L#1(+) and L#2(-)	11	21	L#1(+) and L#2(-)
	10	L#1(+) and L#2(-)		22	L#1(+) and L#2(-)
6	11	L#1(+) and L#2(-)	12	23	L#1(+) and L#2(-)
	12	L#1(+) and L#2(-)		24	L#1(+) and L#2(-)

3. After completing all current transformer terminations, connect four (4) current connectors and then remove the twenty-four (24) shorting links.
4. Follow local codes for installation requirement, e.g. conduit, fused disconnect, distance, and wiring.
5. Installation of 0.1A inputs and CL10 or 5A inputs are the same.



CAUTION:

If breakers are energized, shorting links must be installed before:

- a) Disconnecting the CT headers or
- b) Replacing or installing meter heads on the panel.

Bodily injury or damage may result if shorting links are not installed.

INSTALLATION NOTES
 Applicable for the following catalog numbers *:
 MC5c240V x 12R (2EL/12M 240V 1P3W)
 x = "L" for 0.1 Amp inputs or "H" for CL10 (5 Amp) inputs.

* Also applicable when the same meter model number has the suffix: M, RS or P.

CRITICAL: The line association and polarity of the current transformers must be followed or meter will not be installed correctly.

CTs must be all 0.1A or 5A and cannot be mixed on the same meterhead.

1. Each CT has a white side, small white dot, or "H1" marking on only one side of its exterior moulding. Locate this marking since it is critical that the wires are passed through the CT in the correct direction, assuring the correct polarity.

Two wires coming from the line side are passed through each CT.
 Line 1 (Wire 1): Line 1 should be passed through the CT from the side with the white side, dot, or H1 marking.
 Line 2 (Wire 2): Line 2 should be passed through the CT from the side WITHOUT the white side, dot, or H1 marking. Note that these are opposite polarities.

2. The MCI runs CT terminals CT#1 to CT#24 with each terminal connected to Meter #1 (M#1) to Meter #12 (M#12). The number of CT terminal and meter connections will depend on the number of suites available. For example:
 -M#1 connects to CT#1 and CT#2
 -M#2 connects to CT#3 and CT#4
 -repeat for M#3 to M#12

3. After completing all CT terminations, connect the four (4) current connectors from the MCI board to the meterhead and then remove the shorting links for all meter points that are in use.

4. Follow local codes for installation requirement, e.g. conduit, fused disconnect, distance, and wiring.

5. Installation of 0.1A ("L") inputs and CL10 or 5A ("H") inputs are the same.

CAUTION: If breakers are energized, shorting links must be installed before:
 a) disconnecting the CT headers or
 b) replacing or installing meter heads on the panel.

WARNING: Bodily injury or damage may result if shorting links are not installed.

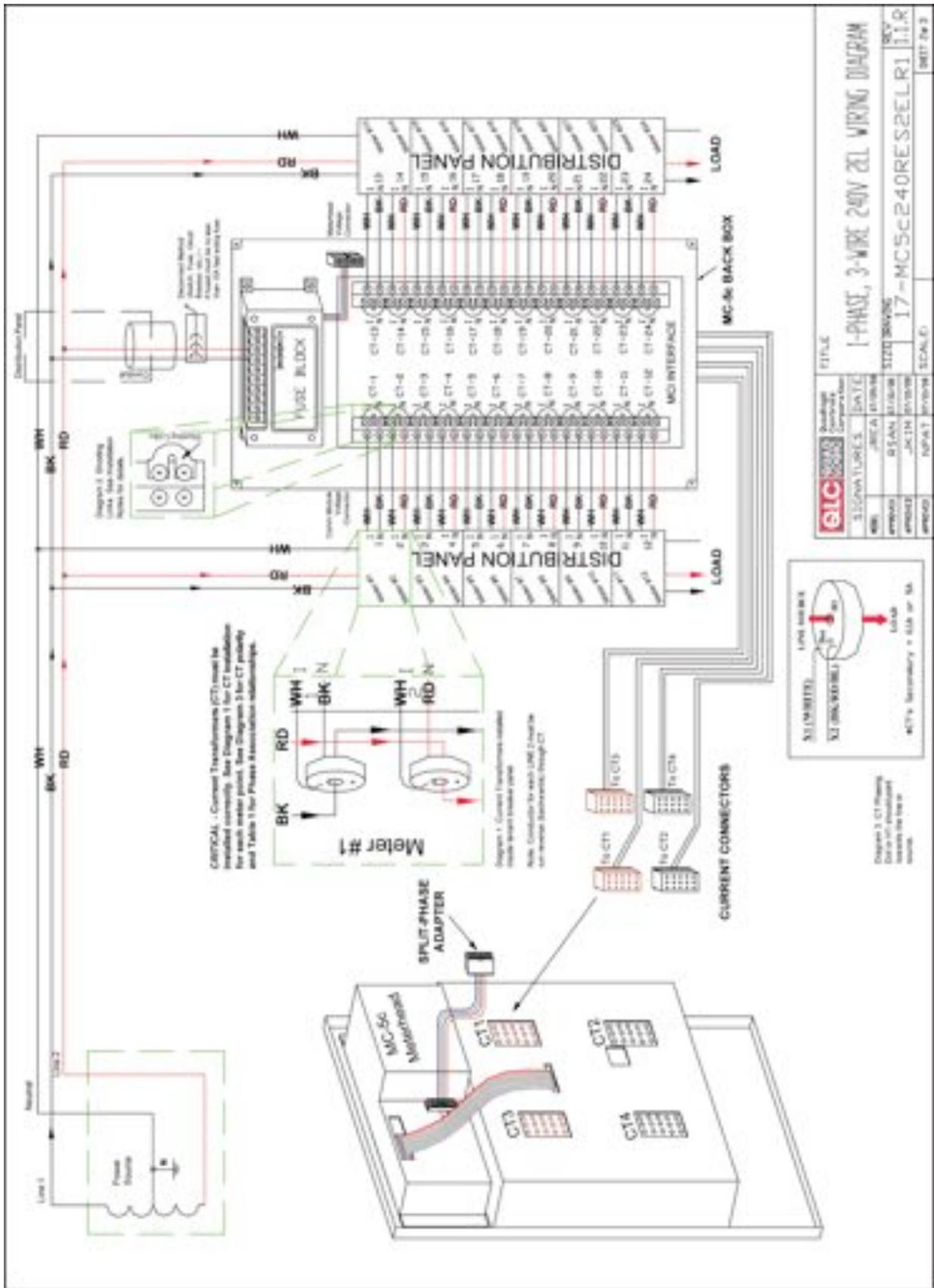
Meter # (M#)	MCI Board CT #	Reference Voltage Line*
1	1	LINE 1
	2	LINE 2
2	3	LINE 1
	4	LINE 2
3	5	LINE 1
	6	LINE 2
4	7	LINE 1
	8	LINE 2
5	9	LINE 1
	10	LINE 2
6	11	LINE 1
	12	LINE 2
7	13	LINE 1
	14	LINE 2
8	15	LINE 1
	16	LINE 2
9	17	LINE 1
	18	LINE 2
10	19	LINE 1
	20	LINE 2
11	21	LINE 1
	22	LINE 2
12	23	LINE 1
	24	LINE 2

*Line #1 points toward DOT or H1 of CT
 *Line #2 points away from DOT or H1 of CT

Table 1. Line Association Table

QC Quality Control		DATE		REV	
DESIGNED BY	DATE	APPROVED BY	DATE	REVISION	DESCRIPTION
PROJECT	NO.	DATE	NO.	NO.	NO.
SCALE	TITLE				
	1-PHASE, 3-WIRE 240V 2EL WIRING DIAGRAM				
	17-MC5c240RES2ELR1				
	SHEET 1 of 2				

Figure 4-15. 1-phase, 3-wire 240V 2EL wiring



BEFORE READING THE DISPLAY FOR ANY MC-5c PRODUCT

CAUTION: When reading the meter display, all consumption and demand values must be multiplied by the correct multiplier to calculate true value. This includes all register values (kWh, kW, KVARHtg, KVARHld, etc.) and Phase Diagnostic values (real time Amps, Watts, etc.).

Volts, phase angle, frequency and power factor are displayed on the LCD as their true values and should not be multiplied.

The multiplier value is dependent upon the ratio of the external Current Transformers (CTs) and can be different for different meter points. Please consult Table 1 CT Multipliers for the appropriate value dependent upon the rating (or size) of the CT.

HOW CT MULTIPLIERS ARE CALCULATED:

0.1AMP CTs

The multiplier values for CTs with 0.1A secondary ratings are derived by dividing the primary side rating by 100. For example, a 50:0.1A-rated CT will have a multiplier of 50 ÷ 100, which is 0.50. A 100:0.1A rated CT will have a multiplier of 100 ÷ 100 which is 1.

5AMP CTs

For CTs with 5A secondary ratings, the multipliers are derived by dividing the primary side rating by 5. For example, a 200-5A-rated CT will have a multiplier of 200 ÷ 5, which is 40.

EXAMPLE:

Meter point with 400:0.1A CT

LCD reading for meter is 3422.119kWh

The correct cumulative consumption (kWh) for this meter is **13688.476 kWh**.

(400 ÷ 100 = 4. Multiply face value for consumption and demand values by 4. 3422.119 x 4 = 13688.476)

NOTE: Failure to use the appropriate multiplier will result in an incorrect diagnosis of the meter's functionality and incorrect revenue billing.

Meter Voltage Ratings	CT Rating	Multiplier for 0.1A CT	Multiplier for 5.0A CT
FOR 120V, 208V, 240V (Wye), 277V, 347V, 416V, 480V, 600V	50A	x0.5	x10.0
	100A	x1.0	x20.0
	200A	x2.0	x40.0
	400A	x4.0	x80.0
	600A	x6.0	x120.0
	800A	x8.0	x160.0
	1200A	x12.0	x240.0
	1500A	x15.0	x300.0
	1800A	x16.0	x320.0
	2000A	x20.0	x400.0
	3000A	x30.0	x600.0
	3200A	x32.0	x640.0
4000A	x40.0	x800.0	

FOR 240V (Split-Phase)	100A	x0.5	x20.0
	200A	x1.0	x40.0

Table 1. CT Multipliers

REV	DESCRIPTION	DATE	APPROVED

ELC QUADLOGIC Controls Corporation	TITLE
SUBMITTER'S NAME	1-PHASE, 3-WIRE 240V 2EL WIRING DIAGRAM
DATE	
AREA	
DESIGNER	
PROJECT	
DATE	
SCALE	17-MC5c240RES2ELR:1:1R
	REV

CHAPTER 5

USING THE METER

DISPLAY NAVIGATION

The following figure shows the MC-5c user interface (LCD window) located on the front panel of the meter. It is easy to navigate the various sub-menus to read metering data, reset values and view configuration data.

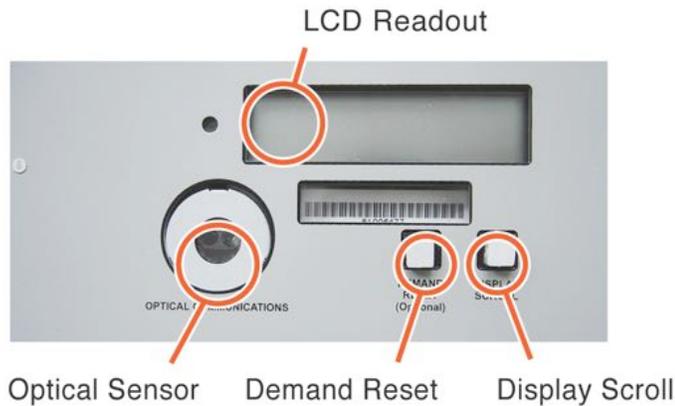


Figure 5-1. MiniCloset-5 front panel display.

Press and hold the “Display Scroll” button, which is the small square button on the right side when you are facing the meter. After two seconds, the LCD will display, REVERSE. If you continue to hold down the Display Scroll button, after another two seconds the LCD will display FORWARD. These are simply directional indicators that you can use to navigate left and right through the different menu register headings as shown on below. Each heading will be displayed in two-second intervals. Note that the MC-5c defaults to the kWh register.

Meter LCD Headings:

kWh Registers	kW Registers	Event Diagnostic Registers
Serial # Registers	Phase Diagnostic Registers	PLC Registers

Releasing the display scroll button at a given menu heading will allow you to cycle through the registers listed under the selected menu heading as shown in Figure 5-2, The Display Menu. For example, if the meter is in FORWARD mode and the Display Scroll button is released when the LCD reads “Serial # Registers”, each subsequent depression of the Display Scroll button will show the following, in the order it appears below:

Serial #
Registers

Serial #
70005932

ASIC Version
FS1004F

Software Version
392b0136

Release Time
15:17 7/30/2005

Checksum
eee9f9b1

Hunt 19200 baud
8 b no parity

To reverse scrolling direction at either the heading level or within a submenu, press and hold the display scroll button. When REVERSE is displayed after two seconds, release the display scroll button. You can now go backwards through the menu selections by pressing and releasing the display scroll button.

To go back to the forward scrolling option, follow the same procedure, except release the display scroll button when FORWARD is displayed.



Caution:

When reading the meter display, all consumption and demand values must be multiplied by the correct multiplier to calculate true value. Please refer to Chapter 6 for more details.

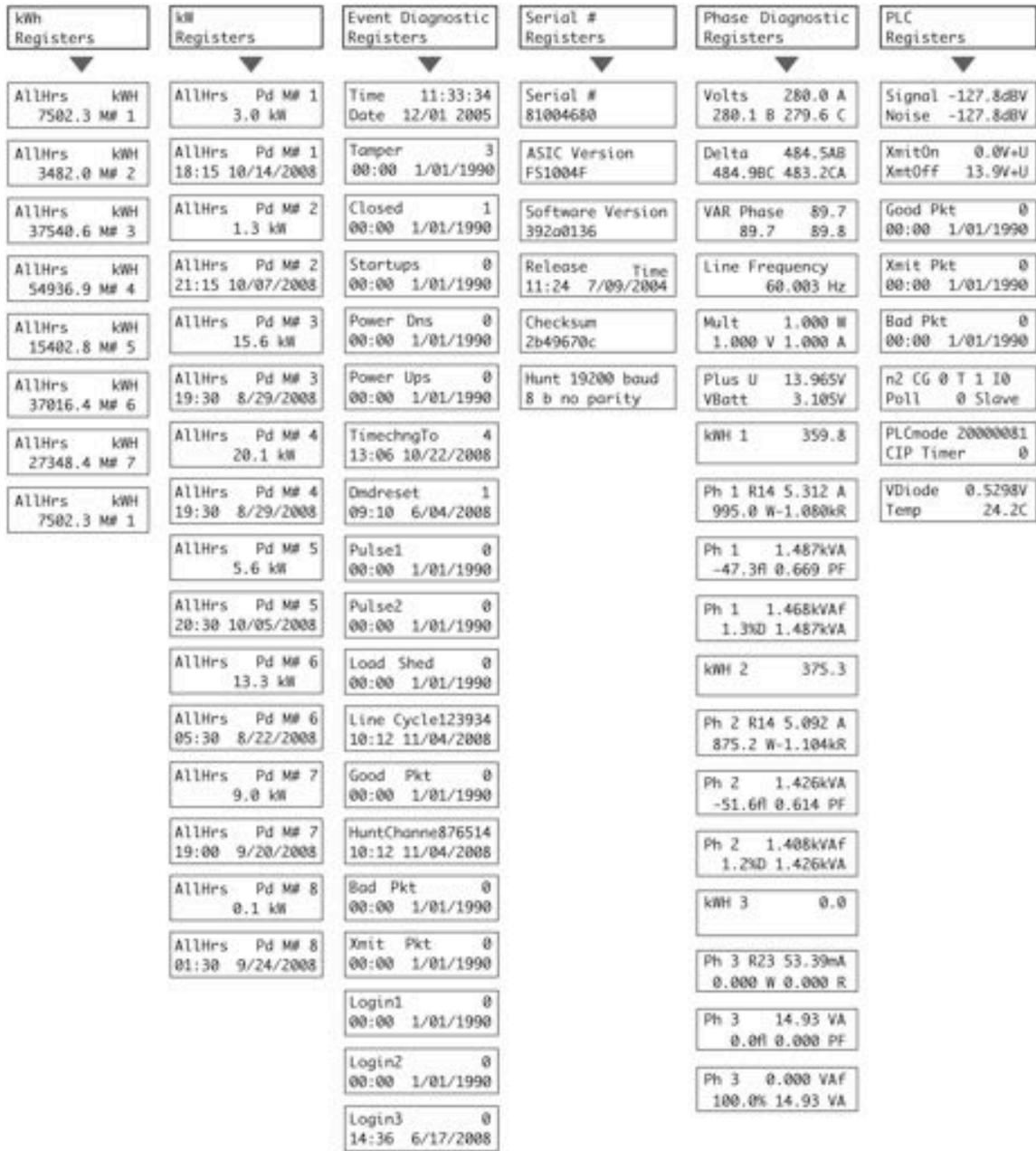


Figure 5-2. The Display Menu Structure For an 8-meter point MC-5c.

To follow is an explanation of each of the menu options under Phase Diagnostics Registers:

Phase Diagnostic Registers	Phase Diagnostic Menu
Volts 280.0 A 280.1 B 279.6 C	Line-to-Neutral Voltages
Delta 484.5AB 484.96C 483.2CA	Line-to-Line Voltages
VAR Phase 89.7 89.7 89.8	Reactive Phase Angle, typ. = 90
Line Frequency 60.003 Hz	Line Frequency, typ. = 60
Mult 1.000 W 1.000 V 1.000 A	Meter Internal Multipliers
Plus U 13.965V VBatt 3.105V	Vbatt = Internal Battery Voltage
kWH 1 359.8	Phase 1 Daily kWh Register
Ph 1 R14 5.312 A 995.0 W-1.080kR	Phase 1 Current (A), Real Power (W), Reactive Power (R)
Ph 1 1.487kVA -47.3fl 0.669 PF	Ph 1 Apparent Power (VA); Phase Angle (Degree); Power Factor (PF)
Ph 1 1.468kVAF 1.3% 1.487kVA	Ph 1 Apparent Power at Fundamental Frequency (Vaf) Total Harmonic Distortion; THD%
kWH 2 375.3	Phase 2 Daily kWh Register
Ph 2 R14 5.092 A 875.2 W-1.104kR	Ph 2 Current (A); Real Power (W); Reactive Power (R)
Ph 2 1.426kVA -51.6fl 0.614 PF	Ph 2 Apparent Power (VA); Phase Angle (Degree) Power Factor (PF)
Ph 2 1.408kVAF 1.2% 1.426kVA	Ph 2 Apparent Power at Fundamental Frequency (Vaf); Total harmonic Distortion; THD%
kWH 3 0.0	Phase 3 Daily kWh Register
Ph 3 R23 53.39mA 0.000 W 0.000 R	Ph 3 Current (A); Real Power (W); Reactive Power (R)
Ph 3 14.93 VA 0.0fl 0.000 PF	Ph 3 Apparent Power (VA); Phase Angle (Degree) Power Factor (PF)
Ph 3 0.000 VAF 100.0% 14.93 VA	Ph 3 Apparent Power at Fundamental Frequency (Vaf); Total harmonic Distortion; THD%

VERIFYING METER FUNCTIONALITY

It is very important to verify that the MC-5c and the CTs are properly installed. Follow the steps below to verify the voltage, kWh reading, current, and energy.

I. Verifying Voltage

1. Press and hold the Display Scroll button until the following menu heading is displayed:

Phase Diagnostic
Registers

- Release the Display Scroll button. Scroll down by pressing and releasing the Display Scroll button until the "Volts" screen is displayed (examples shown for 120V, 277V, and 347V):

Volts	125.3 A	Volts	276.3 A
124.0 B	124.7 C	277.0 B	277.7 C

Volts	348.5 A
347.1 B	347.7 C

- Verify that phases A, B, and C are displaying voltages within normal range, which is -10% to +10% of the rated voltage.

II. Verifying kWh Reading

- Press and hold the Display Scroll button until the following menu is displayed:

kWh Registers

- Release the Display Scroll button. Scroll down by pressing and releasing the Display Scroll button until the following screen is displayed, indicating the All Hours kWh reading for Meter # 1 (M# 1):

AllHrs	kWh
1.046 M# 1	

- Verify that the kWh value increases on the LCD (assumes active load).
- To view screens for Meters 2 to 8 (M# 2 to M# 8 for a 3-Phase Meter) repeat steps 1 to 3 as above.

III. Verifying Current and Energy

- Press and hold the Display Scroll button. Scroll down by pressing and releasing the Display Scroll button until the following menu heading is displayed:

Phase Diagnostic Registers

- Release the Display Scroll button. Scroll down by pressing and releasing the Display Scroll button until the following screen is displayed:

Phase 1	7.468 A
818.7 W	100.5 R

The A(mperage) reading is the indication of current. The A(mperage) reading in the display above will always be a positive number, even if the CT was incorrectly installed. Check the reading, and using the correct multiplier, see if it indicates the approximate expected current. Remember that this applies to Phase 1 only. If all the numbers on the multiplier screen (under the Phase Diagnostics menu in Figure 5-2) were 1.00 and the current transformers are 100:0.1, the correct multiplier is 1 and the readings are the actual values seen on the LCD. If the CT's are 200:0.1, multiply the LCD reading by 2.

The W(att) reading is the indication of power. The W(att) reading will also count forward when viewed on the LCD. A negative power reading is indicative of an incorrectly installed CT, or one that is cross-phased with the wrong voltage (phase) leg. The R(eactive) reading

can be negative, depending on the nature of the load. Negative values indicate a capacitive load while positive values indicate an inductive load.

3. Scroll down by pressing and releasing the Display Scroll button until the following screen is displayed:



Under normal conditions the phase angle (x.x°) should be between -30° and +30° and the power factor should be a number between 0.80 – 1.0.



Power factor for inductive loads will typically be lower than that of resistive loads, typically between 0.60 and 0.80.

If the phase angle on the lower left is a number close to 180° it indicates the CT was installed backwards, or is 180° out-of-phase. If the angle is close to 120°, at least two CTs have been cross-phased, and a similar number will appear in the phase angle data in Phase 2.

4. To view screens for phases 2 to 24, repeat steps 1 to 3 as above.

RESETTING DEMAND VALUES (FOR COMMERCIAL APPLICATIONS ONLY)

Use the following procedure to reset the Demand registers to zero:

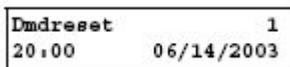


BE CERTAIN TO RECORD THE CURRENT PEAK DEMAND (WITH THE TIME AND DATE) FOR EACH METERING POINT MEASURED BY THE MC-5c, BEFORE RESETTING THE DEMAND.

Once you reset the demand according to the instructions below, you cannot retrieve any prior demands locally. If you are unsure, then using the above instructions, scroll through to the demand (kW) and record the demand value (kW) for each metering point. (As a back up, locally resetting the demand will obviously not delete the demand from the demand values already retrieved and stored in the meter, Transponder or software.)



1. Press and hold the Demand Reset button.
2. The LCD will initially display the Quadlogic Copyright message.
3. The LCD will then display the Dmdreset event screen:



4. Keep the Demand Reset button depressed until the screen updates and displays the current date and time. This signifies that the demand has been reset.

CHAPTER 6

APPLYING MULTIPLIERS

READING THE DISPLAY

CAUTION:

When reading the meter display, all consumption and demand values must be multiplied by the correct multiplier to calculate true value. This includes all register values (kWh, kW, kVARHLg, kVARHLd, etc.) and Phase Diagnostic values (real time Amps, Watts, etc.).

Volts, phase angle, frequency and power factor are displayed on the LCD as their true values and should not be multiplied.

The multiplier value is dependent upon the ratio of the external Current Transformers (CTs) and can be different for different meter points. The following table **MUST** be used to obtain actual consumption and demand readings.

Meter Boltage Ratings	CT Rating	Multiplier for 0.1A CT	Multiplier for 5.0A CT
For 120V, 208V, 230V, 240V (Wye), 277V, 347V, 480V, 600V	50A	x0.5	X10.0
	100A	x1.0	X20.0
	200A	x2.0	X40.0
	400A	x4.0	X80.0
	600A	x6.0	X120.0
	800A	x8.0	X160.0
	1200A	x12.0	X240.0
	1500A	x15.0	X300.0
	2000A	x20.0	X400.0
	3000A	x30.0	X600.0
4000A	x40.0	X800.0	

Table 6.1 Standard multiplier table.

Meter Boltage Ratings	CT Rating	Multiplier for 0.1A CT	Multiplier for 5.0A CT
For 240V (Split-phase)	100A	X0.5	X20.0
	200A	X1.0	X40.0

Table 6.2 Multiplier table for a 240V split-phase MiniCloset-5c meter.

HOW CT MULTIPLIERS ARE CALCULATED

0.1Amp CTs

The multiplier values for CTs with 0.1A secondary ratings are derived by dividing the primary side rating by 100. For example, a 50:0.1A-rated CT will have a multiplier of $50 \div 100$, which is 0.50. A 100:0.1A rated CT will have a multiplier of $100 \div 100$ which is 1. (Except for 240V MC-5c meters.)

5Amp CTs

For CTs with 5A secondary ratings, the multipliers are derived by dividing the primary side rating by 5. For example, a 200:5A-rated CT will have a multiplier of $200 \div 5$, which is 40. (Except for 240V MC-5c meters.)

Example:

Meter point with 400:0.1A CT

LCD reading for meter is 3422.119kWh

The correct cumulative consumption (kWh) for this meter is **13688.476** kWh.

($400 \div 100 = 4$. Multiply face value for consumption and demand values by 4. $3422.119 \times 4 = 13688.476$)

The multiplier must be applied when calculating both kW and kWh readings on every screen displayed on the LCD.



A 240V split-phase MiniCloset-5 meter is the **ONLY** meter type that has a different multiplier structure (as shown in Table 6.2). This is due to the fact that internal multipliers were already applied in the meter during the calibration process.



Failure to use the appropriate multiplier will result in an incorrect diagnosis of the meter's functionality and incorrect revenue billing.

CHAPTER 7

COMMUNICATIONS

OVERVIEW

In addition to integrated PLC, Quadlogic meters have an optical port as a standard feature and an optional modem, RS-232, or RS-485 module through which communications with the meter can be established. Any computer with a terminal emulation program such as HyperTerminal Private Edition can be utilized. The meter utilizes ASCII text type commands and responses for interrogation and programming.

HYPERTERMINAL PRIVATE EDITION SETUP

HyperTerminal Private Edition is one of the many terminal emulation programs that can be used to communicate with Quadlogic meters. Follow the procedures below to set up a HyperTerminal session suitable for meter communications.

1. Open HyperTerminal Private Edition. If the program is not yet installed in the computer, download the program from Hilgraeve's website (<http://www.hilgraeve.com/>).



Commercial users need to purchase this program according to this software manufacturer's rules and regulations.

2. Enter the session name and click OK.



Figure 7-1. New Connection Window

3. Select the appropriate COM port that will be used for the optical coupler. The optical coupler will be used to communicate with the meter. This will be placed on the optical port of the meter and held in place magnetically.



Figure 7-2. Connect To Window

4. Select the necessary parameters for communication. The session should be set at 19200/8/N/1/N Click OK.

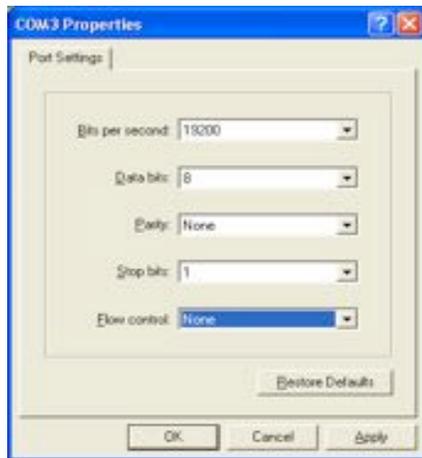


Figure 7-3. COM Port Properties Window

5. Go to the Properties window and select the Settings tab. Go to the ASCII Setup and check the "Echo typed characters locally" box. Click on OK.



Figure 7-4. ASCII Setup Window

Once HyperTerminal is setup, the user can now log in into the meter.

SECURITY HIERARCHY

Quadlogic meters are protected by a security hierarchy of Level 1 (least secure) through Level 5 (most secure). Each level allows access to increasing data parameters and manipulation of the meter. Once logged in at the specific level, access to that level and all those levels below it are permitted. The levels are defined as follows:

Level 1	Reader	Basic reading of meter data only
Level 2	Technician	Access to TOU data
Level 3	Meter Superintendent	Reading of all data (demand reset, time change, etc.), View TOU
Level 4	Utility	Allows limited clearing and reprogramming of the device
Level 5	Meter Lab	Allows full clearing and reprogramming of the device (Contact manufacturer.)

LOGGING IN TO THE METER

A Quadlogic meter is logged into by establishing proper communications and issuing the following command set **attn_-S<Serial Number>_-<Password><enter>**.

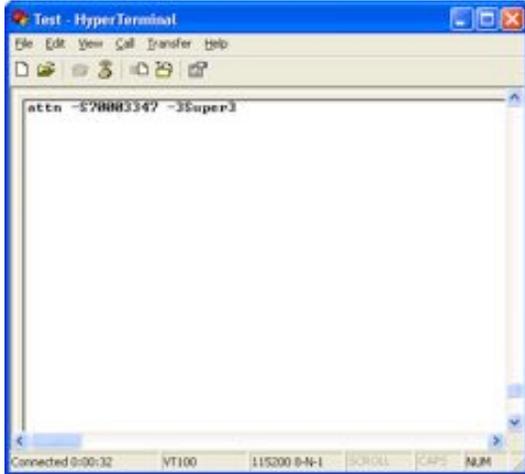


Figure 7-5. Login String

The serial number of the meter is a unique 8-digit number assigned specifically to the meter. The password in the syntax depends on what security the user wants or was assigned. The table below lists the possible passwords that may be used at different security levels.



Passwords are case sensitive.

Level Number	Level Description	Password
Level 1	Reader	1reader1
Level 2	Technician	2tech2
Level 3	Meter Superintendent	3Super3

Once the login string has been delivered, the Quadlogic meter will display a Quadlogic Copyright message followed by the "CIP#" prompt. The "CIP#" prompt is the indication that the login was successful and the next command can be entered.

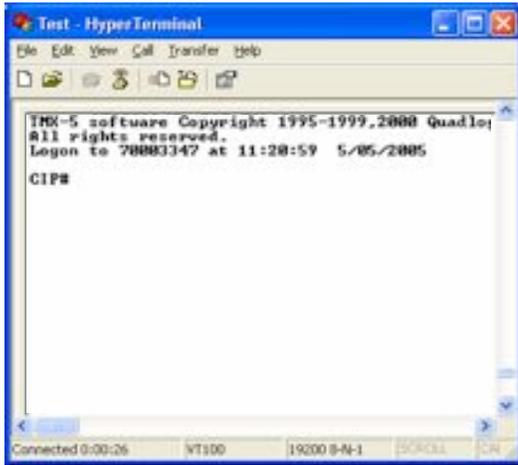


Figure 7-6. CIP# Prompt



Throughout this section, the "_" (underscore) will denote one (1) space. Also note that all commands are case sensitive.

BASIC METER DATA

I. Requesting Meter Data

Quadlogic meters are comprised of two separate sections; the mdt (Meter Data Totals)/TOU and the mdw (Mass Memory/Data Log).

The meter can be programmed for a total of 16 discrete billing parameters depending on how the meter is configured. Each register provides for a unidirectional billing register, TOU function, demand register, and/or interval log.

II. Meter Data Totals

Access to the main billing registers is gained by entering mdt_-T<enter>.

```
CIP#mdt -T
```

serno	M#	Q#	T#	TOU	Units	CONS	CONSDATE	PEAK	TIME of PEAK
60009550	1	1	1	ALL-Hrs	kWH	15.36	1/02/1990	3.47	00:15 3/04/2005

Where: Serno – specific meter’s serial number

M# - meter number

Q# - Billing quantity number (#1 is kWh, see Advanced Programming for a complete list of available billing parameters)

T# - Number of periods in the active Time-of-Use Schedule

TOU – Time-of-Use period annunciator

Units – Billing Parameter

Cons – Total real-time consumption (before multiplier is applied)

Consdate – Consumption date

Peak – Peak demand of given billing parameter (before multiplier is applied)

Time of Peak – Time of peak demand

Access to daily accumulation log is gained by entering **mdt_-d<enter>**.

```
CIP#mdt -d
```

M#	Q#	T#	1#	TOU	Units					
1	1	1	0	ALL-Hrs	kWH	xxxx.xxx	0.000	0.009	0.664	
1	1	1	4	ALL-Hrs	kWH	0.793	1.071	0.784	0.731	
1	1	1	8	ALL-Hrs	kWH	1.056	0.628	0.000	0.000	
1	1	1	12	ALL-Hrs	kWH	0.762	2.168	1.685	2.584	
1	1	1	16	ALL-Hrs	kWH	0.000	xxxx.xxx	xxxx.xxx	xxxx.xxx	

III . Mass Memory/Data Log

Access to interval data can be gained in three (3) different formats: 1) By parameter and day, 2) Space delimited form, and 3) Excel spreadsheet format.

1) By Parameter and day

- Enter **mdt_-m<enter>** for the configuration table.
- Enter **mdw_-L<enter>** for a list of dates in the log.
- Combine list to access day for specific parameter and day **mdw_Q1_I2<enter>**.

```
CIP#mdt -m
```

location of config table - Flash
 Serial # = 60009550
 Number of phases = 3
 Number of pulse counters = 2
 Number of tou periods = 1
 Overlap = 1
 Internal multiplier = 1.000000 voltage multiplier = 1.000000

M#	Q#	Units	Log/Day	TOU	DND	ACC	PFM	Log1	Red1	Acc1	SP
1	1	kWH	96	Y	Y	Y	3	N	N	N	22
1	2	DkVARHLg	288	N	N	N	3	N	N	N	22
1	3	DkVARHLd	0	N	N	N	3	N	N	N	22
1	4	D-kVAH	0	N	N	N	3	N	N	N	22
1	5	D-kA2H	0	N	N	N	3	N	N	N	25
1	6	R-kWH	0	N	N	N	3	N	N	N	22
1	7	RkVARHLg	0	N	N	N	3	N	N	N	22
1	8	RkVARHLd	0	N	N	N	3	N	N	N	22
1	9	R-kVAH	0	N	N	N	3	N	N	N	22
1	10	R-kA2H	0	N	N	N	3	N	N	N	25
1	11	kV2H	0	N	N	N	3	N	N	N	20
1	12	kV2H	0	N	N	N	3	N	N	N	20
1	13	Counts1	0	N	N	N	1	N	N	N	0
1	14	Counts2	0	N	N	N	1	N	N	N	0
1	15	MCycles	0	N	N	N	1	N	N	N	0
1	16	HelvinH	0	N	N	N	1	N	N	N	20

```
CIP#mdw -L
```

M#	Q#	1#	Units	---/--/----	4/03/2005	4/11/2005	4/12/2005
1	1	0	kWH	---/--/----			
1	1	4	kWH	4/13/2005	4/14/2005	4/15/2005	4/16/2005
1	1	8	kWH	4/17/2005	4/18/2005	4/19/2005	5/03/2005
1	1	12	kWH	5/14/2005	5/16/2005	5/31/2005	6/30/2005

In the above table, "1#" represents the day number that corresponds to the listed date on the right. The table works in a left to right sequence. For example, day 1#0 has no corresponding date. Day 1#1 is 4/03/2005 and day 1#2 is 4/11/2005. The following line lists day 1#4 as 4/13/2005 and so on.

Combine the desired Q# (Billing Quantity) and 1# (day number) to request the specific data.

```
CIP# CIP#mdw -Q1 -16
```

serno	M#	Q#	1#	Units	YYYYDate.Time	Interval Data							
60009550	1	1	6	kW	20050415.0015	3.41	2.59	5.64	1.25	2.22	4.41	5.50	5.10
60009550	1	1	6	kW	20050415.0215	0.32	0.99	1.54	2.31	1.98	2.01	1.76	2.64
60009550	1	1	6	kW	20050415.0415	4.12	1.25	2.16	4.44	2.74	xxxx.xxx	xxxx.xxx	xxxx.xxx

The above table lists all the interval data for Q#1 (kW) on 1#6 (4/15/2005) in block form.

The YYYYDate.Time lists the end of interval time stamp and is read left to right in a similar fashion to the mdw_-L table. Each number, reading left to right indicates the peak kW reading for the next 15minute interval as shown below. For example, the peak kW at the interval period ending at 04:00AM on 4/15/2005 was 2.64.

20050415.0015= Period ending on April 15, 2005 at 12:15am
The unmultiplied kW reading at this time was 3.41kW

Numbers indicate the unmultiplied peak kW readings at the following times:

CIP#	CIP#mdw	-Q1	-16	serno	M#	Q#	l#	Units	YYYYDate.Time	Interval Data	12:30am	12:45am	1:00am	1:15am			
60009550	1	1	6	kW	20050415.0015	3.41	2.59	5.64	1.25	2.22	4.41	5.50	5.10				
60009550	1	1	6	kW	20050415.0215	0.32	0.99	1.54	2.31	1.98	2.01	1.76	2.64				
60009550	1	1	6	kW	20050415.0415	4.12	1.25	2.16	4.44	2.74	xxxx.xxx	xxxx.xxx	xxxx.xxx				



The characters "xxxx.xxx" denotes no power to the meter at the end of the interval.

2) Space Delimited Form

Entering the command **mdw<enter>** will list all the interval log data (for all billing parameters) in a space delimited format. It may be captured and for input in to various other software platforms.

```

CIP#mdw
serno      M#  p#  Q#  Units      YYYYDate.Time      Accum
60009550   1   A   1   kW         20050403.1300      0.12 W
60009550   1   A   1   kW         20050403.1400      0.87 W
60009550   1   A   1   kW         20050403.1500      0.06 W
60009550   1   A   1   kW         20050411.1600      0.86 W
60009550   1   A   1   kW         20050411.1700      0.85 W
60009550   1   A   1   kW         20050411.1800      0.18 W
60009550   1   A   1   kW         20050411.1900      0.85 W
    
```

3) Excel Spreadsheet Form

Entering the command **mdw_-E<enter>** will list all interval log data in a format that can be imported into Excel. The date column will then need to be formatted to an Excel format.

```

CIP#mdw -E
serno      M#  p#  Q#  Units      -Date.Time--      Accum
60009550   1   A   1   kW         38536.012600      5.428kW
60009550   1   A   1   kW         38536.019300      6.100kW
60009550   1   A   1   kW         38536.031700      6.848kW
60009550   1   A   1   kW         38536.043200      7.084kW
60009550   1   A   1   kW         38536.050800      7.096kW
60009550   1   A   1   kW         38536.062200      6.840kW
60009550   1   A   1   kW         38536.074600      6.864kW
    
```

IV. Phase Diagnostics

Quadlogic meters will display phase diagnostics data in real time for Volts, Amps, Watts, VAR Lagging, Power Factor, Phase Angle, and by phase accumulation (i.e. for each phase and for the total accumulation of the three phases)

```
CIP#md -p
M# p# Ri vR Amps Volts Watts Vars kWhr kVARHr
S 1 14 2 71.66 A 121.1 V 3.746kW -527.0 VARLg 13.58
S 2 15 4 0.000 A 121.4 V 0.000 W 0.000 VARLg 0.00
S 3 16 4 0.000 A 121.0 V 0.000 W 0.000 VARLg 0.00
total 0.00
```

V. Event Log

Quadlogic meters store an event log list and by event. To access the list enter **event_<enter>**.

CIP#event -d			
1	Teaper	0 00:00	1/01/1990 T
2	Closed	0 00:00	1/01/1990 T
3	Startups	2 14:27	8/16/2005 S
4	Power Dns	1 04:56	6/11/2005 S
5	Power Ups	0 00:00	1/01/1990 S
6	Matchdog	2 14:27	8/16/2005 S
7	No Battery	0 00:00	1/01/1990 S
8	BadParDown	0 00:00	1/01/1990 S
9	SpuriousRat	0 00:00	1/01/1990 S
10	TimechnngTo	2 14:03	7/07/2005 T
11	TimechnngFrom	1 13:12	7/06/2005 T
12	Indreset	0 00:00	1/01/1990 T
13	Pulse1	0 00:00	1/01/1990 p
14	Pulse2	0 00:00	1/01/1990 p
15	Load shed	0 00:00	1/01/1990 Dp
16	Line Cycles	70692 11:23	8/17/2005 P
17	Good Pkt	0 00:00	1/01/1990 P
18	HuntChannel	5004 11:23	8/17/2005 P
19	Bad Pkt	0 00:00	1/01/1990 P
20	Xmit Pkt	0 00:00	1/01/1990 P
21	Logout	227 10:36	8/17/2005 s
22	Login1	0 00:00	1/01/1990 s
23	Login2	0 00:00	1/01/1990 s
24	Login3	0 00:00	1/01/1990 s
25	Login4	0 00:00	1/01/1990 Ts
26	Login5	21 11:22	8/17/2005 Ts
28	CrashEvent	0 00:00	1/01/1990 S
29	StoreConfig	3 15:32	7/15/2003 Ts
30	PicFreeze	0 00:00	1/01/1990 S
31	TimeError	1 13:12	7/06/2005 S
32	PhError	103 10:00	8/17/2005 S
33	StoreCalib	47 17:20	7/07/2003 Ts
34	ColdStart	8 10:22	10/01/2004 Ts
35	StoreSerno	1 06:58	4/28/2003 Ts
36	StorePPH	0 00:00	1/01/1990 Ts
37	NewPasswd1	0 00:00	1/01/1990 s
38	NewPasswd2	0 00:00	1/01/1990 s
39	NewPasswd3	0 00:00	1/01/1990 s
40	NewPasswd4	0 00:00	1/01/1990 Ts
41	NewPasswd5	0 00:00	1/01/1990 Ts
43	SyncRTC	1506 10:27	8/17/2005 e
44	StoreMults	0 00:00	1/01/1990 Ts
45	StoreStty	0 00:00	1/01/1990 s
46	StoreScroll	0 00:00	1/01/1990 s
47	StorePoll	0 00:00	1/01/1990 s
48	StoreHdvr	1 06:58	4/28/2003 Ts
49	Intervals	2349 01:00	8/17/2005 D
50	Demands	783 01:00	8/17/2005 DB
51	DailyAccums	1305 01:00	8/17/2005 DB
52	StartData	261 01:00	8/17/2005 DB
53	EndData	261 xx:xx	xx/xx/xxxx DB
54	NextSector	0 00:00	1/01/1990 e
55	StartSector	12 01:00	7/02/2005 e
56	StartDay	261 01:00	8/17/2005 e
57	DataXfer	0 00:00	1/01/1990 P
58	SoftVersion	12 14:28	8/16/2005 e
59	PicControl	75 02:28	8/17/2005 P
60	XrefTable	0 00:00	1/01/1990 P
61	TouTable	0 00:00	1/01/1990 Ps
62	DaylightTab	0 00:00	1/01/1990 Ps
63	DataMarker	261 01:00	8/17/2005 DB

ADVANCED METER PROGRAMMING

VI. Setting Data

The meter requires the date and time to be set in the meter from the default which is

00:00:01 1/01/1990 Monday

The date can be displayed by the dt<enter> command. To change the date and time type in the new date and time in the following format at the CIP# prompt

dt_hh:mm:ss_mm/dd/yyyy

```
CIP#dt 10:35:00 7/01/2005
CIP#dt
10:35:03 7/01/2005 Friday
```

To verify the changes type in **dt<enter>** once again.

VII. Customizing the Display Scroll

The Quadlogic meter can be programmed with a custom display scroll table using the following commands

- 1) **disp_-d<enter>** - Displays all available display registers.
- 2) **disp_0_0_-s<enter>** - Displays 0 0 register, kWh.
- 3) **disp_34_0_-s<enter>** - Displays the serial number of the device.
- 4) **disp_-W1234<enter>** - Writes the display scroll settings to the flash memory.
- 5) **disp_-s<enter>** - Displays programmed registers.

CHAPTER 8

TROUBLESHOOTING

RESOLVING METER ISSUES

Problem: Meter does not power up

- Make sure the voltage plug is connected to the meter head.
- Measure voltage connections at fuse block (phase to neutral).
 - WYE meter models power phase A to neutral.
 - Delta meter models power phase A to phase B.
- If expected voltage is present, check fuses at fuse block (black box located inside the meter on the back panel).
- 1 fuse for meter power (must be either 1/4th A for 120V or 1/8th A for 277 V).
- 3 fuses for voltage measurements (4A).
- If proper voltage is present at the fuse block and the internal fuses are good and LCD still does not display anything, return meter head only for RMA repair. (It is not necessary to return meter box with fuse block.)

Problem: Zero voltage appears on the LCD

- Measure voltage connections at fuse block (phase to neutral)
 - WYE meter models power phase A to neutral
 - Delta meter models power phase A to phase B
- If expected volts are present, check fuses at fuse block (black box located inside the meter on the back panel).
 - 1 fuse for meter power (must be either 1/4th A for 120V or 1/8th A for 277 V)
 - 3 fuses for voltage measurements (4A)

Problem: Negative watts

- CT is reversed. Check phase polarity of CT installation.
- Verify proper connection of CT secondaries.
- Verify proper connection of any contractor wire extension.
- Confirm that the phase angle is between $+30^\circ$ and -30° .

Problem: Phase Angle not between $+30^\circ$ and -30° (see Figure 8-1 for Vector Diagram)

- If angle falls between 90° and 150° OR between -90° and -150° :
 - the CT is installed on one of the incorrect phases
- If angle falls between 150° and -150° :
 - the CT polarity is reversed OR the wires are reversed
- If angle falls between -30° and -90° :
 - that means the CT polarity is reversed AND the CT is installed on one of the incorrect phases
- If metering large inductive loads (e.g. Elevators, HVAC, pumps) phase diagnostics may not be an accurate verification

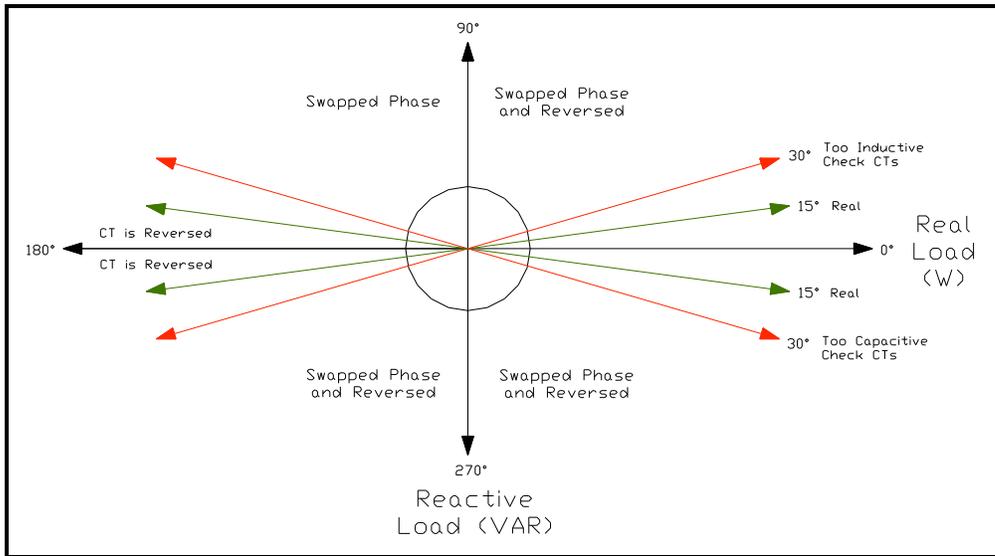


Figure 8-1. Vector Diagram

CHAPTER 9

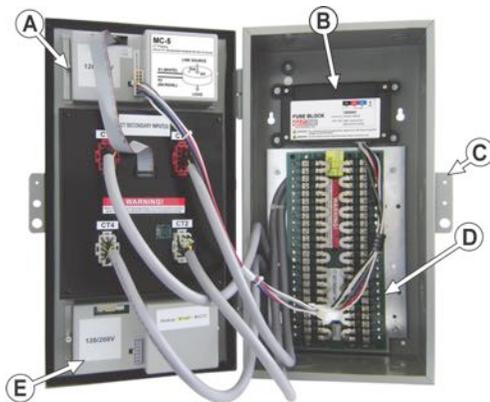
REPAIR AND SPARE PARTS

REPAIR OR REPLACEMENT

Quadlogic requires prior approval and an assigned RMA (Return Merchandise Authorization) number before accepting any merchandise returns. An RMA request form which includes complete repair and/or return for credit policies can be found on our website at www.quadlogic.com. If you are returning equipment for credit, a 20% restocking fee shall apply. Note: RMA shipping charges to Quadlogic are the responsibility of the product owner. Quadlogic will return merchandise back to the customer via UPS Ground at no charge. (International Customers: Quadlogic will pay for standard cost of clearance through duties and customs for receipt of authorized return merchandise only. Clearance through duties and customs is the customer's responsibility for return shipments.)

SPARE PARTS

Below is a list of spare parts that can be purchased by a customer in the event that a part of a MiniCloset-5 meter has been damaged.



- A. Meter Head – Main component of the MiniCloset-5c. The Meter Head contains the Meter Module, through which all signals transmit, events are recorded and meter data is stored.
- B. Fuse Block – Provides termination for the voltage taps. It supplies power and fuse protection to the Meter Head.
- C. MC-5c Back Box – Metal box housing the metering device and the MCI board.
- D. MCI – MiniCloset Interface, provides termination for the current transformers (CT).
- E. Communications Module (option)

CHAPTER 10

MISCELLANEOUS

PREVENTIVE MAINTENANCE

There is no necessary preventive maintenance or inspection.

Use a soft dry cloth to clean the meter.

A Toshiba CR2032 coin battery is used in each device ONLY for the clock when power is lost, and is intended to be good for decades before replacement. The meter does not rely on the battery, and the meter data is stored in non-volatile FLASH memory.

WARRANTY INFORMATION

Quadlogic Controls Corporation warrants its equipment for 3 years from the ship date against defects in material or workmanship when installed in accordance with manufacturer's instructions by qualified personnel. This warranty does not cover installation, removal, reinstallation or labor costs and excludes normal wear and tear. The warranty does not cover product which has been altered from its original manufactured condition due to faulty installation, tampering, accident, neglect, abuse, force majeure or abnormal conditions of operation. Obligation under this warranty is limited to repair and/or replacement, at Quadlogic's option, of the manufactured product and in no event shall Quadlogic be liable for consequential or incidental damages.

RELEASE DATES

Manual	QLC Part Number	Revision Number	Release Date
MiniCloset-5c Manual	MC5c_USMAN_R1.0.R	1.0.R	1.1.09

REVISION HISTORY

Date	Page	Change	Description

APPENDIX

THE COMMUNICATIONS MODULE

A Quadlogic meter or Scan Transponder can have an optional communications module that will allow the system to be interrogated remotely through a modem device or allow multiple Quadlogic devices to be connected in a network through a RS-485 device (see Figure A.1).

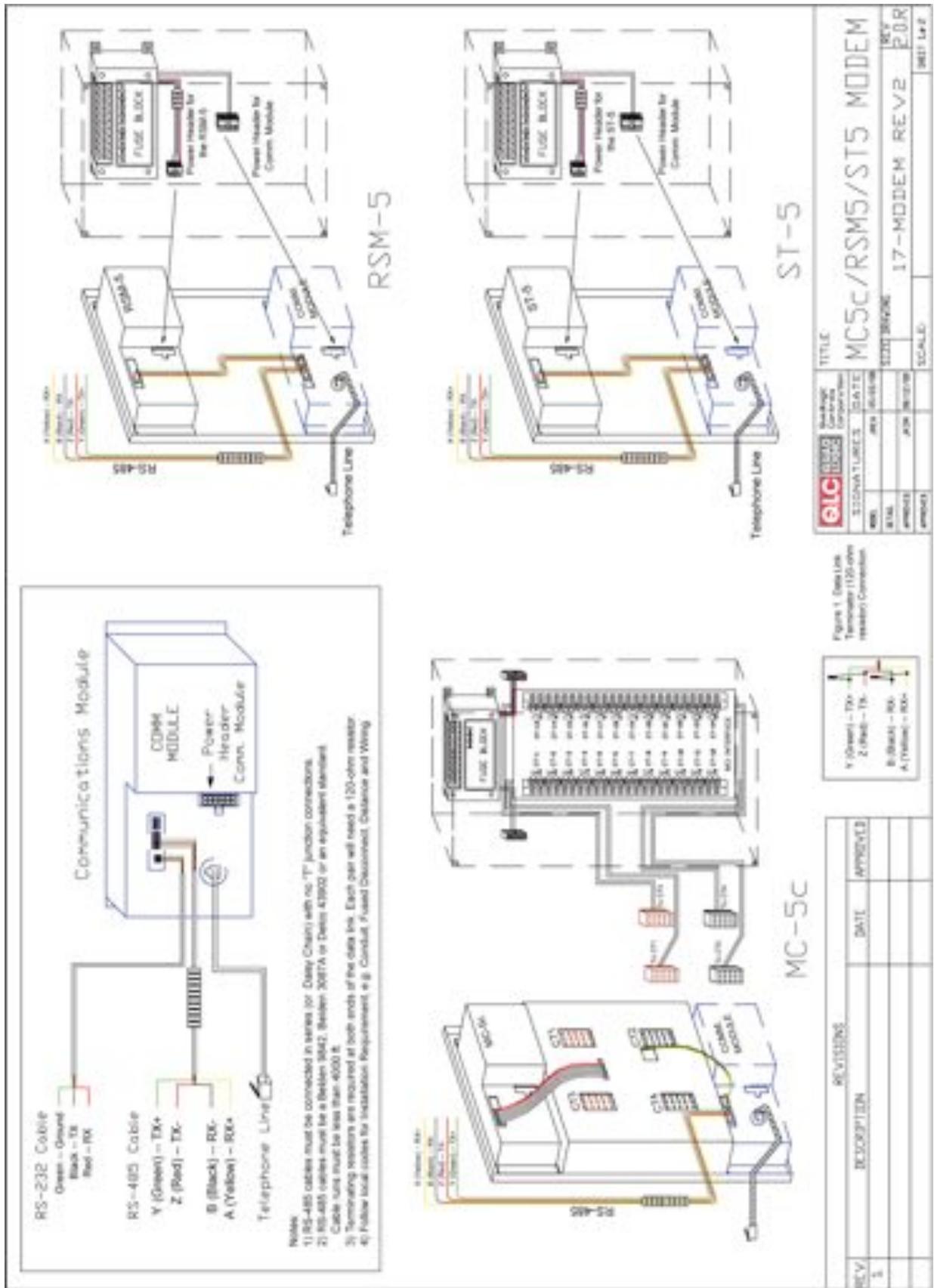


Figure A-1. MC-5c with modem installation.

RS-485 OVERVIEW

Quadlogic devices may sometimes use a RS-485 interface to construct a multi-point communications network. The RS-485 interface is connected in a 4-wire full-duplex mode and is capable of handling 32 transmitters along with 32 receivers. In a four-wire network it is necessary that one node be a master node and all others be slaves. The network is connected so that the master node communicates to all slave nodes and all slave nodes communicate only with the master node.

GUIDELINES FOR PROPER WIRING OF A RS-485 NETWORK

Cable Selection¹

Selecting data cable for a RS-485 system is important because intermittent communication problems are often caused by marginal cable and can be difficult to troubleshoot. The most important parameters that dictate the type of cable that will be used are Characteristic Impedance, Shunt Capacitance, and cable length or transmission run.

Characteristic Impedance (Ohms)

A value based on the inherent conductance, resistance, capacitance and inductance of a cable that represents the impedance of an infinitely long cable. When the cable is cut to any length and terminated with this Characteristic Impedance, measurements of the cable will be identical to values obtained from the infinite length cable. That is to say that the termination of the cable with this impedance gives the cable the appearance of being infinite length, allowing no reflections of the transmitted signal. If termination is required in a system, the termination impedance value should match the Characteristic Impedance of the cable.

Shunt Capacitance (pF-ft)

The amount of equivalent capacitive load of the cable, typically listed in a per foot basis. One of the factors limiting total cable length is the capacitive load. Systems with long lengths benefit from using low capacitance cable.

Cable Length (Transmission Run)

Typical RS-485 systems have a maximum transmission run of 4000 feet. The total transmission run will start from the first unit up to the last unit in the data link network.

The type of cable used for RS-485 is typically a twisted-pair wire which is simply a pair of wires with equal lengths and is twisted together. A twisted-pair wire helps prevent radiated EMI and it also reduces the effects of received EMI. Because the two wires are close together and twisted, the noise received on one wire will tend to be the same as that received on the second wire. This type of noise is referred to as "common-mode noise." As RS-485 receivers are designed to look for signals that are the opposite of each other, they can easily reject noise that is common to both.

Recommended wires include Delco 43902, Belden 3087A, and Belden 9842.

¹ <http://www.arcelect.com/485info.htm>

Termination Resistors²

A terminating resistor is a resistor that is placed at the extreme end or ends of a cable. The value of the terminating resistor is ideally the same value as the characteristic impedance of the cable.

The value of the terminating resistor MUST match the characteristic impedance of the wire or else reflections will occur when the signal travels down the cable. There are instances where reflections are bound to happen because of cable and resistor tolerances; however, large enough mismatches may cause reflections big enough to bring about errors in the transmitted data.

With this in mind, it is important to match the terminating resistance and the characteristic impedance as closely as possible. The position of the terminating resistors is also very important. Termination resistors should always be placed at the far ends of the cable.

Datalink Network

Quadlogic meters and Scan Transponders can be set-up to be a data link communication network when an RS-485 module is available (see Figure A-2). The data link communication network can have up to thirty (30) meters which are daisy chained together. The beginning and end of each 30-meter segment within the network MUST have two (2) terminating resistors for each pair of wires.

The data link communication network most of the time will have a Quadlogic device with a Modem/RS-485 module where a dedicated telephone line will be plugged in. It is highly recommended to put the Quadlogic device with the Modem/RS-485 module at the beginning of the network. Furthermore, the total wire run of the network MUST not exceed the wire limit of 4,000 feet.

Occasionally, however, it becomes necessary for a particular meter to be further away from the "main RS-485 Data Link trunk" than the distance allowed by the Data Link Plug assembly. In such an event, a longer, extended cable CANNOT be used to connect that meter to the RS-485 Data Link in an elongated "T" junction configuration. Rather, the RS-485 must be routed directly into that individual meter and then drawn back out from that meter to the next meter in the system in one continuous line.



WARNING:

While it would seem reasonable for a branch or "T" connection to run from RS-485 Data Link and permit the proper functioning of the data gathering, this is not a solution. It is absolutely imperative that a Quadlogic metering system with RS-485 Data Link never have branches running from the main line. The twisted, shielded pair wires must "enter" and "exit" each meter in the system with the exception of the first and last "terminator" meters.

² http://www.maxim-ic.com/appnotes.cfm/appnote_number/763

RS-485 Data Link Installation Guidelines

1. If there is more than one MC-5c, install the other MC-5cs and the interconnecting RS-485 line, if required, which links all of the MC-5cs. See Figure A-2.
2. An RS-485 line is a pair of wires, AWG #20 or larger in diameter, which begins at one MC-5c where a terminator is placed.
3. The RS-485 line runs from MC-5c to MC-5c ending at the final MC-5c, where another terminator is placed.
4. It is critically important that there should never be three RS-485 pairs entering or leaving a MC-5c box.
5. For the two MC-5s which gave terminators, only one RS-485 pair leaves each box.
6. For the other MC-5cs, if there are more than two, exactly two RS-485 lines should leave the box: each line goes to another transponder in the daisy-chain. Only one modem should be installed in a data link system. If there are two or more modems in a data link system, the transponders will not communicate with each other.
7. There may be no more than 32 MC-5cs on a daisy-chain. If there are more than 32, special care must be taken, which is beyond the scope of these instructions.
8. If possible, run the RS-485 lines in a conduit to protect them from damage. It is critically important to observe the polarity of the wires. The RS-485 data link uses a black and yellow color code. Match black to black and yellow to yellow; otherwise the data link will not work.
9. Avoid having loose conductors by using wire nuts to connect wires together. Use wire nuts suitable for the wires' gauge.
10. The data link should run no more than 4000 feet.
11. To Test the data link, measure the DC voltage across the yellow to black wire. This should measure between 0.1V and 0.3V. If it is negative or outside of that range, re-check all of the MC-5c boxes according to the above specifications.

RS-485 network problems are often caused by cabling issues which may be difficult to troubleshoot. Complications include:

- Inability to log in to a Quadlogic device.
- Intermittent or no communication to a Quadlogic device.
- Garbled characters appear on the terminal screen when logged into a Quadlogic device.

Listed below are guides that can help troubleshoot a faulty RS-485 network.

- Make sure the meter is energized.
- Make sure that there is voltage coming into the fuseblock of the Quadlogic device. It may also be necessary to check if the fuses in the fuseblock are not yet blown.
- Make sure the voltage plug is connected properly to the meterhead and communications module.
- Make sure the 4-wire communications cable is connected to the communications module and the Quadlogic meter or Scan-Transponder head.
- Make sure there is black tape covering the optical port window on meter.
- Make sure that recommended wires were used.
 - Must use 2 Pair (Dual Twisted ONLY) wire with 24 AWG or thicker. Shield is not necessary but if there is a shield, ground shield to metal housing at only of the ends of the network. Do not connect at the other end or at midpoints.
 - Recommended wires are Belden 9842, Belden 3087A or Delco 43902.

- Make sure the RS-485 wires are spliced together correctly.
 - Like colors from pigtails connect to the same circuit.
 - Make sure enough insulation is stripped off wire to make solid contact with the circuit.
 - Use wire nuts that are rated for the number of wires and gauge.
 - Avoid excess bare wire outside of the wire nut.
 - Make sure that the wires are not shorted together or to the box.
- Make sure there are no "T" branches in the RS-485 network.
 - Pigtails make a short wire connection to straight network.
- Make sure there are no bare wires touching any metal conductors.
- Make sure data link is not more than 4000 feet with the meter at the end of the link.
- Make sure terminating resistors are in place.
- Make sure that there is only ONE communications module with a modem in the data link."

If the problems persists after verification contact a Quadlogic technical support representative for further assistance. It is possible that the Quadlogic device is defective and may need replacement.

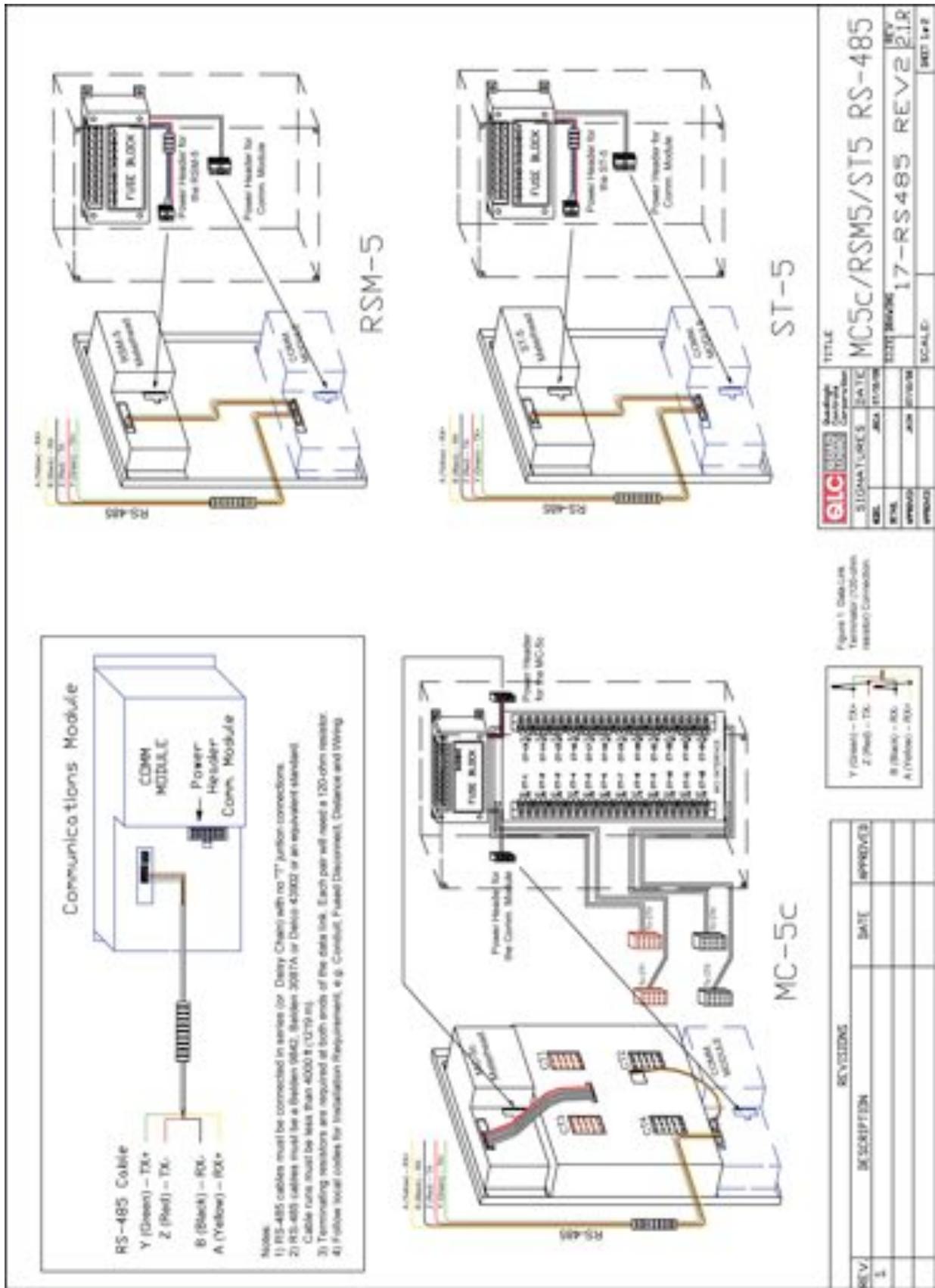
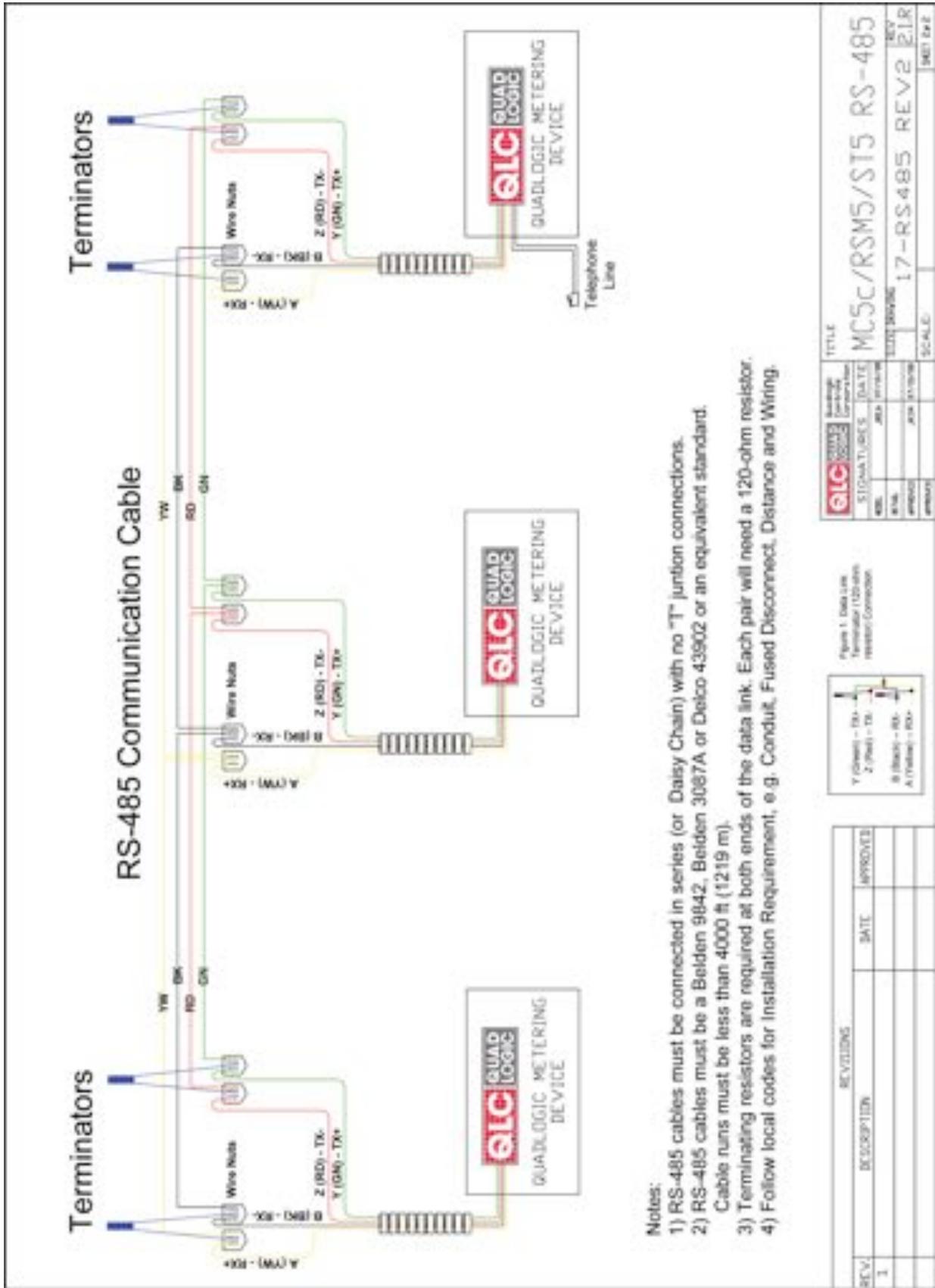


Figure A-2. MC-5c communication network (RS-485).



Notes:

- 1) RS-485 cables must be connected in series (or Daisy Chain) with no "T" junction connections.
- 2) RS-485 cables must be a Belden 9842, Belden 3087A or Delco 43902 or an equivalent standard. Cable runs must be less than 4000 ft (1219 m).
- 3) Terminating resistors are required at both ends of the data link. Each pair will need a 120-ohm resistor.
- 4) Follow local codes for Installation Requirement, e.g. Conduit, Fused Disconnect, Distance and Wiring.

REV.	DESCRIPTION	DATE	APPROVED
1			

REVOLUTIONS		SCALE:		SHEET NO. 2	
TITLE		MCS5c/RSM5/ST5 RS-485		REV	
STANDARD		DATE		REV	
MATERIAL		DATE		REV	
BY		DATE		REV	
CHECKED		DATE		REV	
APPROVED		DATE		REV	

THE PULSE DATALOGGER MODULE

The MiniCloset-5c can use Pulse Datalogger Modules (PDM) to collect pulses from other utility meters (water, gas, BTU, etc.) that have optional Form-A dry-contact pulse outputs. Each PDM, which is powered by the MC-5c, can accommodate 12 discrete meters. Four (4) PDMs can be daisy-chained together to create a total of 48 discrete inputs.

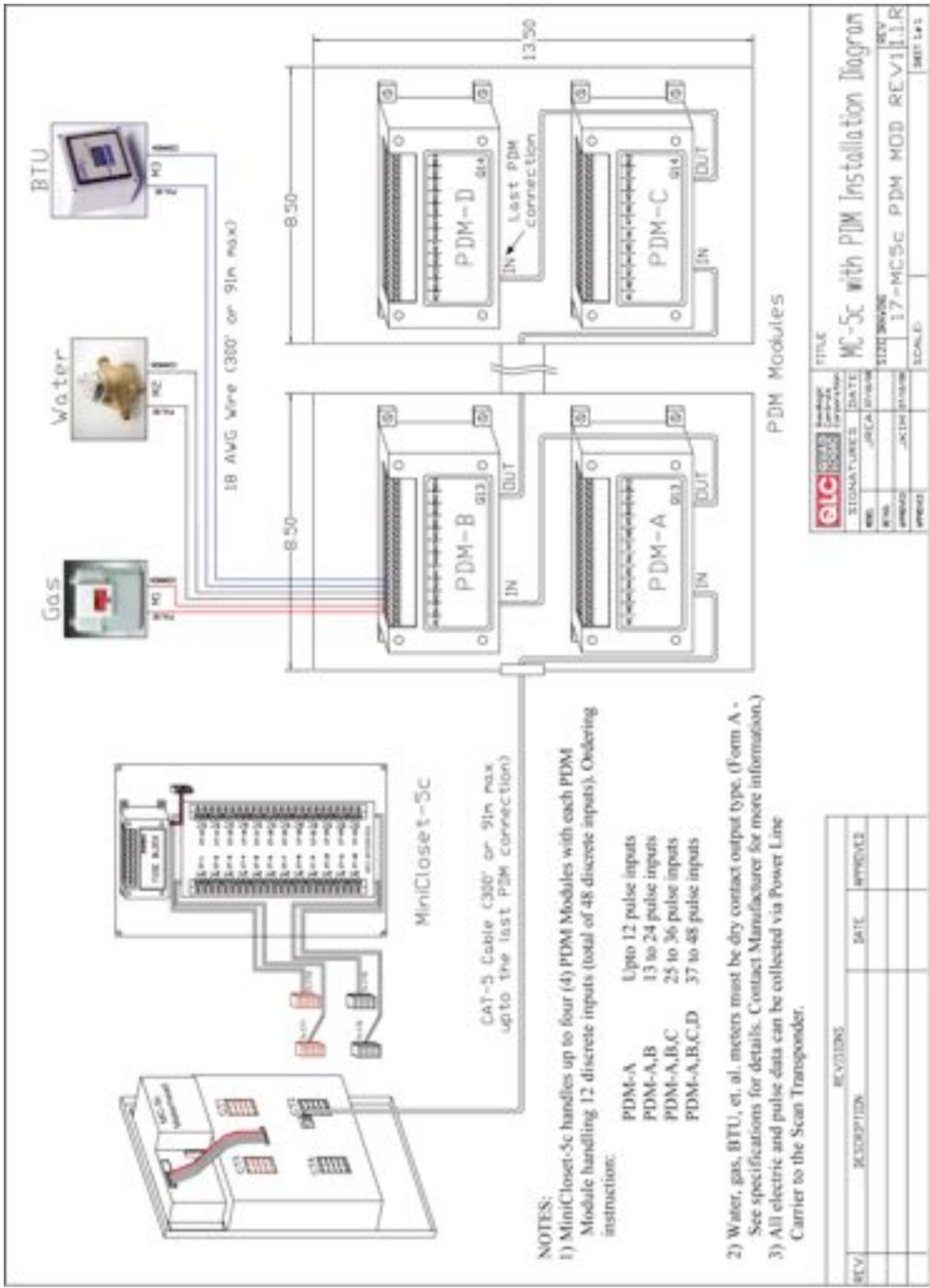
Note: The MC-5c needs to be configured to accept pulses for it to start collecting the pulse outputs from the other utility meters.

The PDMs need to be connected to the MC-5c via a CAT-5 cable. The MC-5c-to-PDM chain can run up to 300 feet. Once connected, the MC-5c will initialize the PDMs to start reading the pulses coming out of the other utility meters. A PDM can count pulses even during a power outage as long as it has already been initialized by the MC-5c. The pulses can be logged in programmable intervals, i.e. 5-, 15-, 30-, and 60-minute intervals.

The pulses that are counted by the PDM consist of a 'closed' state on the external contact, followed by an 'open' state. In order to be reliably registered, the time that the contact is 'open' must be at least the Min Pulse Width, and the time that the contact is 'closed' must also be at least the Min Pulse Width.

<i>Interrogating Signal Specifications:</i>	Min. Pulse Width:
	Power on - 50 msec.
	Power off - 500 msec.*
	Max. Pulse Rate:
	Power on - 10 pulses/sec max
	Power off - 1 pulse/sec max
	Peak voltage: 5.5V
	Peak current: not applicable
	Isolation: The interrogating signal is completely isolated from the AC line, with isolation barriers rated for at least 2.5 KV.
	Max. signal debounce tolerance: 20msec.

* When the MC-5c loses power or is disconnected from the PDM, the PDM has the capability to record pulses using its onboard battery for power. In this situation, the sample rate of the PDM is reduced to decrease current drain and extend battery life.



QUADLOGIC

33-00 Northern Blvd.
Long Island City, NY 11101
Tel (212) 930-9300 Fax (212) 930-9394
www.quadlogic.com