Engineering Data

ED15063-2

Group: **Controls**

Part Number: **ED 15063**

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MicroTech II®
Chiller Unit Controller
Protocol Information

Modbus® Protocol

- WSC Water-Cooled Centrifugal, Single-Compressor
- WDC Water-Cooled Centrifugal, Dual-Compressor
- WPV Water-Cooled Centrifugal, Single-Compressor
- HSC Water-Cooled Single-Compressor Centrifugal, Heat Recovery
- HDC Water-Cooled Dual-Compressor Centrifugal, Heat Recovery
- TSC Water-Cooled Single-Compressor Centrifugal, Templifier
- WMC Water-Cooled Centrifugal, Magnetic Bearing
- WCC Water-Cooled Centrifugal, Counterflow
- AGZ Air-Cooled Global Scroll
- ACZ Air-Cooled Scroll Condensing Unit
- WGZ Water-Cooled Global Scroll
- AGS Air-Cooled Global Screw
- WGS Water-Cooled Global Screw

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Limited Warranty

Consult your local McQuay Representative for warranty details. Refer to Form 933-43285Y. To find your local McQuay Representative, go to www.mcquay.com.

Notice

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Revision History

ED 15063-0	May 15, 2003	Preliminary release.
ED 15063-1	May 18, 2005	Added points for Solid State Starter – Current, Voltage, Power and Power Factor Corrected some incorrect register listings Changed doc to have only Holding Registers and Coils Added WGS and WMC data Added WMC, HSC HDC, and TSC to front page and Chiller Model table
ED 15063-2	Nov 22, 2005	Added WCC to front page and Chiller Model table Corrected Modbus Alarms table Added Compressor Current, Compressor Power and Compressor Voltage to the Compressor Select Table

Software Revision

This edition documents all versions of the standard MicroTech II® Chiller Unit Controller firmware and all subsequent revisions until otherwise indicated.

Reference Documents

Company	Number	Title	Source
McQuay International	IOMM WSC WDC	The McQuay DISTINCTION Series Single/Dual Compressor Centrifugal Chillers Installation, Operating and Maintenance Manual	www.mcquay.com
McQuay International	OM CentrifMicro II	MicroTech II Controller for Centrifugal Chillers and Templifiers Operating Manual	www.mcquay.com
McQuay International	IM 743	MicroTech II Chiller Unit Controller Modbus Communication Module Installation Manual	www.mcquay.com
McQuay International	IMM AGS IMM AGSB	GeneSys? Air-Cooled Screw Compressor Chiller	www.mcquay.com
McQuay International	IOMM ACZ/AGZ	Air-Cooled Scroll Condensing Unit & Air-Cooled Scroll Chiller w/Remote Evaporators Installation, Operation, and Maintenance Manual	www.mcquay.com
McQuay International	IOMM ACZ	Air-Cooled Scroll Condensing Unit Installation, Operation, and Maintenance Manual	www.mcquay.com
McQuay International	IOMM AGZ IOMM AGZ1	Air-Cooled Scroll Compressor Chiller & Air-Cooled Scroll Compressor Water Chiller Installation, Operation, and Maintenance Manual	www.mcquay.com
McQuay International	IOMM WGZ	Water-Cooled Scroll Compressor Chiller Installation, Operation and Maintenance Manual	www.mcquay.com
McQuay International	IOMM WPV	WPV Centrifugal Compressor Chillers Installation, Operating and Maintenance Manual	www.mcquay.com
McQuay International	OM AGS	GeneSys? Air-Cooled Screw Compressor Chiller Operation Manual	www.mcquay.com
McQuay International	IOMM TSC	MicroTech II Templifier Single Compressor Centrifugal Installation, Operation, and Maintenance Manual	www.mcquay.com
Gould, Inc.		Modbus® Application Protocol	www.Modbus.org
Gould, Inc.		Modbus Over Serial Line	www.Modbus.org

Introduction

This document contains the necessary information to incorporate a MicroTech II Chiller Unit Controller from McQuay International into your Building Automation System (BAS). It includes all necessary Modbus? variables and corresponding MicroTech II Chiller Unit Controller data points. Modbus terms and principles are not defined. Refer to the appropriate specifications for definitions and details.

Chiller Models

The following table lists the model designators of McQuay International Chiller units and the corresponding description.

WSC	Water-Cooled Centrifugal, Single-Compressor
WDC	Water-Cooled Centrifugal, Dual-Compressor
WPV	Water-Cooled Centrifugal, Single-Compressor
HSC	Water-Cooled Single-Compressor Centrifugal, Heat Recovery
HDC	Water-Cooled Dual-Compressor Centrifugal, Heat Recovery
TSC	Water-Cooled Single-Compressor Centrifugal, Templifier
WMC	Water-Cooled Centrifugal, Magnetic Bearing
WCC	Water-Cooled Centrifugal, Counterflow
AGZ	Air-Cooled Global Scroll
ACZ	Air-Cooled Scroll Condensing Unit
WGZ	Water-Cooled Global Scroll
AGS	Air-Cooled Global Screw
WGS	Water-Cooled Global Screw

Controller Data Points

The MicroTech II Chiller Unit Controller contains data points or unit variables that are accessible from three different user interfaces: the unit keypad/display, the Operator Interface Touch Screen, or a Modbus serial network. Not all points are accessible from each interface. This manual lists all important data points and the corresponding network path for each applicable interface. Refer to the applicable Operation Manual for keypad/display and Operator Interface Touch Screen details. See Reference Documents on page 4 for manual part numbers.

Modbus Protocol Information

Compatibility

The MicroTech II Chiller Unit Controller can be configured in an interoperable Modbus network. The controller must have the corresponding Modbus Communication Module installed.

The MicroTech II Chiller Unit Controller conforms to the Modbus Standards published at www.Modbus.org. See the Reference Documents on page 4.

Protocol Definitions

The Modbus protocol is a standardized Application Level (OSI Level 7) protocol used in interoperable Industrial Control networks. Modbus provides the communication infrastructure necessary to integrate products manufactured by different vendors and to integrate control services that are now independent.

It specifies how requests from the client are sent to a server and how servers reply. The client constructs a PDU (protocol data unit) and sends it to a specific server or broadcasts it to all servers. The PDU contains a function code that defines the action the client is requesting from the server(s). The PDU also includes a data field that further defines the action to the server, for example, the location of the data to be read.

A normal reply from a server includes the same function code and a response data field. In the case of a read operation, the response data field contains the requested data. In the case of a write operation, the response data field contains an echo of the write data of the request command. If the server detects an error in the transmission, the reply to the client includes and exception function code and the response data field contains an exception code.

Controllers can communicate on standard Modbus networks using one of two transmission modes: ASCII or RTU. Users select the serial port communication parameters (baud rate, parity mode, etc), during configuration of the controller. The mode and serial parameters must be the same for all devices on a Modbus network. Transmission mode determines how information is packed into the message fields and decoded. In RTU mode, each byte contains two hexadecimal characters, and in ASCII mode, each byte contains one ASCII character. ***The MicroTech II Chiller Unit Controller uses the RTU mode only.***

The MicroTech II Chiller Unit Controller uses the following data structure: 8 data bits, 1 or 2 stop bits, and no parity bit. It uses data transmission rates from 1200 to 19200 bps.

Valid Function Codes

The MicroTech II Chiller Unit Controller supports eight public function codes.

Function Code	Description	Definition
01 (0x01)	Read Coils	This function code reads status from 1 to 2000 contiguous coils in a remote device.
02 (0x02)	Read Discrete Inputs	This function code reads status from 1 to 2000 contiguous discrete inputs in a remote device.
03 (0x03)	Read Holding Registers	This function code reads the contents of a contiguous block of holding registers in a remote device.
04 (0x04)	Read Input Registers	This function code reads from 1 to approx. 125 contiguous input registers in a remote device.
05 (0x05)	Write Single Coil	This function code writes a single output to either ON or OFF in a remote device.
06 (0x06)	Write Single Register	This function code writes a single holding register in a remote device.
15 (0x0F)	Write Multiple Coils	This function code forces each coil in a sequence of coils to either ON or OFF in a remote device.
16 (0x10)	Write Multiple Registers	This function code writes a block of contiguous registers (1 to approx. 120 registers) in a remote device.

Valid Error Codes

The MicroTech II Chiller Unit Controller supports three error or exception codes.

Error Codes	Description	Definition
01	Illegal Function	The function code received in the query is not an allowable action for the server (or slave).
02	Illegal Data Address	The data address received in the query is not an allowable address for the server (or slave).
03	Illegal Data Value	A value contained in the query data field is not an allowable value for server (or slave).

Modbus Data Point

Each data point accessible from a Modbus network is described with a table that gives the data type and index. If the data point represents an enumerated variable, the enumerations are also listed.

Example Data Point: Chiller On Off

This output network variable indicates the current state of the chiller. The OFF state is represented by 0, and the ON state is represented by 1. (D2)

Data Type	Index	Measurement	Units	Valid Range
Coil	2	Chiller State	NA	0 = Off (Disable) 1 = On (Enable)

Data Type

Data is represented as either single-bit elements or 16-bit elements. A single-bit element is referred to as a Discrete Input when it refers to read-only data and as a Coil when it refers to read-write data. A 16-bit element is referred to as a Input Register when it refers to read-only data and as an Holding Register when it refers to read-write data.

Index

There can be as many as 65,536 elements of each data type in a Modbus device. Data elements are numbered from 1 to 65,536 in each type. Data elements are addressed with an index in the range from 0 to 65,535. The index is ***not*** the address of the data element in the unit controller memory. The index is used in Modbus PDUs to specify the location the data in the unit controller. This means, for example, that data element number 1 is addressed using index 0 in the PDU.

Valid Range

Some properties are standard data types and some are enumerated sets. If the property value represents a range of values, e.g., temperature or pressure, a range of values is given. If the property value is an enumerated set, all enumerated values and corresponding meaning are given.

Configuring the Unit Controller

The MicroTech II Chiller Unit Controller and the Modbus Communication Module together are designed, programmed, and configured at the factory to be a chiller unit controller accessible over a Modbus network. No additional programming is required to make this a chiller unit controller. The unit controller is ready to operate with the default values of the various parameters set at the factory. Default values may be changed with the unit keypad or via the network. Parameters must be adjusted to accommodate your particular network. See the appropriate Operation Manual for default values and keypad operating instructions and the Modbus Communication Module Installation Manual (see Reference Documents section for manual part numbers.)

Typical Application: Minimum Integration

When you have integrated the unit into your network, you can monitor and control unit operation from your workstation. At a minimum, you can:
• Display and monitor data points
• Turn the unit on or off
• Operate the unit safely

Set up the Unit for Network Control

Setup for Centrifugal Chiller MicroTech II Network Control:

1. Disable the chiller. The chiller should not be operating while performing this setup.
2. At the chiller touch screen interface panel:
   a. In the SETPOINTS MODE screen, set the #9 setpoint, BAS Protocol to Modbus. Use the Operator Password of "2001."
   b. In the SETPOINTS MODE screen, set the #3 setpoint, Control Source to Local
3. Verify with the chiller/control company technician that the chiller is operational on BAS.
4. In the SETPOINTS MODE screen, set the #3 setpoint, Control Source to BAS.

Setup for all Other Chillers MicroTech II Network Control:

1. Set the Set Unit Setpoint screen 1 initially to Source = Keypad.
2. Verify that Modbus is selected as the Protocol in the applicable menu screen shown in the table below.
3. Verify with the chiller/control company technician that the chiller is operational on a BAS.
4. Set the Unit Setpoint screen 1 to Source = Network.

Model	AGZ-A	ACZ-A	AGZ-B	ACZ-B	AGS-B	AGS-C	WGS	WGZ
Menu Screen	9	6	9	7	12	14	15	10
Password	2001	2001	2001	2001	8945	8453	8745	2001

NOTE: Models AGZ-A/B, ACZ-A/B, and WGZ have one unit controller, while models AGS-B/C and WGS have one unit controller and multiple circuit controllers. Unit settings for AGS-B/C and WGS models are adjusted on the unit controller.

Display Important Data Points

Typical workstation displays of MicroTech II Unit Controller attributes include the following significant data points (page number of detailed description in parenthesis). Each data point is identified with a number that also identifies it in the Comprehensive Data Point Tables. These data points are also shaded in the comprehensive tables so that you can distinguish them. References in the text of this section also identify these data points with a number and shading.

Table 1: Significant Data Points

No.	Configuration	No.	Temperatures	No.	Setpoints	No.	Alarms
1	Chiller Status (12)	5	Evaporator Entering Water Temperature (16)	9	Cool Setpoint (16)	11	Alarm Digital Output (20)
2	Chiller Mode Set-point (12)	6	6 Evaporator Leaving Water Temperature (16)	10	Capacity Limit Setpoint (11)	12	Clear Alarms (20)
3	Actual Capacity (11)	7	Condenser Entering Water Temperature (15)			13	Active Alarms (21)
4	Chiller Enable (11)	8	Condenser Leaving Water Temperature (15)				

You can display any number of additional data points based on job requirements or individual preference. See Modbus Data Points on page 7 for lists of all Modbus Variables available to the network. For a more detailed description of all available data points, see the Detailed Data Point Information section on page 11 of this document.

Comprehensive Data Point Tables

Modbus Data Points

Chiller Variables

Note: See the appropriate Operation Manual for specific data ranges and default values.

Network Control Property	Page	Read/ Write	Data Type	Description
Active Setpoint	12	R	Holding Register	-40°- 199°F
Actual Capacity (3)	12	R	Holding Register	0 - 160%
Capacity Limit (Output) (10)	12	R	Holding Register	0 - 160%
Capacity Limit Setpoint (10)	12	W	Holding Register	0 - 160%
Chiller Enable (Input) (4)	12	R/W	Coil	0=Off, 1=On
Chiller Limited	12	R	Coil	0=Not Limited, 1=Limited
Chiller Local/Remote	13	R	Coil	0=Remote, 1=Local
Chiller Mode Output	13	R	Coil	1=ICE, 2=COOL, 3=HEAT
Chiller Mode Setpoint	13	R/W	Holding Register	1=ICE, 2=COOL, 3=HEAT
Chiller On Off	13	R	Coil	0=Chiller Off, 1=Chiller On
***Chiller Status (1)**	**13**	**R**	**Holding Register**	**1=Off, 2=Start, 3=Run, 4=Pre-Shutdown, 5=Service**
Compressor Current	13	R	Holding Register	0 - 65,535
Compressor Discharge Temperature	14	R	Holding Register	-460°- 621°F
Compressor Percent RLA	14	R	Holding Register	0 -110%
Compressor Power	14	R	Holding Register	0 - 65,535
Compressor Run Hours	14	R	Holding Register	0 - 65,535
Compressor Select	15	R/W	Holding Register	See page 13
Compressor Starts	15	R	Holding Register	0 - 65,535
Compressor Suction Line Temperature	15	R	Holding Register	-40°- 244°F
Compressor Voltage	15	R	Holding Register	0 - 65,535
***Condenser Entering Water Temperature (7)**	**16**	**R**	**Holding Register**	**-40° - 244°F**
Condenser Flow Switch Status	16	R	Coil	0=No Flow, 1=Flow
***Condenser Leaving Water Temperature (8)**	**16**	**R**	**Holding Register**	**-40° - 244°F**
Condenser Pump Run Hours	16	R	Holding Register	0 - 65,535
Condenser Refrigerant Pressure	16	R	Holding Register	-3276.8 – 3276.7 psi
Condenser Saturated Refrigerant Temperature	16	R	Holding Register	-40° - 244°F
Condenser Water Flow Rate	16	R	Holding Register	0 - 65,535
Condenser Water Pump Status	17	R	Coil	0=Pump Off Request, 1=Pump On Request
***Cool Setpoint (9)**	**17**	**R/W**	**Holding Register**	**10? - 120°F**
***Evaporator Entering Water Temperature (5)**	**17**	**R**	**Holding Register**	**-40° - 244°F**
Evaporator Flow Switch Status	17	R	Coil	0=No Flow, 1=Flow
Evaporator Leaving Water Temperature for Unit(6)	17	R	Holding Register	-40° - 244°F
***Evaporator Leaving Water Temperature for Compressor**	**17**	**R**	**Holding Register**	**-40° - 244°F**
Evaporator Pump Run Hours	17	R	Holding Register	0 – 65,535
Evaporator Refrigerant Pressure	18	R	Holding Register	-3276.8 – 3276.7 psi
Evaporator Saturated Refrigerant Temperature	18	R	Holding Register	-40° - 244°F
Evaporator Water Flow Rate	18	R	Holding Register	0 - 65,535
Evaporator Water Pump Status	18	R	Coil	0=Pump Off Request, 1=Pump On Request
Heat Recovery Entering Water Temperature	18	R	Holding Register	-40° - 244°F
Heat Recovery Leaving Water Temperature	18	R	Holding Register	-40° - 244°F
Heat Setpoint	18	R/W	Holding Register	50° - 120°F

Network Control Property	Page	Read/ Write	Data Type	Description
Ice Setpoint	19	R/W	Holding Register	15? - 35°F, Default=25°F
Liquid Line Refrigerant Pressure	19	R	Holding Register	-22592 - 22591 psi
Liquid Line Refrigerant Temperature	19	R	Holding Register	-40°- 244°F
Oil Feed Pressure	19	R	Holding Register	-22592 - 22591 psi
Oil Feed Temperature	19	R	Holding Register	-40° - 244°F
Oil Sump Pressure	19	R	Holding Register	-22592 - 22591 psi
Oil Sump Temperature	19	R	Holding Register	-40° - 244°F
Outdoor Air Temperature	20	R	Holding Register	-40° - 244°F
Pump Select	20	R/W	Coil	0=Pump No. 1, 1=Pump No. 2
Run Enabled	20	R	Coil	0=OFF, 1=Run Allowed

*Boldface indicates data points required for typical minimum integration.

Chiller Alarm Variables

Network Control Property	Page	Read/ Write	Data Type	Description
Alarm Digital Output (11)	21	R	Coil	0-No Alarm, 1=Alarm
Clear Alarms (12)	21	R/W	Coil	0=Normal, 1=Clear Alarm
Active Alarms (13)	22	R	Holding Register	16 Holding Registers: Each bit representing an alarm condition

Detailed Data Point Information

This section lists the information (the data) that is available to the Industrial Control System via the Modbus RTU protocol. This information is used to safely operate and log the performance of the chiller. The systems integrator also uses this information when creating custom graphics.

Table 2: Data Points for Chiller Models

Data Point	WSC/WDC/WPV/WMC /WCC/HSC/TSC/HDC	AGZ	ACZ	WGZ	AGS	WGS
Active Alarms	X	X	X	X	X	X
Active Setpoint	X	X		X	X	X
Actual Capacity	X	X	X	X	X	X
Alarm Digital Output	X	X	X	X	X	X
Capacity Limit Output	X	X*	X*	X	X	X
Capacity Limit Setpoint	X	X*	X	X	X	X
Chiller Enable	X	X	X	X	X	X
Chiller Limited	X	X*	X*	X	X	X
Chiller Local/Remote	X	X	X	X	X	X
Chiller Mode Output	X	X	X	X	X	X
Chiller Mode Setpoint	X	X	X	X		X
Chiller On Off	X	X	X	X	X	X
Compressor Current***	X					X
Compressor Discharge Temperature	X				X	X
Compressor Percent RLA	X					
Compressor Power***	X					X
Compressor Run Hours	X	X	X	X	X	X
Compressor Select	X	X	X	X	X	X
Compressor Starts	X	X	X	X	X	X
Compressor Suction Line Temperature	X	X				X
Compressor Voltage***	X					X
Condenser Entering Water Temperature	X					X
Condenser Flow Switch Status	X					X
Condenser Leaving Water Temperature	X					X
Condenser Pump Run Hours	X					
Condenser Refrigerant Pressure	X	X	X	X	X	X
Condenser Saturated Refrigerant Temperature	X	X	X	X	X	X
Condenser Water Flow Rate	X					
Condenser Water Pump Status	X					X
Cool Setpoint	X	X		X	X	X
Evaporator Entering Water Temperature	X	X				X
Evaporator Flow Switch Status	X	X	X	X	X	X
Evaporator Leaving Water Temperature for Compressor	X					
Evaporator Leaving Water Temperature for Unit	X	X	X	X	X	X
Evaporator Pump Run Hours	X					
Evaporator Refrigerant Pressure	X	X	X	X	X	X
Evaporator Saturated Refrigerant Temperature	X	X	X	X	X	X
Evaporator Water Flow Rate	X					
Evaporator Water Pump Status	X	X		X	X	X
Heat Recovery Entering Water Temperature	X					
Heat Recovery Leaving Water Temperature	X					
Heat Setpoint	X					
Ice Setpoint	X	X		X	X	X
Liquid Line Refrigerant Pressure					X	
Liquid Line Refrigerant Temperature	X				X	
Network Clear Alarm	X	X	X	X	X	X
Oil Feed Pressure**	X					
Oil Feed Temperature**	X					
Oil Sump Pressure**	X					
Oil Sump Temperature**	X					
Outdoor Air Temperature		X	X	X		
Pump Select	X					
Run Enabled	X	X		X	X	X

*Dual circuit models only
**Not in WMC model
***Optional. Solid State Starter required

Active Setpoint

This output network variable indicates the current value of the setpoint temperature used to control the temperature of the Leaving Chilled Water or Leaving Hot Water. Based on the operating mode of the chiller, this value is derived from the Cooling Setpoint or the optional Heating Setpoint. The default mode is Cooling and is used unless changed by the Mode input. (A2)

Data Type	Index	Measurement	Units	Valid Range
Holding Register	40003	Temperature	°F x 10	-40°-199°F

Actual Capacity

This output network variable indicates the percent of capacity the chiller is currently producing. It may be more or less than the nominal capacity of the chiller. (A10)

Data Type	Index	Measurement	Units	Valid Range
Holding Register	40011	Percent of chiller capacity	% x 10	0% to 160%

Capacity Limit Output

This output variable is a measure of the ratio of operating capacity to full capacity expressed in percent. This level may be adjusted via an operator workstation or other network device, but cannot be adjusted above a factory-specified limit. It indicates the current value of the Capacity Limit (Input) data point. (A42)

Data Type	Index	Measurement	Units	Valid Range
Holding Register	40043	Percent of maximum capacity	% x 10	0% to 160%.

Capacity Limit Setpoint

Capacity Limit is a measure of the ratio of operating capacity to full capacity expressed in percent. The variable can set the operating value (input). This input network variable sets the maximum capacity level of the chiller. This level may be adjusted via an operator workstation or other network device, but cannot be adjusted above a factory-specified limit. (A3).

Data Type	Index	Measurement	Units	Valid Range
Holding Register	40004	Percent of maximum capacity	% x 10	0% to 160%.

Chiller Enable

The Chiller Enable data point starts the chiller in a particular way. (D1)

Data Type	Index	Measurement	Units	Valid Range
Coil	2	Chiller State	NA	0 = Off (disable) 1 = On (enable)

Chiller Limited

This output network variable indicates the main running mode and states of the Chiller. The Limited network variable indicates whether conditions may exist that prevent the chiller from reaching setpoint. (D6)

Data Type	Index	Measurement	Units	Valid Range
Coil	7	Status	NA	0 = Not Limited 1 = Limited

Chiller Local/Remote

The Local/Remote network variable indicates whether the chiller is in local control or allowed to be controlled remotely over the network. (D5)

Data Type	Index	Measurement	Units	Valid Range
Coil	6	Mode	NA	0= Remote 1 = Local

Chiller Mode Output

This output data point indicates the current operating mode of the chiller. (I19)

Data Type	Index	Measurement	Units	Valid Range
Coil	40148	HVAC Mode	NA	1. ICE 2. COOL 3. HEAT

Chiller Mode Setpoint

The Chiller Mode data point sets the mode of operation of the chiller and provides the ability for another node on the network to place a chiller in another mode. (I17)

Data Type	Index	Measurement	Units	Valid Range
Holding Register	40146	HVAC Mode	NA	1. ICE 2. COOL 3. HEAT

Chiller On Off

This output network variable indicates the current state of the chiller. The OFF state is represented by 0, and the ON state is represented by 1. (D2)

Data Type	Index	Measurement	Units	Valid Range
Coil	3	Chiller State	NA	0 = Off 1 = On

Chiller Status

This output network variable indicates the main running mode and states of the Chiller. The mode provides the primary running states of a chiller and the state provides an indicator of other conditions present. (I18)

Data Type	Index	Measurement	Units	Valid Range
Holding Register	40147	Chiller State	NA	1. Off 2. Start 3. Run 4. Pre Shutdown 5. Service

Compressor Current

This output network variable indicates the compressor current of the compressor selected with Compressor Select on page 15. (A26)

Data Type	Index	Measurement	Units	Valid Range
Holding Register	40027	Electric Current	Amperes	0 -65,535