Bitronics

MultiComm & MultiComm RTH

Modbus Plus Interface Option Manual

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ML0006 Document

MTWIE4(A,B), MTWDE4(A,B) MTWIEC4(A,B), MTWDEC4(A,B)	3 Element 4 Wire (WYE)
MTWIE5(A,B), MTWDE5(A,B) MTWIEC5(A,B), MTWDEC5(A,B)	2 Element 3 Wire (DELTA)
MTWIE6(A,B), MTWDE6(A,B)	2½ Element 4 Wire (WYE)

Firmware Version 3.60 and Later
Includes Information on CI1 Option (1 Amp Inputs)

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1.0 DESCRIPTION

1.1 Introduction

The Modbus Plus [1] protocol option for the MultiComm and MultiComm RTH family of instruments is designed to allow operation of these instruments on MODBUS PLUS networks. The MultiComm and MultiComm RTH meters are MODICON certified, and can connect directly to MODBUS PLUS networks. The MODBUS PLUS protocol is a high speed peer to peer token passing network designed by Modicon. The MODBUS PLUS network allows a wide variety of devices and topologies.

1.2 Features

* Rugged Bitronics design
* Dedicated communications processor: fast response for maximum instrument polling rates.
* User selectable instrument address with pushbutton front panel display
* MODBUS PLUS network status/diagnostic LED visible from front panel
* Simple command to read any number of instrument quantities
* Simple energy reset and demand reset commands
* Data available through HOLDING REGISTER READ and/or GLOBAL DATA
* Supports remote setting of CT and PT scaling factors and display screen setup
* MODICON Certified

1.3 Specifications

Resolution:

Amperes:	0.1% of 5* A nominal
Volts:	0.07% of 120V nominal
Frequency:	0.01 Hz

* - When CT1 Option (1Amp Input) is installed, divide this value by 5

[1] - MODICON®, MODBUS® and Modbus Plus™ are trademarks of Schneider Electric.

1.3 Specifications, Cont'd

Watts/VARs/VAs:

Per Phase: 0.1% of 500* secondary Watts nominal
Total: 0.1% of 1500* secondary Watts nominal (2 ½ or 3 ELEMENT)
0.1% of 1000* secondary Watts nominal (2 ELEMENT)

Power Factor: 0.001
K Factor: 0.01
TDD, THD: 0.1%

Accuracy: Same as base meter (0.25% Class per ANSI Std 460-1988)

Modbus Plus

Connector: 9-pin D-connector for shielded twisted pair Modbus Plus

Communication: Modbus Plus 1 Megabit per second

Distance: 1,500 ft (450m) per section, 6,000 ft (1800m) with repeaters

Functions: Global Data and Read Holding Registers (FUNC 3)
Preset Single Register (FUNC 6) and Preset Multiple Register (FUNC 16) for Writeable Registers Only
Diagnostics (FUNC 8 - SUBFUNC 21) Get/Clear Network Statistics

Response Time:

Model	Response Time MAX (TYP)	Global Data Updated	All 8 Task Paths Serviced MAX
MTWIE(C)_A	650ms (300ms)	600ms	650ms
MTWDE(C)_A	650ms (300ms)	600ms	650ms
MTWIE(C)_B	150ms (75ms)	100ms[1]	150ms
MTWDE(C)_B	200ms (100ms)	150ms[1]	200ms

[1] - No READ or WRITE requests and input 56Hz to 75Hz, otherwise use Max Response Time

Addressability: Modbus Plus Device Node Addresses 1 .. 64
Task Path Addresses 1 .. 8

Mode: Host Device (must specify task path in routing address)

EEPROM Memory Endurance:
CT\PT Ratios: 1,000,000 minimum CT\PT ratio changes (CT\PT ratio writes)

* - When CT1 Option (1Amp Input) is installed, divide this value by 5

2.0 PRINCIPLES OF OPERATION

2.1 Modular Construction

The Bitronics MultiComm Modbus Plus Option is composed of two major modules. The Modbus Plus network connects to the output connector board which in turn is driven by the by the Modbus Plus Peer processor.

2.2 Modbus Plus Connector Board

The Modbus Plus network connection is made via the DB-9 connector on the back of the instrument. An EARTH GROUND input is provided by a #10-32 brass stud, also located on the rear cover of the instrument. WARNING - DO NOT over-tighten the nuts on the input connections, HAND tighten with a standard nutdriver, 12 inch-pounds is recommended, MAXIMUM torque is 15 inch-pounds. This EARTH GROUND connection is required for proper Modbus Plus operation, and should be connected to a good earth ground. Both the DB9 and the Earth Ground input are connected to the Modbus Plus Connector Board, which also contains transformer and capacitive isolation of the meter from the actual Modbus Plus cable. The shield of the Modbus Plus cable is connected to the EARTH GROUND terminal through a transient protection network. A flexible circuit connects this board with the Modbus Plus PEER Processor Board (see **Figure 2** for schematic).

2.3 Modbus Plus PEER Processor Board

The Modbus Plus PEER Processor Board contains an Intel 80C152JA communications controller and its associated circuitry. This processor handles all the token-passing, error detecting, message transaction and other network overhead required by the Modbus Plus network. When the PEER processor receives a Modbus Plus message, it checks if the Modbus Plus ADDRESS is the address of this node. The NODE ADDRESS is set via two 16-position rotary switches SW3 and SW4, which are also located on this board (See section 4.1 for instructions on setting the NODE ADDRESS). If the Modbus Plus address matches this node, the peer processor passes the transaction message through the DUAL-PORT RAM to the HOST processor. The HOST processor then completes the transaction, and sends a response through the DUAL-PORT RAM back to the PEER processor, which then sends the appropriate Modbus Plus message on the network.

The transceiver IC is also located on this board. This IC provides the drive to transmit and receive messages on the Modbus Plus cable. The transceiver is connected to the Modbus Plus Connector Board via a Kapton ribbon cable which plugs into a three pin connector on the front of the electronics module.

Status of the Modbus Plus network at this node is indicated by the Modbus Plus Diagnostic LED which is located in the upper left hand corner of the PEER processor board. This Diagnostic LED is visible through the faceplate, and can been seen in the upper left hand corner of the upper display. Section 3.9 describes the operation of the Diagnostic LED.

The CT/PT switch and the select pushbutton are also mounted on the PEER Processor Board, however both these switches are read by the HOST processor. A second pushbutton switch is mounted on the faceplate, and connected to the Peer Processor board via a pair of wires and a connector. This switch is connected in parallel with the select switch mounted on the Peer Processor board, and is used to stop and start the scrolling of the front display. Refer to the MultiComm Alpha Series Users Manual for detailed information concerning the display.

3.0 MODBUS-PLUS INTERFACE

3.1 Introduction

The Modbus Plus network is a local area network originally designed for industrial control applications, which has recently been applied to a wide range of utility applications. The network enables programmable controllers, host computers, MMIs and a wide variety of other devices (such as Bitronics MultiComm instruments) to communicate throughout an industrial plant or substation. The network supports up to 64 addressable node devices at a data rate of 1 million bits per second. Up to 32 devices can connect directly to the network cable (shielded twisted pair) over a length of 1500 feet (450 meters). Repeater devices are used to extend the cable distance to 6000 feet (1800 meters) and to allow connection to all 64 node devices.

The network is a physical bus, in that all nodes are attached to a piece of cable. At each end of the cable must be a terminator. This terminator prevents unwanted electrical reflections of the signal sent on the network cable. Modicon sells Modbus Plus cable connectors that come in two types. Inline connectors are dark grey in color and are used in the middle of a Modbus Plus network cable. Special terminating connectors that are light grey contain the terminator, and are used at both ends of the Modbus Plus cable.

Multiple Modbus Plus networks can be joined through Bridge Plus or similar devices. Messages originating at a node on one network can be routed through one or more bridges to a destination node on another network. Data is passed through bridges to other networks only when needed.

Logically, the network is a ring, a token ring to be more specific. Network nodes are identified by addresses assigned by the user. Each node's address is independent of its physical site location. Addresses are within the range of 1 to 64 decimal, and do not have to be sequential. Duplicate addresses are not allowed.

Network nodes function as peer members of a logical ring, gaining access to the network upon receipt of a token frame. The token is a grouping of bits that is passed in a rotating address sequence from one node to another. Where multiple networks are joined by a bridge or bridges, the token is not passed through the bridge device. Each network maintains its own token rotation sequence independently of the other networks.

While holding the token, a node initiates message transactions with other nodes. Each message contains routing fields that define the source and destination, including its routing path through bridges to the final destination node on a remote network.

When passing the token, a node can write into a global database that is broadcast to all nodes on the network. Each node has a maximum of 32 global data registers (16 bits each) that it can write. Global data is transmitted as a field within the token frame. Other nodes monitor the token pass and can extract the global data. Each node therefore maintains its own copy of the global database (64 nodes x 32 global data registers/node) which allows for rapid updating of alarms, setpoints and other data. Each network maintains its own unique global database, as the token is not passed through a bridge to another network.

For more information, the manual "MODICON MODBUS PLUS NETWORK PLANNING AND INSTALLATION GUIDE" (GM-MBPL-001) may be purchased for a nominal fee directly from Modicon Inc.

3.2 MultiComm Modbus Plus Implementation

The Modbus Plus implementation in the MultiComm instrument conforms to all the standard Modbus Plus specifications and capabilities, such as maximum nodes, distance, signal sensitivity, etc. The MultiComm instrument is classified as a HOST-BASED DEVICE in the Modbus Plus structure. Of the 44 data items (70 data items in transducers with demand measurements, 341 data items in transducers with demand and harmonics measurements) that are available from the MultiComm instrument , 27 (31 in "B" Versions) can be obtained via the Modbus Plus Network via GLOBAL DATA. Global Data is a common data base shared by all nodes on a MODBUS PLUS network. Any of the 44 data items (70 on transducers with demand measurements, 341 data items in transducers with demand and harmonics measurements) can be read directly by issuing a READ HOLDING REGISTERS command from the requesting node.

3.3 Modbus Plus Routing Address

The MODBUS PLUS routing address is 5 bytes long. This allows for communications over one or more Bridge Plus devices that connect two separate MODBUS PLUS networks together. Because the MultiComm instrument is a HOST-BASED DEVICE, the Modbus Plus address must contain two routing addresses. The next-to-last NON-ZERO byte is the PHYSICAL ADDRESS (1-64) of the meter. The last NON-ZERO byte in the routing field is the TASK PATH NUMBER (1-8**)** inside the meter. If you are familiar with addressing MODICON's PLCs, you will notice that the routing path is slightly different. When addressing PLCs it is not necessary to specify a task path number in the routing field. This is because the task path number is automatically selected inside a PLC designated device. In a HOST designated device, the task path number is NOT automatically selected, so it is necessary to specify it in the routing address field. Since the address of the meter and the task number each require 1 byte of information, the remaining 3 bytes allow for communications through one, two or three Bridge Plus devices.

Example 1: Communications to a node on the same network.
42.4.0.0.0 Meter address #42, task path #4

Example 2: Communications to a node on another MODBUS PLUS network connected by one Bridge Plus device.

33.42.4.0.0 Bridge address #33 on local network, Meter address #42, task path #4

Example 3: Communications to a node on another MODBUS PLUS network connected by three Bridge Plus devices.

21.5.63.42.4 1st Bridge address #21 on local network
2nd Bridge address #5 on next network
3rd Bridge address #63 on the subsequent network
Meter address #42
Task path #4

When reading register(s) of the MultiComm instrument from different requesting devices, it is recommended to use a different task path number for each of the separate requesting devices. This will prevent contention when the two requesting devices try to read the meter at the same time.

3.4 Transaction Timing

The MultiComm instruments complete an entire set of calculations approximately every 150 milliseconds (600msec for non “B” Versions). At the completion of the calculation the HOST processor updates the GLOBAL DATA in the PEER, and then the HOST processor also services any pending transactions on the eight task paths. All eight tasks are serviced at this time, however they are serviced only once. If a transaction is received on a task path that has just been serviced, that request will be serviced after the next set of calculations are completed (max response time).

Model	Response Time MAX (TYP)	Global Data Updated	All 8 Task Paths Serviced MAX
MTWIE(C)4A,5A,6A	650ms (300ms)	600ms	650ms
MTWDE(C)4A,5A,6A	650ms (300ms)	600ms	650ms
MTWIE(C)4B,5B,6B	150ms (75ms)	100ms[1]	150ms
MTWDE(C)4B,5B,6B	200ms (100ms)	150ms[1]	200ms

[1] - No READ or WRITE requests and input 56Hz to 75Hz, otherwise use Max Response Time.

The Energy and Demand registers can be RESET by writing the appropriate value to Holding Register 40100. The resets and their associated values are listed in **Table 1** (see Section 3.2). The Registers will be reset within 0.6 seconds, however it takes the meter 5 seconds to clear the energy data stored in the EEPROM and up to 10 seconds to reset the demand data stored in EEPROM. The USER must ensure that the power is not interrupted to the meter for this 5 or 10 second period after this command is issued.

The CT/PT Ratio and Divisor Registers (40041-40044), TDD Amps Denominators (40101-40103), Tag Register (40099) and the Display Setup Registers (40092-40096) can be set by writing to the proper register. The registers will be written to EEPROM within 700 milliseconds.

3.5 Data Format

The MultiComm instrument contains a set of holding registers (4XXXX) into which the instrument places values that correspond to the measurements the instrument is making. These holding registers can be read by any other device on the network using a READ HOLDING REGISTER or READ DATA command.

The MultiComm instrument also writes 27 words of data (31 words for any "B" version) to the Modbus Plus GLOBAL DATA SPACE. Every node on this network maintains this data in its own memory. The global data is accessed by using the MSTR function block (in a PLC). Users of other devices are advised to refer to their specific user's guide to determine how their device handles GLOBAL DATA. GLOBAL DATA is not transmitted across BRIDGES, nor is it transmitted to Modbus devices connected via a BRIDGE-PLUS.

For both GLOBAL DATA and HOLDING REGISTER DATA, the Health Check Register should always be read and checked before interpreting data, since some failure modes will cause erroneous data to be presented (See Section 3.8). The data is represented in **OFFSET BINARY** format, for conversion of the register data into **ENGINEERING UNITS**, please refer to Section 3.7. For specifics concerning the correct command and its implementation, users are directed to the User's manual for the specific device that will request the data. Listed on the following pages are the register assignments for the MultiComm instruments. The available registers depend upon the particular model of MultiComm instrument. The registers have been broken down into four blocks, which are shown in Figure 1. These various blocks are listed on the following pages. Table 2 indicates which blocks pertain to which models. The registers are also divided into two sections by Element Type, 2½ or 3 Element models are in the first section, and 2 Element models are in the second section. Note that unless otherwise specified, all registers are READ-ONLY.

Models	Instan-taneous	Demand	RTH Summary	RTH Individuals	Element Type
MTWIE(C)4A,6A,4B,6B	X				3 / 2½
MTWIE(C)5A,5B	X				2
MTWDE(C)4A,6A	X	X			3 / 2½
MTWDE(C)5A	X	X			2
MTWDE(C)4B,6B	X	X	X	X	3 / 2½
MTWDE(C)5B	X	X	X	X	2

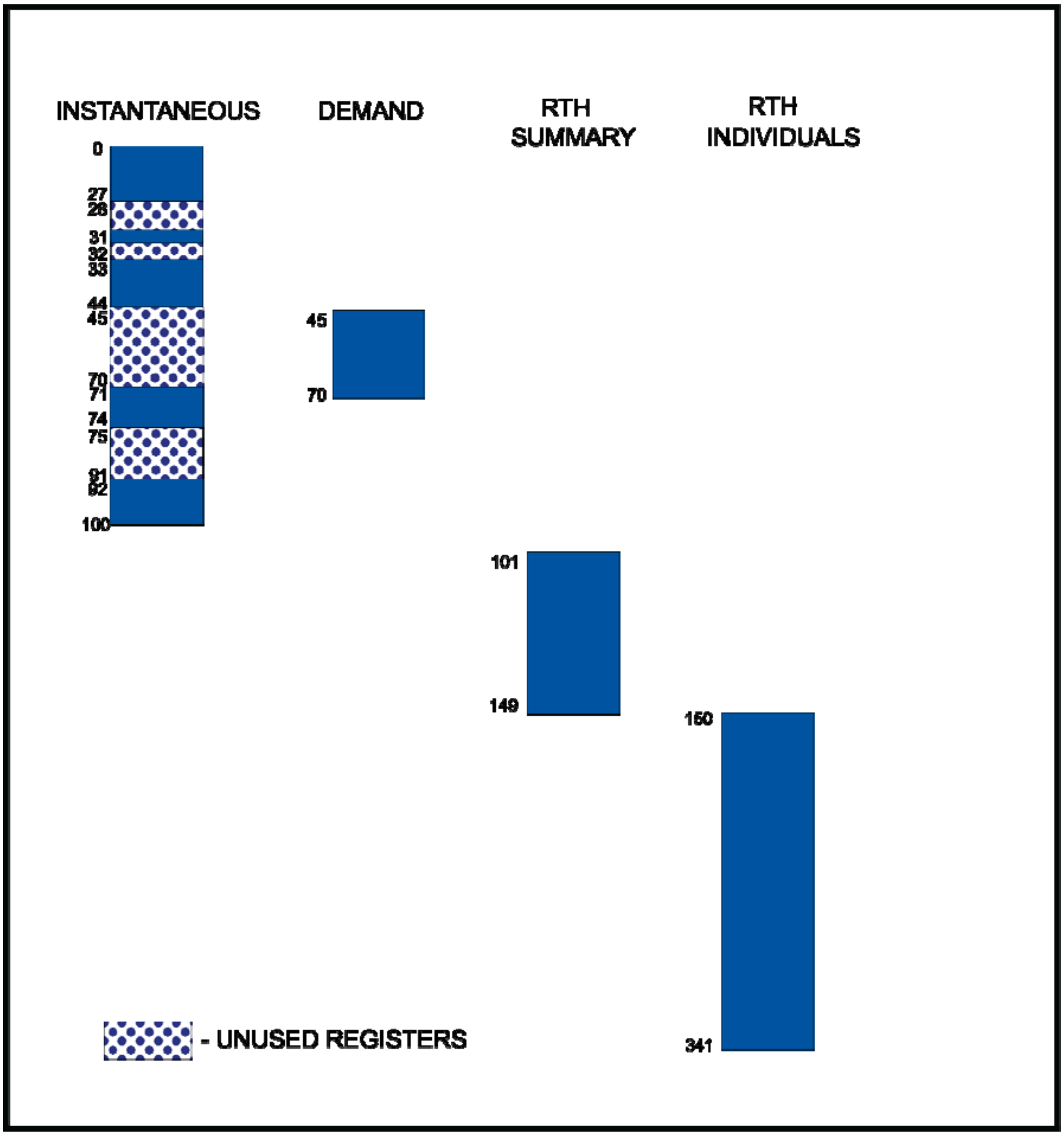


Figure 1 - Register Memory Map

3.5.1 INSTANTANEOUS Data Registers for 2 ½ or 3 Element Models

Quantity	Holding Register	Global Register	Representation
Health Check	40001	1	Refer to Section 3.8
Amperes Phase A	40002	2	2047 = 0Amps; 4095 = 10.0*Amps
Amperes Phase B	40003	3	
Amperes Phase C	40004	4	
Volts Phase A-N	40005	5	2047 = 0Volts; 4095 = 150.0Volts
Volts Phase B-N	40006	6	
Volts Phase C-N	40007	7	
Watts Total 3 Phase	40008	8	0 = -3000*Watts; 2047 = 0Watts; 4095 = +3000*Watts
VARs Total 3 Phase	40009	9	0 = -3000*VARs; 2047 = 0VARs; 4095 = +3000*VARs
Watts Phase A	40010	10	0 = -1000*Watts; 2047 = 0Watts 4095 = +1000*Watts
Watts Phase B	40011	11	
Watts Phase C	40012	12	
VARs Phase A	40013	13	0 = -1000*VARs; 2047 = 0VARs 4095 = +1000*VARs
VARs Phase B	40014	14	
VARs Phase C	40015	15	
CT Ratio	40016	16	Normalized ratio (Does not include decimal point) 500< Ratio <9999 (CT:5) or (CT:1 with CT1 option) 1000 < Ratio < 9999 (PT:1)
PT Ratio	40017	17	
Neutral Current	40018	18	2047 = 0Amps; 4095 = 15.0*Amps
+ kWatthour (High)	40019	19	0=0kWh; 9999=99,990,000kWh
+ kWatthour (Low)	40020	20	0=0kWh; 9999=9,999kWh
- kWatthour (High)	40021	21	0=0kWh; 9999=-99,990,000kWh
- kWatthour (Low)	40022	22	0=0kWh; 9999=-9,999kWh
+ kVARhour (High)	40023	23	0=0kVARh; 9999=99,990,000kVARh
+ kVARhour (Low)	40024	24	0=0kVARh; 9999=9,999kVARh
- kVARhour (High)	40025	25	0=0kVARh; 9999=-99,990,000kVARh
- kVARhour (Low)	40026	26	0=0kVARh; 9999=-9,999kVARh

* - When CT1 Option (1Amp Input) is installed, divide this value by 5

3.5.1 INSTANTANEOUS Data Registers for 2 ½ or 3 Element Models (Cont'd)

Quantity	Holding Register	Global Register	Representation
Frequency	40027	27	0 = <45.00Hz; 4500 = 45.00Hz 7500 = 75.00Hz; 9999 =>75.00Hz
Unused	40028	28[2]	Always 2047
Unused	40029	29[1]	Always 2047
Unused	40030	30[1]	Always 2047
Heartbeat State Counter	40031	31	See Section 3.10
Unused	40032	N/A	Always 2047
VAs Phase A	40033	N/A	2047 = 0VA; 4095 = 1000*VA
VAs Phase B	40034	N/A	2047 = 0VA; 4095 = 1000*VA
VAs Phase C	40035	N/A	2047 = 0VA; 4095 = 1000*VA
VAs Total 3 Phase	40036	N/A	2047 = 0VAs; 4095 = 3000*VAs
PF Phase A	40037	N/A	1047 = -1; 2047 = 0; 3047 = +1 4046 = Amps or Volts too low (-) lagging; (+) leading
PF Phase B	40038	N/A	1047 = -1; 2047 = 0; 3047 = +1 4046 = Amps or Volts too low (-) lagging; (+) leading
PF Phase C	40039	N/A	1047 = -1; 2047 = 0; 3047 = +1 4046 = Amps or Volts too low (-) lagging; (+) leading
PF Total 3 Phase	40040	N/A	1047 = -1; 2047 = 0; 3047 = +1 4046 = Amps or Volts too low (-) lagging; (+) leading
CT Ratio	40041	N/A	Read/Write normalized ratio, copied to 40016
CT Ratio Divisor	40042	N/A	Read/Write; = 1,10,100, or 1000
PT Ratio	40043	N/A	Read/Write normalized ratio, copied to 40017
PT Ratio Divisor	40044	N/A	Read/Write; = 1,10,100, or 1000
Unused	40045-70	N/A	Always 2047

* - When CT1 Option (1Amp Input) is installed, divide this value by 5

[2] "B" Version Instruments Only

3.5.1 INSTANTANEOUS Data Registers for 2 ½ or 3 Element Models (Cont'd)

Quantity	Holding Register	Representation
Meter Type Identifier	40071	See **Table 5**
Communications Firmware Rev.	40072	Packed BCD XX.XX
Host Firmware Rev.	40073	Packed BCD XX.XX
Host Micro Firmware Rev.	40074	Packed BCD XX.XX
Unused	40075-91	Always 2047
Display Screen Setup Register 1	40092	Read/Write - See **Table 4**
Display Screen Setup Register 2	40093	Read/Write - See **Table 4**
Display Screen Setup Register 3	40094	Read/Write - See **Table 4**
Display Screen Setup Register 4	40095	Read/Write - See **Table 4**
Display Screen Setup Register 5	40096	Read/Write - See **Table 4**
Configuration Setup Register 1	40097	Read/Write - Future Expansion Always returns 0
Configuration Setup Register 2	40098	Read/Write - Future Expansion Always returns 0
User Writeable Tag Register	40099	Read/Write - 0 to 32,767
Energy RESET	40100	Write ONLY; Bit 0 - See **Table 3**
Unused	40101-103	Always 2047

3.5.2 DEMAND Data Registers for 2 ½ or 3 Element Models

Quantity	Holding Register	Representation
Present Demand Amps φA	40045	
Present Demand Amps φB	40046	2047[1] = 0Amps; 4095 = 10.0[*]Amps
Present Demand Amps φC	40047	
Max Demand Amps φA	40048	
Max Demand Amps φB	40049	2047[1] = 0Amps; 4095 = 10.0[*]Amps
Max Demand Amps φC	40050	
Present Demand Amps N	40051	2047[1] = 0Amps; 4095 = 15.0[*]Amps
Max Demand Amps N	40052	2047[1] = 0Amps; 4095 = 15.0[*]Amps
Present Demand Volts φA	40053	
Present Demand Volts φB	40054	2047[1] = 0Volts; 4095 = 150.0Volts
Present Demand Volts φC	40055	
Max Demand Volts φA	40056	
Max Demand Volts φB	40057	2047[1] = 0Volts; 4095 = 150.0Volts
Max Demand Volts φC	40058	
Min Demand Volts φA	40059	
Min Demand Volts φB	40060	2047[1] = 0Volts; 4095 = 150.0Volts
Min Demand Volts φC	40061	
Present Demand Watts Total	40062	0 = -3000[*]Watts; 2047[1] = 0Watts
Max Demand Watts Total	40063	4095 = +3000[*]Watts
Min Demand Watts Total	40064	
Present Demand VARs Total	40065	0 = -3000[*]VARs; 2047[1] = 0VARs
Max Demand VARs Total	40066	4095 = +3000[*]VARs
Min Demand VARs Total	40067	
Present Demand VAs Total	40068	
Max Demand VAs Total	40069	2047[1] = 0VAs; 4095 = +3000[*]VAs
Min Demand VAs Total	40070	
Amp Demand RESET	40100	Read/Write Bit 1 - See **Table 3**
Volt Demand RESET	40100	Read/Write Bit 2 - See **Table 3**
Power Demand RESET	40100	Read/Write Bit 3 - See **Table 3**

[*] - When CI1 Option (1Amp Input) is installed, divide this value by 5
[1] - MTWIExB models always return the value 2047

3.5.3 RTH SUMMARY Data Registers for 2 ½ or 3 Element Models

Quantity	Holding Register	Representation
Amp Demand RESET	40100	Read/Write Bit 1 - See **Table 3**
Volt Demand RESET	40100	Read/Write Bit 2 - See **Table 3**
Power Demand RESET	40100	Read/Write Bit 3 - See **Table 3**
Harmonic Demand RESET	40100	Read/Write Bit 4 - See **Table 3**
TDD Denominator Amps φA	40101	Read/Write 2047[1] = 0Amps; 4095 = 10.0[*]Amps. If reg = 2047, then Fund Amps will be used (THD) Factory Default = 5[*] Amps Secondary
TDD Denominator Amps φB	40102	
TDD Denominator Amps φC	40103	
Fundamental Amps φA	40104	2047 = 0Amps; 4095 = 10.0[*]Amps
Fundamental Amps φB	40105	
Fundamental Amps φC	40106	
Fundamental Amps Neutral	40107	2047 = 0Amps; 4095 = 15.0[*]Amps
Fundamental Volts φA	40108	2047 = 0Volts; 4095 = 150.0Volts
Fundamental Volts φB	40109	
Fundamental Volts φC	40110	
TDD[2] Amps φA	40111	0 = 0.0%; 9999 = 999.9% Set to 0 on low signal
TDD[2] Amps φB	40112	
TDD[2] Amps φC	40113	
TDD[2] Odd Amps φA	40114	0 = 0.0%; 9999 = 999.9% Set to 0 on low signal
TDD[2] Odd Amps φB	40115	
TDD[2] Odd Amps φC	40116	
TDD[2] Even Amps φA	40117	0 = 0.0%; 9999 = 999.9% Set to 0 on low signal
TDD[2] Even Amps φB	40118	
TDD[2] Even Amps φC	40119	
THD Volts φA	40120	0 = 0.0%; 9999 = 999.9% Set to 0 on low signal
THD Volts φB	40121	
THD Volts φC	40122	
THD Odd Volts φA	40123	0 = 0.0%; 9999 = 999.9% Set to 0 on low signal
THD Odd Volts φB	40124	
THD Odd Volts φC	40125	
THD Even Volts φA	40126	0 = 0.0%; 9999 = 999.9% Set to 0 on low signal
THD Even Volts φB	40127	
THD Even Volts φC	40128	

[*] - When CI1 Option (1Amp Input) is installed, divide this value by 5
[1] - MTWIExB models always return the value 2047
[2] - If TDD Denominator is set to 2047 (0Amps) the TDD calculation will use Fundamental Amps as the Denominator, which will result in all Current Distortions being expressed as THD.

3.5.3 RTH SUMMARY Data Registers for 2 ½ or 3 Element Models (Cont'd)

Quantity	Holding Register	Representation
K-Factor Amps φA	40129	|
K-Factor Amps φB	40130	| 100 = 1.00; 65,535 = 655.35
K-Factor Amps φC	40131	| Set to 100 on low signal
Displacement PF φA	40132	| 1047 = -1; 2047 = 0; 3047 = +1
Displacement PF φB	40133	| 4046 = Amps or Volts too low
Displacement PF φC	40134	| (-) lagging; (+) leading
Displacement PF Total	40135	1047 = -1; 2047 = 0; 3047 = +1 4046 = Amps or Volts too low (-) lagging; (+) leading
Present Demand Fund. Amps N	40136	2047 = 0Amps; 4095 = 15.0[*]Amps
Max Demand Fund. Amps N	40137	2047 = 0Amps; 4095 = 15.0[*]Amps
Present Demand TDD[1] Amps φA	40138	|
Present Demand TDD[1] Amps φB	40139	| 0 = 0.0%; 9999 = 999.9%
Present Demand TDD[1] Amps φC	40140	|
Max Demand TDD[1] Amps φA	40141	|
Max Demand TDD[1] Amps φB	40142	| 0 = 0.0%; 9999 = 999.9%
Max Demand TDD[1] Amps φC	40143	|
Present Demand THD Volts φA	40144	|
Present Demand THD Volts φB	40145	| 0 = 0.0%; 9999 = 999.9%
Present Demand THD Volts φC	40146	|
Max Demand THD Volts φA	40147	|
Max Demand THD Volts φB	40148	| 0 = 0.0%; 9999 = 999.9%
Max Demand THD Volts φC	40149	|

[*] - When CT1 Option (1Amp Input) is installed, divide this value by 5

[1] If TDD Denominator is set to 2047 (0Amps) the TDD calculation will use Fundamental Amps as the Denominator, which will result in all Current Distortions being expressed as THD.

3.5.4 RTH INDIVIDUAL Data Registers for 2 ½ or 3 Element Models

Quantity	Holding Register	Representation
φA Amps Distortion Denominator	40150	2047 = 0Amps; 4095 = 10.0[*]Amps =40101 if TDD, =40104 if THD
φA Amps Demand Distortion[1] - I_1	40151	0 = 0.0%; 9999 = 999.9% Set to 0 on low signal
φA Amps Demand Distortion[1] - I_2	40152	
:	:	
:	:	
φA Amps Demand Distortion[1] - I_{30}	40180	
φA Amps Demand Distortion[1] - I_{31}	40181	
φA Volts Distortion Denominator	40182	2047 = 0Volts; 4095 = 150.0Volts =40108
φA Volts Harm. Distortion - V_1	40183	0 = 0.0%; 9999 = 999.9% Set to 0 on low signal
φA Volts Harm. Distortion - V_2	40184	
:	:	
:	:	
φA Volts Harm. Distortion - V_{30}	40212	
φA Volts Harm. Distortion - V_{31}	40213	
φB Amps Distortion Denominator	40214	2047 = 0Amps; 4095 = 10.0[*]Amps =40102 if TDD, =40105 if THD
φB Amps Demand Distortion[1] - I_1	40215	0 = 0.0%; 9999 = 999.9% Set to 0 on low signal
φB Amps Demand Distortion[1] - I_2	40216	
:	:	
:	:	
φB Amps Demand Distortion[1] - I_{30}	40244	
φB Amps Demand Distortion[1] - I_{31}	40245	
φB Volts Distortion Denominator	40246	2047 = 0Volts; 4095 = 150.0Volts =40109
φB Volts Harm. Distortion - V_1	40247	0 = 0.0%; 9999 = 999.9% Set to 0 on low signal
φB Volts Harm. Distortion - V_2	40248	
:	:	
:	:	
φB Volts Harm. Distortion - V_{30}	40276	
φB Volts Harm. Distortion - V_{31}	40277	

[*] - When CT1 Option (1Amp Input) is installed, divide this value by 5

[1] If TDD Denominator is set to 2047 (0Amps) the TDD calculation will use Fundamental Amps as the Denominator, which will result in all Current Distortions being expressed as THD.

3.5.4 RTH INDIVIDUAL Data Registers for 2 ½ or 3 Element Models (Cont'd)

Quantity	Holding Register	Representation
φC Amps Distortion Denominator	40278	2047 = 0Amps; 4095 = 10.0*Amps =40103 if TDD, =40106 if THD
φC Amps Demand Distortion[1] - I_1	40279	0 = 0.0%; 9999 = 999.9% Set to 0 on low signal
φC Amps Demand Distortion[1] - I_2	40280	
:	:	
:	:	
φC Amps Demand Distortion[1] - I_{30}	40308	
φC Amps Demand Distortion[1] - I_{31}	40309	
φC Volts Distortion Denominator	40310	2047 = 0Volts; 4095 = 150.0Volts =40110
φC Volts Harm. Distortion - V_1	40311	0 = 0.0%; 9999 = 999.9% Set to 0 on low signal
φC Volts Harm. Distortion - V_2	40312	
:	:	
:	:	
φC Volts Harm. Distortion - V_{30}	40340	
φC Volts Harm. Distortion - V_{31}	40341	

* - When CT1 Option (1Amp Input) is installed, divide this value by 5

1 If TDD Denominator is set to 2047 (0Amps) the TDD calculation will use Fundamental Amps as the Denominator, which will result in all Current Distortions being expressed as THD.

3.5.5 INSTANTANEOUS Data Registers for 2 Element Models

Quantity	Holding Register	Global Register	Representation
Health Check	40001	1	Refer to Section 3.8
Amperes Phase A	40002	2	
Amperes Phase B	40003	3	2047 = 0Amps; 4095 = 10.0*Amps
Amperes Phase C	40004	4	
Volts Phase A-B	40005	5	
Volts Phase B-C	40006	6	2047 = 0Volts; 4095 = 150.0Volts
Volts Phase C-A	40007	7	
Watts Total 3 Phase	40008	8	0 = -2000*Watts; 2047 = 0Watts; 4095 = +2000*Watts
VARs Total 3 Phase	40009	9	0 = -2000*VARs; 2047 = 0VARs; 4095 = +2000*VARs
Unused	40010	10	
Unused	40011	11	Always 2047
Unused	40012	12	
Unused	40013	13	
Unused	40014	14	Always 2047
Unused	40015	15	
CT Ratio	40016	16	Normalized ratio (Does not include decimal point)
PT Ratio	40017	17	500< Ratio <9999 (CT:5) or (CT:1 with CT1 option) 1000 < Ratio < 9999 (PT:1)
Unused	40018	18	Always 2047
+ kWatthour (High)	40019	19	0=0kWh; 9999=99,990,000kWh
+ kWatthour (Low)	40020	20	0=0kWh; 9999=9,999kWh
- kWatthour (High)	40021	21	0=0kWh; 9999=-99,990,000kWh
- kWatthour (Low)	40022	22	0=0kWh; 9999=-9,999kWh
+ kVARhour (High)	40023	23	0=0kVARh; 9999=99,990,000kVARh
+ kVARhour (Low)	40024	24	0=0kVARh; 9999=9,999kVARh
- kVARhour (High)	40025	25	0=0kVARh; 9999=-99,990,000kVARh
- kVARhour (Low)	40026	26	0=0kVARh; 9999=-9,999kVARh

* - When CT1 Option (1Amp Input) is installed, divide this value by 5

3.5.5 INSTANTANEOUS Data Registers for 2 Element Models (Cont'd)

Quantity	Holding Register	Global Register	Representation
Frequency	40027	27	0 = <45.00Hz; 4500 = 45.00Hz 7500 = 75.00Hz; 9999 =>75.00Hz
Unused	40028	28[3]	|
Unused	40029	29[1]	| Always 2047
Unused	40030	30[1]	|
Heartbeat State Counter	40031	31	See Section 3.10
Unused	40032	N/A	|
Unused	40033	N/A	| Always 2047
Unused	40034	N/A	|
Unused	40035	N/A	|
VAs Total 3 Phase	40036	N/A	2047 = 0VAs; 4095 = 2000*VAs
Unused	40037	N/A	|
Unused	40038	N/A	| Always 2047
Unused	40039	N/A	|
PF Total 3 Phase	40040	N/A	1047 = -1; 2047 = 0; 3047 = +1 4046 = Amps or Volts too low (-) lagging; (+) leading
CT Ratio	40041	N/A	Read/Write normalized ratio, copied to 40016
CT Ratio Divisor	40042	N/A	Read/Write; = 1,10,100, or 1000
PT Ratio	40043	N/A	Read/Write normalized ratio, copied to 40017
PT Ratio Divisor	40044	N/A	Read/Write; = 1,10,100, or 1000
Unused	40045-70	N/A	Always 2047

* - When CT1 Option (1Amp Input) is installed, divide this value by 5

[3] "B" Version Instruments Only

3.5.5 INSTANTANEOUS Data Registers for 2 Element Mode (Cont'd)

Quantity	Holding Register	Representation
Meter Type Identifier	40071	See **Table 5**
Communications Firmware Rev.	40072	Packed BCD XX.XX
Host Firmware Rev.	40073	Packed BCD XX.XX
Host Micro Firmware Rev.	40074	Packed BCD XX.XX
Unused	40075-91	Always 2047
Display Screen Setup Register 1	40092	Read/Write - See **Table 4**
Display Screen Setup Register 2	40093	Read/Write - See **Table 4**
Display Screen Setup Register 3	40094	Read/Write - See **Table 4**
Display Screen Setup Register 4	40095	Read/Write - See **Table 4**
Display Screen Setup Register 5	40096	Read/Write - See **Table 4**
Configuration Setup Register 1	40097	Read/Write - Future Expansion Always returns 0
Configuration Setup Register 2	40098	Read/Write - Future Expansion Always returns 0
User Writeable Tag Register	40099	Read/Write - 0 to 32,767
Energy RESET	40100	Write ONLY; Bit 0 - See **Table 3**
Unused	40101-103	Always 2047

3.5.6 DEMAND Data Registers for 2 Element Models

Quantity	Holding Register	Representation
Present Demand Amps φA Present Demand Amps φB Present Demand Amps φC	40045 40046 40047	2047[1] = 0Amps; 4095 = 10.0*Amps
Max Demand Amps φA Max Demand Amps φB Max Demand Amps φC	40048 40049 40050	2047[1] = 0Amps; 4095 = 10.0*Amps
Unused	40051	Always 2047[1]
Unused	40052	Always 2047[1]
Present Demand Volts φA-B Present Demand Volts φB-C Present Demand Volts φC-A	40053 40054 40055	2047[1] = 0Volts; 4095 = 150.0Volts
Max Demand Volts φA-B Max Demand Volts φB-C Max Demand Volts φC-A	40056 40057 40058	2047[1] = 0Volts; 4095 = 150.0Volts
Min Demand Volts φA-B Min Demand Volts φB-C Min Demand Volts φC-A	40059 40060 40061	2047[1] = 0Volts; 4095 = 150.0Volts
Present Demand Watts Total Max Demand Watts Total Min Demand Watts Total	40062 40063 40064	0 = -2000*Watts; 2047[1] = 0Watts 4095 = +2000*Watts
Present Demand VARs Total Max Demand VARs Total Min Demand VARs Total	40065 40066 40067	0 = -2000*VARs; 2047[1] = 0VARs 4095 = +2000*VARs
Present Demand VAs Total Max Demand VAs Total Min Demand VAs Total	40068 40069 40070	2047[1] = 0VAs; 4095 = +2000*VAs
Amp Demand RESET	40100	Read/Write Bit 1 - See **Table 3**
Volt Demand RESET	40100	Read/Write Bit 2 - See **Table 3**
Power Demand RESET	40100	Read/Write Bit 3 - See **Table 3**

* - When CI1 Option (1Amp Input) is installed, divide this value by 5
[1] - MTWIExB models always return the value 2047

3.5.7 RTH SUMMARY Data Registers for 2 Element Models

Quantity	Holding Register	Representation
Amp Demand RESET	40100	Read/Write Bit 1 - See **Table 3**
Volt Demand RESET	40100	Read/Write Bit 2 - See **Table 3**
Power Demand RESET	40100	Read/Write Bit 3 - See **Table 3**
Harmonic Demand RESET	40100	Read/Write Bit 4 - See **Table 3**
TDD Denominator Amps φA	40101	Read/Write 2047[1] = 0Amps;
TDD Denominator Amps φB	40102	4095 = 10.0[*]Amps. If reg = 2047,
TDD Denominator Amps φC	40103	then Fund Amps will be used (THD)
		Factory Default = 5[*] Amps Secondary
Fundamental Amps φA	40104	
Fundamental Amps φB	40105	2047 = 0Amps; 4095 =10.0[*]Amps
Fundamental Amps φC	40106	
Unused	40107	Always 2047
Fundamental Volts φA-B	40108	
Fundamental Volts φB-C	40109	2047 = 0Volts; 4095 = 150.0Volts
Fundamental Volts φC-A	40110	
TDD[2] Amps φA	40111	
TDD[2] Amps φB	40112	0 = 0.0%; 9999 = 999.9%
TDD[2] Amps φC	40113	Set to 0 on low signal
TDD[2] Odd Amps φA	40114	
TDD[2] Odd Amps φB	40115	0 = 0.0%; 9999 = 999.9%
TDD[2] Odd Amps φC	40116	Set to 0 on low signal
TDD[2] Even Amps φA	40117	
TDD[2] Even Amps φB	40118	0 = 0.0%; 9999 = 999.9%
TDD[2] Even Amps φC	40119	Set to 0 on low signal
THD Volts φA-B	40120	
THD Volts φB-C	40121	0 = 0.0%; 9999 = 999.9%
THD Volts φC-A	40122	Set to 0 on low signal
THD Odd Volts φA-B	40123	
THD Odd Volts φB-C	40124	0 = 0.0%; 9999 = 999.9%
THD Odd Volts φC-A	40125	Set to 0 on low signal
THD Even Volts φA-B	40126	
THD Even Volts φB-C	40127	0 = 0.0%; 9999 = 999.9%
THD Even Volts φC-A	40128	Set to 0 on low signal

[*] - When CI1 Option (1Amp Input) is installed, divide this value by 5
[1] - MTWIExB models always return the value 2047
[2] - If TDD Denominator is set to 2047 (0Amps) the TDD calculation will use Fundamental Amps as the Denominator, which will result in all Current Distortions being expressed as THD.

3.5.7 RTH SUMMARY Data Registers for 2 Element Models (Cont'd)

Quantity	Holding Register	Representation
K-Factor Amps φA	40129	100 = 1.00; 65,535 = 655.35 Set to 100 on low signal
K-Factor Amps φB	40130	
K-Factor Amps φC	40131	
Unused	40132	Always 2047
Unused	40133	
Unused	40134	
Displacement PF Total	40135	1047 = -1; 2047 = 0; 3047 = +1 4046 = Amps or Volts too low (-) lagging; (+) leading
Unused	40136	Always 2047
Unused	40137	
Present Demand TDD[1] Amps φA	40138	0 = 0.0%; 9999 = 999.9%
Present Demand TDD[1] Amps φB	40139	
Present Demand TDD[1] Amps φC	40140	
Max Demand TDD[1] Amps φA	40141	0 = 0.0%; 9999 = 999.9%
Max Demand TDD[1] Amps φB	40142	
Max Demand TDD[1] Amps φC	40143	
Present Demand THD Volts φA-B	40144	0 = 0.0%; 9999 = 999.9%
Present Demand THD Volts φB-C	40145	
Present Demand THD Volts φC-A	40146	
Max Demand THD Volts φA-B	40147	0 = 0.0%; 9999 = 999.9%
Max Demand THD Volts φB-C	40148	
Max Demand THD Volts φC-A	40149	

[1] If TDD Denominator is set to 2047 (0Amps) the TDD calculation will use Fundamental Amps as the Denominator, which will result in all Current Distortions being expressed as THD.

3.5.8 RTH INDIVIDUAL Data Registers for 2 Element Models

Quantity	Holding Register	Representation
φA Amps Distortion Denominator	40150	2047 = 0Amps; 4095 = 10.0*Amps =40101 if TDD, =40104 if THD
φA Amps Demand Distortion[1] - I_1	40151	
φA Amps Demand Distortion[1] - I_2	40152	
:	:	0 = 0.0%; 9999 = 999.9%
:	:	Set to 0 on low signal
φA Amps Demand Distortion[1] - I_{30}	40180	
φA Amps Demand Distortion[1] - I_{31}	40181	
φA-B Volts Distortion Denominator	40182	2047 = 0Volts; 4095 = 150.0Volts =40108
φA-B Volts Harm. Distortion - V_1	40183	
φA-B Volts Harm. Distortion - V_2	40184	
:	:	0 = 0.0%; 9999 = 999.9%
:	:	Set to 0 on low signal
φA-B Volts Harm. Distortion - V_{30}	40212	
φA-B Volts Harm. Distortion - V_{31}	40213	
φB Amps Distortion Denominator	40214	2047 = 0Amps; 4095 = 10.0*Amps =40102 if TDD, =40105 if THD
φB Amps Demand Distortion[1] - I_1	40215	
φB Amps Demand Distortion[1] - I_2	40216	
:	:	0 = 0.0%; 9999 = 999.9%
:	:	Set to 0 on low signal
φB Amps Demand Distortion[1] - I_{30}	40244	
φB Amps Demand Distortion[1] - I_{31}	40245	
φB-C Volts Distortion Denominator	40246	2047 = 0Volts; 4095 = 150.0Volts =40109
φB-C Volts Harm. Distortion - V_1	40247	
φB-C Volts Harm. Distortion - V_2	40248	
:	:	0 = 0.0%; 9999 = 999.9%
:	:	Set to 0 on low signal
φB-C Volts Harm. Distortion - V_{30}	40276	
φB-C Volts Harm. Distortion - V_{31}	40277	

* - When CT1 Option (1Amp Input) is installed, divide this value by 5

[1] If TDD Denominator is set to 2047 (0Amps) the TDD calculation will use Fundamental Amps as the Denominator, which will result in all Current Distortions being expressed as THD.

3.5.8 RTH INDIVIDUAL Data Registers for 2 Element Models (Cont'd)

Quantity	Holding Register	Representation
φC Amps Distortion Denominator	40278	| 2047 = 0Amps; 4095 = 10.0* Amps | =40103 if TDD, =40106 if THD
φC Amps Demand Distortion[1] - I_1	40279	|
φC Amps Demand Distortion[1] - I_2	40280	|
:	:	| 0 = 0.0%; 9999 = 999.9%
:	:	| Set to 0 on low signal
φC Amps Demand Distortion[1] - I_{30}	40308	|
φC Amps Demand Distortion[1] - I_{31}	40309	|
φC-A Volts Distortion Denominator	40310	| 2047 = 0Volts; 4095 = 150.0Volts | =40110
φC-A Volts Harm. Distortion - V_1	40311	|
φC-A Volts Harm. Distortion - V_2	40312	|
:	:	| 0 = 0.0%; 9999 = 999.9%
:	:	| Set to 0 on low signal
φC-A Volts Harm. Distortion - V_{30}	40340	|
φC-A Volts Harm. Distortion - V_{31}	40341	|

* - When CT1 Option (1Amp Input) is installed, divide this value by 5

[1] If TDD Denominator is set to 2047 (0Amps) the TDD calculation will use Fundamental Amps as the Denominator, which will result in all Current Distortions being expressed as THD.

3.6 Writeable Registers

3.6.1 Setting CT and PT Ratios

The MultiComm instrument is capable of internally storing and recalling CT and PT ratios via the network interface, or through the internal toggle/push-button (Refer to Section 4.1 of the MultiComm User Manual). These ratios are used to scale the display values in engineering (primary) units. These ratios are also used to scale the Energy quantities, registers 40019 through 40026 (Refer to Section 3.5 for register assignments) which are also in primary units. When the CT and PT ratios are set, they are written to registers 40041 through 40044, and are stored in non-volatile memory on the CT/PT Board. Each ratio is stored in two registers, one for the normalized format ratio, and the other for the divisor. Allowable constants for CT Value (40041) are 500 to 9999, and 1000 to 9999 for PT Value (40043). The divisors may be 1, 10, 100, or 1000 only. The number stored will be the high side rating of the CT. A 500:5 ratio CT will have a value of 500 stored, while a 100:1 CT will have a value of 100 stored. For example, to calculate a CT ratio from the data stored in the MultiComm, use the following equation:

$$CT_{RATIO} = \frac{CT\ Value\ (40041)}{CT\ Ratio\ Divisor\ (40042)\ x\ CT\ Secondary}$$

$$PT_{RATIO} = \frac{PT\ Value\ (40043)}{PT\ Ratio\ Divisor\ (40044)}$$

The CT and PT ratios values may be used with the equations in Section 3.5 or 3.7 to derive primary unit quantities from the MultiComm. For example, the equation for amperes becomes:

$$AMPEREs = \frac{Value - 2047}{2048}\ x\ Full\ Scale\ Value\ x\ CT\ Ratio$$

The values stored in registers 40041 and 40043 are duplicated in registers 40016 and 40017 respectively. Registers 40016 and 40017 are READ ONLY and cannot be written to. In the event of a CT/PT Ratio Checksum Failure, the value in the CT Ratio and PT Ratio registers default to 65535 (FFFF Hex), and the value in the CT Ratio Divisor and PT Ratio Divisor default to 0001. See Section 3.8 for more details.

WARNING - THE RATIO NON-VOLATILE MEMORY STORAGE HAS A 1,000,000 CYCLE ENDURANCE (RATIOS CAN BE CHANGED 1,000,000 TIMES). ONLY WRITE TO RATIO REGISTERS WHEN THE RATIOS NEED TO BE CHANGED.

3.6.2 Resetting Energy and Demands

The Energy and Demand registers can be RESET by writing a bit pattern to Holding Register 40100. Any "1" bits in the proper position cause initiation of the corresponding RESET. Multiple RESETs can be accomplished by using either multiple WRITE commands or a single WRITE command with multiple bits set. Table 3 shows the correspondence between the RESET functions and the bits set. The Registers will be reset within 0.6 seconds, however it may take the meter up to 10 seconds to clear the data stored in the EEPROM. The USER must ensure that the power is not interrupted to the meter for this 10 second period after this command is issued.

Bit Position	Value	Description	Registers Affected	Global
0	1	Reset (ZERO) Energy	40019 .. 40026	19..26
1	2	Reset AMP Demands	40045 .. 40052, 40136, 40137	N/A
2	4	Reset Volt Demands	40053 .. 40061	N/A
3	8	Reset Power Demands	40062 .. 40070	N/A
4	16	Reset Harmonic Demands	40138 .. 40149	N/A

3.6.3 TDD Writeable Denominators

The MultiComm instrument is capable of internally storing and recalling Current Values that are used as Denominators in determining the Total Demand Distortion (TDD). The denominator values are stored for each phase, and are stored in Registers 40101, 40102, 40103 for Phase A, Phase B, and Phase C respectively. These denominators affect all Current Harmonic Measurements (Refer to Section 3.5 for register assignments). The Denominators are written to registers 40101 through 40103 over the Modbus Plus communication port, and are stored in non-volatile memory on the Analog Board. The value that needs to be stored follows the same offset binary equation that is used with the other measurements. For a 5A secondary CT, the equation for amperes becomes:

where Value is the Binary Value that should be stored in the denominator register, and Amperes is the actual value of primary current that the user intends for the TDD calculations. The factory default value is 3071 which corresponds to 5 Amps Secondary (1 Amp for CI1 option). If the value stored in the denominator register are set to Zero amps (Value = 2047), then the Harmonic Distortion calculations will use the Fundamental Magnitude of the current, which will result in the Distortion Values to be in the form of THD

$$AMPEREs = \frac{Value - 2047}{2048} \; x \; 10 \; x \; \frac{CT\ Value}{CT\ Ratio\ Divisor\ x\ 5}$$

instead of TDD. The values stored in registers 40101, 40102 and 40103 are duplicated in registers 40150, 40214 and 40278 respectively if the value are non-zero (TDD). If registers 40101,2,3 are set to zero (THD) then the registers 40150, 40214 and 40278 will contain the Magnitude of the Fundamental.

WARNING - THE DENOMINATOR NON-VOLATILE MEMORY STORAGE HAS A 1,000,000 CYCLE ENDURANCE (DENOMINATORS CAN BE CHANGED 1,000,000 TIMES). ONLY WRITE TO THE DENOMINATOR REGISTERS WHEN THE DENOMINATORS NEED TO BE CHANGED.

3.6.4 Display Configuration Registers

In addition to configuring the display using the internal switches, MultiComm "B" instruments allow the user to configure the front panel display via the network port. This is accomplished utilizing five Display Configuration Registers, which are shown in Table 4. These registers are 16 bits wide, and are programmed in a binary fashion. The lower 8 bits of the first register (register 92) contain status information. Bit 7 (D) is set (bit = 1) if the display has not been configured. If this bit is set, the display will be configured to the factory default setting, which is to show all available screens, and front panel resets enabled. Scrolling of the display screens is controlled by Register 92 bit 6 (S). If this bit is set (bit=1), then the display is in the scrolling mode. The lower 6 bits of register 92 are the present screen number if the display has been stopped (scrolling off). If the display is scrolling, then these 6 bits will be zero. The remaining bits of Register 92, bits 8 through 15, are screen enable bits, with each bit corresponding to a specific screen number. Setting the appropriate bit (bit=1) enables the in screen indicated in the table. Descriptions of the actual screen number indicated in Table 3 are presented in the appropriate MultiComm Instrument Manual. Bit 8 (screen 0) is the "Front Panel Reset Enable" screen, which does not get displayed, but when enabled allows the user to reset Demand Values from the front panel push button. Registers 93 through 96 contain the rest of the screen enables as indicated in Table 4. The upper 8 bits of register 96 are not used. The table also lists the decimal value of each bit position, as an aid in determining the decimal value to place in each register. For example, if a user wanted to enable screens 8, 9, 10 and 20, the user would write the value 4103 decimal (1 + 2 + 4 + 4096 = 4103) to register 93. This is equivalent to writing 0001 0000 0000 0111 Binary or 1007 Hexadecimal to register 93. The Display Configuration is stored in non-volatile memory (EEPROM) and it will be correct after a power outage.

WARNING - THE DISPLAY CONFIGURATION NON-VOLATILE MEMORY STORAGE HAS A 1,000,000 CYCLE ENDURANCE (DISPLAY CONFIG CAN BE CHANGED 1,000,000 TIMES).ONLY WRITE TO THE DISPLAY CONFIG REGISTERS WHEN THE DISPLAY NEEDS TO BE CHANGED.

	Bit Position															
	15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Decimal Value / **Register**	32768	16384	8192	4096	2048	1024	512	256	128	64	32	16	8	4	2	1
40092	7	6	5	4	3	2	1	0	D	S	Screen Number if Stopped, Else 0					
40093	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8
40094	39	38	37	36	35	34	33	32	31	30	29	28	27	26	25	24
40095	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40
40096	Unused								63	62	61	60	59	58	57	56

3.6.5 Communication Configuration Registers

MultiComm "B" instruments provide READ/WRITE Communication Configuration Registers that allow the user to configure various parameters within the instrument. These Communication Configuration Registers are currently undefined for Modbus Plus, and will always return 0, however they are stored in non-volatile memory (EEPROM) to allow for future upgrades.

WARNING - THE COMMUNICATION CONFIGURATION NON-VOLATILE MEMORY STORAGE HAS A 1,000,000 CYCLE ENDURANCE (CONFIG CAN BE CHANGED 1,000,000 TIMES). ONLY WRITE TO THE CONFIGURATION REGISTERS WHEN THE CONFIGURATION NEEDS TO BE CHANGED.

3.6.6 Tag Register

MultiComm "B" instruments provide a "TAG" register for user identification purposes. This register is READ/WRITE register that allows the user to write a number from 1 to 32,767 in the tag register. The Instrument will write this value in non-volatile memory EEPROM, so that the value will be available after any power outage. Any attempts to write values above 32,767 will return an illegal value error. Units will be set to 0 from the factory.

WARNING - THE TAG REGISTER NON-VOLATILE MEMORY STORAGE HAS A 1,000,000 CYCLE ENDURANCE (THE TAG REGISTER CAN BE CHANGED 1,000,000 TIMES). ONLY WRITE TO THE TAG REGISTER WHEN THE TAG NEEDS TO BE CHANGED.

3.7 Converting Data to Engineering Units

As was mentioned in Section 3.5, the majority of the data in both the Global and Holding Registers is stored in a **12-BIT OFFSET BINARY** format. This format was chosen to allow efficient use of registers, since both positive and negative quantities can be transmitted without the use of a SIGN (polarity) register. In this format, ZERO (0) is represented as 2047 counts, the most negative number is represented by 0 counts and the most positive number is represented by 4095 counts. While it would appear that this format limits the **ACCURACY** of the values transmitted in the registers, the **RESOLUTION** of this method is one part in 2048 which is 0.05%, actually 5 times better than the rated accuracy of the instrument, and therefore has no measurable effect on the accuracy of the transmitted value.

When displaying these values at another location, it may be desirable to convert the offset binary format into **ENGINEERING UNITS**. This conversion is readily accomplished using the following simple scaling equations:

BASIC EQUATION FOR OFFSET BINARY:

$$\text{Engineering Units} = \frac{\text{Value - 2047}}{2048} \text{ x Full Scale}_{\text{SECONDARY}} \text{ x Ratio}$$

The CT and PT ratios are the **NAMEPLATE** ratings of the transducer transformers. The PT ratio in these equations is the same as the PT ratio stored in the transducer since convention is to specify the PT ratio as a ratio to 1. For 5Amp CTs, the CT ratio in these equations is not the same as the ratio stored in the meter, but rather the number stored in the meter divided by 5. This is due to the fact that 5Amp CT ratios are normally specified as a ratio to 5. For 1Amp Cts, the CT ratio is the same as that stored in the instrument. Refer to Section 3.6.1 for more information on the CT/PT Ratios. For example a 500:5 CT and a 4:1 PT would have the following ratios:

$$CT_{RATIO} = 500 : 5 = \frac{500}{5} = 100 \qquad PT_{RATIO} = 4 : 1 = \frac{4}{1} = 4$$

The **Value** referred to in the equations would be the value stored in the register that you wished to convert to engineering units. For example if you wanted to convert Phase A Amperes into engineering units, Value would be the value in Holding Register 40002.

The **ENERGY Registers** are stored in the **BIN8** format, making these values readily usable with the standard **Double Precision Integer Math** functions available on PLCs. Using this data format, the address specifying the **WORD** (both registers) is the address of the first of the two registers in the pair (i.e. the one with the lowest register number). This register will have the most significant portion of the number. If the BIN8 data format is specified, no conversion is required.

FREQUENCY is stored as a single binary value that is the actual frequency times 100.

PHASE is stored as an offset binary value that is the phase difference times 10.

THD and **TDD** are stored as a single binary value that is the actual THD or TDD times 10.

K FACTOR is stored as a single binary value that is the actual K Factor times 100.

2 ½ or 3 ELEMENT EQUATIONS:

$$AMPEREs_{(Inst, Fund, Demand, Max)} = \frac{Value - 2047}{2048} \; x \; 10^{*} \; x \; CT_{RATIO}$$

$$AMPEREs_{N\,(Inst, Fund, Demand, Max)} = \frac{Value - 2047}{2048} \; x \; 15^{*} \; x \; CT_{RATIO}$$

$$VOLTs_{L\text{-}N\,(Inst, Fund, Demand, Min, Max)} = \frac{Value - 2047}{2048} \; x \; 150 \; x \; PT_{RATIO}$$

$$VOLTs_{L\text{-}L\,(Inst, Demand, Min, Max)}(SCALED) = \frac{Value - 2047}{2048} \; x \; 150 \; x \; PT_{RATIO} \; x \; \sqrt{3}$$

$$WATTs\,(VARs)(VAs\,)_{TOTAL\,(Inst, Demand, Min, Max)} = \frac{Value - 2047}{2048} \; x \; 3000^{*} \; x \; PT_{RATIO} \; x \; CT_{RATIO}$$

$$WATTs\,(VARs)(VAs\,)_{PER\ PHASE\,(Inst)} = \frac{Value - 2047}{2048} \; x \; 1000^{*} \; x \; PT_{RATIO} \; x \; CT_{RATIO}$$

$$kWh\,(kVARh) = Value_{HIGH} \; x \; 10{,}000 + Value_{LOW}$$

$$FREQUENCY = \frac{Value}{100}$$

$$PF_{(True, Displacement)} = \frac{Value - 2047}{1000} \; (- Lag \;, + Lead \;)$$

$$PHASE\ DIFFERENCE = \frac{Value - 2047}{10} \; (+ Line\ Leading\ Ref)$$

$$THD, TDD_{(Amps, Volts, Inst, Demand, Max)} = \frac{Value}{10}$$

$$K\ FACTOR = \frac{Value}{100}$$

$$*\ For\ CT1\ Option, divide\ this\ value\ by\ 5$$

2 ELEMENT EQUATIONS:

$$AMPEREs_{(Inst, Fund, Demand, Max)} = \frac{Value - 2047}{2048} \times 10^{*} \times CT_{RATIO}$$

$$VOLTs_{L-L\ (Inst, Fund, Demand, Min, Max)} = \frac{Value - 2047}{2048} \times 150 \times PT_{RATIO}$$

$$WATTs\ (VARs)(VAs)_{TOTAL\ (Inst, Demand, Min, Max)} = \frac{Value - 2047}{2048} \times 2000^{*} \times PT_{RATIO} \times CT_{RATIO}$$

$$kWh\ (kVARh) = Value_{HIGH} \times 10{,}000 + Value_{LOW}$$

$$FREQUENCY = \frac{Value}{100}$$

$$PF_{(True, Displacement)} = \frac{Value - 2047}{1000}\ (-Lag, +Lead)$$

$$PHASE\ DIFFERENCE = \frac{Value - 2047}{10}\ (+\ Line\ Leading\ Ref)$$

$$THD, TDD_{(Amps, Volts, Inst, Demand, Max)} = \frac{Value}{10}$$

$$K\ FACTOR = \frac{Value}{100}$$

* *For CT1 Option, divide this value by 5*

The above equations provide answers in fundamental units (VOLTs, AMPs, WATTs and VARs). If the user desires other units such as KILOVOLTs, KILOWATTs or KILOVARs, the answers given by the equations should be divided by 1,000. If the user desires MEGAWATTs or MEGAVARs, the answers given by the equations should be divided by 1,000,000.

3.8 Health Check

The following information is contained in the Health Check register (bit 15 is the high order bit and the description indicates the meaning when the bit is set). **The Health Check Register should always be read and checked before interpreting data, since some failure modes will cause erroneous data to be presented.** Please consult **Table I** in the base instrument MultiComm Users Manual for a full description of the failures.

BIT	DESCRIPTION	Self Test Fault	Display Code
0	CT/PT Ratio Checksum Failure [4]	2	---1
1	CT/PT Board Calibration Checksum Failure [5]	3	---2
2	Analog Board Calibration Checksum Failure [2]	4	---3
3	Input Over-Range (Clipping) [6]	6	---4
4	Program Memory (EPROM) Failure [7]	7	---5
5	A/D Self-Test Error [4]	8	---6
6	External Memory (XRAM) Failure [4]	9	---7
7	Host-MultiComm Interface Crash	10	---8
8	Phase Calibration Checksum Failure [8]	N/A	N/A
9	Energy Storage Checksum Failure [9]	11	---9
10	Demand Storage Parity Error [10]	12	--10
11	Configuration Parity Error	13	--11
12	Future Expansion - will read 0		
13	Future Expansion - will read 0		
14	Future Expansion - will read 0		
15	Will Always Read 0		

[4] - All measurements except energy are accurate, CT & PT ratio may be corrupted, no display on instrument. All Energies calculated after the failure will be in secondary units (CTR = 5:5 & PTR = 1:1).

[5] - Accuracy of measurements reduced to +/-3% or better.

[6] - Accuracy of measurements reduced - dependent on amount of signal overrange.

[7] - Data may be corrupted and is unreliable.

[8] - Accuracy of WATT/VAR/Energy measurements reduced to +/-0.5% or better.

[9] - Stored Energy Data may be corrupted and may be unreliable.

[10] - Minimum and Maximum Demand Data may be corrupted. Present Demands unaffected.

3.9 Modbus Plus Diagnostic LED

The Modbus Plus Diagnostic LED is an indicator that shows the type of communications activity on the Modbus Plus port on the MultiComm instrument. The Diagnostic LED is a red indicator that is located in the upper left corner of the top display. Because the LED is actually on the board below the Display Board, the Diagnostic LED has a limited viewing angle. A specific flash pattern indicates the nature of the Modbus Plus communication activity as listed below:

Six flashes per second: The normal operating state for a Modbus Plus node. The node is successfully receiving and passing the token. All nodes on the network should be flashing this pattern.

One flash per second: The node is offline after just being powered up, or after hearing a message from another node with the same address (duplicate addresses are not allowed). In this state, the node monitors the network and builds a table of active nodes and token-holding nodes. It remains in this state for five seconds, then attempts to go to its normal operating state.

Two flashes, then OFF for two seconds: The node is hearing the token being passed among other nodes, but is never receiving the token. Check the network link for an open or short circuit, or for a defective termination. Check that the flexible circuit connector inside the MultiComm instrument is correctly seated.

Three flashes, then OFF for 1.7 seconds: The node is not hearing any other nodes. It is periodically claiming the token, but finding no other node to which to pass it. Check the network link for an open or short circuit, or for a defective termination. Check that the flexible circuit connector inside the MultiComm instrument is correctly seated.

Four flashes, then OFF for 1.4 seconds: The node has heard a valid message from another node that is using the same address as this node. The node remains offline in this state as long as it continues to hear the duplicate address. If the duplicate address is not heard for five seconds, the node then changes to the pattern of one flash every second.

3.10 Heartbeat State Counter

MultiComm “B” instruments provide a Heartbeat State Counter Register that allows the user to determine when the data is updated within the instrument. For Modbus Plus this counter is also available in Global Data. This counter will increment by the number of internal 10 millisecond states that have elapsed since the last time the data was updated. Users can use a change in this value as an indication of the instant that the data has been updated in the MultiComm processor. On sequential polls, users can also use the difference in this counter to determine the time that has elapsed between poles. A third use of this register as a visual indicator that the data is changing, allows users of certain MMIs to identify disruption in the polling of the instrument. The Heartbeat State Counter is a full 16bit counter that rolls over at 65535 (655.35 seconds - 10.9225 minutes). The counter starts at zero on power-up, and is NOT stored in non-volatile memory.

Model	ID	Model	ID
MTWIE1B	201	MTWDE1B	301
MTWIE2B	202	MTWDE2B	302
MTWIE3B	203	MTWDE3B	303
MTWIE4B	204	MTWDE4B	304
MTWIE5B	205	MTWDE5B	305
MTWIE6B	206	MTWDE6B	306
MTWIEC1B - VI3	207	MTWDEC1B - VI3	307
MTWIEC2B - VI2	208	MTWDEC2B - VI2	308
MTWIEC2B - VI4	209	MTWDEC2B - VI4	309
MTWIEC4B - VI3	210	MTWDEC4B - VI3	310
MTWIEC5B - VI2	211	MTWDEC5B - VI2	311
MTWIEC5B - VI4	212	MTWDEC5B - VI4	312

3.11 Meter ID Register

MultiComm “B” instruments provide an “ID” register for model identification purposes. This register is preprogrammed at the factory, refer to table 5.

4.0 INSTALLATION

4.1 Setting Modbus Plus Address

The MultiComm instrument provides for direct connection to a Modbus Plus Network. As was mentioned in Section 3.3, each device on a given network must have a different PHYSICAL ADDRESS. A pair of address selector switches (SW3 & SW4) are located on the Modbus Plus Peer Processor Board, and they are accessible through holes in the Display Board. When the meter is powered, the ADDRESS can be easily checked by pressing the front mounted SELECT button down and scrolling through the available screens (refer to the MultiComm Users Manual for more details on the screens). After all the screens have been viewed, a marker screen (CT/ID/PT shown below) will be displayed for 1.2 seconds.

5000	CT Ratio	(5000:5 shown)(5000:1 with CT1 option)
12	ID Address	(12 shown)
1000	PT Ratio	(1000:1 shown)
CT·ID·PT		

This screen serves two purposes - to indicate to the user that all enabled screens have been viewed and to provide the CT/ID/PT information. The Modbus Plus Address is on the middle display. This provides the user with a simple method verifying the address without having to remove the faceplate of the instrument.

If the ADDRESS needs to be changed, the following procedure should be followed:

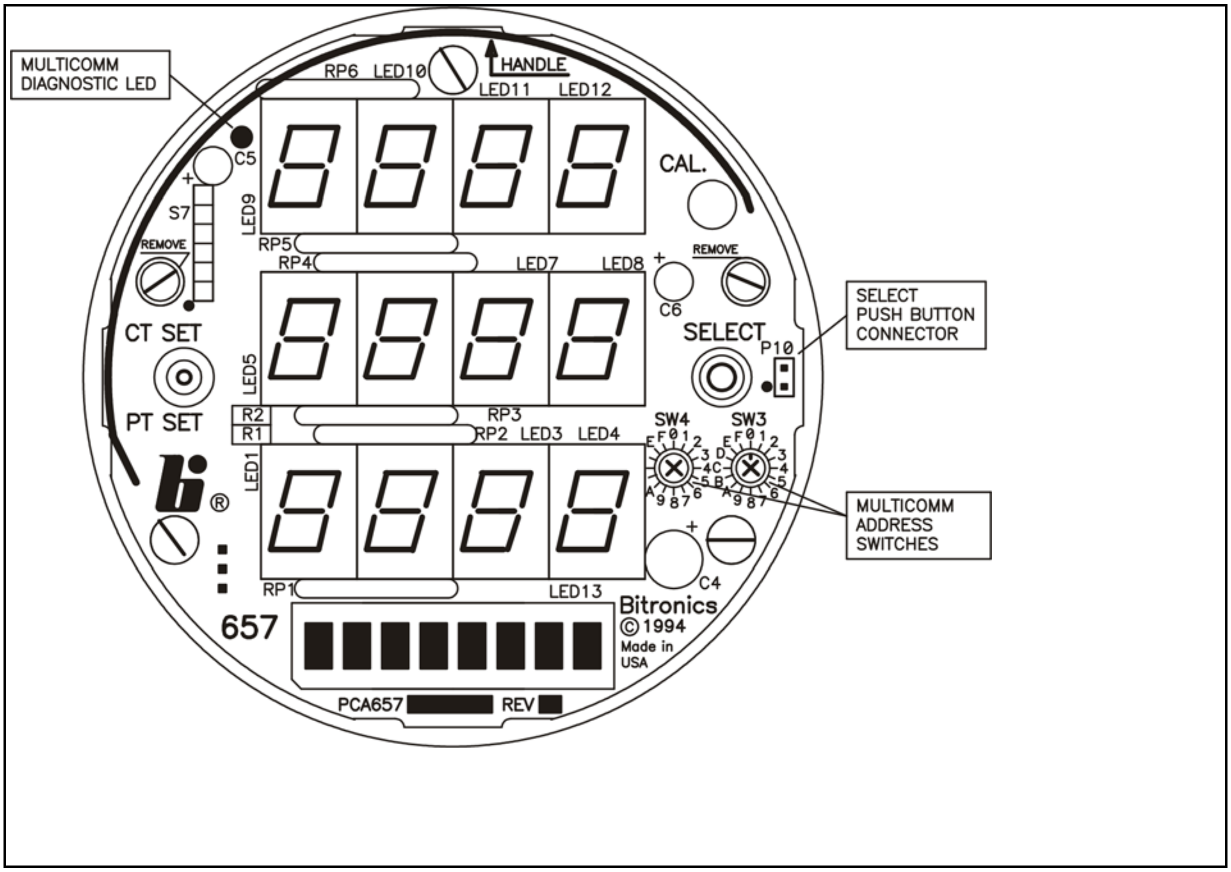
1. With the MultiComm meter under power, remove the four screws holding the front panel to the meter. Carefully move the front panel away from the instrument to expose the front panel select switch, and disconnect the connector from the display board. Remove the faceplate and gasket.

2. Flip the small toggle switch on the left of the meter UP for CT set (DOWN for PT set). The top display will show the present CT setting, the middle display will show the instrument address and the bottom display will show the present PT setting. The Alphanumeric display will indicate which ratio is being set. **Be careful not to push the Select button at this time or the CT\PT ratio will be altered.**

3. Return the toggle to the center position. The alphanumeric display will show a **Select?** prompt for 2 seconds. If the Select button is pressed during the time, the alphanumeric display will indicate **Okay**, and the user will enter the **Display Programming Mode**. If the select button is not pressed, the **Select?** prompt will be followed by a digit check (8888 displayed) and the meter will return to normal operation.

4. The ADDRESS selector switches are SW3 & SW4, and are located on the right hand side of the Display Board, just below the SELECT pushbutton. The switches have 16 positions (0-9,A-F). The switch can be rotated with a small flat blade screwdriver, or a small phillips screwdriver. Using the table on the next page, find the desired MODBUS PLUS address and dial the switches SW4 and SW3 to the

corresponding hexadecimal values. **The NEW address will NOT take effect until the instrument has gone through its power-on functions.**



This can be accomplished by re-powering the instrument. For installed instruments where re-powering is not practical, the user may force the instrument into the power up sequence. To accomplish this, the CT/PT toggle should be moved from the center position to the up position. Then the user should **PRESS and HOLD** the SELECT button down for longer than 1.2 seconds, which will initiate a restart of the instrument. Return the toggle to the center position. You will see a digit check (8888 displayed).

5. Flip the small toggle switch on the left of the meter UP for CT set (DOWN for PT set). The top display will show the present CT setting, the middle display will show the instrument address and the bottom display will show the present PT setting. The Alphanumeric display will indicate which ratio is being set. **Be careful not to push the Select button at this time or the CT\PT ratio will be altered.** Verify that both ratios and the Modbus Plus Address are correct. Return the toggle to the center position. If the Modbus Plus Address is not correct, repeat step 4. If the CT and/or PT ratio have changed, refer to the MultiComm Users Manual for instructions on setting the CT/PT.

6. Replace gasket, carefully plug in the select switch connector to the two pin connector on the right hand side of the display board. Replace the front cover, being careful to dress the yellow cable to the select switch around the bottom display. Replace the four cover screws. Done!!

MB+ ADDR	SW 4	SW 3
1	0	0
2	0	1
3	0	2
4	0	3
5	0	4
6	0	5
7	0	6
8	0	7
9	0	8
10	0	9
11	0	A
12	0	B
13	0	C
14	0	D
15	0	E
16	0	F

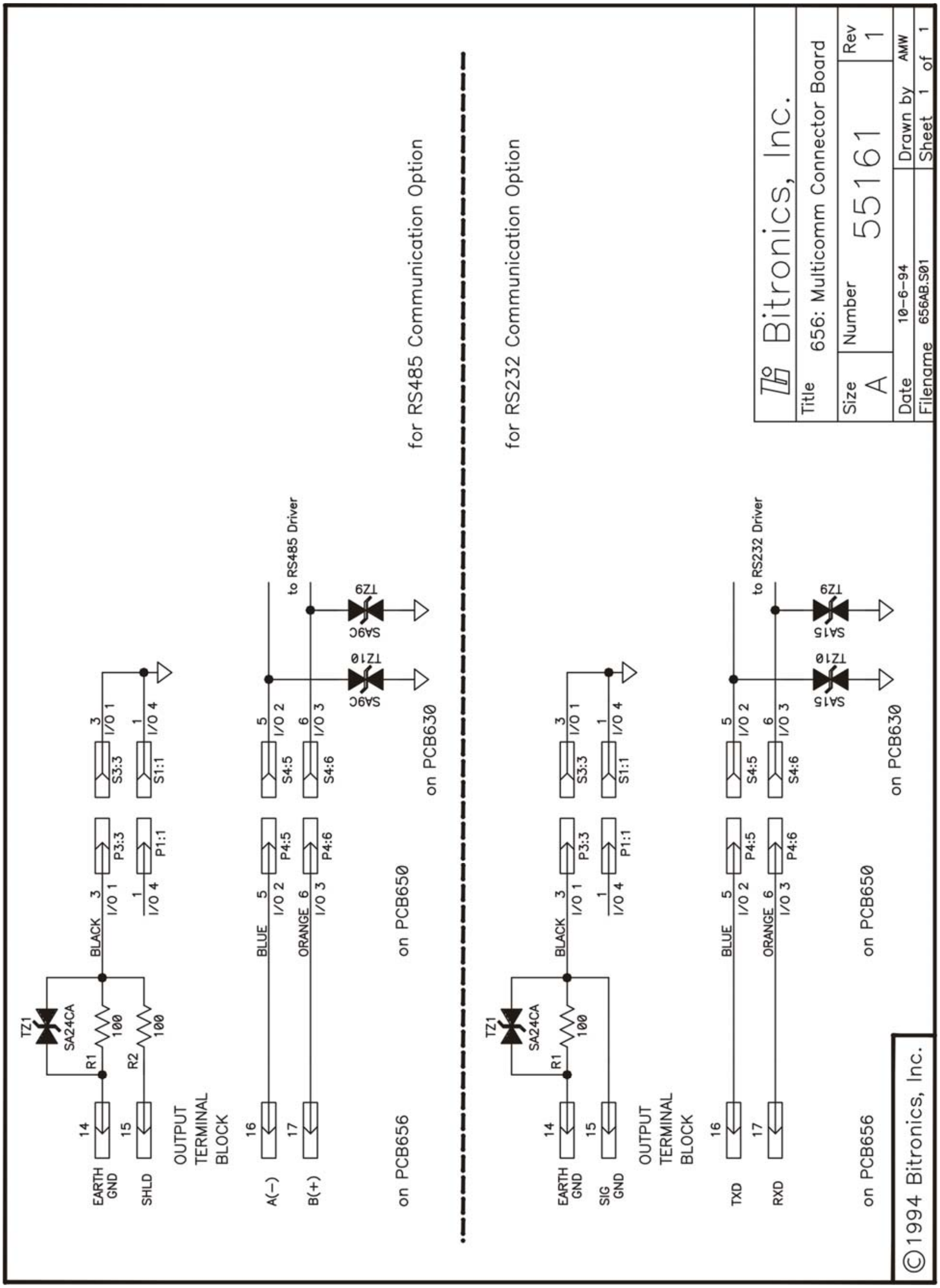
MB+ ADDR	SW 4	SW 3
17	1	0
18	1	1
19	1	2
20	1	3
21	1	4
22	1	5
23	1	6
24	1	7
25	1	8
26	1	9
27	1	A
28	1	B
29	1	C
30	1	D
31	1	E
32	1	F

MB+ ADDR	SW 4	SW 3
33	2	0
34	2	1
35	2	2
36	2	3
37	2	4
38	2	5
39	2	6
40	2	7
41	2	8
42	2	9
43	2	A
44	2	B
45	2	C
46	2	D
47	2	E
48	2	F

MB+ ADDR	SW 4	SW 3
49	3	0
50	3	1
51	3	2
52	3	3
53	3	4
54	3	5
55	3	6
56	3	7
57	3	8
58	3	9
59	3	A
60	3	B
61	3	C
62	3	D
63	3	E
64	3	F

4.2 Modbus Plus Cable

The Modbus Plus cable connects to the MultiComm instrument via a standard 9-pin D connector located on the back of the instrument. Modicon recommends Belden 9841 cable or equivalent. The instrument is designed to accept standard Modicon Modbus Plus Connectors. The cable should enter the connector from the side with 4 pins, i.e. the narrow side. If the user is employing the Modicon Connector Tool (AS-MBPL-001), the wires should be dressed the same as the Modicon 385/485. This cable dress will put the Modbus Plus Cable to the outside of the meter, and will minimize the interference between the cable and the input studs. The Modbus Plus Connector should be secured to the MultiComm instrument using #4-40 screws supplied with the Modicon Connector Kit. For additional details, request Modicon publication GM-MBPL-001 “Modicon Modbus Plus Network Planning and Installation Guide” directly from your local Modicon distributor.



for RS485 Communication Option
for RS232 Communication Option
EARTH GND
SHLD
SIG GND
14
15
16
17
A(−)
B(+)
TXD
RXD
OUTPUT TERMINAL BLOCK
TZ1
SA24CA
R1
R2
100
BLACK
BLUE
ORANGE
I/O 1
I/O 2
I/O 3
I/O 4
P3:3
P1:1
P4:5
P4:6
S3:3
S1:1
S4:5
S4:6
TZ9
TZ10
SA9C
SA15
to RS485 Driver
to RS232 Driver
on PCB656
on PCB650
on PCB630
© 1994 Bitronics, Inc.
Bitronics, Inc.
Title
656: Multicomm Connector Board
Size
A
Number
55161
Rev
1
Date
10-6-94
Drawn by
AMW
Filename
656AB.S01
Sheet 1 of 1

Revision	Date	Changes	By
A	01/30/2009	Update Bitronics Name, Logo	E. Demicco
B	08/09/09	Updated logos and cover page	MarCom
C			

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