Power Line Communications Metering Systems

MiniCloset-5

Installation Manual

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Thank you for purchasing a MiniCloset-5 multi-channel electric power meter manufactured by Quadlogic Controls Corporation. Quadlogic has been designing, manufacturing, and selling digital electric metering systems for over 20 years. We appreciate your business.

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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.

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 24 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-5 includes PLC communications as a standard feature. In most installations, the meter data from the MiniCloset-5 is read remotely via PLC.

Scan Transponder-5 (PLC Data Concentrator)

When the MiniCloset-5 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-5 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.

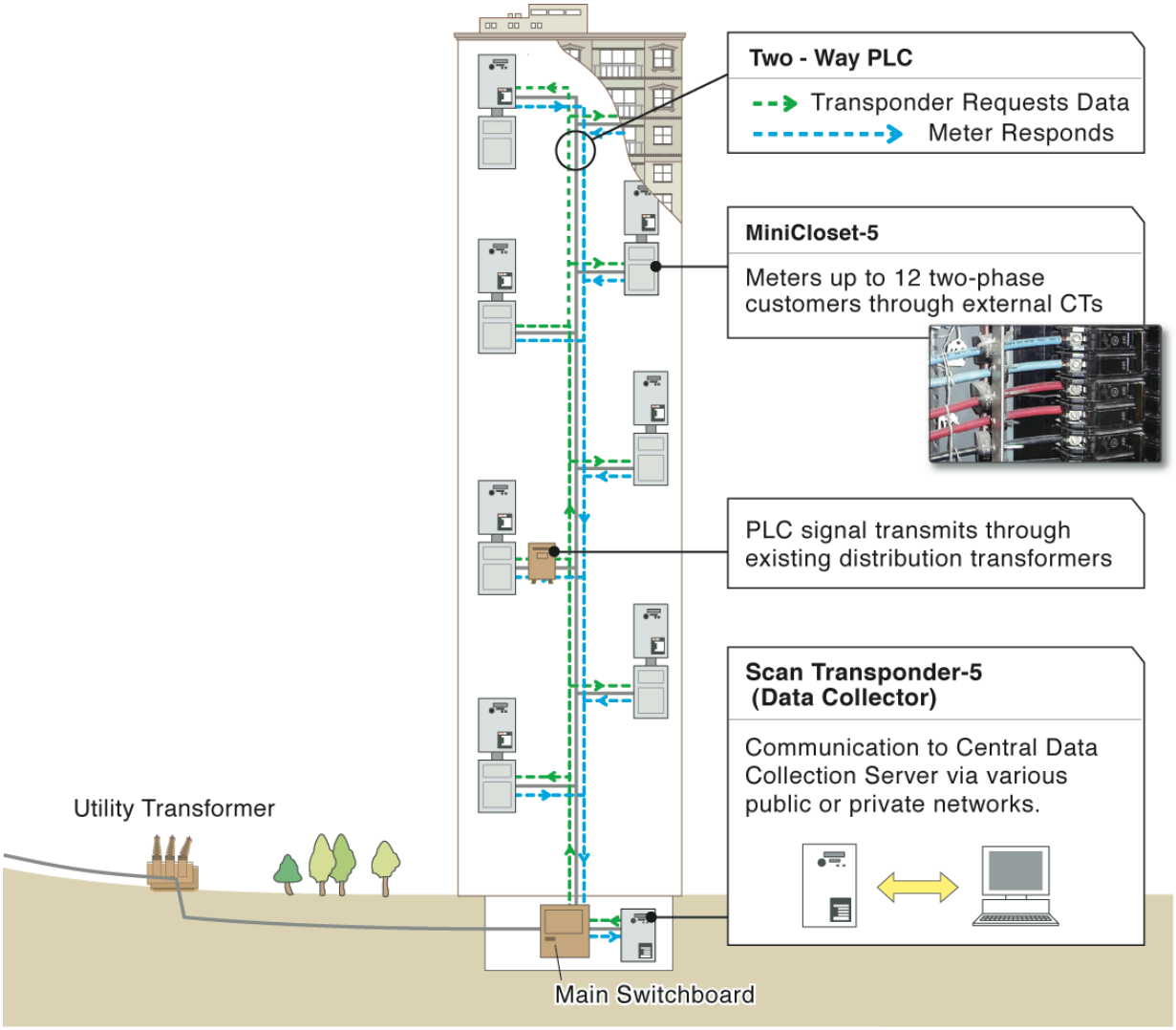


Figure 1-2. Typical Quadlogic metering system.

CHAPTER 2
ABOUT THE MINICLOSET-5

THE MINICLOSET-5

The MiniCloset-5, or MC-5, 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 from hourly 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-5.

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

Using a Pulse Datalogger Module (PDM), the MC-5 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-5.

SPECIFICATIONS

Metering Specifications

Metered Voltage:	120, 208, 220, 230, 240, 277, 347, 380, 400 480, 600 VAC Delta or Wye, 50/60 Hz
Secondary Current Input:	0.1 Amp or 5 Amp CT inputs available
Programmable:	(8) 3-phase meters, (12) 2-phase meters, or (24) Single-phase meters (number of meter points available will vary by model)
Four Quadrant Consumption & Demand for each of the 24 channels:	Delivered and received: kW, kVARLeading, kVARLagging, kVA, Volts-squared hours, and amp-squared hours
Programmable Interval Data & Peak Demand:	5 minutes to hourly time window 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 received by the MiniCloset-5 is not available in time-of-use blocks.)
Pulse Datalogger Module (PDM-12): meters	Collects data from up to 12 water, gas, or BTU Form A Dry Contact Inputs PDM connects to MiniCloset-5 via CAT5 Maximum 4 PDM units to a MC5 (daisy chain) Total of 48 discrete inputs total Pulses will count during a power outage Pulses can be logged in programmable intervals Power supplied by MiniCloset-5
Distance :	Pulse meter to PDM - 300' max.(18 gauge min.) PDM to MC5 - 300' CAT5 cable
Interrogating Signal Specifications:	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.

NOTE

Note: 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.

Data Collection Options:	IQ Software MV-90 TIM Module ASCII-based, open-data protocol Open-source data conversion program

* When the MC5 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.

Communications Options

Although a MiniCloset-5 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-5, 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)

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 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

4 Megabyte non-volatile flash memory retains daily and interval metering data (even during power outage).

During power outage, long-life lithium battery maintains time, logs incoming pulses, and stores the current interval data

Shipping Weight and Dimensions

2 Enclosures (each): 13.5”H x 8.5”W x 4.5”D
Field mounting option: Top-to-bottom or side-to-side
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: 1
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: C12.2 and C12.16 for accuracy
UL and CUL: recognized under E204142
Industry Canada: MC#AE-1148

PARTS AND ASSEMBLY

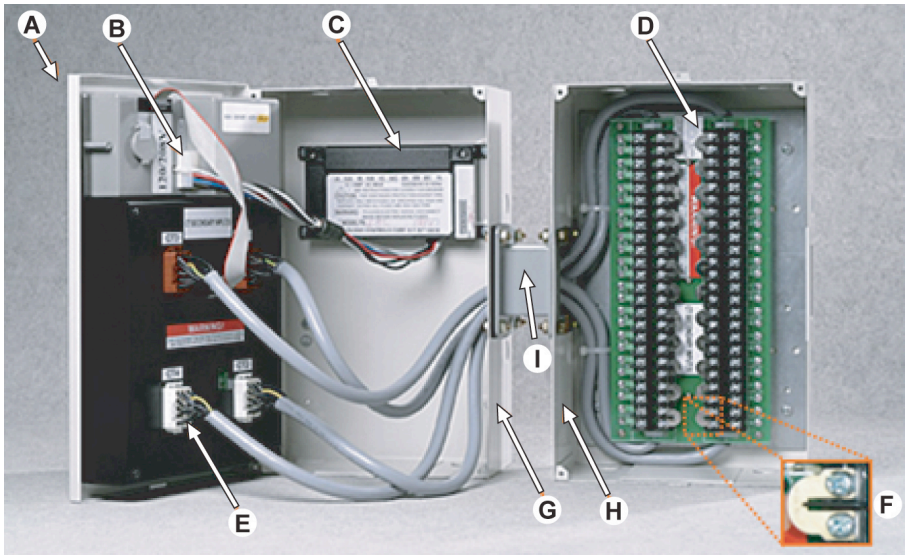


Figure 3-1. MiniCloset-5, Parts and Assembly.

A. Meter Head – Main component of the MiniCloset-5. 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. MCI – MiniCloset Interface, provides termination for the current transformers (CT).
E. Current Connectors – A 15-pin connector that connects the MCI and the Meter Head together. Each MC-5 has 4 Current Connectors.
F. Shorting Links – Provide termination for CTs when the Current Connectors are disconnected from the meter head
G. MC-5 Back Box – Metal box housing the metering device.
H. MCI box – Metal box housing the MCI.
I. Two-inch Square Connector - Connector between the MC-5 back box and the MCI box with gaskets.

NOTE The MiniCloset-5 can be mounted side to side (A) or from top to bottom (B) as shown in Figure 3-2.

(A) (B)

Figure 3-2. Typical MC-5 Installation Orientation.

ACCESSORIES

I. Modem and Data Link Communications Module

The Modem and RS-485 module is an optional accessory that can be ordered with the MC-5. The modem module connects to a dedicated telephone line allowing remote data access to the device. Users can download data or troubleshoot the system from a home or office computer.

The Data Link External Communications or RS-485 module allows multiple Quadlogic meters to be connected together. RS-485 utilizes two (2) shielded, twisted pairs of #16 AWG stranded wires.

Figure 3-4. MiniCloset-5 with Modem and Data Link External Communications Module.

II. 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, k VARh, 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 hardware & 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

III. 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-5.

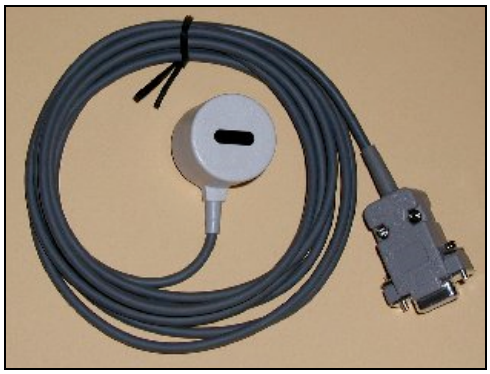


Figure 3-5. The Abacus Optical Probe.

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.

CHAPTER 4
INSTALLATION

OVERVIEW

This chapter contains installation instructions and wiring diagrams for all MiniCloset-5 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-5 configuration. When installing the meter, it is critical that you use the correct wiring instructions. There are six possible installation categories, and each meter model falls into one of these categories. See pages 25 and 26 to identify the correct instructions for your meter.

INSTALLATION CAUTIONS AND WARNING

- 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.
- 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

NOTE

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-5 installation procedure consists of the following steps:

1. Install metal boxes and conduit and route internal wiring harness
2. If optional communication module 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 boxes and conduit

You will need the following QLC-supplied items:

- MC-5 back box (with optional communications module, if required),
- (1) MCI box, and
- (1) 2" square connector with gaskets.

The MC5 back box is the enclosure for the meter head. The MC5 back box is supplied with the MC-5 fuse block installed in the box, and, if the optional communication module is to be installed, the communications module enclosure is supplied pre-mounted to the top of the MC5 back box. The MCI box 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. Choose a section of wall to mount the meter. This should be as close as possible to the distribution panel (preferably within 24"). The MC-5 mounts in 2 metal boxes that must be attached to the wall and connected by conduit. These enclosures may be mounted in several orientations. See Figure 4-2 for acceptable mounting configurations. Note that the MC-5 back box and the MCI box can either be side by side, or one above the other. You should choose the configuration that will fit best in the available mounting area.

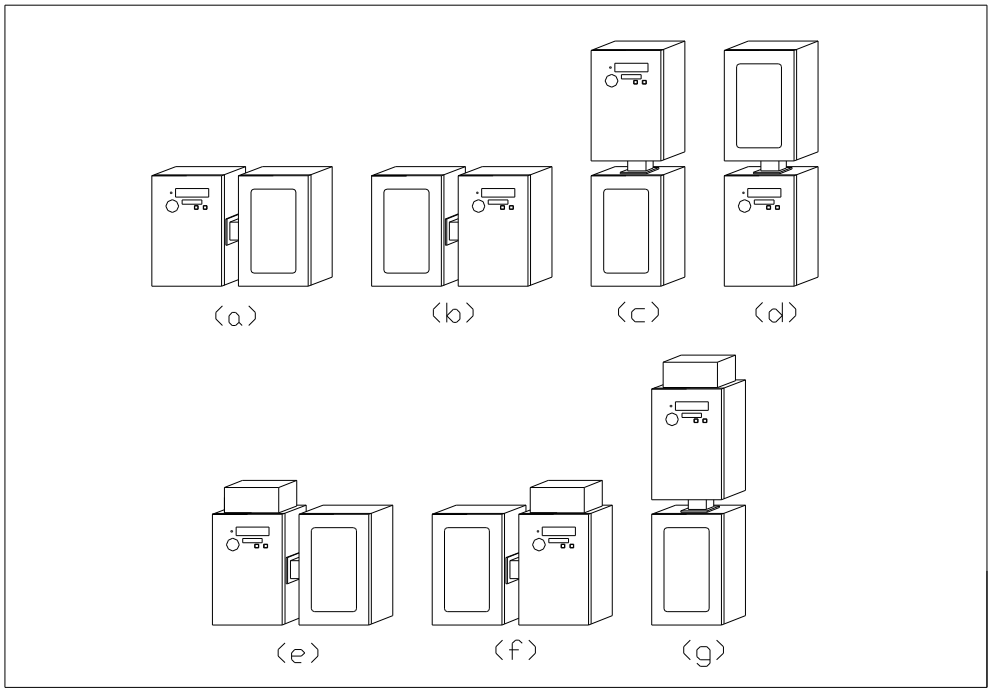


Figure 4-2. Acceptable moving configurations for the MC-5.

2. After you have determined the mounting configuration, remove the square punch-out from the side of the MC5 back box that will be connecting to the MCI box.

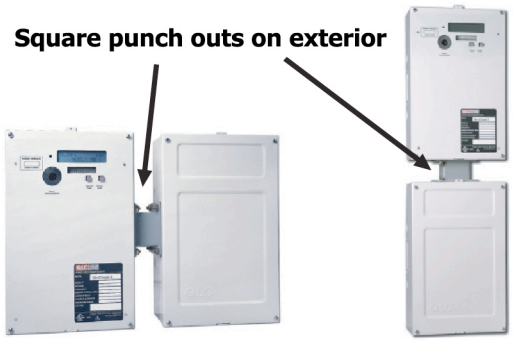


Figure 4-3. Location of punch-out for box interconnection.

3. Mount the metal conduit to the side opening of the MC-5 back box prior to mounting the box to the wall. This will set the spacing between the two boxes.

4. Mount the MC-5 back box to the wall, or in the wall for flush mount installations. Connect the distribution panel box to the MC-5 back box with a metal conduit. This conduit will be used for the voltage taps. 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.

5. Note which side of the MCI box will be connecting to the MC-5 box, based on the mounting configuration you have chosen. Now remove the square punch-out from that side of the MCI box.

6. Attach the MCI box to the MC-5 back box by screwing the metal conduit to the MCI box.

7. Remove the MCI and metal plate assembly from the MCI box by unscrewing the four corner screws holding the metal plate.

8. Mount the MCI box to the wall. Now both boxes are mounted to the wall and are connected by the 2” metal conduit.

9. Screw the MCI and the metal plate assembly back in the MCI box with the 4 screws.

10. Run a metal conduit from the distribution panel box to the MCI 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.

11. Both metal boxes must be grounded. Either a ground wire may be run and attached to one of the box mounting screws, or the boxes 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.

12. Route the internal wiring harness between the boxes. The 4 large current connectors must pass through the 2” square conduit from the MCI box to the MC5 back box.

13. If using the optional communications module, you must arrange for the proper type of communication line to be brought into 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. The opening to the communications module housing is supplied with a conduit sleeve and wire pigtails for the communication line connections. Communication

lines may be surface-mounted, or a conduit may be run into the provided sleeve.

Step 2: Connect optional communications wiring

1. Determine what type of communications line is being used. Possibilities are: telephone line, RS-232 serial data, or RS-485 serial data.

2. Refer to detailed information for the communication line required (See Appendix, Page 89).

Step 3: Connect voltage taps

WARNING:
Power must be off when connecting these wires!

Note – this is the general procedure for connecting the voltage taps. For specific wiring instructions, refer to the detailed information for your specific installed configuration. This information begins on page 25.

1. Locate the incoming feeder phase (hot) wires in the distribution panel. Tape the incoming feeder wires with colored electrical tape according to phase, for identification purposes. See detailed information for specific instructions (Page 25).

2. Tap the feeder wires 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.). The color of the insulation on these wires must match the color of the tape on the feeder wire to which they are connected. If neutral is required, tap the neutral connection with a #12 AWG stranded wire with white insulation. See detailed information for specific instructions (Page 25).

3. Run the #12 AWG feeder phase tap wires through the conduit to the MC5 back box. Connect the wires to the MiniCloset-5 Fuse Block. See detailed information for specific instructions (Page 25).

4. Step 3 is complete

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.

NOTE This is the general procedure for connecting the current transformers. For specific wiring instructions, refer to the detailed information for your specific installed configuration. This information begins on page 25.

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 MCI 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 must be extended. Extend the CT wires with #16 AWG stranded wire. This 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 a particular CT's secondary wires. You must keep track of which white wire goes with each individual colored wire. For example, they could be taped together before being pulled through the conduit.

NOTE 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. See detailed information for specific wiring instructions (beginning on page 25).

5. Run the CT secondary wires through the conduit to the MCI 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. See detailed information for specific instructions (Page 25).

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

NOTE

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 MC5 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 are all plugged in securely and correctly in the meter head. Hang the meter head on the back box and secure the faceplate with 4 screws.

5. Remove the shorting links from the MCI

6. Hang cover on MCI box and secure with 4 screws

7. If power was off, turn it on

8. Installation is complete. The LCD on the MC5 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. 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. Please refer to Chapter 6: Applying Multipliers.

There are six variations on how to wire the MiniCloset-5. Identify your meter model number below and see the corresponding wiring diagram and instructions on the pages indicated.

I. 3-Phase 4-Wire Wye Wiring and Installation (See page 27)

Catalog Number	Description
MC5 120V 01A 06C	3EL/6M 120/208V 3P4W
MC5 120V 01A 08C	3EL/8M 120/208V 3P4W
MC5 277V 01A 06C	3EL/6M 277/480 3P4W
MC5 277V 01A 08C	3EL/8M 277/480V 3P4W
MC5 120V CL10 06C	EL/6M 120/208V 3P4W
MC5 120V CL10 08C	3EL/8M 120/208V 3P4W
MC5 277V CL10 06C	3EL/6M 277/480V 3P4W
MC5 277V CL10 08C	3EL/8M 277/480V 3P4W
MC5 347V CL10 06C	3EL/6M 347/600 3P4W
MC5 347V CL10 08C	3EL/8M 347/600V 3P4W

II. 1-Phase, 3-Wire 120/208V Wiring and Installation (See page 34)

Catalog Number	Description
MC5 120V 01A 03R	2EL/3M 120/208V 3P4W
MC5 120V 01A 06R	2EL/6M 120/208V 3P4W
MC5 120V 01A 09R	2EL/9M 120/208V 3P4W
MC5 120V 01A 12R	2EL/12M 120/208V 3P4W
MC5 120V CL10 03R	2EL/3M 120/208V 3P4W
MC5 120V CL10 06R	2EL/6M 120/208V 3P4W
MC5 120V CL10 09R	2EL/9M 120/208V 3P4W
MC5 120V CL10 12R	2EL/12M 120/208V 3P4W

III. 3-Phase, 4-Wire 1EL Wiring (See page 40)

Catalog Number	Description
MC5 120V 01A 24R	1EL/24M 120/208V 3P4W
MC5 277V 01A 24R	1EL/24M 277/480 3P4W

IV. 3-Phase, 3-Wire Delta Wiring (See page 46)

Catalog Number	Description
MC5 480V 01A 12C	2EL/12M 480VDELTA3P3W
MC5 480V CL10 12C	2EL/12M 480VDELTA3P3W

V. 1-Phase, 3-Wire 240V 1EL Wiring (See page 52)

Catalog Number	Description
MC5 240V 01A 24R	1EL/24M 240V 1P3W
MC5 240V CL10 24R	1EL/24M 240V 1P3W

VI. 1-Phase, 3-Wire 240V 2 EL Wiring (See page 59)

Catalog Number	Description
MC5 240V 01A 12R	2EL/12M 240V 1P3W
MC5 240V CL10 12R	2EL/12M 240V 1P3W

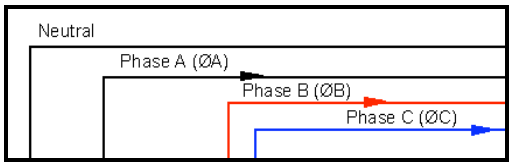
CAUTION:
When reading the meter display, all consumption and demand values must be multiplied by the correct multiplier to calculate true value. Please refer to Chapter 6 for more details.

I. 3-Phase, 4-Wire Wye Wiring and Installation

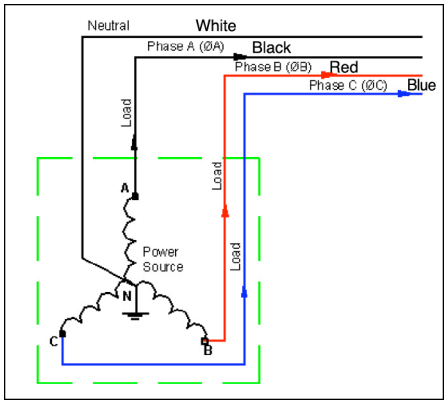
Catalog Number	Description
MC5 120V 01A 06C	3EL/6M 120/208V 3P4W
MC5 120V 01A 08C	3EL/8M 120/208V 3P4W
MC5 277V 01A 06C	3EL/6M 277/480 3P4W
MC5 277V 01A 08C	3EL/8M 277/480V 3P4W
MC5 120V CL10 06C	3EL/6M 120/208V 3P4W
MC5 120V CL10 08C	3EL/8M 120/208V 3P4W
MC5 277V CL10 06C	3EL/6M 277/480V 3P4W
MC5 277V CL10 08C	3EL/8M 277/480V 3P4W
MC5 347V CL10 06C	3EL/6M 347/600 3P4W
MC5 347V CL10 08C	3EL/8M 347/600V 3P4W

Detailed wiring instructions

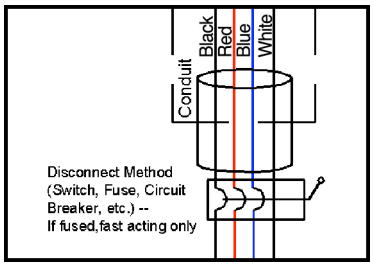
A) Voltage taps
   i. Follow voltage tap installation procedure on page 21.
   ii. Color-code the main feeder wires as follows: Black – phase A; Red – Phase B; Blue – phase C.



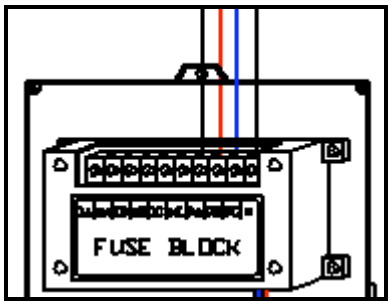
   iii. Connect #12 AWG wires to phase A, phase B, phase C, and Neutral. Wires must be Black (phase A), Red (phase B), Blue (phase C), and White (Neutral)



iv. If required, run the hot wires through a disconnect switch (if fused, use 15A 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 22

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 installation of the current transformers 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. 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
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

Meter	MCI Board CT	Voltage Phase
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

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. MC5 120V 01A 06C
   b. MC5 277V 01A 06C
   c. MC5 120V CL10 06C
   d. MC5 347V CL10 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 numbers*:

45-MC5 120V 01A 06C (3EL/6M 120/208V 3P4W) 45-MC5 120V CL10 06C (3EL/6M 120/208V 3P4W)
45-MC5 120V 01A 08C (3EL/8M 120/208V 3P4W) 45-MC5 120V CL10 08C (3EL/8M 120/208V 3P4W)
45-MC5 277V 01A 06C (3EL/6M 277/480V 3P4W) 45-MC5 277V CL10 06C (3EL/6M 277/480V 3P4W)
45-MC5 277V 01A 08C (3EL/8M 277/480V 3P4W) 45-MC5 277V CL10 08C (3EL/8M 277/480V 3P4W)

*These instructions are also applicable when the same meter model number has the suffix: -E, -P or EP.

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. Within the meter, the current reading from the CT is combined with the voltage readingfor 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#8

2. After completing all CT terminations, connect the four (4) current connectors and then remove the the twenty-four (24) shorting links.

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

4. Installation of 0.1A inputs and CL10 or 5A inputs are the same.

5. For six (6) 3-phase metering points, model numbers:

   - 45-MC5 120V 01A 06C - 45-MC5 277V CL10 06C
   - 45-MC5 277V 01A 06C - 45-MC5 347V CL10 06C

   use meter points M#1-M#6. M#7 and M#8 are not functional.

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.

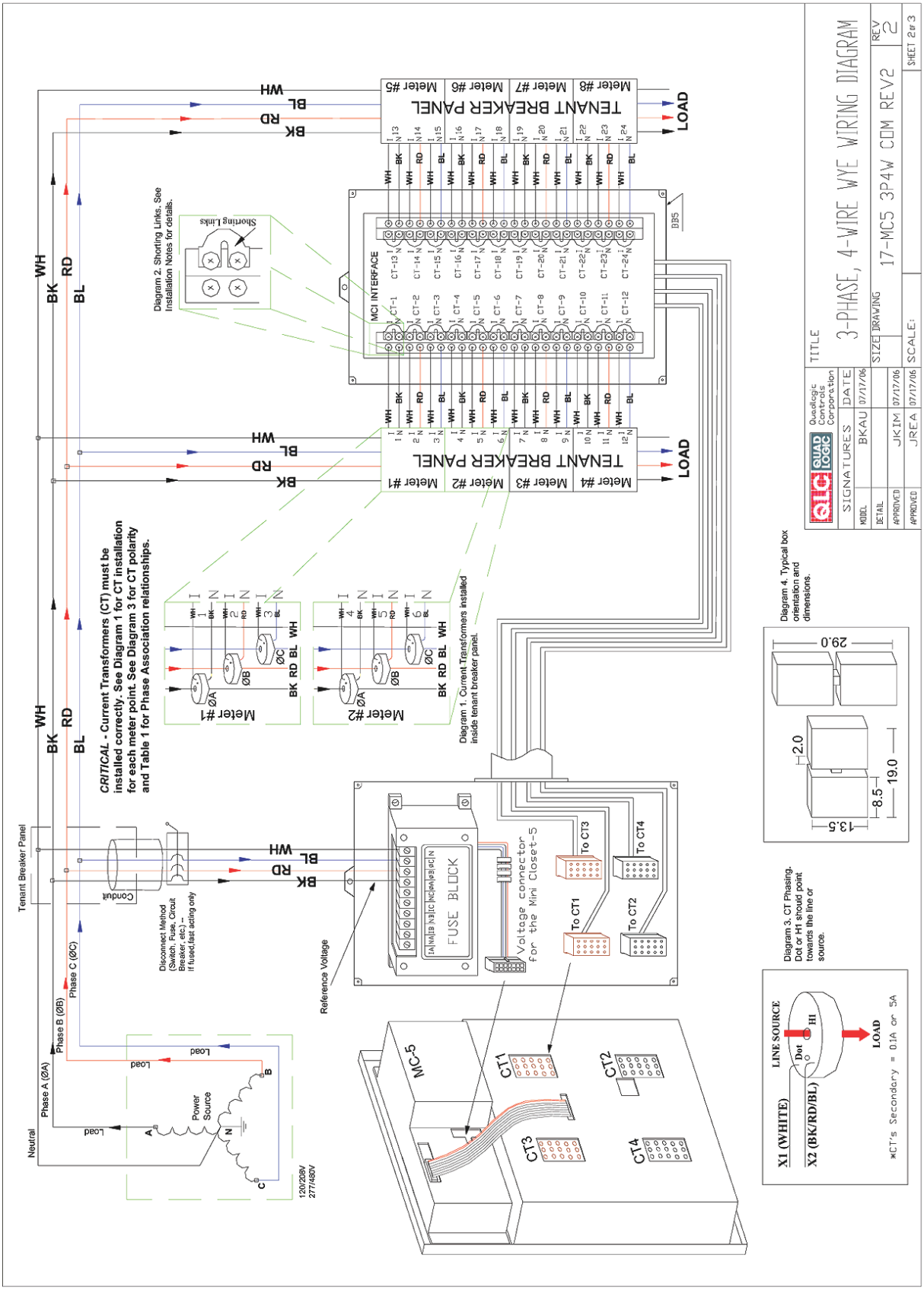
WARNING: Bodily injury or damage may result if shorting links are not installed.

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

Table 1. Phase Association Table

QLC QUAD LOGIC Quadlogic Controls Corporation			TITLE 3-PHASE, 4-WIRE WYE WIRING DIAGRAM		
SIGNATURES		DATE			
MODEL	BKAU	07/17/06	SIZE	DRAWING 17-MC5 3P4W COM REV2	REV 2
DETAIL					
APPROVED	JKIM	07/17/06			
APPROVED	JREA	07/17/06	SCALE:		SHEET 1 of 3

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


3-PHASE, 4-WIRE WYE WIRING DIAGRAM
17-MC5 3P4W COM REV2
REV 2
SHEET 2 of 3
TITLE
SIZE DRAWING
SCALE:
Quadlogic Controls Corporation
SIGNATURES DATE
MODEL BKAU 07/17/06
DETAIL
APPROVED JKIM 07/17/06
APPROVED JREA 07/17/06
TENANT BREAKER PANEL
Meter #1 Meter #2 Meter #3 Meter #4
Meter #5 Meter #6 Meter #7 Meter #8
LOAD
MCI INTERFACE
DB5
Shorting Links
Diagram 2. Shorting Links. See Installation Notes for details.
CRITICAL - Current Transformers (CT) must be installed correctly. See Diagram 1 for CT installation for each meter point. See Diagram 3 for CT polarity and Table 1 for Phase Association relationships.
Meter #1
Meter #2
Diagram 1. Current Transformers installed inside tenant breaker panel.
Tenant Breaker Panel
Conduit
Disconnect Method (Switch, Fuse, Circuit Breaker, etc.) – If fused,fast acting only
Reference Voltage
FUSE BLOCK
Voltage connector for the Mini Closet-5
To CT1
To CT2
To CT3
To CT4
MC-5
CT1
CT2
CT3
CT4
Phase A (ØA)
Phase B (ØB)
Phase C (ØC)
Neutral
Load
Power Source
120/208V
277/480V
Diagram 4. Typical box orientation and dimensions.
29.0
2.0
19.0
8.5
13.5
Diagram 3. CT Phasing. Dot of H1 should point towards the line or source.
LINE SOURCE
X1 (WHITE)
X2 (BK/RD/BL)
Dot
H1
LOAD
*CT's Secondary = 0.1A or 5A

BEFORE READING THE DISPLAY FOR ANY MC5 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, 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
FOR 240V	100A	x0.5	x20.0
	200A	x1.0	x40.0

Table 1. CT Multipliers

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
2	UPDATE CT MULTIPLIER TABLE	07/17/06	JKIM

QLC QUAD LOGIC Quadlogic Controls Corporation			TITLE 3-PHASE, 4-WIRE WYE WIRING DIAGRAM	
SIGNATURES		DATE		
MODEL	BKAU	07/17/06		
DETAIL			SIZE DRAWING 17-MC5 3P4W COM REV2	REV 2
APPROVED	JKIM	07/17/06		
APPROVED	JREA	07/17/06	SCALE:	SHEET 3 OF 3

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.

II. 1-Phase, 3-Wire 120/208V Wiring and Installation

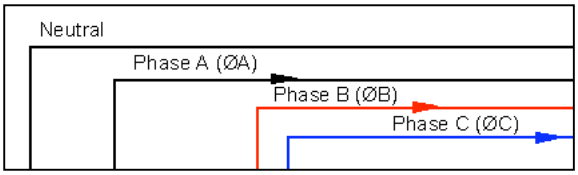
Catalog Number	Description
MC5 120V 01A 03R	2EL/3M 120/208V 3P4W
MC5 120V 01A 06R	2EL/6M 120/208V 3P4W
MC5 120V 01A 09R	2EL/9M 120/208V 3P4W
MC5 120V 01A 12R	2EL/12M 120/208V 3P4W
MC5 120V CL10 03R	2EL/3M 120/208V 3P4W
MC5 120V CL10 06R	2EL/6M 120/208V 3P4W
MC5 120V CL10 09R	2EL/9M 120/208V 3P4W
MC5 120V CL10 12R	2EL/12M 120/208V 3P4W

Detailed Wiring Instructions

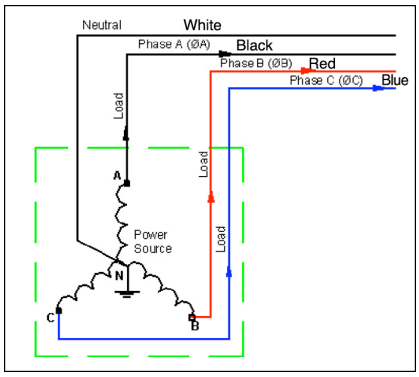
A) Voltage taps

i. Follow voltage tap installation procedure on page 21.

ii. Color-code the main feeder wires as follows: Black – phase A; Red – phase B; Blue – phase C.

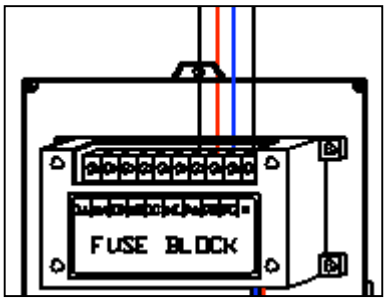


iii. Connect #12 AWG wires to phase A, phase B, phase C, and Neutral. Wires must be Black (phase A), Red (phase B), Blue (phase C), and White (Neutral)



iv. If required, run the hot wires through a fused disconnect

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 22.

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 (see Section B) and each three CT connections repeat an A-B, C-A, and B-C order.

Meter	MCI Board CT	Voltage Phase
1	1	A
	2	B
2	3	C
	4	A
3	5	B
	6	C
4	7	A
	8	B
5	9	C
	10	A
6	11	B
	12	C

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

Figure 4-6. CT phase association for single-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.

INSTALLATION NOTES

Applicable for the following catalog numbers*:

45-MC5 120V 01A 03R (2EL/3M 120/208V 3P4W) 45-MC5 120V CL10 03R (2EL/3M 120/208V 3P4W)
45-MC5 120V 01A 06R (2EL/6M 120/208V 3P4W) 45-MC5 120V CL10 06R (2EL/6M 120/208V 3P4W)
45-MC5 120V 01A 09R (2EL/9M 120/208V 3P4W) 45-MC5 120V CL10 09R (2EL/9M 120/208V 3P4W)
45-MC5 120V 01A 12R (2EL/12M 120/208V 3P4W) 45-MC5 120V CL10 12R (2EL/12M 120/208V 3P4W)

*These instructions are also applicable when the same meter model number has the suffix: -E, -P or EP.

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. Within the meter, the current reading from the CT is combined with the voltage readingfor 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-A, and B-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 and then remove the the twenty-four (24) shorting links.

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

4. Installation of 0.1A inputs and CL10 or 5A inputs are the same.

5. For three (3), six (6), and nine (9) 3-phase metering points, model numbers:

   - 45-MC5 120V 01A 03R - 45-MC5 120V CL10 03R
   - 45-MC5 120V 01A 06R - 45-MC5 120V CL10 06R
   - 45-MC5 120V 01A 09R - 45-MC5 120V CL10 09R

   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.

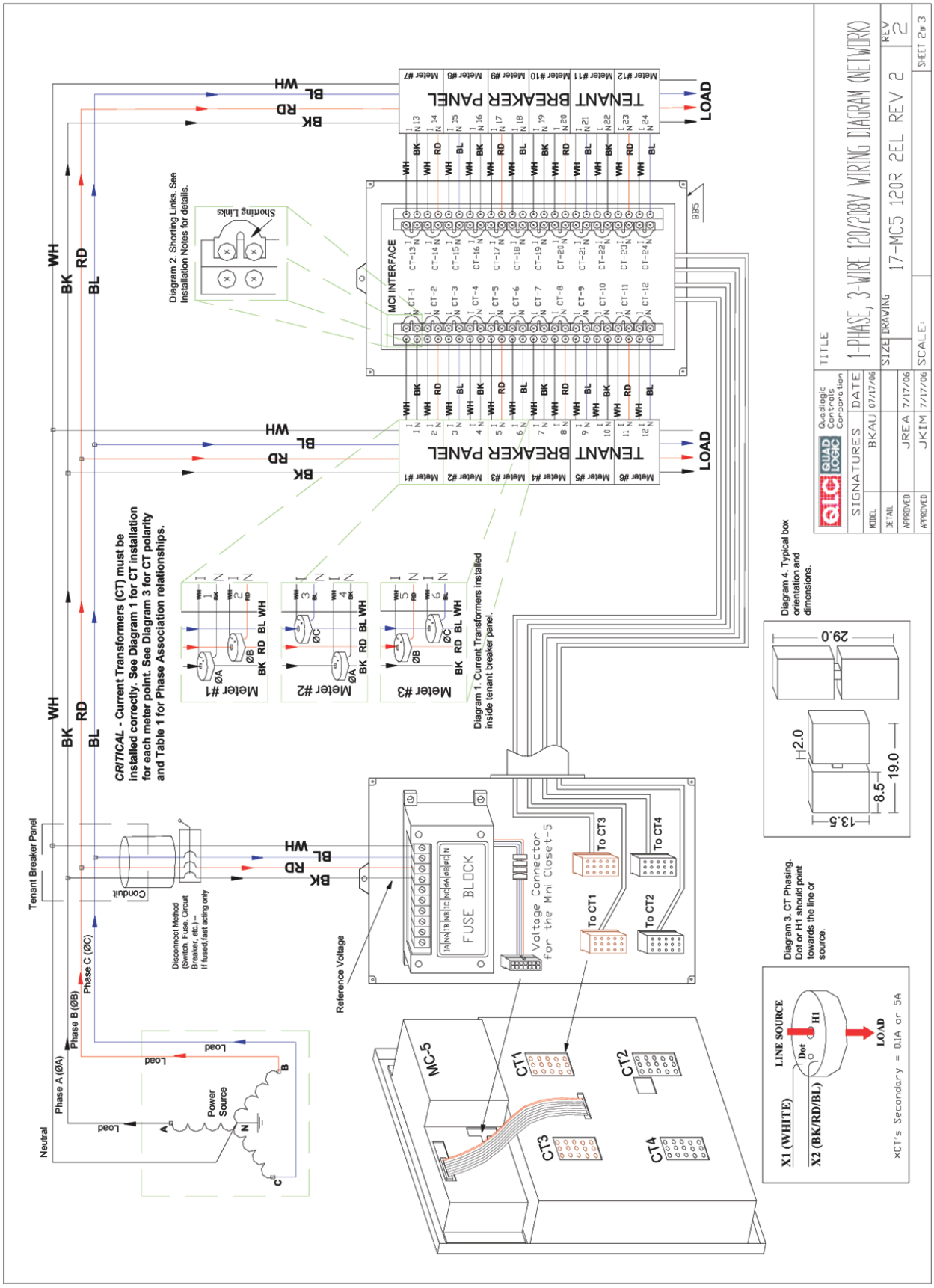
WARNING: Bodily injury or damage may result if shorting links are not installed.

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

Table 1. Phase Association Table

QLC QUAD LOGIC Quadlogic Controls Corporation			TITLE 1-PHASE, 3-WIRE 120/208V WIRING DIAGRAM (NETWORK)	
SIGNATURES		DATE		
MODEL	BKAU	07/17/06	SIZE DRAWING 17-MC5 120R 2EL REV 2	REV 2
DETAIL				
APPROVED	JKIM	07/17/06		
APPROVED	JREA	07/17/06	SCALE:	SHEET 1 of 3

Figure 4-7. single-phase, 3-wire 120/208V wiring.


TENANT BREAKER PANEL
LOAD
MCI INTERFACE
Shorting Links
Diagram 2. Shorting Links. See Installation Notes for details.
CRITICAL - Current Transformers (CT) must be installed correctly. See Diagram 1 for CT installation for each meter point. See Diagram 3 for CT polarity and Table 1 for Phase Association relationships.
Meter #1
Meter #2
Meter #3
Diagram 1. Current Transformers installed inside tenant breaker panel.
Tenant Breaker Panel
Conduit
Disconnect Method (Switch, Fuse, Circuit Breaker, etc.) — If fused,fast acting only
Reference Voltage
FUSE BLOCK
Voltage Connector for the Mini Closet-5
To CT1
To CT2
To CT3
To CT4
MC-5
CT1
CT2
CT3
CT4
Power Source
Neutral
Phase A (ØA)
Phase B (ØB)
Phase C (ØC)
Load
Diagram 3. CT Phasing. Dot or H1 should point towards the line or source.
LINE SOURCE
X1 (WHITE)
X2 (BK/RD/BL)
LOAD
*CT's Secondary = 0.1A or 5A
Diagram 4. Typical box orientation and dimensions.
29.0
2.0
13.5
8.5
19.0
Quadlogic Controls Corporation
SIGNATURES
DATE
BKAU 07/17/06
JREA 7/17/06
JKIM 7/17/06
TITLE
1-PHASE, 3-WIRE 120/208V WIRING DIAGRAM (NETWORK)
SIZE
DRAWING
17-MC5 120R 2EL REV 2
REV 2
SCALE:
SHEET 2 of 3

BEFORE READING THE DISPLAY FOR ANY MC5 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, 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
FOR 240V	100A	x0.5	x20.0
	200A	x1.0	x40.0

Table 1. CT Multipliers

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
2	UPDATE CT MULTIPLIER TABLE	07/17/06	JKIM

QLC QUAD LOGIC Quadlogic Controls Corporation			TITLE 1-PHASE, 3-WIRE 120/208V WIRING DIAGRAM (NETWORK)
SIGNATURES		DATE	
MODEL	BKAU	07/17/06	
DETAIL			SIZE DRAWING 17-MC5 120R 2EL REV 2 REV 2
APPROVED	JREA	07/17/06	
APPROVED	JKIM	07/17/06	SCALE: SHEET 3 of 3

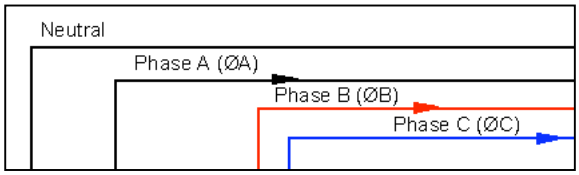
CAUTION:
When reading the meter display, all consumption and demand values must be multiplied by the correct multiplier to calculate true value. Please refer to Chapter 6 for more details.

III. 3-Phase, 4-Wire 1EL Wiring and Installation

Catalog Number	Description
MC5 120V 01A 24R	1EL/24M 120/208V 3P4W
MC5 277V 01A 24R	1EL/24M 277/480 3P4W

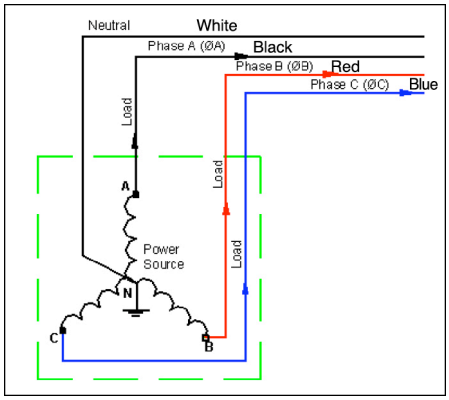
Detailed wiring instructions

A) Voltage taps
   i. Follow voltage tap installation procedure on page 21.
   ii. Color-code the main feeder wires as follows: Black – phase A; Red – phase B; Blue – phase C.

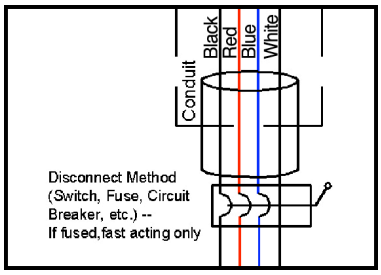


   iii. Connect #12 AWG wires to phase A, phase B, and phase C. Wires must be Black (phase A), Red (phase B), and Blue (phase C).
   iv. If required, run the hot wires through a fused disconnect
   v. Run wires through conduit to MC5 back box. Connect to screw terminals on fuse block. Black – VA; Red –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

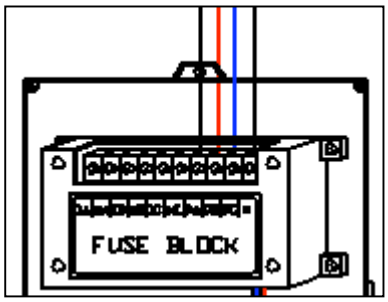
B) CT installation
   i. Follow CT installation procedure on page 22.
   ii. For each load, determine which voltage phase supplies the power. Then use a CT with the corresponding color code for that load (Black, Red, or Blue).
   iii. Route the load wire through the CT as shown in the diagram



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 (see Table 1) 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 4-8. 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 Table 1 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 'L' (0.1A inputs) and 'H' (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*:

45-MC5 120V 01A 24R (1EL/24M 120/208V 3P4W)
45-MC5 277V 01A 24R (1EL/24M 277/480V 3P4W)

*These instructions are also applicable when the same meter model number has the suffix: -E, -P or EP.

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. Within the meter, the current reading from the CT is combined with the voltage readingfor 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, and C phase is a single meter point (see Table 1 for full listing):

   - Meter #1 (M#1) is CT1
   - Meter #2 (M#2) is CT2
   - repeat for M#3 to M#24

2. After completing all CT terminations, connect the four (4) current connectors and then remove the the twenty-four (24) shorting links.

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

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.

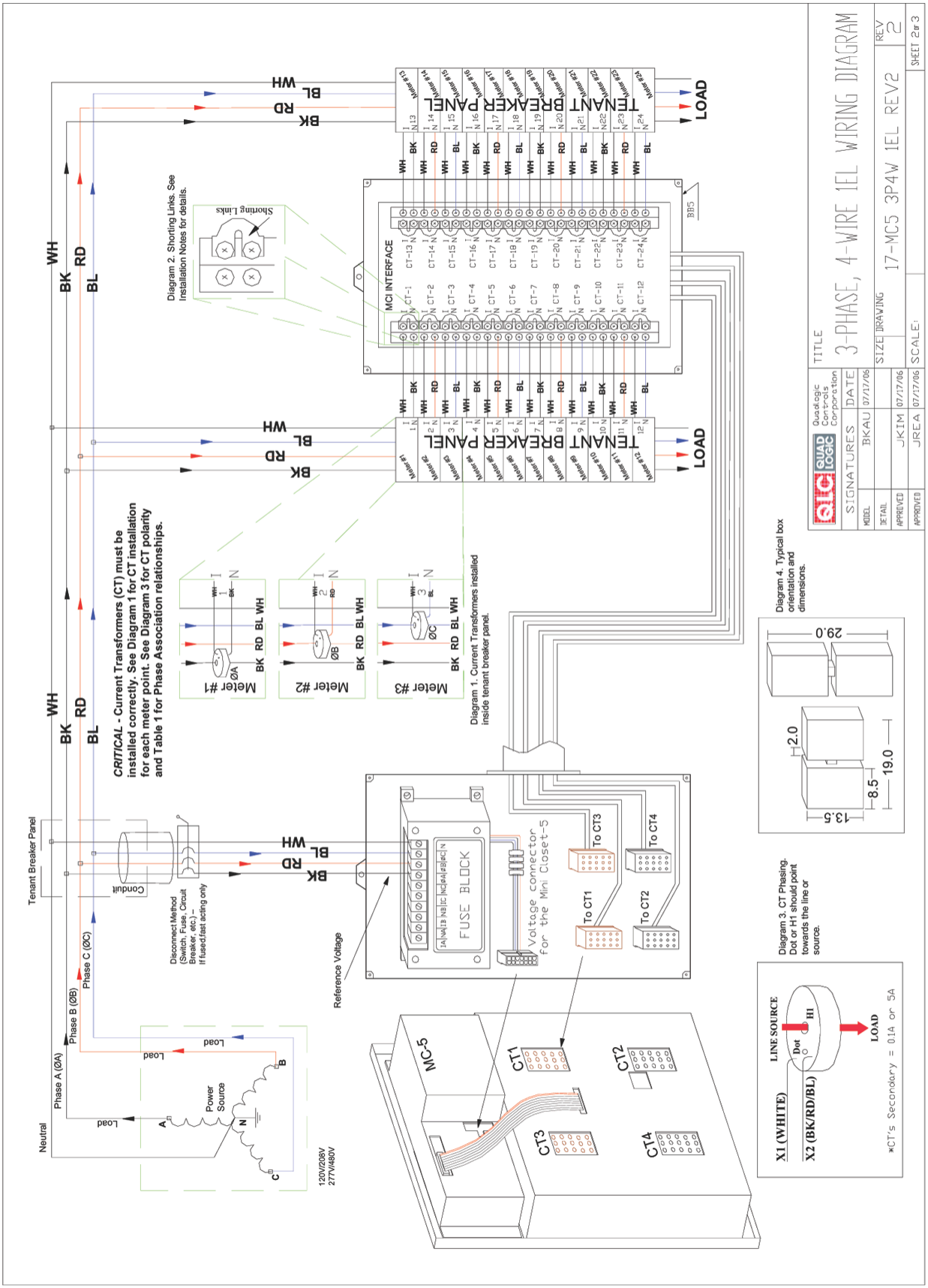
WARNING: Bodily injury or damage may result if shorting links are not installed.

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

Table 1. Phase Association Table

QLC QUAD LOGIC Quadlogic Controls Corporation			TITLE 3-PHASE, 4-WIRE 1EL WIRING DIAGRAM		
SIGNATURES		DATE			
MODEL	BKAU	07/17/06			
DETAIL			SIZE DRAWING 17-MC5 3P4W 1EL REV2		REV 2
APPROVED	JKIM	07/17/06			
APPROVED	JREA	07/17/06	SCALE:		SHEET 1 of 3

Figure 4-9. single-phase, 3-wire 120/208V wiring.


TITLE
3-PHASE, 4-WIRE 1EL WIRING DIAGRAM
17-MC5 3P4W 1EL REV2
REV 2
SHEET 2 of 3
SIZE DRAWING
SCALE:
Quadlogic Controls Corporation
SIGNATURES
DATE
MODEL
BKAU 07/17/06
DETAIL
JKIM 07/17/06
APPROVED
JREA 07/17/06
APPROVED
TENANT BREAKER PANEL
LOAD
MCI INTERFACE
Shorting Links
Diagram 2. Shorting Links. See Installation Notes for details.
CRITICAL - Current Transformers (CT) must be installed correctly. See Diagram 1 for CT installation for each meter point. See Diagram 3 for CT polarity and Table 1 for Phase Association relationships.
Meter #1
Meter #2
Meter #3
Diagram 1. Current Transformers installed inside tenant breaker panel.
Tenant Breaker Panel
Conduit
Disconnect Method (Switch, Fuse, Circuit Breaker, etc.) – If fused:fast acting only
Reference Voltage
FUSE BLOCK
Voltage connector for the Mini Closet-5
To CT1
To CT2
To CT3
To CT4
MC-5
CT1
CT2
CT3
CT4
Phase A (ØA)
Phase B (ØB)
Phase C (ØC)
Neutral
Load
Power Source
120V/208V
277V/480V
Diagram 4. Typical box orientation and dimensions.
29.0
2.0
19.0
8.5
13.5
Diagram 3. CT Phasing. Dot or H1 should point towards the line or source.
LINE SOURCE
X1 (WHITE)
X2 (BK/RD/BL)
Dot
H1
LOAD
*CT's Secondary = 0.1A or 5A

BEFORE READING THE DISPLAY FOR ANY MC5 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, 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
FOR 240V	100A	x0.5	x20.0
	200A	x1.0	x40.0

Table 1. CT Multipliers

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
2	UPDATE CT MULTIPLIER TABLE	07/17/06	JKIM

QLC QUAD LOGIC Quadlogic Controls Corporation			TITLE 3-PHASE, 4-WIRE 1EL WIRING DIAGRAM
SIGNATURES		DATE	
MODEL	BKAU	07/17/06	
DETAIL			SIZE DRAWING 17-MC5 3P4W 1EL REV2 REV 2
APPROVED	JKIM	07/17/06	
APPROVED	JREA	07/17/06	SCALE: SHEET 3 of 3

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.

IV. 3-Phase, 3-Wire Delta Wiring and Installation

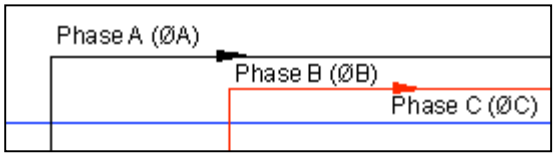
Catalog Number	Description
MC5 480V 01A 12C	2EL/12M 480VDELTA3P3W
MC5 480V CL10 12C	2EL/12M 480VDELTA3P3W
MC5 600V CL10 12C	2EL/12M 600VDELTA3P3W

Detailed wiring instructions

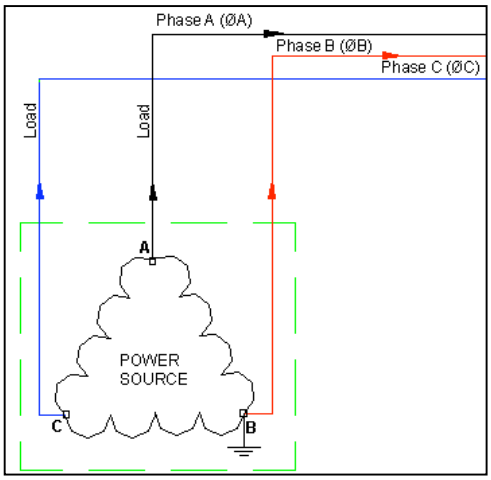
A) Voltage taps

i. Follow voltage tap installation procedure on page 21.

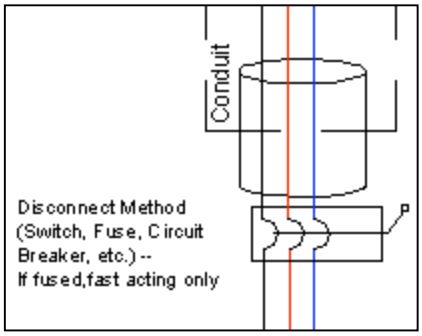
ii. Color-code the main feeder wires as follows: Black – phase A; Red – phase B; Blue – phase C.



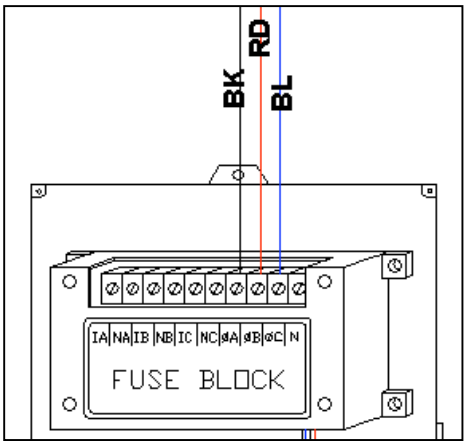
iii. Connect #12 AWG wires to phase A, phase B, and phase C. Wires must be Black (phase A), Red (phase B), and Blue (phase C).



iv. If required, run the hot wires through a fused disconnect



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 22.

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 4-9).

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 Table 1) and each two CT connections repeat an A-C, A-C, A-C pattern

Meter	MCI Board CT	Voltage Phase
1	1	A
	2	C
2	3	A
	4	C
3	5	A
	6	C
4	7	A
	8	C
5	9	A
	10	C
6	11	A
	12	C

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

Figure 4-9. 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 'L' (0.1A inputs) and 'H' (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*:

45-MC5 480V 01A 12C (2EL/12M 480V DEL 3P3W)
45-MC5 480V CL10 12C (2EL/12M 480V DEL 3P3W)
45-MC5 208V 01A 12C (2EL/12M 208V DEL 3P3W)
45-MC5 208V CL10 12C (2EL/12M 208V DEL 3P3W)

*These instructions are also applicable when the same meter model number has the suffix: -E, -P or EP.

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. 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 and then remove the the twenty-four (24) shorting links.

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

4. 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.

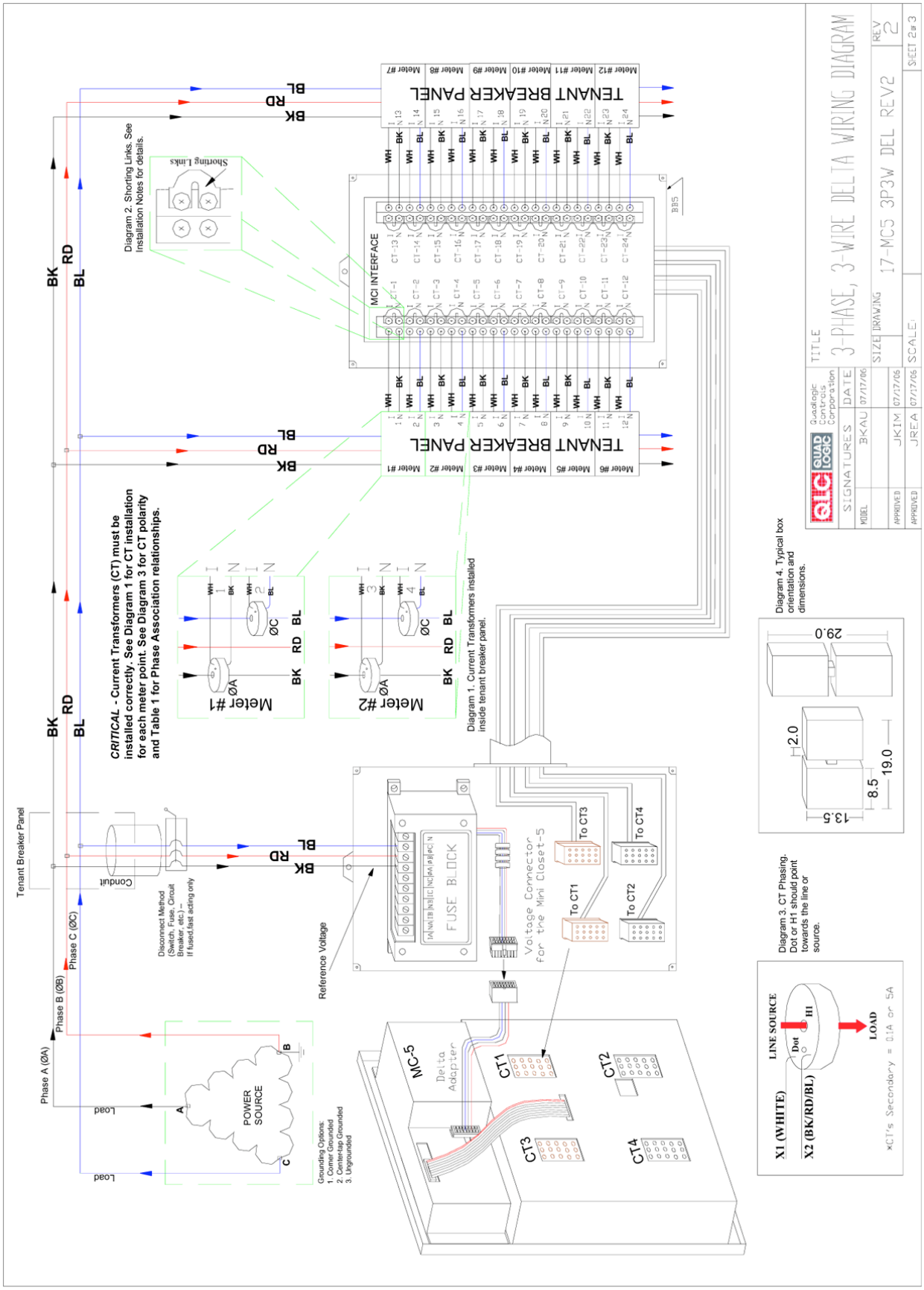
WARNING: Bodily injury or damage may result if shorting links are not installed.

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

Table 1. Phase Association Table

QLC QUAD LOGIC Quadlogic Controls Corporation		TITLE 3-PHASE, 3-WIRE DELTA WIRING DIAGRAM	
SIGNATURES	DATE		
MODEL BKAU	07/17/06		
		SIZE DRAWING 17-MC5 3P3W DEL REV2	REV 2
APPROVED JKIM	07/17/06		
APPROVED JREA	07/17/06	SCALE:	SHEET 1 of 3

Figure 4-10. 3-phase, 3-wire delta wiring.


3-PHASE, 3-WIRE DELTA WIRING DIAGRAM
17-MC5 3P3W DEL REV2
TENANT BREAKER PANEL
MCI INTERFACE
Shorting Links
Diagram 2. Shorting Links. See Installation Notes for details.
CRITICAL - Current Transformers (CT) must be installed correctly. See Diagram 1 for CT installation for each meter point. See Diagram 3 for CT polarity and Table 1 for Phase Association relationships.
Meter #1
Meter #2
Diagram 1. Current Transformers installed inside tenant breaker panel.
Tenant Breaker Panel
Phase A (ØA)
Phase B (ØB)
Phase C (ØC)
Conduit
Disconnect Method (Switch, Fuse, Circuit Breaker, etc.) – If fused,fast acting only
Reference Voltage
FUSE BLOCK
Voltage Connector for the Mini Closet-5
To CT1
To CT2
To CT3
To CT4
MC-5
Delta Adapter
CT1
CT2
CT3
CT4
POWER SOURCE
Load
Grounding Options:
1. Corner Grounded
2. Center-tap Grounded
3. Ungrounded
Diagram 4. Typical box orientation and dimensions.
29.0
2.0
19.0
8.5
13.5
Diagram 3. CT Phasing. Dot or H1 should point towards the line or source.
LINE SOURCE
LOAD
X1 (WHITE)
X2 (BK/RD/BL)
Dot
H1
*CT's Secondary = 0.1A or 5A
Quadlogic Controls Corporation
SIGNATURES
DATE
MODEL
SIZE
DRAWING
SCALE
SHEET 2 of 3
REV 2

BEFORE READING THE DISPLAY FOR ANY MC5 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, 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
FOR 240V	100A	x0.5	x20.0
	200A	x1.0	x40.0

Table 1. CT Multipliers

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
2	UPDATE CT MULTIPLIER TABLE	07/17/06	JKIM

QLC QUAD LOGIC Quadlogic Controls Corporation

SIGNATURES		DATE
MODEL	BKAU	07/17/06
APPROVED	JREA	07/17/06
APPROVED	BKAU	07/17/06

TITLE 3-PHASE, 3-WIRE DELTA WIRING DIAGRAM

SIZE DRAWING 17-MC5 3P3W DEL REV2 REV 2

SCALE: SHEET 3 of 3

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.

V. 1-Phase, 3-Wire 240V 1EL Wiring and Installation

Catalog Number	Description
45-MC5 240V 01A 24R	1EL/24M 240V 1P3W
45-MC5 240V CL10 24R	1EL/24M 240V 1P3W

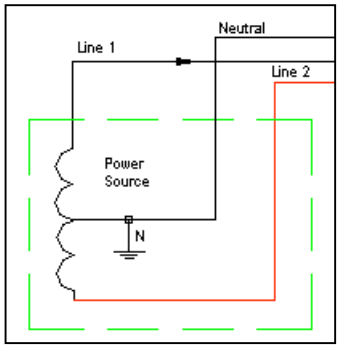
Detailed wiring instructions

A) Voltage taps

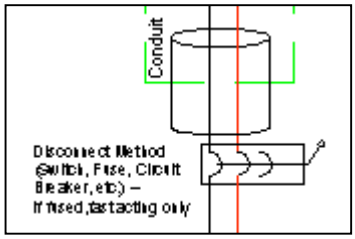
i. Follow voltage tap installation procedure on page 21.

ii. Color-code the main feeder wires as follows: Black – Line 1; Red – Line 2.

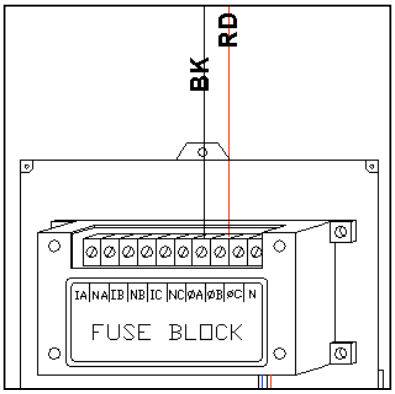
iii. Connect #12 AWG wires to Line 1 and Line 2. Wires must be Black (Line 1) and Red (Line 2).



iv. If required, run the hot wires through a fused disconnect



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 22.
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 Line 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.

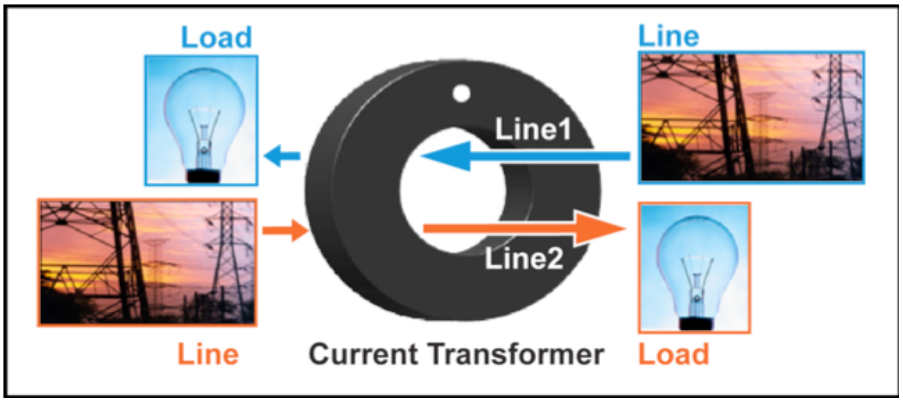


Figure 4-11. Line 1 and Line 2 passed through a current transformer.

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
1	1	L#1(+) and L#2(-)
2	2	L#1(+) and L#2(-)
3	3	L#1(+) and L#2(-)
4	4	L#1(+) and L#2(-)
5	5	L#1(+) and L#2(-)
6	6	L#1(+) and L#2(-)
7	7	L#1(+) and L#2(-)
8	8	L#1(+) and L#2(-)
9	9	L#1(+) and L#2(-)
10	10	L#1(+) and L#2(-)
11	11	L#1(+) and L#2(-)
12	12	L#1(+) and L#2(-)

Meter	MCI Board CT	Reference Voltage Line
13	13	L#1(+) and L#2(-)
14	14	L#1(+) and L#2(-)
15	15	L#1(+) and L#2(-)
16	16	L#1(+) and L#2(-)
17	17	L#1(+) and L#2(-)
18	18	L#1(+) and L#2(-)
19	19	L#1(+) and L#2(-)
20	20	L#1(+) and L#2(-)
21	21	L#1(+) and L#2(-)
22	22	L#1(+) and L#2(-)
23	23	L#1(+) and L#2(-)
24	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. 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*:

45-MC5 240V 01A 24R (1EL/24M 240V 1P3W)
45-MC5 240V CL10 24R (1EL/24M 240V 1P3W)

*These instructions are also applicable when the same meter model number has the suffix: -E, -P or EP.

CRITICAL: The line 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 CT.
   Line 1 (Wire 1): Line 1 should be passed though 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 and then remove the 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.

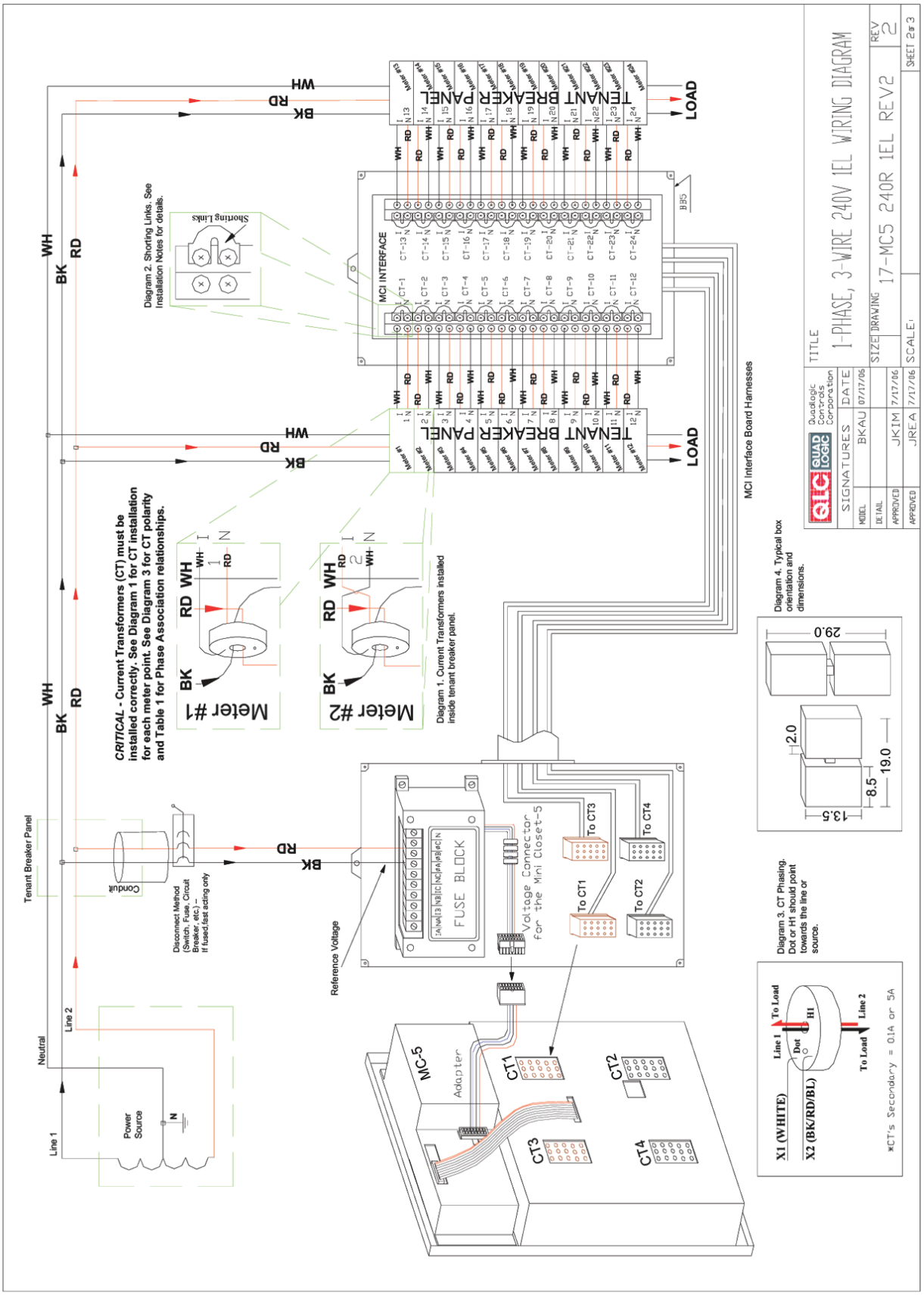
Meter # (M#)	MCI Board CT #	Reference Voltage Line*
1	1	L#1 (+) & L#2 (-)
2	2	L#1 (+) & L#2 (-)
3	3	L#1 (+) & L#2 (-)
4	4	L#1 (+) & L#2 (-)
5	5	L#1 (+) & L#2 (-)
6	6	L#1 (+) & L#2 (-)
7	7	L#1 (+) & L#2 (-)
8	8	L#1 (+) & L#2 (-)
9	9	L#1 (+) & L#2 (-)
10	10	L#1 (+) & L#2 (-)
11	11	L#1 (+) & L#2 (-)
12	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 DOT or H1 of CT
L#2 (-) = Line #2 points away Dot or H1 of CT

Table 1. Line Association Table

QLC QUAD LOGIC Quadlogic Controls Corporation			TITLE 1-PHASE, 3-WIRE 240V 1EL WIRING DIAGRAM	
SIGNATURES		DATE		
MODEL	BKAU	07/17/06		
DETAIL			SIZE DRAWING 17-MC5 240R 1EL REV2	REV 2
APPROVED	JKIM	07/17/06		
APPROVED	JREA	07/17/06	SCALE:	SHEET 1 of 3

Figure 4-12. 1-phase, 3-wire 240V 1EL wiring


TITLE
1-PHASE, 3-WIRE 240V 1EL WIRING DIAGRAM
SIZE DRAWING 17-MC5 240R 1EL REV2
REV 2
SHEET 2 of 3
SCALE:
Quadlogic Controls Corporation
SIGNATURES DATE
MODEL BKAU 07/17/06
DETAIL JKIM 7/17/06
APPROVED JREA 7/17/06
APPROVED
TENANT BREAKER PANEL
LOAD
MCI INTERFACE
MCI Interface Board Harnesses
Shorting Links
Diagram 2. Shorting Links. See Installation Notes for details.
CRITICAL - Current Transformers (CT) must be installed correctly. See Diagram 1 for CT installation for each meter point. See Diagram 3 for CT polarity and Table 1 for Phase Association relationships.
Meter #1
Meter #2
Diagram 1. Current Transformers installed inside tenant breaker panel.
Tenant Breaker Panel
Conduit
Disconnect Method (Switch, Fuse, Circuit Breaker and 2 If fused,fast acting only
Reference Voltage
FUSE BLOCK
Voltage Connector for the Mini Closet-5
To CT1
To CT2
To CT3
To CT4
Neutral
Line 1
Line 2
Power Source
MC-5
Adapter
CT1
CT2
CT3
CT4
Diagram 4. Typical box orientation and dimensions.
29.0
2.0
19.0
8.5
13.5
Diagram 3. CT Phasing. Dot or H1 should point towards the line or source.
X1 (WHITE)
X2 (BK/RD/BL)
Line 1
Dot
H1
To Load
Line 2
*CT's Secondary = 0.1A or 5A

BEFORE READING THE DISPLAY FOR ANY MC5 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, 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
FOR 240V	100A	x0.5	x20.0
	200A	x1.0	x40.0

Table 1. CT Multipliers

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
2	UPDATE CT MULTIPLIER TABLE	07/17/06	JKIM

QLC QUAD LOGIC Quadlogic Controls Corporation			TITLE 1-PHASE, 3-WIRE 240V 1EL WIRING DIAGRAM	
SIGNATURES		DATE		
MODEL	BKAU	07/17/06		
DETAIL			SIZE DRAWING 17-MC5 240R 1EL REV2	REV 2
APPROVED	JREA	07/17/06		
APPROVED	JKIM	07/17/06	SCALE:	SHEET 3 OF 3

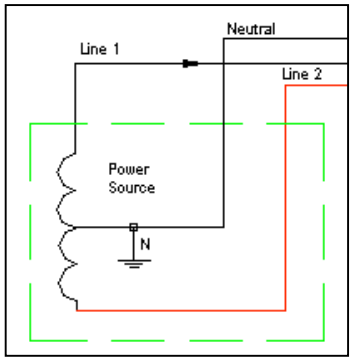
CAUTION:
When reading the meter display, all consumption and demand values must be multiplied by the correct multiplier to calculate true value. Please refer to Chapter 6 for more details.

VI. 1-Phase, 3-Wire 240V 2EL Wiring and Installation

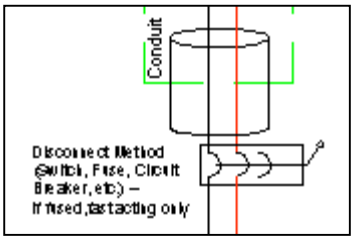
Catalog Number	Description
MC5 240V 01A 12R	2EL/12M 240V 1P3W
MC5 240V CL10 12R	2EL/12M 240V 1P3W

Detailed wiring instructions

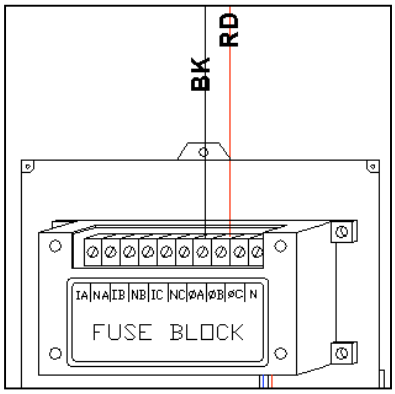
A) Voltage taps
   i. Follow voltage tap installation procedure on page 21.
   ii. Color-code the main feeder wires as follows: Black – Line 1; Red – Line 2.
   iii. Connect #12 AWG wires to Line 1 and Line 2. Wires must be Black (Line 1) and Red (Line 2).



   iv. If required, run the hot wires through a fused disconnect



   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 22.
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 Line 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 4-13).

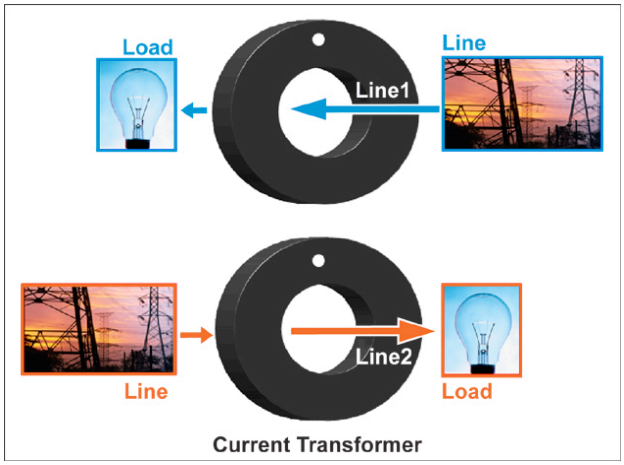


Figure 4-13. Line 1 and Line 2 passed through two different current transformers.

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
1	1	L#1(+) and L#2(-)
	2	L#1(+) and L#2(-)
2	3	L#1(+) and L#2(-)
	4	L#1(+) and L#2(-)
3	5	L#1(+) and L#2(-)
	6	L#1(+) and L#2(-)
4	7	L#1(+) and L#2(-)
	8	L#1(+) and L#2(-)
5	9	L#1(+) and L#2(-)
	10	L#1(+) and L#2(-)
6	11	L#1(+) and L#2(-)
	12	L#1(+) and L#2(-)

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

45-MC5 240V 01A 12R (2EL/12M 240V 1P3W)
45-MC5 240V CL10 12R (2EL/12M 240V 1P3W)

*These instructions are also applicable when the same meter model number has the suffix: -E, -P or EP.

CRITICAL: The line 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 CT.
   Line 1 (Wire 1): Line 1 should be passed though 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 and then remove the 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.

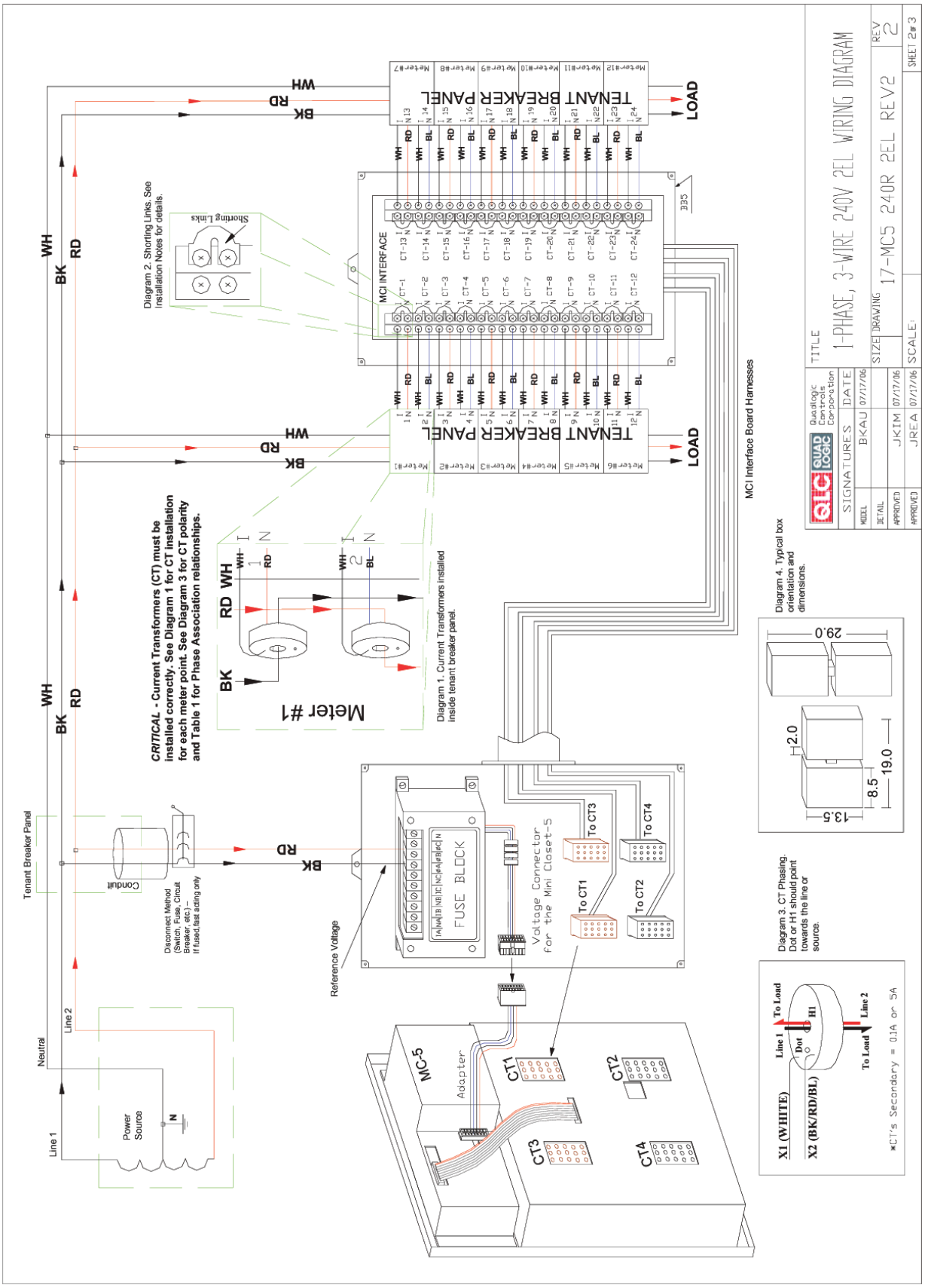
Meter # (M#)	MCI Board CT #	Reference Voltage Line*
1	1 2	LINE 1 LINE 2
2	3 4	LINE 1 LINE 2
3	5 6	LINE 1 LINE 2
4	7 8	LINE 1 LINE 2
5	9 10	LINE 1 LINE 2
6	11 12	LINE 1 LINE 2
7	13 14	LINE 1 LINE 2
8	15 16	LINE 1 LINE 2
9	17 18	LINE 1 LINE 2
10	19 20	LINE 1 LINE 2
11	21 22	LINE 1 LINE 2
12	23 24	LINE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

**Note: Line #1 points toward DOT or H1 of CT*
Line #2 points away Dot or H1 of CT

Table 1. Line Association Table

QLC QUAD LOGIC Quadlogic Controls Corporation			TITLE 1-PHASE, 3-WIRE 240V 2EL WIRING DIAGRAM	
SIGNATURES		DATE		
MODEL	BKAU	07/17/06		
DETAIL			SIZE DRAWING 17-MC5 240R 2EL REV2	REV 2
APPROVED	JKIM	07/17/06		
APPROVED	BKAU	07/17/06	SCALE:	SHEET 1 of 3

Figure 4-14. single-phase, 3-wire 240V 2 EL wiring.


1-PHASE, 3-WIRE 240V 2EL WIRING DIAGRAM
17-MC5 240R 2EL REV2
TITLE
SIZE DRAWING
SCALE
SHEET 2 of 3
REV 2
SIGNATURES
DATE
BKAU 07/17/06
JKIM 07/17/06
JREA 07/17/06
Quadlogic Controls Corporation
TENANT BREAKER PANEL
LOAD
MCI INTERFACE
MCI Interface Board Harnesses
Diagram 2. Shorting Links. See Installation Notes for details.
Shorting Links
CRITICAL - Current Transformers (CT) must be installed correctly. See Diagram 1 for CT installation for each meter point. See Diagram 3 for CT polarity and Table 1 for Phase Association relationships.
Meter #1
Diagram 1. Current Transformers installed inside tenant breaker panel.
Tenant Breaker Panel
Neutral
Line 1
Line 2
Power Source
Conduit
Disconnect Method (Switch, Fuse, Circuit Breaker, etc.) - If fused, fast acting only
Reference Voltage
FUSE BLOCK
Voltage Connector For the Mini Closet-5
To CT1
To CT2
To CT3
To CT4
MC-5
Adapter
CT1
CT2
CT3
CT4
Diagram 4. Typical box orientation and dimensions.
29.0
2.0
19.0
8.5
13.5
Diagram 3. CT Phasing. Dot or H1 should point towards the line or source.
X1 (WHITE)
X2 (BK/RD/BL)
Line 1
To Load
Dot
H1
Line 2
*CT's Secondary = 0.1A or 5A

BEFORE READING THE DISPLAY FOR ANY MC5 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, 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
FOR 240V	100A	x0.5	x20.0
	200A	x1.0	x40.0

Table 1. CT Multipliers

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
2	UPDATE CT MULTIPLIER TABLE	07/17/06	JKIM

QLC QUAD LOGIC Quadlogic Controls Corporation			TITLE 1-PHASE, 3-WIRE 240V 2EL WIRING DIAGRAM	
SIGNATURES		DATE		
MODEL	BKAU	07/17/06		
DETAIL			SIZE DRAWING 17-MC5 240R 2EL REV2	REV 2
APPROVED	JREA	07/17/06		
APPROVED	JKIM	07/17/06	SCALE:	SHEET 3 of 3

BEFORE READING THE DISPLAY FOR ANY MC5 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.

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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, 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
FOR 240V	100A	x0.5	x20.0
	200A	x1.0	x40.0

Table 1. CT Multipliers

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
2	UPDATE CT MULTIPLIER TABLE	07/17/06	JKIM

QLC QUAD LOGIC Quadlogic Controls Corporation			TITLE 1-PHASE, 3-WIRE 240V 2EL WIRING DIAGRAM	
SIGNATURES		DATE		
MODEL	BKAU	07/17/06		
DETAIL			SIZE DRAWING 17-MC5 240R 2EL REV2	REV 2
APPROVED	JREA	07/17/06		
APPROVED	JKIM	07/17/06	SCALE:	SHEET 3 of 3

MENU NAVIGATION

The following figure shows the MC-5 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.

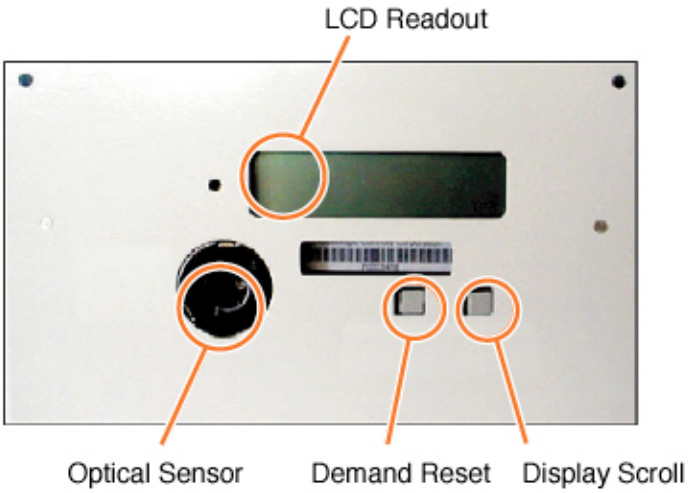


Figure 5-1. MiniCloset-5 front panel display.

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-5 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 <u>under</u> 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.

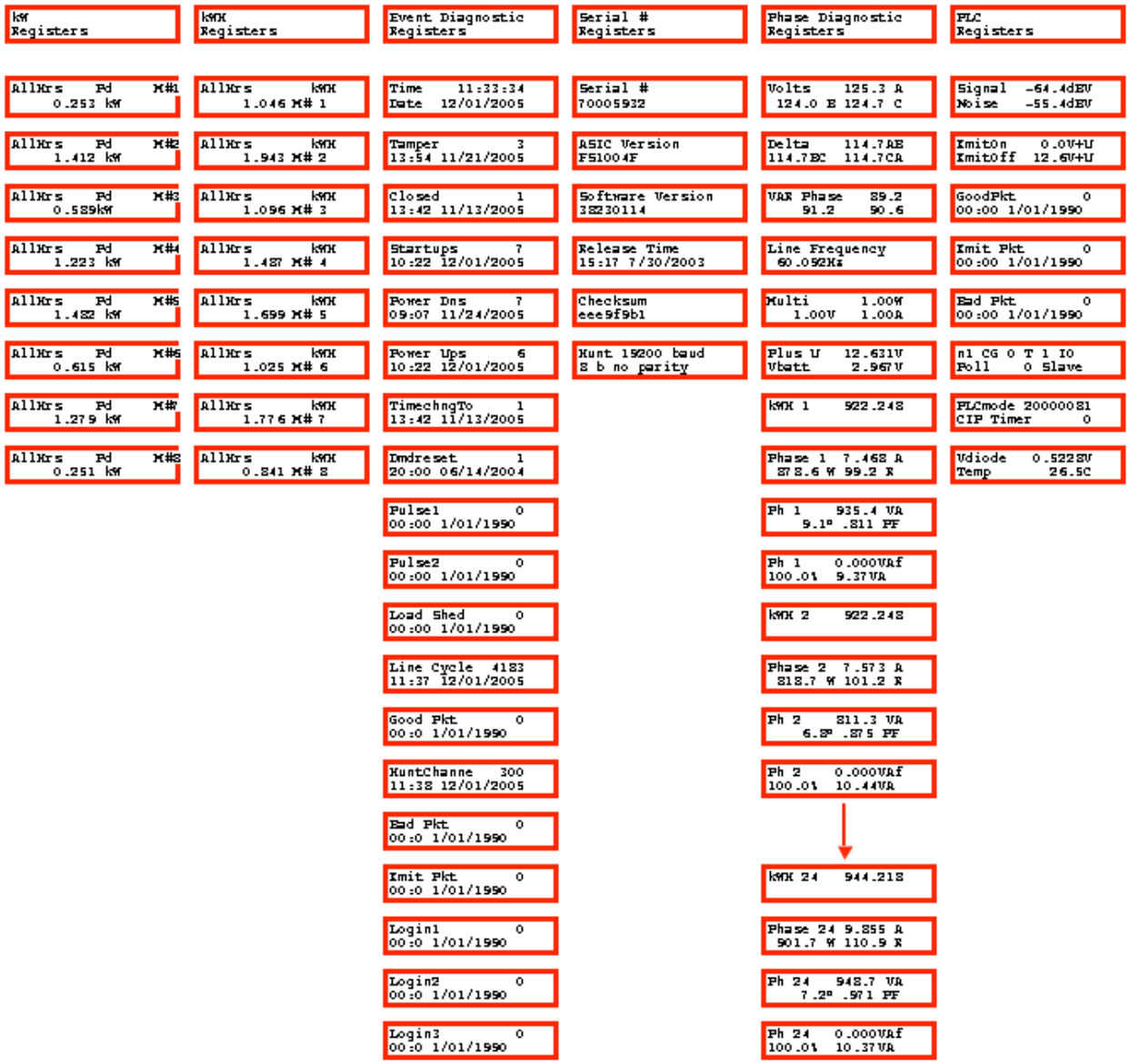


Figure 5-2. The Display Menu Structure For an 8-meter point MC5.

Verifying Meter Functionality

It is very important to verify that the MC-5 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
```

2) 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
124.0 B      124.7 C
```

```
Volts        276.3 A
277.0 B      277.7 C
```

```
Volts        348.5 A
347.1 B      347.7 C
```

3) 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

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

```
kWH
Registers
```

2. 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
```

3. Verify that the kWh value increases on the LCD (assumes active load).
4. 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

1. 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
```

2. 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:

```
Ph 1          935.4 VA
6.8°           .875 PF
```

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.

NOTE

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 Phase 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 MC5, 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:

```
Dmdreset              1
20:00       06/14/2003
```

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.

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 Voltage Ratings	CT Rating	Multiplier for 0.1A CT	Multiplier for 5.0A CT
FOR 120V, 208V, 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 Voltage Ratings	CT Rating	Multiplier for 0.1A CT	Multiplier for 5.0A CT
FOR 240V	100A	x0.5	x 20.0
	200A	x1.0	x 40.0

Table 6.2 Multiplier table for a 240V MiniCloset-5 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 ÷ 100, which is 0.50. A 100:0.1A rated CT will have a multiplier of 100 ÷ 100 which is 1. (Except for 240V MC5 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 ÷ 5, which is 40. (Except for 240V MC-5 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 ÷ 100 = 4. Multiply face value for consumption and demand values by 4. 3422.119 x 4 =13688.476)

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

NOTE A 240V 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/).

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

2. Enter the session name and click OK.

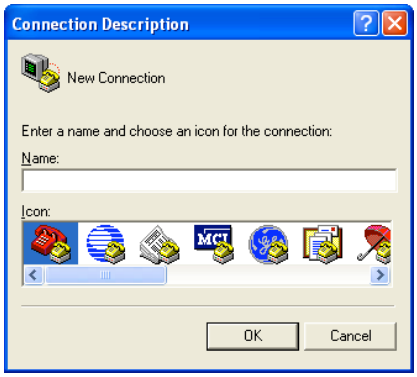


Figure 7-1. New Connection Window

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. Click OK.

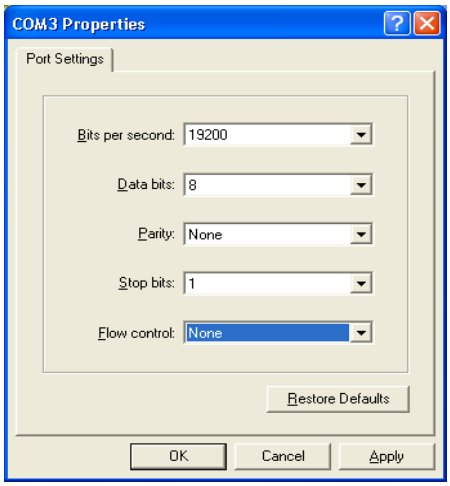


Figure 7-3. COM Port Properties Window

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

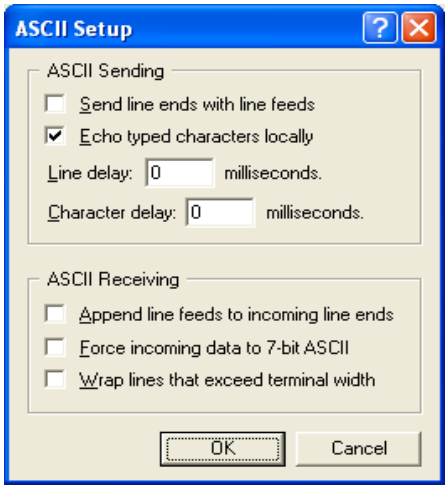


Figure 7-4. ASCII Setup Window

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

SECURITY HIERARCH

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>.**

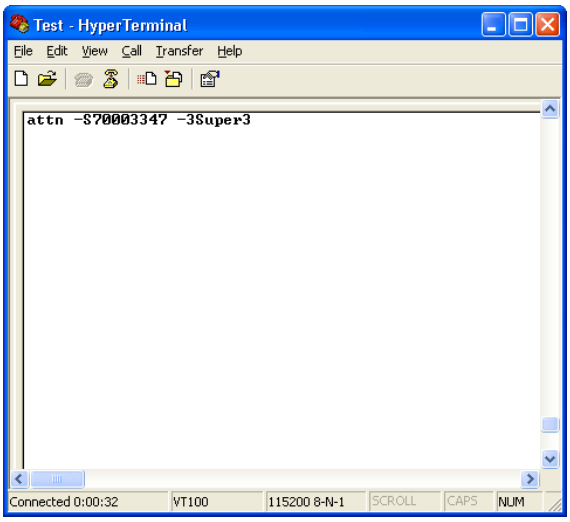


Figure 7-5. Login String

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.

NOTE Passwords are case sensitive.

Level Number	Level Description	Password
Level 1	Reader	1reader1
Level 2	Technician	2tech2
Level 3	Meter Superintendent	3Super3
Level 4	Utility	4UtIlItY4

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.

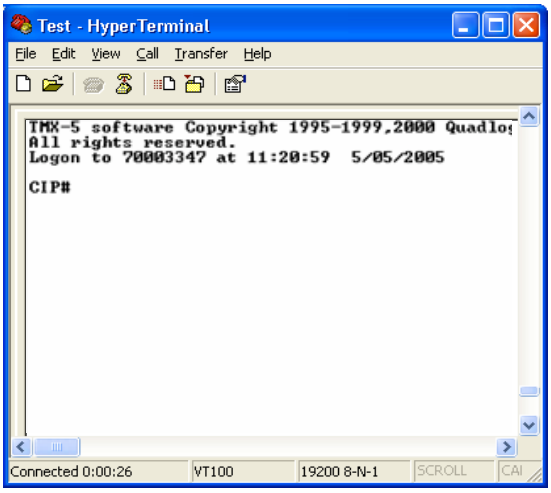


Figure 7-6. CIP# Prompt

NOTE 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 (unmultiplied)
Consdate – Consumption date
Peak – Peak demand of given billing parameter (unmultiplied)
Time of Peak – Time of peak demand

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

```
CIP#mdt -d
M# Q# T# l# 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

a. Enter **mdt_-m<enter>** for the configuration table.
b. Enter **mdw_-L<enter>** for a list of dates in the log.
c. Combine list to access day for specific parameter and day **mdw_Q1_l2<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 DMD ACC PPM Log1 Dmd1 Acc1 BP
  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 KelvinH       0   N   N   N   1    N    N    N 20

CIP#mdw -L
 M# Q# l# Units
  1  1  0 kWH      --/--/----  4/03/2005  4/11/2005  4/12/2005
  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, "l#" 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# l# 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:

12:30am 12:45a 1:00am 1:15am

```
CIP# CIP#mdw -Q1 -16
serno      M# Q# l# 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
```

NOTE

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_-d<enter>***.

```
CIP#event -d
 1 Tamper                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 Watchdog              2 14:27  8/16/2005 S
 7 No Battery            0 00:00  1/01/1990 S
 8 BadPwrDown            0 00:00  1/01/1990 S
 9 SpuriousRst           0 00:00  1/01/1990 S
10 TimechngTo            2 14:03  7/07/2005 T
11 TimechngFrom          1 13:12  7/06/2005 T
12 Dmdreset              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 PlcFreeze             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  4/28/2033 Ts
36 StorePPM              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            1586 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 StoreHdwr             1 06:58  4/28/2033 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 PlcControl           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/yyy

```
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.

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° and -30°.

Problem: ***Phase Angle not between +30°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

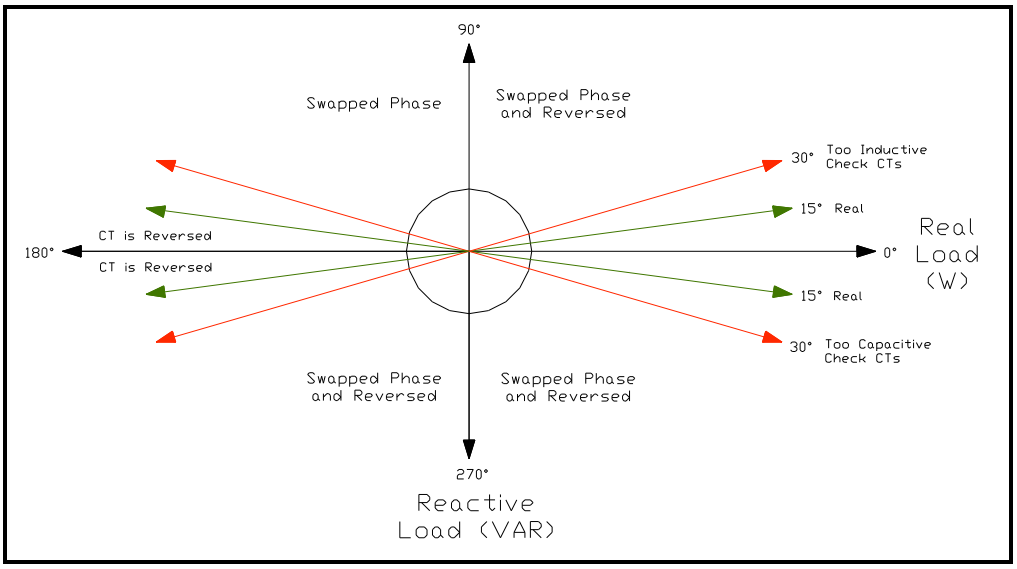


Figure 8-1. Vector Diagram

REPAIR AND SPARE PARTS

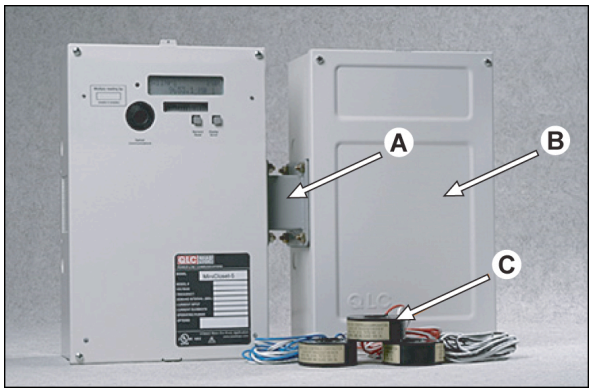
REPAIR

For repair or parts replacement, contact Quadlogic Controls Corporation. Our Sales Administrator will provide the customer with a Return Merchandise Authorization (RMA) number that will be referenced to the product that will be returned. The customer will be responsible for shipping the product to Quadlogic. In turn, Quadlogic will ship back the product to the customer in the same manner in which it was received. Out of warranty meters will be charged for labor and materials used.

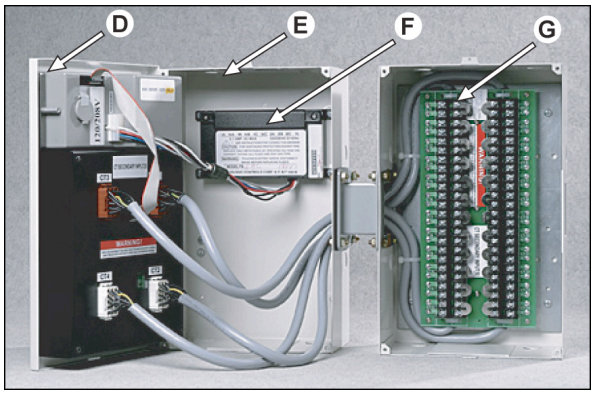
SPARE PARTS

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. Connector
B. Front MCI Cover
C. Current Transformer



D. Meter Head
E. Back Box
F. Fuse Block
G. MCI



H. Communications Module

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 to be free of defects in material or workmanship for a period of three (3) years from the date of purchase unless defects are due to neglect, misuse, acts of God, tempering or similar causes. Quadlogic's obligations under this warranty shall be to, at Quadlogic's discretion and in accordance with QLC's Return Merchandise Authorization (RMA) procedures, repair or replace, any equipment that is returned for warranty claim. Purchaser must return defective equipment to QLC pre-paid, and QLC will return repaired or replaced merchandise via UPS Ground at its expense. QLC does not accept responsibility for consequential damages arising from any defects in its equipment.

Release Dates

Manual	QLC Part Number	Revision Number	Release Date
MiniCloset-5 Manual	MC5 MAN REV1.2.R	1.2.R	072406

Revision History

Date	Page	Change	Description

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).

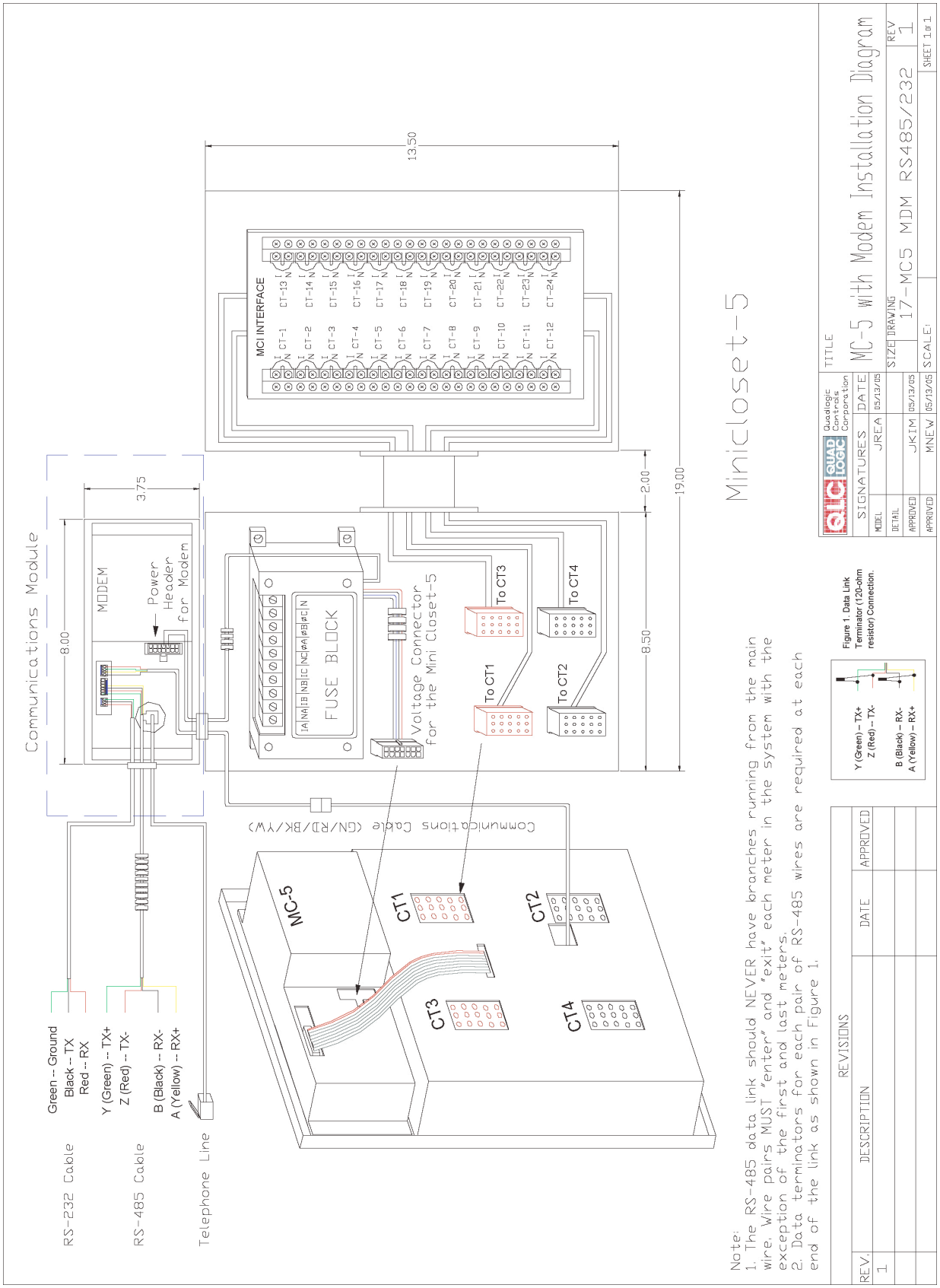


Figure A-1. MC-5 with modem installation.

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 Selection*

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)

* http://www.arcelect.com/485info.htm

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.

Termination Resistors†

A terminating resistor 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 8.2). 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

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

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.

RS-485 Data Link Installation Guidelines

1. If there is more than one MC-5, install the other MC-5s and the interconnecting RS-485 line, if required, which links all of the MC-5s. See Figure 8.2.
2. An RS-485 line is a pair of wires, AWG #20 or larger in diameter, which begins at one MC-5 where a terminator is placed.
3. The RS-485 line runs from MC-5 to MC-5 ending at the final MC-5, where another terminator is placed.
4. It is critically important that there should never be three RS-485 pairs entering or leaving a MC-5 box.
5. For the two MC-5s which gave terminators, only one RS-485 pair leaves each box.
6. For the other MC-5s, 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-5s 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-5 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 login into 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.

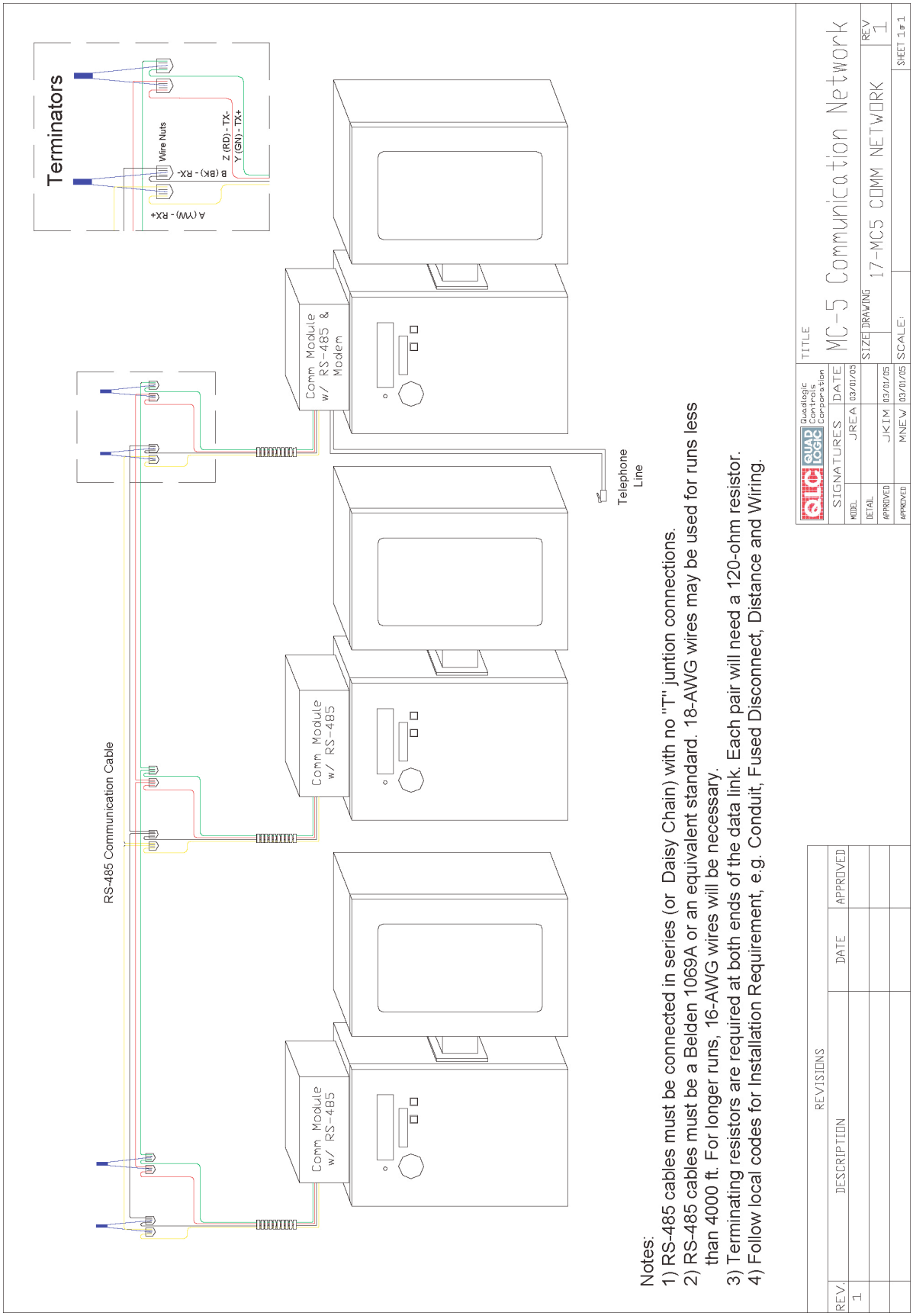


Figure A-2. MC-5 communications network.

THE PULSE DATALOGGER MODULE

The MiniCloset-5 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-5, can accommodate 12 discrete meters. Four (4) PDMs can be daisy-chained together to create a total of 48 discrete inputs.

Note: The MC-5 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-5 via a CAT-5 cable. The MC-5-to-PDM chain can run up to 300 feet. Once connected, the MC-5 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-5. 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.

Interrogating Signal Specifications:

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 MC5 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.