Protocol Operation

Modbus® Communications Protocol

Models:

Digital 550 Controller
Digital Controller
Microprocessor-Plus Controller (with Communications)
DXPower™ 1500 Transfer Switch Controller
DXPower™ 1000 Transfer Switch Controller
MATS/MATS+ Controller
Power Monitor

MP-6113 10/06c

Table of Contents

Table of Contents, continued

IMPORTANT SAFETY INSTRUCTIONS. Electromechanical equipment, including generator sets, transfer switches, switchgear, and accessories, can cause bodily harm and pose life-threatening danger when improperly installed, operated, or maintained. To prevent accidents be aware of potential dangers and act safely. Read and follow all safety precautions and instructions. SAVE THESE INSTRUCTIONS.

This manual has several types of safety precautions and instructions: Danger, Warning, Caution, and Notice.

⚠ DANGER

Danger indicates the presence of a hazard that ***will cause severe personal injury, death***, or ***substantial property damage***.

⚠ WARNING

Warning indicates the presence of a hazard that ***can cause severe personal injury, death,*** or ***substantial property damage***.

⚠ CAUTION

Caution indicates the presence of a hazard that ***will*** or ***can cause minor personal injury*** or ***property damage***.

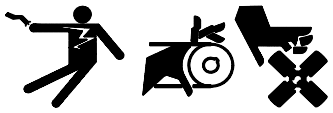
NOTICE

Notice communicates installation, operation, or maintenance information that is safety related but not hazard related.

Safety decals affixed to the equipment in prominent places alert the operator or service technician to potential hazards and explain how to act safely. The decals are shown throughout this publication to improve operator recognition. Replace missing or damaged decals.

Accidental Starting

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

Hazardous Voltage/ Electrical Shock

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Only authorized personnel should open the enclosure.

Grounding electrical equipment. Hazardous voltage can cause severe injury or death. Electrocution is possible whenever electricity is present. Open the main circuit breakers of all power sources before servicing the equipment. Configure the installation to electrically ground the generator set, transfer switch, and related equipment and electrical circuits to comply with applicable codes and standards. Never contact electrical leads or appliances when standing in water or on wet ground because these conditions increase the risk of electrocution.

Servicing the transfer switch. Hazardous voltage can cause severe injury or death. Deenergize all power sources before servicing. Open the main circuit breakers of all transfer switch power sources and disable all generator sets as follows: (1) Move all generator set master controller switches to the OFF position. (2) Disconnect power to all battery chargers. (3) Disconnect all battery cables, negative (-) leads first. Reconnect negative (-) leads last when reconnecting the battery cables after servicing. Follow these precautions to prevent the starting of generator sets by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer. Before servicing any components inside the enclosure: (1) Remove all jewelry. (2) Stand on a dry, approved electrically insulated mat. (3) Test circuits with a voltmeter to verify that they are deenergized.

Making line or auxiliary connections. Hazardous voltage can cause severe injury or death. To prevent electrical shock deenergize the normal power source before making any line or auxiliary connections.

Short circuits. Hazardous voltage/current can cause severe injury or death. Short circuits can cause bodily injury and/or equipment damage**.** Do not contact electrical connections with tools or jewelry while making adjustments or repairs. Remove all jewelry before servicing the equipment.

Notice

NOTICE

Electrostatic discharge damage. Electrostatic discharge (ESD) damages electronic circuit boards. Prevent electrostatic discharge damage by wearing an approved grounding wrist strap when handling electronic circuit boards or integrated circuits. An approved grounding wrist strap provides a high resistance (about 1 megohm), *not a direct short*, to ground.

This manual provides instructions for using the Modbus® RTU communication protocol with the following DDC/MTU Power Generation ® controllers:

- Digital 550 generator set controller
- 16-Light Microprocessor generator set controller with communications
- Digital generator set controller *
- DXPower™ 1500 ATS controller
- DXPower™ 1000 ATS controller
- MATS/MATS+ ATS controller *
- Power Monitor *

Information in this publication represents data available at the time of print. The manufacturer of DDC/MTU Power Generation products reserves the right to change this literature and the products represented without notice and without any obligation or liability whatsoever.

Read this manual and carefully follow all procedures and safety precautions to ensure proper equipment operation and to avoid bodily injury. Read and follow the Safety Precautions and Instructions section at the beginning of this manual. Keep this manual with the equipment for future reference.

Modbus Protocol

The Modbus® protocol, initially developed by the Modicon Corporation, is a de facto industry communication standard used by a controller to communicate with other devices. A complete discussion of the protocol is beyond the scope of these instructions. See the applicable Modbus® master application program documentation or other reliable technical information sources for Modbus® protocol details.

This manual contains:

- Modbus® connection information
- Controller setup instructions
- Modbus® register documentation

The system designer assumes responsibility for ensuring that the equipment is used only as intended by the manufacturer. Always conduct a full test and debug of the programming software prior to installing and using it in the system. The manufacturer disclaims any and all responsibility for use of third-party application software that will be used to control the equipment.

List of Related Materials

The protocol covered in this manual is part of a total control system. The controller operation manual provides information about setting up the controller to enable remote communications and programming. It also provides information about equipment operating limits, specifications, and functions. See Figure 1 for document part numbers.

Consult the specification sheets, accessory installation instructions, service bulletins, application notes, drawings, and other applicable literature for additional information on equipment operating limits and specifications. Contact your local distributor/dealer or the equipment manufacturer to obtain applicable literature.

Operation Manual for Model:	**Part Number**
Digital 550 Generator Set Controller Operation Manual:	
Version 2.10 and higher	MP-6200
Versions prior to 2.10	MP-6083
Digital 550 Generator Set Controller Setup and Application	MP-6140
Digital Generator Set Controller	MP-5829
Microprocessor-Plus Generator Set Controller	MP-6161
Automatic Transfer Switches with DXPower™ 1500 Controls:	
Model SCS, SCP	MP-6446
Model SSS, SSP	MP-6447
Model SBS, SBP Bypass/Isolation	MP-6448
Model SGS, SGP Bypass/Isolation	MP-6449
Automatic Transfer Switches with DXPower™ 1000 Controls:	
Model SCT, SCP	MP-6126
Model SBT, SBP Bypass/Isolation	MP-6128
Model SDT, SDP	MP-6225
MATS+ Transfer Switch Controller	MP-5664
Digital Power Monitor	MP-5875
Installation Instructions, Connection and Converter Kits	TT-1405
Communication Module for the Microprocessor-Plus Generator Set Controller	TT-1377

Figure 1 List of Related Materials

* Device must be equipped with Modbus/KBUS converter kit GM41143-KP3 for Modbus communication.

Modbus® is a registered trademark of Schneider Electric.

Service Assistance

For professional advice on generator power requirements and conscientious service, please contact your nearest DDC/MTU Power Generation distributor.

- Consult the Yellow Pages under the heading Generators—Electric
- Visit the DDC/MTU Power Generation website at ddcmtupowergeneration.com
- Look at the labels and stickers on your DDC/MTU Power Generation product or review the appropriate literature or documents included with the product

1.1 Network Configurations

A controller can communicate directly to a Modbus® master or participate in a network of devices. It can also be used to interface a local master to a network of devices.

The Modbus® master polls slave devices for data. Controller devices are slaves. Examples of master devices are a personal computer running Monitor III software (or other Modbus driver) and the RSA 1000 remote serial annunciator.

In an RS-485 network there can be only one master device. See Figure 1-1 through Figure 1-4 for an overview of the possible configurations. The configuration chosen determines the required connections and the controller setup.

A Modbus/Ethernet converter can be used to connect a controller or multiple controllers connected in an RS-485 network to the ethernet. See Figure 1-5. One or more Modbus masters can then communicate with the devices over the Ethernet.

The DXPower™ 1500 transfer switch controller does not require a Modbus/Ehternet converter.

The 550 controller can use either RS-232 or RS-485 connections, and can function as an RS-232 to RS-485 converter. Other controllers covered in this manual use RS-485 connections. All devices in a network must use the same baud rate.

Note: Install communication conductors in raceways, cables, or conduit separate from AC power conductors.

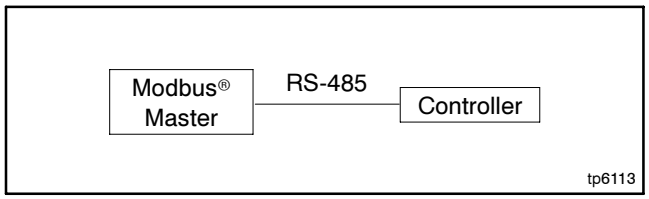


Figure 1-1 Single RS-485 Connection

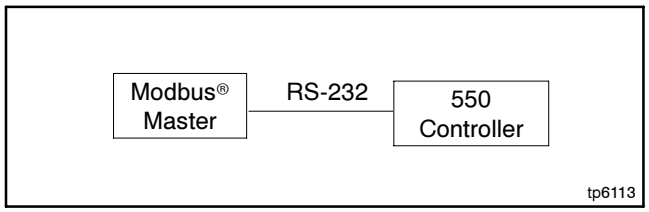


Figure 1-2 Single RS-232 Connection, 550 controller

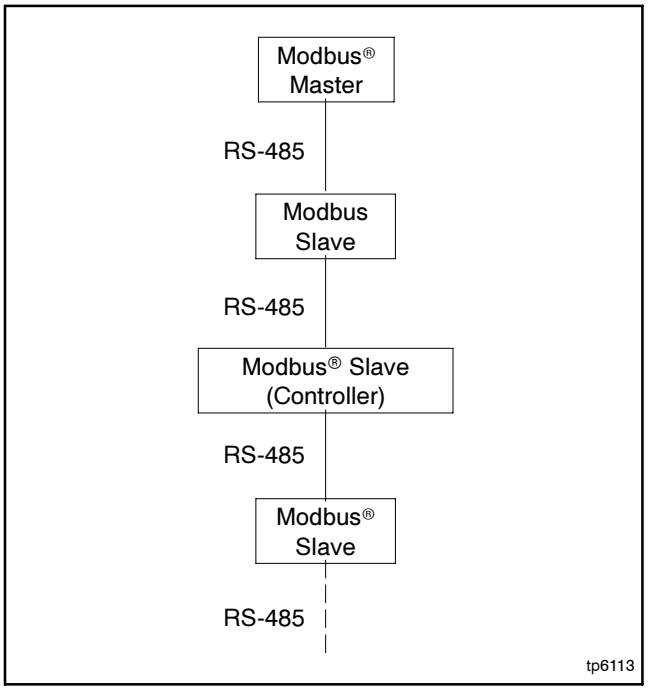


Figure 1-3 RS-485 Network

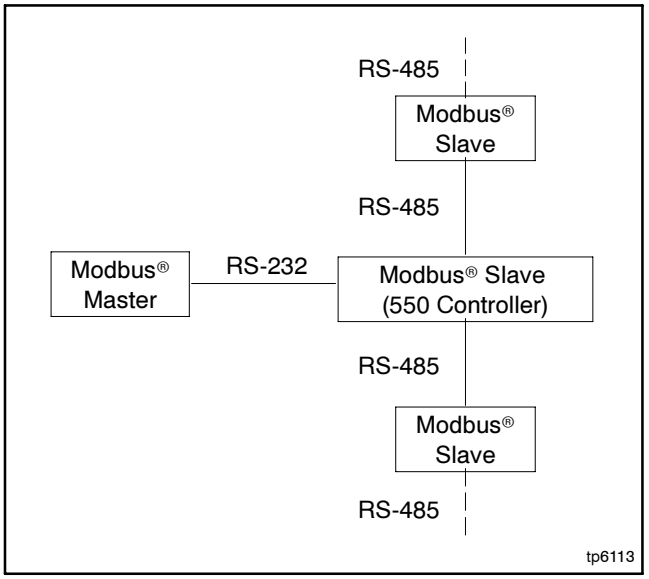


Figure 1-4 RS-485 Network with the 550 Controller used as a Converter

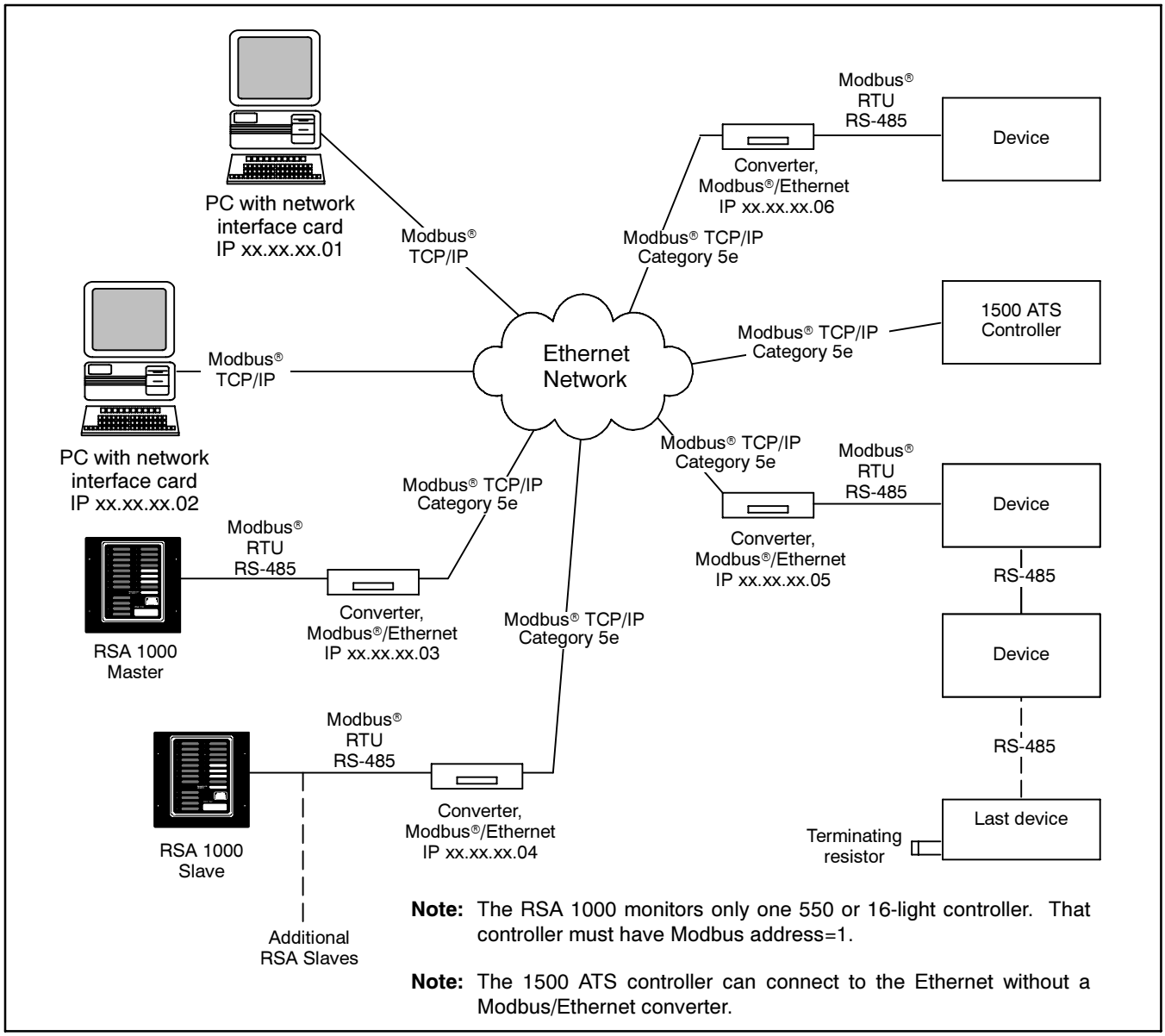


Figure 1-5 Ethernet Connections

1.2 Serial Settings

DDC/MTU Power Generation controllers use the settings shown in Figure 1-6.

All devices in a network must use the same baud rate. Refer to TT-1405 or the section in this Manual for your device to find the available baud rates.

Property	Setting
Data Bits	8
Parity	None
Stop Bits	1

Figure 1-6 Serial Settings

1.3 Modbus Protocol Definitions

The DDC/MTU Power Generation ® devices covered by this manual use the Modbus codes listed in this document to communicate with DDC/MTU Power Generation Monitor III software. For other Modbus applications, the Modbus master must be programmed to read the Modbus registers shown in this manual. A system designer trained in the application of Modbus® protocol must write and thoroughly test the program before implementation.

The tables in Sections 2 through 8 document the generator set controller information available using the Modbus® protocol.

In the tables all word (16-bit) expressions are integers unless otherwise noted and are shown in decimal notation unless otherwise noted. Hexadecimal expressions begin with 0x. Characters are in the standard 8-bit ASCII character set. Unspecified bytes are undefined, such as the high (most significant) byte of holding registers that contain byte data in the low (least significant) byte.

This section defines terms and symbols found used in the Modbus rester tables.

Register. Modbus® registers are 16-bit registers and are numbered consecutively. Request no more than 50 registers at one time. Registers are grouped into blocks of related data. Do not read registers past the end of the block where noted in the tables.

Access. The Access column shows the type of access allowed to the register. RO is read only, WO is write only, and RW is read and write.

Data Description. The Data Description column describes the information located at the address.

Data Type. The Data Type column indicates whether the parameter is a WORD, SWORD, or LONG. See Figure 1-7. If multiple registers are used, the Data Type column shows the number of WORDS used (e.g.WORD*10), and the Range/Units/Notes column provides a breakdown of the information available within the parameter.

Data Type	Description
WORD	16-bit unsigned (neither positive nor negative) value
SWORD	16-bit signed (two's complement) value
LONG	32-bit unsigned value. The least significant word (LSW) is first (at the lowest address).

Figure 1-7 Data Types

WORD [0:15]. Represents a 16-bit word that may be divided to contain several items. Bits 0 through 15 are arranged right-to-left, with bit 0 on the right. See Figure 1-8.

Example: From Section 5.4, DXPower ® 1000 register number 41320 contains the System Start Date. Bits 0 through 4 contain the date of the month, 0–31, represented in binary format. Bits 5 through 8 contain the month, 1–12. Bits 9–15 give the year, starting with the year 2000 (number 0) and extending through 2127 (number 127). For example, the 10th of February, 2025, would be represented as shown in Figure 1-8.

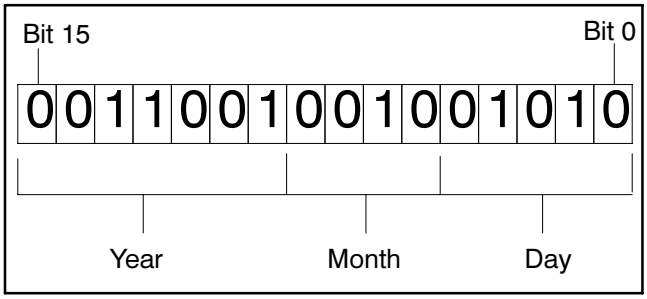


Figure 1-8 16-Bit Word Containing the Date 10 February, 2025 (See the example)

Metric or English Units. The controller display setting determines whether the units are returned or interpreted as metric or English. Read or alter this setting in register 40139. (550 controller only.)

Pipe (|). A pipe symbol (|) indicates the breakdown of data within a word, with the most significant byte first. For example, Min.|Sec means that the most significant byte contains minutes and the least significant byte contains seconds. In the 550 controller Defined Common Fault registers, Selected|Setpoint shows that the first byte indicates whether a given fault has been assigned to the defined common fault, and the last byte indicates the setpoint value for that item.

Pipe Example: Refer to address 40113 for the 550 controller. The table shows that the current date starts at register 40113 and that the date requires two words, or two registers. Register 40113 contains day|month, and register 40114 contains year (two-digits)|day of the week.

Using the Read Holding Registers function to read two registers gives the following **hexadecimal** data:

Register 40113: 190C
Register 40114: 0102

The most significant byte of register 40113 is 19 hexadecimal, which equals 25. This is the day. The least significant byte of register 40113 is 0C hexadecimal, which equals 12. This is the month, December.

The most significant byte of register 40114 is 01 hexadecimal, which equals 1. This gives the year, 2001. The least significant byte of register 40114 is 02 hexadecimal, which equals 2. This gives the day of the week, Tuesday(0= Sunday.)

The date is December 25, 2001, a Tuesday.

Setpoints. Setpoints are non-zero values only for analog inputs. The setpoint values for the analog inputs are:

1=Low Warning
2=High Warning
3=Low Shutdown
4=High Shutdown

All other setpoint values are zero (0=none).

Strings. Strings are character data represented in standard ASCII code. Strings are written as they appear on the controller display, with spaces used to pad to the right. The first character in a string is located in the most significant byte in the first register. The last character is located in the least significant byte of the last word.

Range/Units. This column lists additional information about the register type when applicable. For example, if multiple WORDs are used, this column describes the information stored in each WORD. It also lists the units for measurements which have them, the range for valid input or output when applicable, and the the scale factor for some parameters. Bit 0 is the least significant bit and bit 15 is the most significant.

Ranges and Bits. Some registers list a range of items with a bit set for each item. Interpret the first number in the range as corresponding to Bit 0 and the last number in the range as corresponding to Bit 15. See Section 2.5.6, System Event Codes, for an example.

ECM only. This notation indicates that the item is available only for generator sets equipped with engine control modules (ECMs).

Device ID. Register 49999 contains the device ID for the devices shown in Figure 1-9. The device ID for 340-series devices is set with DIP switches on the Modbus/KBUS converter. See the TT-1405, Installation Instructions, provided with the converter.

Controller	Device ID in Register 49999
Microprocessor-Plus	18
DXPower® 1000	19
Digital 550	20
DXPower® 1500	23

Figure 1-9 Device ID

1.4 Modbus Functions and Exception Codes

The controllers support the Modbus® functions listed in Figure 1-10.

The controller sends exception codes to the Modbus® master to indicate errors. Figure 1-11 lists the exception codes and possible causes.

Modbus® Function	Function Name	Description
03	Read Holding Registers	Reads a single register or a range of registers.
06	Preset Single Register	Sets the value of a single register. Use this function to set all data occupying a single register.
16	Preset Multiple Registers	Sets the value of a sequence of registers. Use this function to set all data occupying multiple registers. The maximum number of registers is 16.

Figure 1-10 Supported Modbus® Functions

Exception Code	Message	Possible Causes
01	Illegal Function	Violates the register access type. Attempts to write registers when the controller programming mode is not set to remote. Attempts to write too many registers using Preset Multiple Registers. The maximum number of registers is 16. Function is not supported.
02	Illegal Data Address	Attempts to read too many registers. The maximum is 50. Attempts to access a nonexistent register.
03	Illegal Data Value	Attempts to set a register to a value outside of the allowable limits. Attempts to set system parameters while the generator set is not in OFF or AUTO. Specifies an incorrect number of registers while attempting to read or write data occupying a sequence of registers. Attempts to modify digital input while the input is high. Attempts to modify analog input while the input is out of range. Attempts to modify preset input that cannot be changed. Attempts to read outside a restricted block. Attempts to define an invalid common fault. Attempts to activate an RDO that is not software-controlled. Attempts to start the engine while the timed run is active.

Figure 1-11 Supported Modbus® Exception Codes

Notes

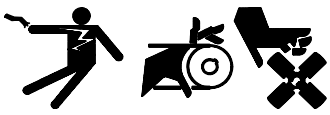
2.1 Specifications

The Digital 550 controller's Modbus® communication capability:

- Supports industry-standard Modbus® RTU protocol.
- Can use Modbus® TCP protocol with the addition of a Modbus/Ethernet converter.
- Connects to a Modbus® master singly over an RS-232 line.
- Uses RS-485 connections to connect to a Modbus® master singly or over an RS-485 network.
- Connects to an Ethernet network using a Modbus/Ethernet converter.
- Can operate as an RS-232 to RS-485 converter.
- Uses standard baud rates of 9600 or 19200.

2.2 Hardware Connections

⚠ WARNING



Accidental starting.
Can cause severe injury or death.

Disconnect the battery cables before working on the generator set. Remove the negative (-) lead first when disconnecting the battery. Reconnect the negative (-) lead last when reconnecting the battery.

Disabling the generator set. Accidental starting can cause severe injury or death. Before working on the generator set or connected equipment, disable the generator set as follows: (1) Move the generator set master switch to the OFF position. (2) Disconnect the power to the battery charger. (3) Remove the battery cables, negative (-) lead first. Reconnect the negative (-) lead last when reconnecting the battery. Follow these precautions to prevent starting of the generator set by an automatic transfer switch, remote start/stop switch, or engine start command from a remote computer.

Plan the connections and refer to Figure 1-2 through Figure 1-4 to identify the cables needed. Use either an RS-232 cable or the supplied RS-485 connector with Belden #9841 or equivalent cable for a single connection. Use the RS-485 connector and Belden #9841 or equivalent cable to connect devices in a network. Attach the RS-485 connectors as shown in Figure 2-1. Use the termination resistor on the last device in the network.

Circuit isolation is recommended for installations that may be exposed to electrical noise. See Appendix B, Noise and Wiring Practices.

Use the following procedure to connect the hardware. Observe the safety precautions.

Controller Connection Procedure

1. Place the generator set master switch in the OFF position.
2. Disconnect the power to the battery charger, if equipped.
3. Disconnect the generator set engine starting battery(ies), negative (-) lead first.
4. Turn off and disconnect the power to all devices in the system.
5. Open the enclosure and locate the connection ports as shown in Figure 2-2 and Figure 2-3.
6. Make connections to the desired controller port(s). For RS-232 connections, use connector P18. For RS-485 connections, use the Modbus® RS-485 connector, P20. (Connectors P19 and P21 are used for other applications.)
7. Close the controller enclosure.
8. Check that the generator set master switch is in the OFF position.
9. Reconnect the generator set engine starting battery, negative (-) lead last.
10. Reconnect power to the battery charger, if equipped.

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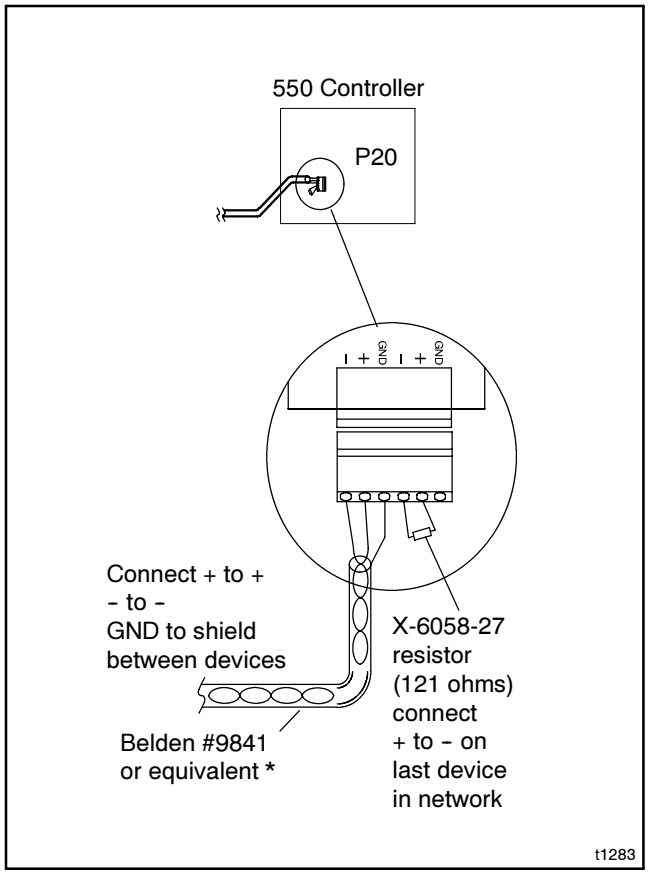
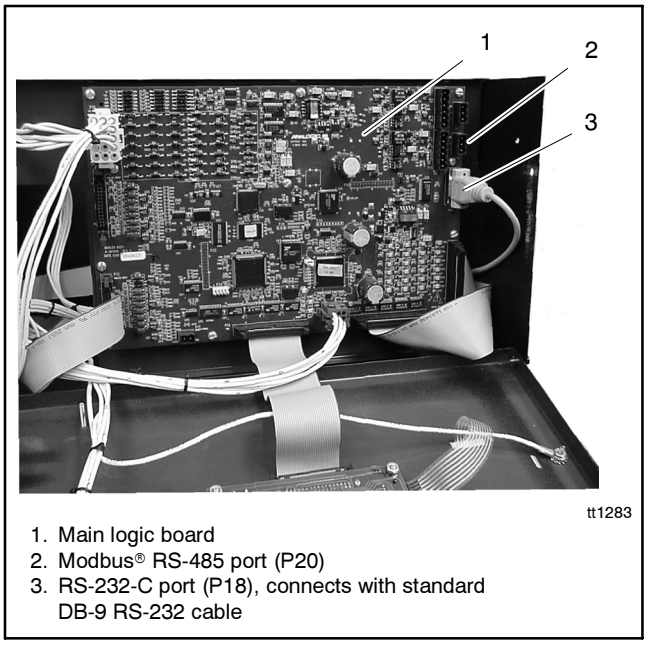


Figure 2-1 RS-485 Connector Details



1. Main logic board
2. Modbus® RS-485 port (P20)
3. RS-232-C port (P18), connects with standard DB-9 RS-232 cable

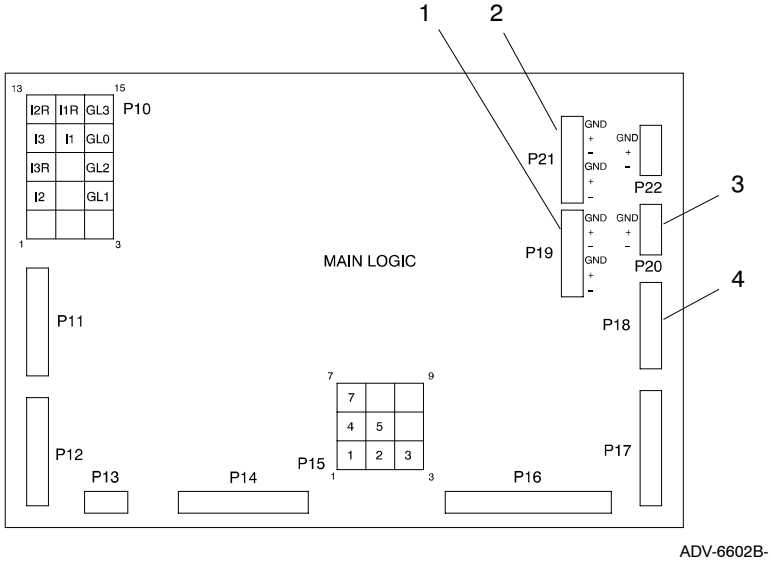
Figure 2-2 Communication Port Locations for the Digital 550 Generator Set Controller

MAIN LOGIC BOARD

P18 RS232 CONNECTIONS
P18–1 CD
P18–2 RX
P18–3 TX
P18–4 DTR
P18–5 GROUND
P18–6 DSR
P18–7 RTS
P18–8 CTS
P18–9 RI

P20 RS485 NON–ISOLATED CONNECTIONS
P20–1 GND
P20–2 +
P20–3 –

P21 RS485A ISOLATED CONNECTIONS
P21–1 GND
P21–2 +
P21–3 –
P21–4 GND
P21–5 +
P21–6 –



1. P19 spare connector for factory use
2. P21 RS-485 KBUS isolated connections
3. P20 RS-485 Modbus® non-isolated connections
4. P18 RS-232 non-isolated connections

Figure 2-3 Communication Connections Pin Identification

Modbus® is a registered trademark of Schneider Electric.

2.3 Controller Setup

After connecting the hardware, set up the controller. Enter the communication settings shown in the procedure below. Refer to the controller operation manual for detailed instructions on how to enter settings through the controller keypad.

Note: Changing the programming mode requires entering the generator set controller access code. Refer to the controller operation manual for more information.

Controller Setup Procedure

1. Go to Menu 14—Programming Mode using the controller keypad. Enter the local programming mode to allow changes to the controller communication settings.
2. Enter the controller access code when prompted by the controller.
3. Go to Menu 13—Communications.
4. Use the MENU arrow buttons to move to the Protocol Modbus® heading.
5. Enter Yes at the Modbus® Online Y/N display.
6. Choose the connection type. Choose Converter and proceed to step 8 if the controller is converting RS-232 to RS-485. Otherwise, choose Single and proceed to step 7.

   Note: The controller automatically selects RS-232 for the primary port if Converter is chosen for the connection type.

7. Choose RS-232 or RS-485 for the primary port, which is the port connected to the Modbus® master.
8. Enter the network address of the controller. Enter 1 (one) for a single connection.

   Note: Use a unique network address for each unit. Use numbers between 1 and 246. Do not use 0 (zero).

9. Select the baud rate. Choose the same baud rate for the Modbus® master, modems, and connected devices .
10. Go to Menu 14—Programming Mode again. Choose either remote programming mode, local programming mode, or programming mode off as described below:

    a. To allow the Modbus® master to read and write to the controller, choose Remote; *or*

    b. To allow only monitoring through the Modbus® connections but local programming through the controller keypad, choose Local; *or*

    c. To turn the programming mode off, allowing no controller programming from either the Modbus® master or the local keypad, choose Off.

11. Enter the controller access code when prompted by the controller.

2.4 Controller Application Code Versions

There are two versions of the Modbus® registers for different versions of the controller's application code. Figure 2-4 shows where to find the Modbus register map for your unit based on the application code version number.

550 Controller Application Code Version	Location of Modbus Register Map
Below 2.10	Appendix C
2.10 or higher	Section 2.5

Figure 2-4 Register Map Locations for Different Application Code Versions

Use the following procedure to access Menu 20 to check the version number of the application code loaded on your controller.

Procedure to Identify the Controller Application Code Version

1. Use the controller keypad to access Menu 20. At the controller display "Enter Menu No: 1–15", press 20 and the Enter key.
2. Use the down arrow key on the controller keypad to step through the factory setup items until "Code Version" is displayed.
3. Record the code version number shown for future reference.
4. Press the Reset Menu key on the controller keypad to exit the menu.

Modbus® is a registered trademark of Schneider Electric.

2.5 Modbus Maps for Controllers with Application Code Versions 2.10 or Higher

This section contains Modbus® registers for Digital 550 controller with application code versions 2.10 or higher (for example, code version 2.20). See Section 2.4 for instructions to determine the application code version number for your controller.

Refer to Section 1.3 for definitions of terms and symbols used in the register tables.

Time delays, setpoints, inputs and outputs, and other user-defined parameters are entered through the controller keypad or Monitor III software. Refer to the Operation Manuals for the 550 controller and Monitor III software for instructions. See the List of Related Materials for document part numbers.

The system event stack registers 41500–41515 contain the status (active or inactive) of fault warnings and shutdowns, inputs, outputs, and MDEC/ADEC alarms. See Section 2.5.6.

The event history registers 40871–41270 contain the time and date information for the last 100 events. See Section 2.5.6 for event message codes.

2.5.1 Guide to the Register Map

Description	Registers
Monitoring	40001-40083
Electrical Output	40001-40032
Engine Status	40033-40060
Analog Input Status	40061-40076
Digital Input Status	40077-40078
Controller Status	40079-40083
Maintenance	40084-40112
Time/Date	40113-40115
Time Delay Settings	40116-40124
Settings and Setpoints	40125-40146
Factory Setup	40147-40226
Digital Input Setup	40227-40499
Analog Input Setup	40500-40739
Remapped Registers *	40740-40837
Relay Driver Output Status (see Section 2.5.4)	40838-40839
Relay Driver Output Setup	40840-40870
Event History	40871-41270
Customer-Defined Character Strings	41271-41295
Reserved and Write-Only Registers	41296-41305
Remote Functions	41306-41413
Reserved for Factory Use	41314-41499
System Event Stack (status of fault warnings and shutdowns, inputs, outputs, and MDEC alarms; see Section 2.5.6.)	41500-41515
Reserved for Wireless Monitor	41516-41536
Reserved	41537-41549
Defined Common Faults (Define/Inspect)	41550-41805
Reserved	41806-49998
Device ID	49999

* Registers 40740-40837 have been mapped to 41550-41647 (Defined Common Faults) for compatability with earlier versions. See Section 2.5.3.

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2.5.2 Modbus Registers

Register	Data Description	Access	Data Type	Range/Units/Notes
40001	L1 - L2 Voltage	RO	WORD	Volts AC
40002	L2 - L3 Voltage	RO	WORD	Volts AC
40003	L3 - L1 Voltage	RO	WORD	Volts AC
40004	L1 - L0 Voltage	RO	WORD	Volts AC
40005	L2 - L0 Voltage	RO	WORD	Volts AC
40006	L3 - L0 Voltage	RO	WORD	Volts AC
40007	L1 Current	RO	WORD	Amps AC
40008	L2 Current	RO	WORD	Amps AC
40009	L3 Current	RO	WORD	Amps AC
40010	Frequency	RO	WORD	Hz X 100
40011	Total kW	RO	WORD	kW
40012	Percent of Rated kW	RO	WORD	% Rated kW
40013	Total Power Factor	RO	SWORD	PF X 100 (SIGNED)
40014	L1 kW	RO	WORD	kW
40015	L1 Power Factor	RO	SWORD	PF X 100 (SIGNED)
40016	L2 kW	RO	WORD	kW
40017	L2 Power Factor	RO	SWORD	PF X 100 (SIGNED)
40018	L3 kW	RO	WORD	kW
40019	L3 Power Factor	RO	SWORD	PF X 100 (SIGNED)
40020	Total kVAR	RO	SWORD	kVAR (SIGNED)
40021	L1 kVAR	RO	SWORD	kVAR (SIGNED)
40022	L2 kVAR	RO	SWORD	kVAR (SIGNED)
40023	L3 kVAR	RO	SWORD	kVAR (SIGNED)
40024	Total kVA	RO	WORD	kVA
40025	L1 kVA	RO	WORD	kVA
40026	L2 kVA	RO	WORD	kVA
40027	L3 kVA	RO	WORD	kVA
40028	Current Lead/Lag	RO	WORD	Bits 0-1 Total Current - Leading = 10 Lagging = 01 Bits 2-3 L1 Current - Leading = 10 Lagging = 01 Bits 4-5 L2 Current - Leading = 10 Lagging = 01 Bits 6-7 L3 Current - Leading = 10 Lagging = 01
40029	Reserved For Future Use	RO	WORD	
40030	Reserved For Future Use	RO	WORD	
40031	Reserved For Future Use	RO	WORD	
40032	Reserved For Future Use	RO	WORD	
40033	Oil Pressure*	RO	WORD	kPa/psi
40034	Coolant Temperature*	RO	SWORD	Degrees C./Degrees F.
40035	Engine Speed*	RO	WORD	RPM
40036	Local Battery Voltage*	RO	WORD	Volts DC X 10
40037	Fuel Pressure*	RO	WORD	kPa/psi DDEC/MDEC/ADEC only
40038	Fuel Temperature*	RO	SWORD	Degrees C./Degrees F. DDEC/MDEC/ADEC only
40039	Fuel Rate*	RO	WORD	Liters/Hour X 100 or Gallons/Hour X 100 DDEC only
40040	Used Last Run*	RO	WORD	Liters/Gallons DDEC only
40041	Coolant Pressure*	RO	WORD	kPa/psi DDEC only
40042	Coolant Level*	RO	WORD	% X 10 DDEC only
40043	Lube Oil Temperature*	RO	SWORD	Degrees C./Degrees F. DDEC/MDEC/ADEC/Waukesha only
40044	Oil Level*	RO	WORD	% X 10 DDEC only
40045	Crankcase Pressure*	RO	WORD	kPa/psi DDEC only
40046	Ambient Temperature *	RO	SWORD	Degrees C./Degrees F. DDEC only
40047	ECM Battery Voltage*	RO	WORD	Volts DC X 10 DDEC/MDEC/ADEC only
40048	ECM Status	RO	WORD	0 = DDEC-Equipped, 1 = Non-ECM, 2 = MDEC/ADEC-Equipped
40049	Intake Air Temperature	RO	SWORD	Degrees C./Degrees F. MDEC/ADEC/Waukesha only

*0x7FD6 = data unavailable. 0x7FFF = data is out of range.

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Register	Data Description	Access	Data Type	Range/Units/Notes
40050	Intake Air Pressure	RO	WORD	Degrees C./Degrees F. MDEC/ADEC only
40051	MDEC/ADEC Fault Codes	RO	WORD	Numeric Fault Code MDEC/ADEC only
40052	Reserved For Future Use	RO	WORD	
40053	Reserved For Future Use	RO	WORD	
40054	Reserved For Future Use	RO	WORD	Mapped to register 41500 for compatibility with earlier controller application code versions. **Note:** Code versions 2.10 and higher use more registers for the Event Stack than previous versions.
40055	Reserved For Future Use	RO	WORD	
40056	Reserved For Future Use	RO	WORD	
40057	Reserved For Future Use	RO	WORD	
40058	Reserved For Future Use	RO	WORD	
40059	Reserved For Future Use	RO	WORD	
40060	Reserved For Future Use	RO	WORD	
40061	Analog Input 00 (Battery Voltage)*	RO	WORD	Volts DC
40062	Analog Input 01*	RO	WORD	User defined and calibrated through the 550 controller. See the controller Operation Manual.
40063	Analog Input 02*	RO	WORD	
40064	Analog Input 03*	RO	WORD	
40065	Analog Input 04*	RO	WORD	
40066	Analog Input 05*	RO	WORD	
40067	Analog Input 06*	RO	WORD	
40068	Analog Input 07*	RO	WORD	
40069	Reserved For Additional Input	RO	WORD	
40070	Reserved For Additional Input	RO	WORD	
40071	Reserved For Additional Input	RO	WORD	
40072	Reserved For Additional Input	RO	WORD	
40073	Reserved For Additional Input	RO	WORD	
40074	Reserved For Additional Input	RO	WORD	
40075	Reserved For Additional Input	RO	WORD	
40076	Reserved For Additional Input	RO	WORD	
40077-40078	Digital Input Status/Option Flags	RO	2 WORDS	Word #1 Digital Inputs 0-15: Bit 0 Remote start contacts Bit 1 Emergency stop Bit 2 Low coolant level Bit 3 Digital Input #3 Bit 4 Digital Input #4 Bit 5 Digital Input #5 Bit 6 Digital Input #6 Bit 7 Digital Input #7 Bit 8 Digital Input #8 Bit 9 Digital Input #9 Bit 10 Digital Input #10 Bit 11 Digital Input #11 Bit 12 Digital Input #12 Bit 13 Digital Input #13 Bit 14 Digital Input #14 Bit 15 Digital Input #15 Word #2: Bit 0 Digital Input #16 Bit 1 Digital Input #17 Bit 2 Digital Input #18 Bit 3 Digital Input #19 Bit 4 Digital Input #20 Bit 5 Digital Input #21 Bit 6 Digital Input #22 Bit 7 Digital Input #23 Bit 8 DDEC Flag Bit 9 MDEC/ADEC Flag Bit 10 Tier1 Flag Bit 11 Waukesha Flag Bits 12-15 Unused Input Is high/option enabled if bit is set Digital inputs are user-defined through the controller or Monitor III software. See the related Operation Manual.

*0x7FD6 = data unavailable. 0x7FFF = data is out of range.

Register	Data Description	Access	Data Type	Range/Units/Notes
40079	Master Switch Position	RO	WORD	0 = Error, 1 = Auto, 2 = Off, 3 = Run
40080	Programming Mode Status	RO	WORD	1 = Off, 2 = Local, 3 = Remote
40081	Reserved For Future Use	RO	WORD	
40082	Reserved For Future Use	RO	WORD	
40083	Reserved For Future Use	RO	WORD	
40084	Total Number of Starts	RO	WORD	Starts
40085	Total Run Time Hrs	RO	LONG	HRS X 100 (LSW FIRST)
40087	Total Run Time Loaded Hrs	RO	LONG	HRS X 100 (LSW FIRST)
40089	Total Run Time Unloaded Hrs	RO	LONG	HRS X 100 (LSW FIRST)
40091	Total Run Time kW Hrs	RO	LONG	kW Hrs (LSW First)
40093	RTSM Total Hrs	RO	LONG	HRS X 100 (LSW FIRST)
40095	RTSM Loaded Hrs	RO	LONG	HRS X 100 (LSW FIRST)
40097	RTSM Unloaded Hrs	RO	LONG	HRS X 100 (LSW FIRST)
40099	RTSM kW Hrs	RO	LONG	kW Hrs (LSW FIRST)
40101	Last Maintenance Date	RO	2 WORDS	Day | Month - Year
40103	Operating Days Since Maint.	RO	WORD	Days
40104	Number of Starts Since Maint.	RO	WORD	Starts
40105	Last Start Date	RO	2 WORDS	Day | Month - Year
40107	Last Start Time	RO	WORD	Hr|Min
40108	Last Run Length	RO	WORD	Hrs X 100
40109	Last Run Loaded	RO	WORD	0 = Unloaded, 1 = Loaded
40110	Timed Run Time (Hr:Min)	RW	WORD	Hr|Min
40111	Timed Run Remaining (Hr:Min)	RO	WORD	Hr|Min
40112	Is Timed Run Active	RO	WORD	1 = True, 0 = False
40113	Current Date	RW	2 WORDS	Day | Month - 2 Digit Year | Day of Week (0=Sunday)
40115	Current Time (24 Hr Clock)	RW	WORD (HR|Min)	Hr|Min
40116	Time Delay Engine Start	RW	WORD	Min | Sec
40117	Time Delay Starting Aid	RW	WORD	Min | Sec
40118	Time Delay Crank On	RW	WORD	Min | Sec
40119	Time Delay Crank Pause	RW	WORD	Min | Sec
40120	Time Delay Engine Cooldown	RW	WORD	Min | Sec
40121	Time Delay Crank Cycles	RW	WORD	Cycles
40122	Time Delay Overvoltage	RW	WORD	Min | Sec
40123	Time Delay Undervoltage	RW	WORD	Min | Sec
40124	Time Delay Load Shed kW	RW	WORD	Min | Sec
40125	Operating Mode	RW	WORD	Bits 0-1: Operating Mode 1=Standby, 2=Prime Power Bit 2: Unused Bit 3: MDEC/ADEC DSC Mode 1 = Enabled, 0 = Disabled Bit 4: MDEC/ADEC VSG Mode 1 =Enabled, 0 = Disabled Bits 5-7: Temp Sensor Type
40126	System Voltage	RW	WORD	Volts AC
40127	System Frequency	RW	WORD	Hz
40128	System Phase	RW	WORD	1 = 3 Phase Delta, 2 = 3 Phase Wye, 3 = Single Phase
40129	kW Rating	RW	WORD	kW
40130	Load Shed Output	RW	WORD	% of kW RATING
40131	Overvoltage	RW	WORD	% of System Voltage
40132	Undervoltage	RW	WORD	% of System Voltage
40133	Overfrequency	RW	WORD	% of System Frequency
40134	Underfrequency	RW	WORD	% of System Frequency
40135	Overspeed	RW	WORD	Hz
40136	Battery Voltage	RW	WORD	Volts DC X 10
40137	Lo Battery Voltage	RW	WORD	Volts DC X 10
40138	Hi Battery Voltage	RW	WORD	Volts DC X 10
40139	Metric Units	RW	WORD	1 = True, 0 = False

*0x7FD6 = data unavailable. 0x7FFF = data is out of range.

Register	Data Description	Access	Data Type	Range/Units/Notes
40140	NFPA 110 Defaults Enabled	RW	WORD	1 = True, 0 = False
40141	Rated Current	RO	WORD	Amps AC
40142	Cooldown Temperature Override	RW	WORD	1 = True, 0 = False
40143	Reserved For Future Use	RO	WORD	
40144	Reserved For Future Use	RO	WORD	
40145	Reserved For Future Use	RO	WORD	
40146	Reserved For Future Use	RO	WORD	
40147	Final Assembly Date	RO	2 WORDS	Day | Month - Year
40149	Final Assembly Clock No.	RO	LONG	99999 Max (LSW FIRST)
40151	Total Operating Days	RO	WORD	Days
40152	Model No.	RO	13 WORDS	26 Character String
40165	Spec. No.	RO	8 WORDS	16 Character String
40173	Genset Serial No.	RO	10 WORDS	20 Character String
40183	Alternator Part No.	RO	10 WORDS	20 Character String
40193	Engine Part No.	RO	10 WORDS	20 Character String
40203	Control No.	RO	LONG	(LSW FIRST)
40205	Code Version	RO	3 WORDS	6 Character String
40208	Setup Lock	RO	WORD	1 = Locked, 0 = Unlocked
40209	Engine Model No.	RO	4 WORDS	8 Character String ECM only
40213	Engine Serial No.	RO	5 WORDS	10 Character String ECM only
40218	Unit No.	RO	5 WORDS	10 Character String ECM only
40223	ECM Serial No.	RO	4 WORDS	8 Character String ECM only
Digital Inputs 1-21 Setup (for status see 40077-40079):				
40227	Digital Input 01	RW	13 WORDS PER INPUT	word 1: Enabled | Function ID Word 2: Inhibit Time (Min|Sec) Word 3: Delay Time (Min|Sec) Word 4-13: 10 Words for 20 Character Description String Refer to Section 2.5.7, Digital Auxiliary Input Functions, for descriptions and codes. See the controller Operation Manual, MP-6200, for factory-reserved and user-selectable inputs for various applications.
40240	Digital Input 02			
40253	Digital Input 03			
40266	Digital Input 04			
40279	Digital Input 05			
40292	Digital Input 06			
40305	Digital Input 07			
40318	Digital Input 08			
40331	Digital Input 09			
40344	Digital Input 10			
40357	Digital Input 11			
40370	Digital Input 12			
40383	Digital Input 13			
40396	Digital Input 14			
40409	Digital Input 15			
40422	Digital Input 16			
40435	Digital Input 17			
40448	Digital Input 18			
40461	Digital Input 19			
40474	Digital Input 20			
40487	Digital Input 21			
Note: Cannot read past end of block				
*0x7FD6 = data unavailable. 0x7FFF = data is out of range.				

Register	Data Description	Access	Data Type	Range/Units/Notes
Analog Input Setup (for status see registers 40061-40068)				
40500	Analog Input 01	RW	16 WORDS PER INPUT	Refer to the controller Operation Manual, MP-6200, for identification of user inputs and factory-reserved inputs for specific applications. Word 1: Warning/Shutdown Enable [Bits 8,9] | Inhibit Time (Sec) Word 2: Warning Time (Sec) | Shutdown Time (Sec) Word 3: Lower Warning Limit Word 4: Upper Warning Limit Word 5: Lower Shutdown Limit Word 6: Upper Shutdown Limit Word 7-16: Analog voltage adjust for switchgear applications only; 10 words for 20 character description string
40516	Analog Input 02			
40532	Analog Input 03			
40548	Analog Input 04			
40564	Analog Input 05			
40580	Analog Input 06			
40596	Analog Input 07			
Note: Cannot read past end of block				
Analog Inputs 8-15 Setup				
40612	Reserved For Non-ECM	RO	16 WORDS PER INPUT	
40628				
40644				
40660				
40676				
40692				
40708				
40724				
Note: Cannot read past end of block				
Define/Inspect RDO Status (2 WORDS). See Section 2.5.4.				
40838	RDO Status: RDO1 - RDO16	RO*	WORD	Output Is High If Individual Bit Is Set. Bit 0 = RDO 1
40839	RDO Status: RDO17 - RDO31	RO*	WORD	Output Is High If Individual Bit Is Set. Bit 0 = RDO 17
Note: Cannot read past end of block				
* Software-controlled RDOs are RW.				
Define/Inspect RDOs (RW, 1 WORD per RDO). See Section 2.5.6				
40840	Relay Driver Output 01	RW	WORD	Selection | Setpoint Function uses the event codes in Section 2.5.6. Setpoints are for analog inputs only; otherwise setpoint=0.
40841	Relay Driver Output 02	RW	WORD	
40842	Relay Driver Output 03	RW	WORD	
40843	Relay Driver Output 04	RW	WORD	
40844	Relay Driver Output 05	RW	WORD	
40845	Relay Driver Output 06	RW	WORD	
40846	Relay Driver Output 07	RW	WORD	
40847	Relay Driver Output 08	RW	WORD	
40848	Relay Driver Output 09	RW	WORD	
40849	Relay Driver Output 10	RW	WORD	
40850	Relay Driver Output 11	RW	WORD	
40851	Relay Driver Output 12	RW	WORD	
40852	Relay Driver Output 13	RW	WORD	
40853	Relay Driver Output 14	RW	WORD	
40854	Relay Driver Output 15	RW	WORD	
40855	Relay Driver Output 16	RW	WORD	
40856	Relay Driver Output 17	RW	WORD	
40857	Relay Driver Output 18	RW	WORD	
40858	Relay Driver Output 19	RW	WORD	
40859	Relay Driver Output 20	RW	WORD	
40860	Relay Driver Output 21	RW	WORD	
40861	Relay Driver Output 22	RW	WORD	
40862	Relay Driver Output 23	RW	WORD	
40863	Relay Driver Output 24	RW	WORD	
*0x7FD6 = data unavailable. 0x7FFF = data is out of range.				

Register	Data Description	Access	Data Type	Range/Units/Notes
40864	Relay Driver Output 25	RW	WORD	Function | Setpoint Function uses the event codes in Section 2.5.6. Setpoints are for analog inputs only; otherwise setpoint=0.
40865	Relay Driver Output 26	RW	WORD	
40866	Relay Driver Output 27	RW	WORD	
40867	Relay Driver Output 28	RW	WORD	
40868	Relay Driver Output 29	RW	WORD	
40869	Relay Driver Output 30	RW	WORD	
40870	Relay Driver Output 31	RW	WORD	
Note: Cannot read past end of block				
Event History. See Section 2.5.6 for event codes.				
40871-40910	Event History - Page 1 (1-10)	RO	40 WORDS	10 events, 4 words each: Event Code|Setpoint Hr|Min Day|Month Year See Section 2.5.6 for event codes. Setpoints are for analog inputs only; otherwise setpoint=0. Note: Message code = 0xFFat end of history.
40911-40950	Event History - Page 2 (11-20)	RO	40 WORDS	
40951-40990	Event History - Page 3 (21-30)	RO	40 WORDS	
40991-41030	Event History - Page 4 (31-40)	RO	40 WORDS	
41031-41070	Event History - Page 5 (41-50)	RO	40 WORDS	
41071-41110	Event History - Page 6 (51-60)	RO	40 WORDS	
41111-41150	Event History - Page 7 (61-70)	RO	40 WORDS	
41151-41190	Event History - Page 8 (71-80)	RO	40 WORDS	
41191-41230	Event History - Page 9 (81-90)	RO	40 WORDS	
41231-41270	Event History - Page 10 (91-100)	RO	40 WORDS	
Note: Cannot read past end of block.				
Customer-Defined Character Strings (defined through Monitor software)				
41271	Designation	RW	5 WORDS	9 Character String
41276	Load	RW	10 WORDS	20 Character String
41286	Location	RW	10 WORDS	20 Character String
Note: Cannot read past end of block.				
41296	Reserved for future use	RO	WORD	
41297	Reserved for future use	RO	WORD	
41298	Reserved for future use	RO	WORD	
41299	Reserved for future use	RO	WORD	
41300	Reserved for future use	RO	WORD	
41301	Reserved for future use	RO	WORD	
41302	Reserved for future use	RO	WORD	
41303	Reserved for future use	RO	WORD	
41304	Reserved for future use	RO	WORD	
41305	Reserved for future use	RO	WORD	
Note: Cannot Read Past End of Block				
Remote Functions				
41306	Start Timed Run	WO	WORD	1 = Start, 0 = No Start
41307	Stop Timed Run	WO	WORD	1 = Stop, 0 = No Stop
41308	Reset Maintenance Records	WO	WORD	1 = Reset, 0 = No Reset
41309	Remote Fault Reset	WO	WORD	1 = Reset, 0 = No Reset
41310	Reserved for future use	RO	WORD	
41311	Reserved for future use	RO	WORD	
41312	Reserved for future use	RO	WORD	
41313	Reserved for future use	RO	WORD	
41314-41499	*Reserved for factory use*			
*0x7FD6 = data unavailable. 0x7FFF = data is out of range.				

Register	Data Description	Access	Data Type	Range/Units/Notes
System Event Stack (must be read as 16 register block)**. See Sections 2.5.5 and 2.5.6.**				
41500	System Events 0-15 Word #1	RO	16 WORDS	System event status. 0=not active 1=active Each bit corresponds to a different event code. See Sections 2.5.5 and 2.5.6.
41501	System Events 16-31 Word #2			
41502	System Events 32-47 Word #3			
41503	System Events 48-63 Word #4			
41504	System Events 64-79 Word #5			
41505	System Events 80-95 Word #6			
41506	System Events 96-111 Word #7			
41507	System Events 112-127 Word #8			
41508	System Events 128-143 Word #9			
41509	System Events 144-159 Word #10			
41510	System Events 160-175 Word #11			
41511	System Events 176-191 Word #12			
41512	System Events 192-207 Word #13			
41513	System Events 208-223 Word #14			
41514	System Events 224-239 Word #15			
41515	System Events 240-255 Word #16			
Note: Cannot Read Past End of Block.				
41516-41536	Reserved	RO	WORD	Reserved for the Wireless Monitor
41537-41549	Reserved	RO	WORD	Reserved for future use
Define/Inspect Defined Common Faults:				
41550	Emergency Stop	RW	WORD	Selected | Setpoint The selected byte indicates whether a given fault has been assigned to the defined common fault: 0=not assigned to the defined common fault; 1=assigned to the defined common fault. The setpoint byte indicates the setpoint value for that item.
41551	Overspeed			
41552	Overcrank			
41553	High Coolant Temperature Shutdown			
41554	Oil Pressure Shutdown			
41555	Low Coolant Temperature (ECM only)			
41556	Low Fuel			
41557	High Coolant Temperature Warning			
41558	Oil Pressure Warning			
41559	Master Not In Auto			
41560	NFPA 110 Fault			
41561	Low Battery Voltage			
41562	High Battery Voltage			
41563	Battery Charger Fault			
41564	System Ready			
41565	Loss of ECM Comm (ECM only)			
41566	No Oil Pressure Signal			
41567	High Oil Temperature Shutdown			
41568	No Coolant Temperature Signal			
41569	Low Coolant Level			
41570	Speed Sensor Fault			
41571	Locked Rotor			
41572	Master Switch Error			
41573	Master Switch Open			
41574	Master Switch Off			
41575	AC Sensing Loss			
41576	Over Voltage			
41577	Under Voltage			
41578	Weak Battery			
41579	Over Frequency			
41580	Under Frequency			
*0x7FD6 = data unavailable. 0x7FFF = data is out of range.				

Register	Data Description	Access	Data Type	Range/Units/Notes
Define/Inspect Defined Common Faults, continued:				
41581	Load Shed kW Overload	RW	WORD	Selected | Setpoint
41582	Load Shed kW Under Frequency			
41583	Over Current			
41584	EPS Supplying Load			
41585	Internal Fault			
41586	Engine Cooldown Delay			
41587	Engine Start Delay			
41588	Starting Aid			
41589	Generator Running			
41590	Air Damper Control			
41591	Ground Fault			
41592	EEPROM Write Failure			
41593	Critical Overvoltage			
41594	Alternator Protect Shutdown			
41595	Air Damper Indicator			
41596	Digital Input 01			**Note:** Analog and digital inputs are user-defined through the controller or Monitor III software. See the related Operation Manual.
41597	Digital Input 02			
41598	Digital Input 03			
41599	Digital Input 04			
41600	Digital Input 05			
41601	Digital Input 06			
41602	Digital Input 07			
41603	Digital Input 08			
41604	Digital Input 09			
41605	Digital Input 10			
41606	Digital Input 11			
41607	Digital Input 12			
41608	Digital Input 13			
41609	Digital Input 14			
41610	Digital Input 15			
41611	Digital Input 16			
41612	Digital Input 17			
41613	Digital Input 18			
41614	Digital Input 19			
41615	Digital Input 20			
41616	Digital Input 21			
41617	Analog Input 01			
41618	Analog Input 02			
41619	Analog Input 03			
41620	Analog Input 04			
41621	Analog Input 05			
41622	Analog Input 06			
41623	Analog Input 07			
41624	Reserved for additional input			
41625	Reserved for additional input			
41626	Reserved for additional input			
41627	Reserved for additional input			
41628	Reserved for additional input			
41629	Reserved for additional input			
41630	Reserved for additional input			
41631	Reserved for additional input			
41632	Defined Common Fault			
*0x7FD6 = data unavailable. 0x7FFF = data is out of range.				

Register	Data Description	Access	Data Type	Range/Units/Notes
Define/Inspect Defined Common Faults, continued:				
41633	Software Controlled RDO#1	RW	WORD	Selected | Setpoint
41634	Software Controlled RDO#2			
41635	Software Controlled RDO#3			
41636	Software Controlled RDO#4			
41637–41348	*Reserved for factory use*			
41649	Genset Parameter Warning			
41650	Genset S/N Mismatch Warning			
41651	Genset S/N Mismatch Shutdown			
41652	*Reserved for factory use*			
41653	Protective Relay Overvoltage			Switchgear applications only. Cannot be defined as common fault or assigned as RDO, but can referenced in event stack/log.
41654	Protective Relay Under Voltage			
41655	Protective Relay Overfrequency			
41656	Protective Relay Underfrequency			
41657	Protective Relay Reverse Power			
41658	Protective Relay Over Power			
41659	Protective Relay Loss of Field			
41660	Protective Relay Overcurrent Vr			
41661	Reverse Power Shutdown			Switchgear applications only.
41662	Over Power Shutdown			
41663	Loss of Field Shutdown			
41664	Over Current Shutdown			
41665	Common Protective Relay Output			Switchgear applications only. Cannot be defined as common fault, but can be assigned as RDO and referenced in event stack/log.
41666	In Synch			Switchgear applications only.
41667	Breaker Trip			
41668	Fuel Valve Relay			Waukesha only
41669	Pre Lube Relay			
41670	Air -Fuel Module Start			
41671	Oil Temperature Loss of Signal			
41672	High Oil Temperature Warning			
41673	Intake Air Temperature Loss of Signal			
41674	High Intake Air Temperature Warning			Waukesha/MDEC/ADEC only
41675	High Intake Air Temperature Shutdown			
41676	MDEC/ADEC Yellow Alarm			MDEC/ADEC only
41677	MDEC/ADEC Red Alarm			
41678	MDEC/ADEC Block Heater Control			
41679	Low Coolant Temperature Shutdown			
41680	MDEC/ADEC Load Shed Over Temperature			
41681–41740	Reserved For Future Use			
41741	Air -Fuel Module Start			Waukesha only
41742–41805	Reserved For Future Use			
Device ID				
49999	Device ID	RO	WORD	Dec 550 Device ID = 20
*0x7FD6 = data unavailable. 0x7FFF = data is out of range.				

2.5.3 Remapped Registers

Registers 40740–40837 have been mapped to 41550–41647 (Defined Common Faults) for compatibility with earlier code versions. Application code versions numbered 2.0 or higher use more registers for Defined Common Faults than versions numbered below 2.0.

Register	Mapped to:	Description
40740	41550	Emergency Stop
40741	41551	Overspeed
40742	41552	Overcrank
40743	41553	High Coolant Temperature Shutdown
40744	41554	Oil Pressure Shutdown
40745	41555	Low Coolant Temperature
40746	41556	Low Fuel
40747	41557	High Coolant Temperature Warning
40748	41558	Oil Pressure Warning
40749	41559	Master Not In Auto
40750	41560	NFPA 110 Fault
40751	41561	Low Battery Voltage
40752	41562	High Battery Voltage
40753	41563	Battery Charger Fault
40754	41564	System Ready
40755	41565	Loss of ECM Comm
40756	41566	No Oil Pressure Signal
40757	41567	High Oil Temperature Shutdown
40758	41568	No Coolant Temperature Signal
40759	41569	Low Coolant Level
40760	41570	Speed Sensor Fault
40761	41571	Locked Rotor
40762	41572	Master Switch Error
40763	41573	Master Switch Open
40764	41574	Master Switch Off
40765	41575	AC Sensing Loss
40766	41576	Over Voltage
40767	41577	Under Voltage
40768	41578	Weak Battery
40769	41579	Over Frequency
40770	41580	Under Frequency
40771	41581	Load Shed kW Overload
40772	41582	Load Shed kW Under Frequency
40773	41583	Over Current
40774	41584	EPS Supplying Load
40775	41585	Internal Fault
40776	41586	Engine Cooldown Delay
40777	41587	Engine Start Delay
40778	41588	Starting Aid
40779	41589	Generator Running
40780	41590	Air Damper Control
40781	41591	Ground Fault
40782	41592	EEPROM Write Failure
40783	41593	Critical Overvoltage
40784	41594	Alternator Protect Shutdown
40785	41595	Air Damper Indicator
40786	41596	Digital Input 01
40787	41597	Digital Input 02
40788	41598	Digital Input 03
40789	41599	Digital Input 04
40790	41600	Digital Input 05
40791	41601	Digital Input 06
40792	41602	Digital Input 07
40793	41603	Digital Input 08
40794	41604	Digital Input 09
40795	41605	Digital Input 10
40796	41606	Digital Input 11
40797	41607	Digital Input 12
40798	41608	Digital Input 13
40799	41609	Digital Input 14
40800	41610	Digital Input 15
40801	41611	Digital Input 16
40802	41612	Digital Input 17
40803	41613	Digital Input 18
40804	41614	Digital Input 19
40805	41615	Digital Input 20
40806	41616	Digital Input 21
40807	41617	Analog Input 01
40808	41618	Analog Input 02
40809	41619	Analog Input 03
40810	41620	Analog Input 04
40811	41621	Analog Input 05
40812	41622	Analog Input 06
40813	41623	Analog Input 07
40814	41624	*Reserved for additional input*
40815	41625	
40816	41626	
40817	41627	
40818	41628	
40819	41629	
40820	41630	
40821	41631	
40822	41632	Defined Common Fault
40823	41633	Software Controlled RDO#1
40824	41634	Software Controlled RDO#2
40825	41635	Software Controlled RDO#3
40826	41636	Software Controlled RDO#4
40827	41637	*Reserved for factory use*
40828	41638	
40829	41639	
40830	41640	
40831	41641	
40832	41642	
40833	41643	
40834	41644	
40835	41645	
40836	41646	
40837	41647	

2.5.4 Relay Driver Outputs

Status. Registers 40838–40839 contain the status (active or not active) of the relay driver outputs (RDOs). Each register is a 16-bit word, and each individual bit corresponds to one RDO. Figure 2-7 illustrates how the RDO status codes are stored.

The RDO is active if the corresponding bit is set (equal to 1). The example in Figure 2-6 shows that RDOs 7, 8, 12, 18, 23, and 30 are active.

To identify the functions assigned to the RDOs, check registers 40840–40870.

Setup. Registers 40840–40870 contain the RDO function and setpoint information. The function assigned to the RDO is indicated by the event codes shown in the first byte of the register. Event codes are listed in the table in Section 2.5.6. Setpoints are for analog inputs only; otherwise setpoint=0.

Register	RDO Number Corresponding to Each Bit															
40848	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
40849	—	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17

Figure 2-5 RDO Status Registers

Register	RDO Status: 0 = Not Set (not active), 1 = Set (active)															
40848	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0
40849	—	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0

Figure 2-6 RDO Status Example

2.5.5 System Event Codes

Event codes are contained in registers 41500 through 41515. Each register is a 16-bit word, and each bit corresponds to a system event code. Figure 2-7 illustrates how the event codes are stored in the system event stack registers. The numbers 0–255 in Figure 2-7 correspond to the event codes shown in the System Event Codes table, Section 2.5.6. For example, number 6 corresponds to low fuel.

The condition indicated by the message code is active if the corresponding bit is set. Figure 2-8 shows register 41500 indicating low battery voltage, a high coolant temperature warning, and a low fuel condition.

Register	Event Code Indicated by Each Bit (See Section 2.5.6 for event code identification.)															
41500	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
41501	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
41502	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32
41503	63	62	61	60	59	58	57	56	55	54	53	52	51	50	49	48
41504	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64
41505	95	94	93	92	91	90	89	88	87	86	85	84	83	82	81	80
41506	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	96
41507	127	126	125	124	123	122	121	120	119	118	117	116	115	114	113	112
41508	143	142	141	140	139	138	137	136	135	134	133	132	131	130	129	128
41509	159	158	157	156	155	154	153	152	151	150	149	148	147	146	145	144
41510	175	174	173	172	171	170	169	168	167	166	165	164	163	162	161	160
41511	191	190	189	188	187	186	185	184	183	182	181	180	179	178	177	176
41512	207	206	205	204	203	202	201	200	199	198	197	196	195	194	193	192
41513	223	222	221	220	219	218	217	216	215	214	213	212	211	210	209	208
41514	239	238	237	236	235	234	233	232	231	230	229	228	227	226	225	224
41515	255	254	253	252	251	250	249	248	247	246	245	244	243	242	241	240

Figure 2-7 Event Codes Stored in System Event Stack Registers 41500 through 41515

Register	Event Code Status: 0 = Not Set, 1 = Set															
41500	0	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0

Figure 2-8 Event Code Status Example, Register 41500

2.5.6 System Event CodeTable

The system event codes in the following table are used for relay driver output functions as well as for events in the event history and the event stack.

Code	Description
0	Emergency Stop
1	Overspeed
2	Overcrank
3	High Coolant Temperature Shutdown
4	Oil Pressure Shutdown
5	Low Coolant Temperature
6	Low Fuel
7	High Coolant Temperature Warning
8	Oil Pressure Warning
9	Master Not In Auto
10	NFPA 110 Fault
11	Low Battery Voltage
12	High Battery Voltage
13	Battery Charger Fault
14	System Ready
15	Loss of ECM Comm
16	No Oil Pressure Signal
17	High Oil Temperature Shutdown
18	No Coolant Temperature Signal
19	Low Coolant Level
20	Speed Sensor Fault
21	Locked Rotor
22	Master Switch Error
23	Master Switch Open
24	Master Switch Off
25	AC Sensing Loss
26	Over Voltage
27	Under Voltage
28	Weak Battery
29	Over Frequency
30	Under Frequency
31	Load Shed kW Overload
32	Load Shed kW Under Frequency
33	Over Current
34	EPS Supplying Load
35	Internal Fault
36	Engine Cooldown Delay
37	Engine Start Delay
38	Starting Aid
39	Generator Running
40	Air Damper Control
41	Ground Fault
42	EEPROM Write Failure
43	Critical Overvoltage
44	Alternator Protect Shutdown
45	Air Damper Indicator
46	Digital Input 01
47	Digital Input 02
48	Digital Input 03
49	Digital Input 04
50	Digital Input 05
51	Digital Input 06
52	Digital Input 07
53	Digital Input 08
54	Digital Input 09
55	Digital Input 10
56	Digital Input 11
57	Digital Input 12
58	Digital Input 13
59	Digital Input 14
60	Digital Input 15
61	Digital Input 16
62	Digital Input 17
63	Digital Input 18
64	Digital Input 19
65	Digital Input 20
66	Digital Input 21
67	Analog Input 01
68	Analog Input 02
69	Analog Input 03
70	Analog Input 04
71	Analog Input 05
72	Analog Input 06
73	Analog Input 07
74	*Reserved for additional input*
75	*Reserved for additional input*
76	*Reserved for additional input*
77	*Reserved for additional input*
78	*Reserved for additional input*
79	*Reserved for additional input*
80	*Reserved for additional input*
81	*Reserved for additional input*
82	Defined Common Fault
83	Software Controlled RDO#1
84	Software Controlled RDO#2
85	Software Controlled RDO#3
86	Software Controlled RDO#4
99	Genset Parameter Warning
100	Genset S/N Mismatch Warning
101	Genset S/N Mismatch Shutdown
103	Protective Relay Overvoltage
104	Protective Relay Under Voltage
105	Protective Relay Overfrequency
106	Protective Relay Underfrequency
107	Protective Relay Reverse Power
108	Protective Relay Over Power
109	Protective Relay Loss of Field
110	Protective Relay Overcurrent Vr
111	Reverse Power Shutdown
112	Over Power Shutdown
113	Loss of Field Shutdown
114	Over Current Shutdown
115	Common Protective Relay Output
116	In Synch
117	Breaker Trip
118	Fuel Valve Relay
119	Pre Lube Relay

Code	Description
120	Air -Fuel Module Start
121	Oil Temperature Loss of Signal
122	High Oil Temperature Warning
123	Intake Air Temperature Loss of Signal
124	High Intake Air Temperature Warning
125	High Intake Air Temperature Shutdown
126	MDEC/ADEC Yellow Alarm
127	MDEC/ADEC Red Alarm
128	MDEC/ADEC Block Heater Control
129	Low Coolant Temperature Shutdown
130	MDEC/ADEC Load Shed Over Temperature
131	*Reserved For Future Use*
191	Air -Fuel Module Start
192-255	*Reserved For Future Use*

2.5.7 Digital Auxiliary Input Functions

The following function ID codes are used in registers 40227-40499 to identify the function that is assigned to each digital input. The assignment is done through the controller keypad or Monitor III software. See the Operation Manual for the 550 controller or Monitor III software.

Digital Auxiliary Input Functions		
Function ID	**Name**	**Notes**
1	Warning	
2	Shutdown Type A	
3	Shutdown Type B	
4	Voltage Raise	
5	Voltage Lower	
6	VAR PF Mode	
7	Remote Shutdown	
8	Remote Reset	
9	Air Damper	
10	Low Fuel Warning	
11	Field Over Volts	
12	Idle Mode	ECM only
13	Battle Switch	
14	Ground Fault	
15	Bat Chgr Fault	
16	High Oil Temperature	
17	Low Coolant Lvl	
18	Low Coolant Temperature	ECM only (not user assignable)
19	Breaker Closed	(not user assignable)
20	Enable Synch	(not user assignable)
21	AFM Shutdown	Waukesha only (not user assignable)
22	Knock Shutdown	Waukesha only (not user assignable)
23	Deton Warning	Waukesha only (not user assignable)
24	Deton Shutdown	Waukesha only (not user assignable)
25	Low Fuel Shutdown	(not user assignable)

Notes

3.1 Introduction

The Digital controller uses KBUS protocol for communication. Modbus/KBUS converter kit GM41143-KP3 is required for Modbus communication with this controller. See Figure 3-1.

Installing the Modbus®/KBUS converter kit allows this controller to communicate with a personal computer running Monitor III software. For other Modbus applications, the Modbus master must be programmed to read the Modbus registers shown in this manual. A system designer trained in the application of Modbus® protocol must write and thoroughly test the program before implementation.

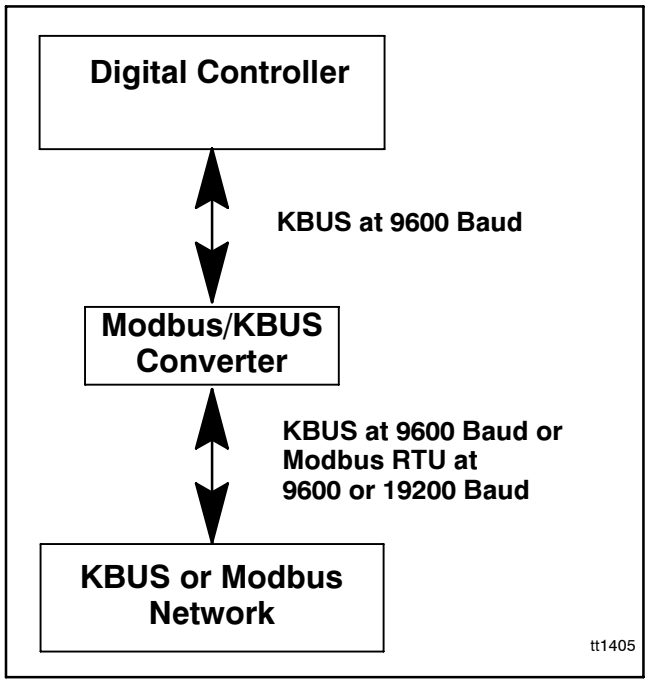


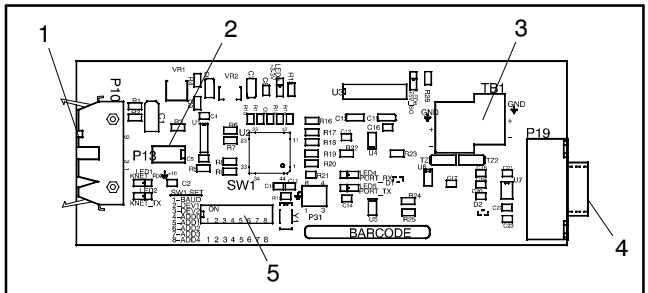
Figure 3-1 Modbus/KBUS Converter Function

3.2 Hardware and Connections

The Modbus/KBUS converter replaces RS-232 and RS-485 communication modules and allows the selection of either KBUS or Modbus communication. Figure 3-2 shows the Modbus/KBUS converter circuit board. See Figure 3-3 for the converter location inside the controller.

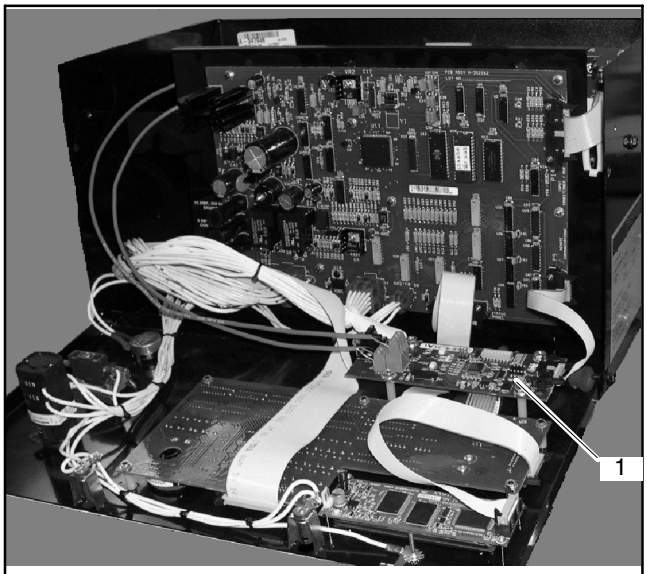
If your device is equipped with an RS-232/RS-485 communication module, remove the old communication module and ribbon cable before installing the new Modbus/KBUS converter and ribbon cable.

Refer to Installation Instructions TT-1405, provided with the converter kit, for converter installation and connection instructions. Set the converter DIP switches for baud rate, device type, and network address as described in TT-1405.



1. P10, ribbon cable connection for 340 generator set and power monitor
2. P13, ribbon cable connection for ATS controller
3. RS-485 connection TB1
4. RS-232 connection P19
5. DIP switches 1–8

Figure 3-2 Modbus/KBUS Converter Board



1. Converter location inside controller

Figure 3-3 Modbus/KBUS Converter Location

3.3 Controller Setup

Configure the controller for remote communications by setting the parameters shown in Figure 3-4. See TT-1405 and the controller Operation Manual for more information.

Device	Menu or Index	Parameter	Setting
Digital generator set controller	Menu 10, Remote Control	Remote Control: Online?	YES
		Remote Control: Local, LAN, Remote, or Remote Area Network?	Select the appropriate setting for your connection type. Use Local for Ethernet connections. See TT-1405 for more information.
		Address	Any *
		Baud rate	9600 †

* The network address for Series 340 devices is set using DIP switches on the converter module and will override the network address on the controller.

† This baud rate must be set at 9600 to match the KBUS side of the Modbus/KBUS converter. It may be different from the Modbus baud rates of other devices in the system.

Figure 3-4 Controller Settings for Modbus Communication

3.4 Modbus Registers

Refer to Section 1.3 for definitions of terms and symbols used in the register tables.

Register	Data Description	Access	Data Type	Range/Units
40001				
40002	System Time	RW	WORD	
40003	Day of Week	RW	WORD	
40004	Month	RW	WORD	1-12
40005	Day	RW	WORD	1-31
40006	Year	RW	WORD	
40007	Week of Month	RW	WORD	
40008	Voltage L1-L2	RO	WORD	volts
40009	Voltage L2-L3	RO	WORD	volts
40010	Voltage L3-L1	RO	WORD	volts
40011	Frequency	RO	WORD	hz
40012	Voltage L1-L0	RO	WORD	volts
40013	Voltage L2-L0	RO	WORD	volts
40014	Voltage L3-L0	RO	WORD	volts
40015	Alert Code	RO	WORD	Alert Code
40016	Engine Speed	RO	WORD	
40017	Coolant Temp	RO	WORD	
40018	Oil Pressure	RO	WORD	
40019	Battery Voltage	RO	WORD	Vdc * 10
40020	L1 Current	RO	WORD	amps
40021	L2 Current	RO	WORD	amps
40022	L3 Current	RO	WORD	amps
40023	Power Factor	RO	WORD	* 100
40024	Total Real Power	RO	WORD	kW
40025	Percent of Max. Power	RW	WORD	% * 100
40034	Status	RO	WORD[0-7]	0-1: Sw. Position (00=open; 01=auto; 10=run; 11=off)
				2-3: Gen. Status (00=stopped; 01=running; 10=crank; 11=undefined)
				4-5: Program Mode (00=off; 01=remote; 10=local; 11=undefined)
40048	Engine Start Time	RW	WORD	sec
40049	Crank Time	RW	WORD	sec
40050	Crank Pause Time	RW	WORD	sec
40051	Num of Crank Cycles	RW	WORD	
40052	Engine Cooldown Time	RW	WORD	sec
40053	Over Voltage Time Delay	RW	WORD	sec
40054	Under Voltage Time Delay	RW	WORD	sec
40055	Starting Aid Time	RW	WORD	sec
40056	Aux 1 Inhibit Time	RW	WORD	sec
40057	Aux 1 Delay Time	RW	WORD	sec
40058	Aux 2 Inhibit Time	RW	WORD	sec
40059	Aux 2 Delay Time	RW	WORD	sec
40060	Aux 3 Inhibit Time	RW	WORD	sec
40061	Aux 3 Delay Time	RW	WORD	sec
40062	Aux 4 Inhibit Time	RW	WORD	sec
40063	Aux 4 Delay Time	RW	WORD	sec
40064	Over Voltage Trip Point	RW	WORD	%, 105-135
40065	Under Voltage Trip Point	RW	WORD	%, 70-95
40066	Over Freq Trip Point	RW	WORD	%, 102-140

Register	Data Description	Access	Data Type	Range/Units
40067	Under Freq Trip Point	RW	WORD	%, 80-98
40068	Over Speed Trip Point	RW	WORD	%, 55-70 <---?
40069	Low Battery Voltage Trip Point	RW	WORD	Vdc * 10
40070	High Battery Voltage Trip Point	RW	WORD	Vdc * 10
40071	System Voltage	RW	WORD	volts, 105-14600
40072	System Frequency	RW	WORD	hz, 48-62
40073	Genset Rating	RW	WORD	kW, 0-3000
40074	Battery Voltage	RW	WORD	Vdc, 12 or 24
40076	Run Time Loaded Since Reset	RO	WORD*2	
40078	Run Time Unloaded Since Reset	RO	WORD*2	
40080	Days of Operation Since Reset	RO	WORD	
40081	kW-hrs Since Reset	RO	WORD*2	
40083	Number Starts Since Reset	RO	WORD	
40084	Month of Reset	RO	WORD	1-12
40085	Day of Reset	RO	WORD	1-31
40086	Year of Reset	RO	WORD	
40087	Run Time Loaded Since Startup	RO	WORD*2	
40089	Run Time Unloaded Since Startup	RO	WORD*2	
40091	Days of Operation Since Startup	RO	WORD	
40092	kW-hrs Since Startup	RO	WORD*2	
40094	Number Starts Since Startup	RO	WORD	
40095	Month of Startup	RO	WORD	1-12
40096	Day of Statup	RO	WORD	1-31
40097	Year of Startup	RO	WORD	
40098	Month of Last Start	RO	WORD	1-12
40099	Day of Last Start	RO	WORD	1-31
40100	Year of Last Start	RO	WORD	
40101	Time of Last Start	RO	WORD	
40102	Duration of Last Run	RO	WORD	
40112	Shutdown #1 Code	RO	WORD	code
40113	Shutdown #1 Month	RO	WORD	1-12
40114	Shutdown #1 Day	RO	WORD	1-31
40115	Shutdown #1 Year	RO	WORD	
40116	Shutdown #2 Code	RO	WORD	code
40117	Shutdown #2 Month	RO	WORD	1-12
40118	Shutdown #2 Day	RO	WORD	1-31
40119	Shutdown #2 Year	RO	WORD	
40120	Shutdown #3 Code	RO	WORD	code
40121	Shutdown #3 Month	RO	WORD	1-12
40122	Shutdown #3 Day	RO	WORD	1-31
40123	Shutdown #3 Year	RO	WORD	
40124	Shutdown #4 Code	RO	WORD	code
40125	Shutdown #4 Month	RO	WORD	1-12
40126	Shutdown #4 Day	RO	WORD	1-31
40127	Shutdown #4 Year	RO	WORD	
40140-40144	Designation	RW	WORD*5	9 chars, 1 per byte, first char = LSB, last byte ignored
40145-40154	Load Description	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40155-40164	Location	RW	WORD*10	20 chars, 1 per byte, first char = LSB

Register	Data Description	Access	Data Type	Range/Units
40165-40177	Model No.	RW	WORD*13	26 chars, 1 per byte, first char = LSB
40178-40185	Spec. No.	RW	WORD*8	16 chars, 1 per byte, first char = LSB
40186-40188	Serial No.	RW	WORD*3	6 chars, 1 per byte, first char = LSB
40189-40191	Controller Serial No.	RW	WORD*3	6 chars, 1 per byte, first char = LSB
40204-40213	Auxiliary 1 Description	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40214-40223	Auxiliary 2 Description	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40224-40233	Auxiliary 3 Description	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40234-40243	Auxiliary 4 Description	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40245	Auxiliary Function Operation	RW	WORD [0-3]	0 = shutdown; 1 = warning (one bit per function)
40264	Relay Driver #1 Code	RW	WORD	code
40265	Relay Driver #2 Code	RW	WORD	code
40266	Relay Driver #3 Code	RW	WORD	code
40267	Relay Driver #4 Code	RW	WORD	code
40268	Relay Driver #5 Code	RW	WORD	code
40269	Relay Driver #6 Code	RW	WORD	code
40270	Relay Driver #7 Code	RW	WORD	code
40271	Relay Driver #8 Code	RW	WORD	code
40272	Relay Driver #9 Code	RW	WORD	code
40273	Relay Driver #10 Code	RW	WORD	code
40274	Common Fault #1 Code	RW	WORD	code
40275	Common Fault #2 Code	RW	WORD	code
40276	Common Fault #3 Code	RW	WORD	code
40277	Common Fault #4 Code	RW	WORD	code
40278	Common Fault #5 Code	RW	WORD	code
40279	Common Fault #6 Code	RW	WORD	code
40300	Run Time	WO	WORD	min
40350	Reset Faults	WO	WORD[0]	0: 1=reset faults; 0=ignored

3.5 Alert Codes

Code	Message Summary
0	Defined Common Fault
1	Air Damper
2	Over Voltage
3	Under Voltage
4	Under Frequency Shutdown
5	Low Coolant Level
6	High Oil Temperature
7	Auxiliary 1
8	Auxiliary 2
9	Auxiliary 3
10	Auxiliary 4
11	Locked Rotor
12	Internal Error
13	EPS Supplying Load
14	Speed Sensor Fault
15	Load Shed
16	kW Overload
17	Under Frequency Warning
18	High Battery Voltage
19	Coolant Temperature Signal Loss
20	Oil Pressure Signal Loss
21	Ground Fault Detected
22	Over Current
23	Engine Cooldown
24	Time Delay Engine Start
25	Generator Running
26	NFPA 110 Common Alarm
27	Starting Aid
28	Low Oil Pressure
29	High Coolant Temperature

Code	Message Summary
30	Overcrank
31	Overspeed
32	Emergency Stop
33	Not In Auto
34	System Ready
35	Low Battery Voltage
36	Battery Charger Fault
37	Low Fuel
38	High Coolant Temperature Warning
39	Low Oil Pressure Warning
40	Low Coolant Temperature
41	Weak Battery
42	Load Shed Underfrequency
43	Load Shed Excess kW
44	Low AC Output
45	Overvoltage L1-L2
46	Overvoltage L2-L3
47	Overvoltage L3-L1
48	Overvoltage L1-L0
49	Overvoltage L2-L0
50	Overvoltage L3-L0
51	Undervoltage L1-L2
52	Undervoltage L2-L3
53	Undervoltage L3-L1
54	Undervoltage L1-L0
55	Undervoltage L2-L0
56	Undervoltage L3-L0
57	Master Switch Open (OFF/RESET)
58	Power-Down Error
59	Overfrequency Shutdown

Section 4 Microprocessor-Plus Controller with Communications

4.1 Introduction

Microprocessor-Plus 16-Light Controllers equipped with red main logic boards and one of the communication boards shown in Figure 4-1 have Modbus® communication capability. The controller:

- Requires the red logic board and a communication board for Modbus communication.
- Supports industry-standard Modbus® RTU protocol.
- Can use Modbus® TCP protocol with the addition of a Modbus/Ethernet converter.
- Uses RS-485 connections to connect to a Modbus® master singly or over an RS-485 network.
- Connects to an Ethernet network using a Modbus/Ethernet converter.
- Uses 19200 baud rate.

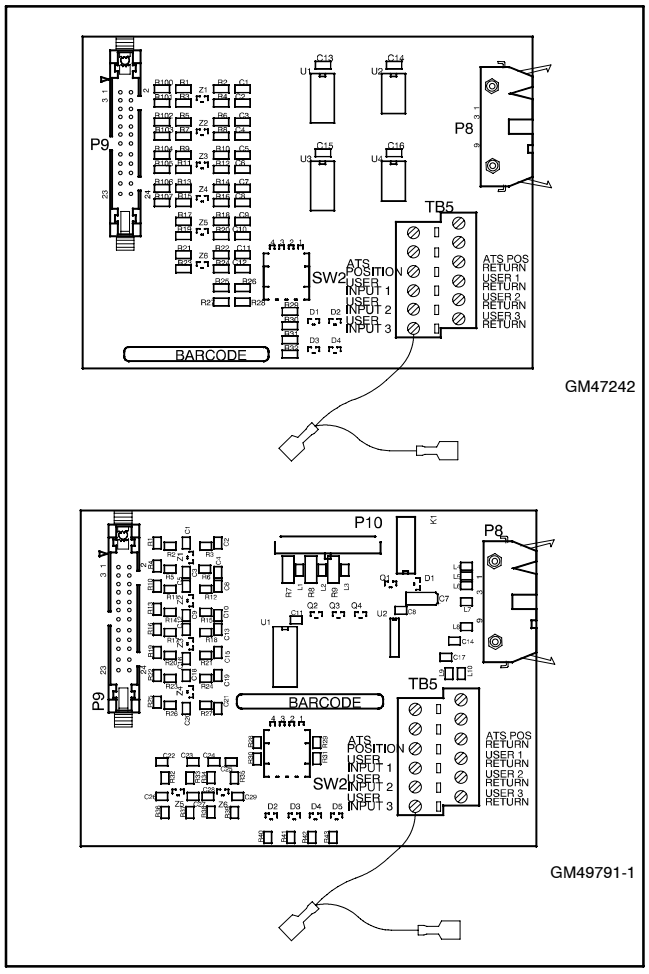


Figure 4-1 Communication Boards

The communication board is required for Modbus® communication with this controller. See Figure 4-3 and Figure 4-2. The communication board accessory kits are:

- GM32644-KA1 or KA2 (factory-installed)
- GM32644-KP1 (field-installed)

The kit includes the communication board, cables, mounting hardware, and installation instructions.

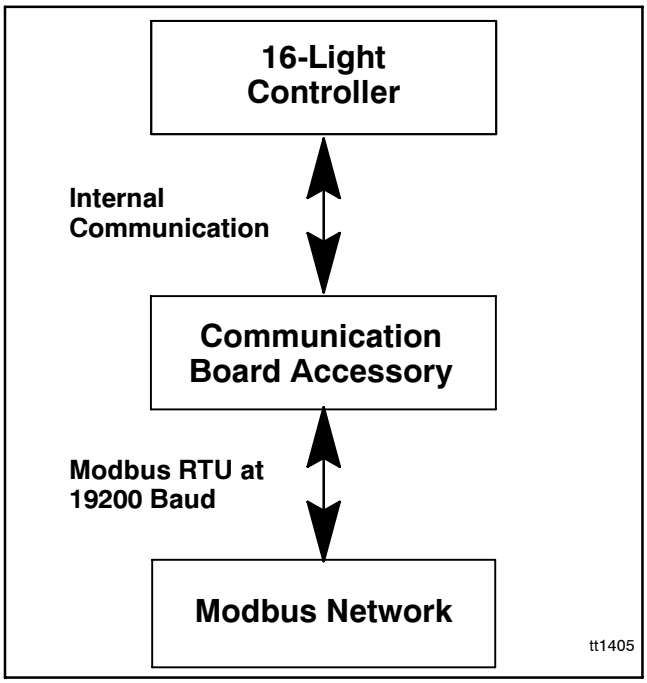
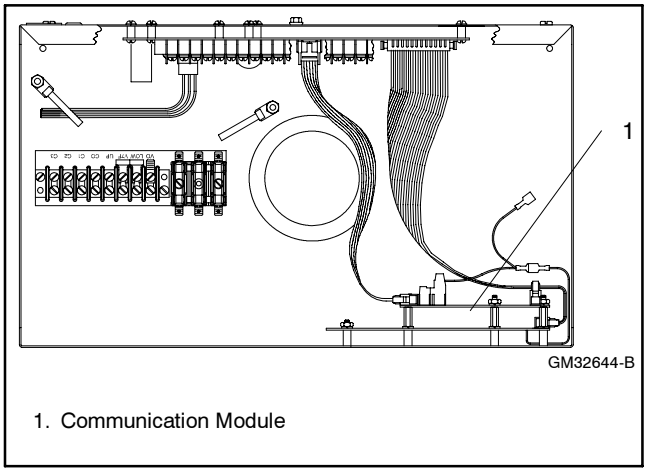


Figure 4-2 Communication Board Function



1. Communication Module

Figure 4-3 Communication Board Location (Controller Top View)

Modbus® is a registered trademark of Schneider Electric.

4.2 Communication Board Identification

Selected generator set models may be equipped with a gauge driver board, which does not provide Modbus® communication. The gauge driver board looks similar to the communication boards shown in Figure 4-1 and is installed in the same location. To identify the board, check the part number on the printed circuit board (PCB) and see Figure 4-4. Part numbers GM47242 and GM49791**-1** are Modbus® communication boards. Gauge driver board part number GM49791**-2** does **not** provide Modbus® communication. Obtain kit GM32644-KP1 to replace the gauge driver board, if necessary.

PCB Part Number	Description
GM47242	Communication Board. Superseded by GM49791-1.
GM49791-1	Communication and Gauge Driver Board
GM49791-2	Gauge Driver Board (no Modbus communication)

Figure 4-4 PCB Board Identification

4.3 Controller Connection and Setup

This section describes how to connect the controller to other devices in a Modbus® network and set up the controller for Modbus® communication. Refer to TT-1377, provided with the communication module, for additional information.

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

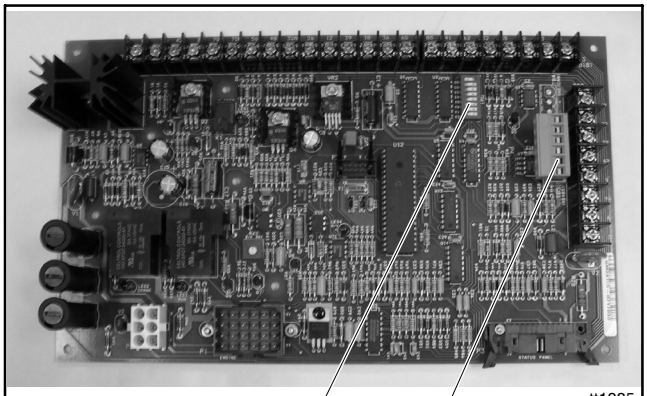
NOTICE

Electrostatic discharge damage. Electrostatic discharge (ESD) damages electronic circuit boards. Prevent electrostatic discharge damage by wearing an approved grounding wrist strap when handling electronic circuit boards or integrated circuits. An approved grounding wrist strap provides a high resistance (about 1 megohm), *not a direct short*, to ground.

4.3.1 Network Connection

Use Belden #9841 or equivalent cable to connect to other devices in an RS-485 network. Connect to the TB5 connector on the controller circuit board shown in Figure 4-5. Attach to the RS-485 connector as shown in Figure 4-6. Use a termination resistor on the last device in the network.

Circuit isolation is recommended for installations that may be exposed to electrical noise. See Appendix B, Noise and Wiring Practices.



1. DIP switches
2. TB5 connector Modbus RS-485 communication connection

Figure 4-5 Microprocessor-Plus Controller Circuit Board with DIP Switches

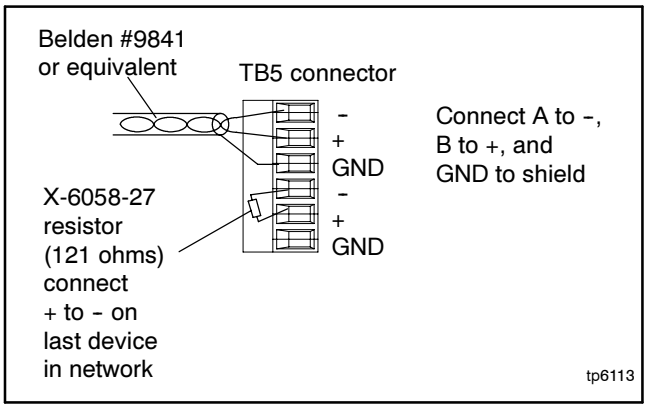


Figure 4-6 RS-485 Connection Details

4.3.2 Controller Setup

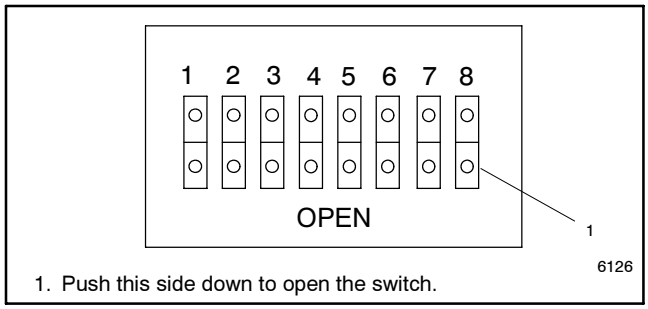
The controller circuit board contains eight DIP switches. Use DIP switches 6, 7, and 8 to set the controller's Modbus® address as described below. See Figure 4-5 for the DIP switch location on the controller circuit board.

Each Modbus® device in the network requires a unique address. Use DIP switches 6, 7, and 8 to assign a unique Modbus® address to each controller in the network. Figure 4-7 shows the DIP switch positions for each address number.

Push down the end of the DIP switch near the OPEN label to open the switch, or push down the other end to close it. See Figure 4-8.

Modbus® Address	DIP Switches		
	6	7	8
	Value = 2	Value = 4	Value = 8
1	Open	Open	Open
3	Closed	Open	Open
5	Open	Closed	Open
7	Closed	Closed	Open
9	Open	Open	Closed
11	Closed	Open	Closed
13	Open	Closed	Closed
15	Closed	Closed	Closed

Figure 4-7 Modbus® Address DIP Switches



1. Push this side down to open the switch.

Figure 4-8 DIP Switch Operation

4.4 Modbus Registers and Codes

This section contains Modbus® registers and codes for the Microprocessor-Plus controller with communications.

Refer to Section 1.3 for definitions of terms and symbols used in the register tables.

4.4.1 Modbus Registers

Register	Parameter	Access	Data Type	Range/Units
40001	System status	RO	WORD (0:3)	0: Set if in run mode, otherwise cleared 1: Set if in cooldown mode, otherwise cleared 2: 0 = 50 Hz; 1 = 60 Hz 3: Set if continuous crank enabled, Cleared if cyclic crank enabled 4: Set if generator running 5: Set if system ready
40002	Remote input status	RO	WORD[0:15]	0: Common fault 1: Low fuel 2: Battery charger fault 3: Low battery voltage 4: Air damper switch 5: Low coolant temperature (non-ECM and J1939) 6: Pre-high coolant temperature (non-ECM) 7: Emergency stop 8: ATS Emergency on 9: User Input #1 10: User Input #2 11: User Input #3 (dedicated to high battery voltage) 12: Communications module DIP switch #1 status 13: Communications module DIP switch #2 status 14: Communications module DIP switch #3 status 15: Communications module DIP switch #4 status
40003	Master switch position	RO	WORD	0 = Fault; 1 = Run; 2 = Auto; 4 = Off
40004	Engine RPM	RO	WORD	0–4000 RPM
40005	Shutdown fault number	RO	WORD	See S/D Fault Code Table, Section 4.4.2, and Section 4.4.3
40006	Flags and warnings	RO	WORD	See Flags/Warnings Code Table, Section 4.4.4. Condition exists if bit is set.
40007	Oil pressure	RO	WORD	kPa
40008	Coolant temperature	RO	WORD	°C + 273
40009	Fuel pressure	RO	WORD	kPa
40010	Fuel temperature	RO	WORD	°C + 273
40011	Charge air pressure	RO	WORD	kPa
40012	Charge air temperature	RO	WORD	°C + 273
40013	ECM supply voltage	RO	WORD	VDC * 10 (0.0 - 99.9 VDC)
40014–40015	ECM hours	RO	WORD * 2	Hrs * 10 (0.0 - 99999.9 hrs) (most significant word first)
40016	ECM temperature	RO	WORD	°C + 273
40017	MDEC/ADEC fault codes	RO	WORD	See MDEC/ADEC engine documentation and Section 4.4.3
40018	Engine communication protocol	RO	WORD	0 = Non ECM; 1 = MTU; 2 = J1939; 3 = MTU w/VSG
40019	Code version	RO	WORD	0–7: Minor version
				8–15: Major version
40020	Manual operations	WO	WORD[0:2]	0: Remote start 1: Remote stop 2: Remote fault reset
49999	Device ID	RO	WORD	Microprocessor-Plus = 18

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4.4.2 Shutdown Fault Codes

Fault Codes	Description
0	No faults present
1	Master switch not in auto (warning)
2	Master switch error
3	Overcrank
4	Locked rotor
5	Overspeed
6	Low oil pressure prealarm (warning)
7	Low oil pressure shutdown
8	High coolant temperature prealarm (warning)
9	High coolant temperature shutdown
10	Low coolant temperature (warning)
11	Aux. delay
12	Aux. immediate
13	MDEC/ADEC yellow alarm (warning)
14	MDEC/ADEC red alarm
15	Loss of ECM comms

4.4.3 MDEC/ADEC Fault Codes

Fault Condition	Register 40005	Register 40017	Controller Response
Loss of ECM communications	15	—	Auxiliary fault LED on steady, horn on.
High engine temperature prealarm	—	67	High Engine Temperature Prealarm LED on steady, horn on.
High engine temperature shutdown	9	68	High Engine Temperature Prealarm and Shutdown LED's on steady, horn on.
Low engine temperature prealarm	—	—	Low Water Temperature LED on steady, horn on.
Low engine temperature shutdown	14	—	Low Water Temperature and Auxiliary Fault LED's on steady, horn on.
Overspeed shutdown	5	30	Overspeed LED on steady, horn on.
Low oil pressure prealarm	—	15	Low Oil Pressure Prealarm LED on steady, horn on.
Low oil pressure shutdown	7	16	Low Oil Pressure Prealarm and Shutdown LED's on steady, horn on.
Low fuel pressure prealarm	—	See MDEC/ADEC documentation	Auxiliary fault LED flashing, horn cycling on/off.
Low fuel pressure shutdown	—	See MDEC/ADEC documentation	Auxiliary fault LED on steady, horn on.
High charge air temperature prealarm	—	5	Auxiliary fault LED flashing, horn cycling on/off.
High charge air temperature shutdown	14	6	Auxiliary fault LED on steady, horn on.
Low coolant level shutdown	14	24	Auxiliary fault LED on steady, horn on.
High lube oil temperature prealarm	—	51	Auxiliary fault LED flashing, horn cycling on/off.
Generic MDEC/ADEC yellow alarm (prealarm)	—	See MDEC/ADEC documentation	Auxiliary fault LED flashing, horn cycling on/off.
Generic MDEC/ADEC red alarm (shutdown)	14	See MDEC/ADEC documentation	Auxiliary fault LED on steady, horn on.

4.4.4 Flags/Warnings

Warning Bits	Description
Bit 0 (LSB)	No AC voltage
Bit 1	MDEC/ADEC yellow alarm
Bit 2	Speed sensor fault
Bit 3	Intermittent speed sensor
Bit 4	Master switch not in auto
Bit 5	MDEC/ADEC charge air temperature warning
Bit 6	MDEC/ADEC low fuel pressure warning
Bit 7	MDEC/ADEC high oil temperature warning
Bit 8	Low oil pressure warning
Bit 9	High coolant temperature warning (MDEC/ADEC and J1939)
Bit 10	Low coolant temperature warning (MDEC/ADEC)
Bit 11	Unused
Bit 12	Unused
Bit 13	Unused
Bit 14	Unused
Bit 15 (MSB)	Unused

5.1 Specifications

The DXPower™ 1500 controller's Modbus® communication capability:

- Supports industry-standard Modbus® RTU protocol through the RS-485 serial ports.
- Uses Modbus® TCP protocol through the Ethernet port.
- Uses RS-485 connections to a single Modbus® master or a network of devices.
- Connects directly to an Ethernet network (RJ-45 connector on the main logic board).
- Uses standard baud rates of 9600, 19200, or 57600.

5.2 Hardware Connections

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

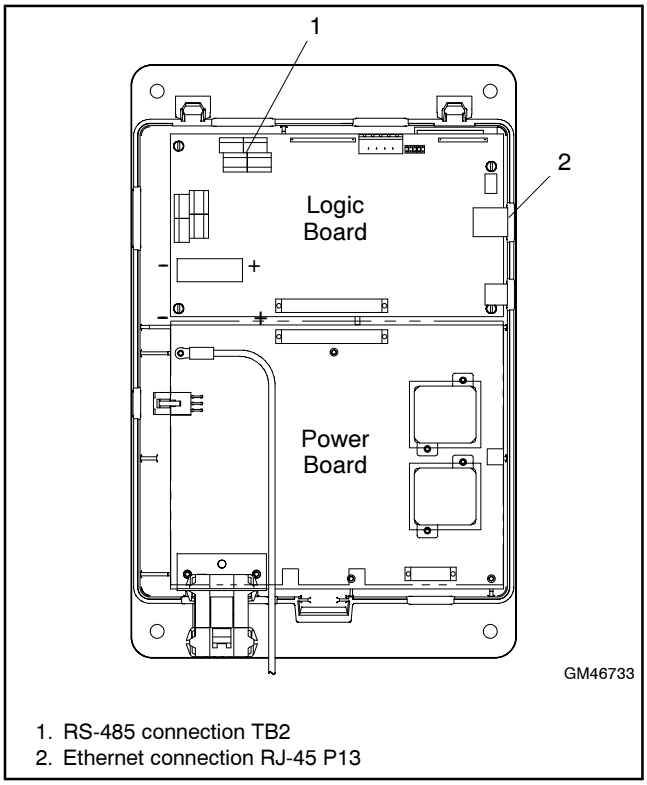
NOTICE

Electrostatic discharge damage. Electrostatic discharge (ESD) damages electronic circuit boards. Prevent electrostatic discharge damage by wearing an approved grounding wrist strap when handling electronic circuit boards or integrated circuits. An approved grounding wrist strap provides a high resistance (about 1 megohm), *not a direct short*, to ground.

The controller uses a non-isolated RS-485 port with connection speeds of 9.6, 19.2, and 57.6 kbps.

1. Disconnect power to the transfer switch by opening switches or circuit breakers before opening the enclosure.
2. Ethernet connection: Use CAT5 network cable to connect to RJ-45 connector P13 on the controller. See Figure 5-1 for the connector location.
3. RS-485 connection:
   a. Remove the controller housing cover to gain access to connector TB2.. See Figure 5-1.
   b. Use #12–24 AWG twisted-pair shielded cable; Belden cable #9841 or equivalent is recommended. Connect the Modbus® input and output to terminal strip TB2. See Figure 5-2. Connect A to negative (–), B to positive (+), and the shield to ground as shown in Figure 5-2.
   c. Tighten the connections to 0.5 Nm (4.4 in. lbs.).
   d. Replace the controller housing cover.
4. Close and lock the transfer switch enclosure door before reconnecting the power.

Note: Install communication conductors in raceways, cables, or conduit separate from AC power conductors.



1. RS-485 connection TB2
2. Ethernet connection RJ-45 P13

Figure 5-1 ATS Controller, Cover Removed

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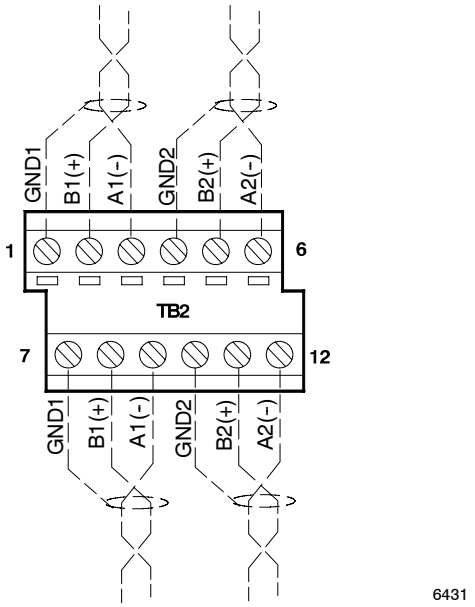

Note: Belden cable #9841 or equivalent is recommended.

Figure 5-2 RS-485 Connections

5.3 Controller Setup

Set the controller communications settings through the controller user interface. Navigate to the Communications Setup screen and set the parameters for serial or ethernet communication as shown in Figure 5-3. Refer to the ATS Operation/Installation for more detailed instructions. See List of Related Materials in the Introduction to this manual.

Set the baud rate of the Modbus® network interface port to match the other devices in the network. Allowable baud rates are 9600,19200, and 57600 baud.

Choose a unique network address for each device in the network.

The series 1500 controller does not operate as a Modbus-to-Ethernet converter for other devices in a network. For multiple device networks connected to the personal computer through the Ethernet, use a Modbus-to-Ethernet converter for the other devices in the network. See TT-1405, provided with the converter, for connection instructions.

Setting	Range	Needed for Connection Type:			Notes
		Serial	Remote Serial (modem)	Ethernet	
Modbus Server TCP	Enabled or Disabled			X	Enable for network communication through the ethernet port.
Modbus Server Port 1	Enabled or Disabled	X	X		Enable for Modbus communication through serial port 1 on the main logic board.
Modbus Server Port 2	Enabled or Disabled	X	X		Enable for Modbus communication through serial port 2 on the main logic board.
Modbus Addr Port 1	001–247 default 1	X	X		Address for RS-485 serial port 1 (on the main logic board). Each port must have a different address.
Modbus Addr Port 2	001–247 default 2	X	X		Address for RS-485 serial port 2 (on the main logic board). Each port must have a different address.
Baud Rate Port 1	9600, 19200, 57600	X	X		Baud rate in bits per second for serial communication between the controller and a personal computer's COM port. All devices in a network must use the same baud rate.
Baud Rate Port 2	9600, 19200, 57600	X	X		
Modbus TCP Unit ID				X	Factory-set to 3. A unit ID is required for Modbus over TCP communication. The unit ID for TCP communication is analogous to the Modbus address for serial communication through the RS-485 ports.
IP Address				X	Obtain from your local network administrator. Every device on the network must have a unique IP address.
Subnet Mask				X	Obtain from your local network administrator.
MAC Address	Factory-set	—	—	X	Hardware address, entered at the factory. Not adjustable. Appears only in the Communications View on the controller's display.

Figure 5-3 Communication Settings

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5.4 Modbus Registers

Refer to Section 1.3 for definitions of terms and symbols used in the register tables.

Time delays, setpoints, inputs and outputs, and other user-defined parameters are programmed using the Setup Program. Refer to the Setup Program Operation Manual for instructions. See the List of Related Materials for document part numbers.

5.4.1 Guide to the Register Map

Description	Registers
Monitoring	40001–40054
Setup *	40057-40058
Time Delays	400059-40077
Trip Point Settings	40078-40107
Outputs (Event code)	40108-40153
Modules Types	40154-40161
I/O Status	40194-40255
Remote I/O Descriptions	40260-40349
Accessories	40740-40742
DIP Switch Positions	40743
Pre/Post Transfer Delays	40750-40787
Common Alarms	40800-40864
Exerciser	40905-40994
Last Outage	41010-41013
Customer-Defined Descriptions †	41110-41149
Password-Protected Factory Settings *	41150-41167
Code Versions	41200-41201
MAC Address	41202
Time/Date	41250-41254
Maintenance History	41300-41320
Manual Operations	41350-41352
Event History	42150-42854
Calibration *	43400-43429
Device ID	49999

* Distributor-level password required to write to these registers
† Descriptions entered through Monitor III software

5.4.2 Passwords

Note: Password-protected parameters are factory-set and should not require changes unless the transfer switch controller is replaced.

If the transfer switch controller needs replacement, some password-protected settings may need to be changed after the new controller assembly is installed. Setup registers, serial numbers, and calibration registers require the distributor-level password, which is not the same as the setup or test passwords for the transfer switch. Distributors must contact the DDC/MTU Power Generation Service Department to obtain the distributor-level password.

Send the data register and the password in the same request. For example, send register 43400 and 43401 together to change the calibration of the L1L2N (normal source) voltage.

5.4.3 Modbus Registers

Register	Data Description	Access	Data Type	Range/Units
40001	System Overview	RO	WORD [0:14]	0-1: Contactor Position (00 = Off; 01 = Normal; 10 = Emerg; 11 = Fault)
				2: Preferred Source (0 = Source1; 1= Source2)
				3-12: Top Event on Warning Stack
				13: Preferred Source Available (0 = No, 1 = Yes)
				14: Standby Source Available (0 = No, 1 = Yes)
				15: Reserved for future use (always 0)
40002	Source N Line-Neutral L1-L0	RO	WORD	Volts AC * 10
40003	Source N Line-Neutral L2-L0	RO	WORD	Volts AC * 10
40004	Source N Line-Neutral L3-L0	RO	WORD	Volts AC * 10
40005	Source E Line-Neutral L1-L0	RO	WORD	Volts AC * 10
40006	Source E Line-Neutral L2-L0	RO	WORD	Volts AC * 10
40007	Source E Line-Neutral L3-L0	RO	WORD	Volts AC * 10
40008	Source N Line Voltage L1-L2	RO	WORD	Volts AC * 10
40009	Source N Line Voltage L2-L3	RO	WORD	Volts AC * 10
40010	Source N Line Voltage L3-L1	RO	WORD	Volts AC * 10
40011	Source E Line Voltage L1-L2	RO	WORD	Volts AC * 10
40012	Source E Line Voltage L2-L3	RO	WORD	Volts AC * 10
40013	Source E Line Voltage L3-L1	RO	WORD	Volts AC * 10
40014	Source N Frequency	RO	WORD	Hz * 10
40015	Source E Frequency	RO	WORD	Hz * 10
40016	Current L1	RO	WORD	Amps * 10
40017	Current L2	RO	WORD	Amps * 10
40018	Current L3	RO	WORD	Amps * 10
40019-40044	Reserved for future use	—	—	Return 0
40045	Phase Rotation Actual	RO	WORD	0 = disabled; 1 = ABC; 2 = CBA (MSB = Normal; LSB = Emerg.)
40046	Phase Rotation Expected	RW	WORD	0 = disabled; 1 = ABC; 2 = CBA
40047	Nominal Normal Voltage	RW	WORD	Volts AC * 10
40048	Nominal Emergency Voltage	RW	WORD	Volts AC * 10
40049	Nominal Normal Frequency	RW	WORD	Hz * 10
40050	Nominal Emergency Frequency	RW	WORD	Hz * 10
40051	Normal Number of Phases	RW	WORD	1 or 3
40052	Emergency Number of Phases	RW	WORD	1 or 3
40053	Rated Amperage	RW	WORD	0-4000
40054	Reserved for future use	—	—	Return 0
40055	Proprietary	—	—	—
40056	Proprietary	—	—	—
40057	Transition Mode	RW	WORD [0:4]	0-1: 00 = Open; 01 = Programmed; 10 = Closed; 11 = Reserved
	Mode of Operation			2-3: 01 = Genset to Util; 10 = Util to Util; 00 = Genset to Genset; 11 = Util to Gen-Gen
	Supervised Transfer Control Switch Position			4: 0 = Auto; 1 = Manual
40058	Password for writing register 40057	WO	WORD	0 - 32768
40059	Normal Engine Start Time Delay	RW	WORD	0-10 sec
40060	Emergency Engine Start Time Delay	RW	WORD	0-10 sec
40061	Normal Ext. Engine Start Time Delay	RW	WORD	0-3600 sec
40062	Emergency Ext. Engine Start Time Delay	RW	WORD	0-3600 sec
40063	Normal Engine Cooldown	RW	WORD	0-3600 sec
40064	Emergency Engine Cooldown	RW	WORD	0-3600 sec

Register	Data Description	Access	Data Type	Range/Units
40065	Standby to Preferred	RW	WORD	0-3600 sec
40066	Preferred to Standby	RW	WORD	0-3600 sec
40067	Off (Preferred to Standby - Prog. Transition)	RW	WORD	0-3600 sec
40068	Off (Standby to Preferred - Prog. Transition)	RW	WORD	0-3600 sec
40069	Fail to Acquire Preferred	RW	WORD	1-3600 sec (1-300 sec for closed transition)
40070	Fail to Acquire Standby	RW	WORD	1-3600 sec (1-300 sec for closed transition)
40071	Fail to Synchronize	RW	WORD	1-3600 sec
40072	Fail to Synch. Enable	RW	WORD	0 = disabled; 1 = enabled
40073	Reserved for future use	—	—	Return 0
40074	Reserved for future use	—	—	Return 0
40075	Active Time Delay #	RO	WORD	
40076	Active Time Delay Remaining	RO	WORD	Seconds * 10
40077	Active Time Delay Preset	RO	WORD	Seconds * 10
40078	Normal Over Voltage Dropout	RW	WORD	105%-135% of Nominal
40079	Normal Over Voltage Pickup	RW	WORD	95%-100% of Nominal
40080	Normal Under Voltage Pickup	RW	WORD	85%-100% of Nominal
40081	Normal Under Voltage Dropout	RW	WORD	75%-98% of Pickup
40082	Normal Unbalance Enabled	RW	WORD	0 = disabled; 1 = enabled
40083	Normal Unbalance Voltage Dropout	RW	WORD	5%-20%
40084	Normal Unbalance Voltage Pickup	RW	WORD	3%-18%
40085	Normal Voltage Debounce Time	RW	WORD	0.1 - 9.9 sec * 10
40086	Emergency Over Voltage Dropout	RW	WORD	105%-135% of Nominal
40087	Emergency Over Voltage Pickup	RW	WORD	95%-100% of Nominal
40088	Emergency Under Voltage Pickup	RW	WORD	85%-100% of Nominal
40089	Emergency Under Voltage Dropout	RW	WORD	75%-98% of Pickup
40090	Emergency Unbalance Enabled	RW	WORD	0 = disabled; 1 = enabled
40091	Emergency Unbalance Voltage Dropout	RW	WORD	5%-20%
40092	Emergency Unbalance Voltage Pickup	RW	WORD	3%-18%
40093	Emergency Voltage Debounce Time	RW	WORD	0.1 - 9.9 sec * 10
40094	Normal Over Freq Dropout	RW	WORD	101%-105% of Pickup
40095	Normal Over Freq Pickup	RW	WORD	105%-120% of Nominal
40096	Normal Under Freq Dropout	RW	WORD	95%-99% of Pickup
40097	Normal Under Freq Pickup	RW	WORD	80%-95% of Nominal
40098	Normal Freq Dropout Time	RW	WORD	0.1 - 15.0 sec * 10
40099	Emergency Over Freq Dropout	RW	WORD	101%-105% of Pickup
40100	Emergency Over Freq Pickup	RW	WORD	105%-120% of Nominal
40101	Emergency Under Freq Dropout	RW	WORD	95%-99% of Pickup
40102	Emergency Under Freq Pickup	RW	WORD	80%-95% of Nominal
40103	Emergency Freq Dropout Time	RW	WORD	0.1 - 15.0 sec * 10
40104	Reserved for future use	—	—	Return 0
40105	Reserved for future use	—	—	Return 0
40106	Reserved for future use	—	—	Return 0
40107	Reserved for future use	—	—	Return 0
40108	MLB Programmable Output #1	RW	WORD	Event Code
40109	MLB Programmable Output #2	RW	WORD	Event Code
40110	Reserved for future use	—	—	Return 0
40111	MLB Programmable Input #1	RW	WORD	Event Code
40112	MLB Programmable Input #2	RW	WORD	Event Code
40113	Reserved for future use	—	—	Return 0
40114	Expansion Board Address 1 Output #1	RW	WORD	Event Code
40115	Expansion Board Address 1 Output #2	RW	WORD	Event Code

Register	Data Description	Access	Data Type	Range/Units
40116	Expansion Board Address 1 Output #3	RW	WORD	Event Code
40117	Expansion Board Address 1 Output #4	RW	WORD	Event Code
40118	Expansion Board Address 1 Output #5	RW	WORD	Event Code
40119	Expansion Board Address 1 Output #6	RW	WORD	Event Code
40120	Expansion Board Address 2 Output #1	RW	WORD	Event Code
40121	Expansion Board Address 2 Output #2	RW	WORD	Event Code
40122	Expansion Board Address 2 Output #3	RW	WORD	Event Code
40123	Expansion Board Address 2 Output #4	RW	WORD	Event Code
40124	Expansion Board Address 2 Output #5	RW	WORD	Event Code
40125	Expansion Board Address 2 Output #6	RW	WORD	Event Code
40126	Expansion Board Address 3 Output #1	RW	WORD	Event Code
40127	Expansion Board Address 3 Output #2	RW	WORD	Event Code
40128	Expansion Board Address 3 Output #3	RW	WORD	Event Code
40129	Expansion Board Address 3 Output #4	RW	WORD	Event Code
40130	Expansion Board Address 3 Output #5	RW	WORD	Event Code
40131	Expansion Board Address 3 Output #6	RW	WORD	Event Code
40132	Expansion Board Address 4 Output #1	RW	WORD	Event Code
40133	Expansion Board Address 4 Output #2	RW	WORD	Event Code
40134	Expansion Board Address 4 Output #3	RW	WORD	Event Code
40135	Expansion Board Address 4 Output #4	RW	WORD	Event Code
40136	Expansion Board Address 4 Output #5	RW	WORD	Event Code
40137	Expansion Board Address 4 Output #6	RW	WORD	Event Code
40138-40143	Reserved for future use	—	—	Return 0
40144	Expansion Board Address 1 Input #1	RW	WORD	Event Code
40145	Expansion Board Address 1 Input #2	RW	WORD	Event Code
40146	Expansion Board Address 2 Input #1	RW	WORD	Event Code
40147	Expansion Board Address 2 Input #2	RW	WORD	Event Code
40148	Expansion Board Address 3 Input #1	RW	WORD	Event Code
40149	Expansion Board Address 3 Input #2	RW	WORD	Event Code
40150	Expansion Board Address 4 Input #1	RW	WORD	Event Code
40151	Expansion Board Address 4 Input #2	RW	WORD	Event Code
40152	Reserved for future use	—	—	Return 0
40153	Reserved for future use	—	—	Return 0
40154	Expansion Board Address 1 Board Type	RO	WORD	0 = No Board Installed; 1 = Standard; 2 = Power
40155	Expansion Board Address 2 Board Type	RO	WORD	0 = No Board Installed; 1 = Standard; 2 = Power
40156	Expansion Board Address 3 Board Type	RO	WORD	0 = No Board Installed; 1 = Standard; 2 = Power
40157	Expansion Board Address 4 Board Type	RO	WORD	0 = No Board Installed; 1 = Standard; 2 = Power
40158	Reserved for future use	—	—	Return 0
40159	Reserved for future use	—	—	Return 0
40160	Alarm Option Board	RO	WORD	0 = No Board Installed; 1 = Normal; 2 = Chicago; 3 = Silence
40161	Battery Option Board Installed	RO	WORD	0 = No Board Installed; 1 = Installed
40162-40193	Reserved for future use	—	—	Return 0
40194	MLB Output State	RO	WORD [0:1]	One bit per output
40195	MLB Input State	RO	WORD [0:1]	One bit per input
40196	Expansion Board #1 Outputs State	RO	WORD [0:X]	One bit per output
40197	Expansion Board #2 Outputs State	RO	WORD [0:X]	

Register	Data Description	Access	Data Type	Range/Units
40198	Expansion Board #3 Outputs State	RO	WORD [0:X]	
40199	Expansion Board #4 Outputs State	RO	WORD [0:X]	
40200	Expansion Board #1 Inputs State	RO	WORD [0:1]	One bit per input
40201	Expansion Board #2 Inputs State	RO	WORD [0:1]	
40202	Expansion Board #3 Inputs State	RO	WORD [0:1]	
40203	Expansion Board #4 Inputs State	RO	WORD [0:1]	
40250	Software Controlled Outputs State	RW	WORD[0:3]	One bit per output
40251	Software Controlled Outputs Assigned	RO	WORD [0:3]	One bit per output
40252	Remote Monitoring Input State	RO	WORD [0:4]	One bit per input
40253	Remote Monitoring Input Assigned	RO	WORD [0:4]	One bit per input
40260–40269	SCO #1 Description	RW	WORD*10	Software controller output
40270–40279	SCO #2 Description	RW	WORD*10	
40280–40289	SCO #3 Description	RW	WORD*10	
40290–40299	SCO #4 Description	RW	WORD*10	
40300–40309	Reserved for future use	—	—	Return 0 (all registers)
40310–40319	Remote Monitored Input #1 Description	RW	WORD*10	
40320–40329	Remote Monitored Input #2 Description	RW	WORD*10	
40330–40339	Remote Monitored Input #3 Description	RW	WORD*10	
40340–40349	Remote Monitored Input #4 Description	RW	WORD*10	
40350–40359	Reserved for future use	—	—	Return 0 (all registers)
40600–40698	Reserved for future use	—	—	Return 0 (all registers)
40699	Proprietary	—	—	
40700	Proprietary	—	—	
40740	Accessory Setup	RW	WORD [0:15]	0: Enable Engine Start Extended Time Delay
				1: Reserved for future use (always 0)
				2: Enable In Phase Monitor
				3: Remote Test Loading (0=Loaded; 1=Unloaded)
				4: Commit to Transfer
				5: Peak Shave Delay Bypass
				6: 3-Source Eng. Start Mode (0=pref. first; 1=both @ same time)
				7: 3-source Pref. Source Toggle
				8: In Phase Transition Angle (0=Lagging; 1=Leading)
				9-15: In Phase Transition Angle

Register	Data Description	Access	Data Type	Range/Units
40741	Reserved for future use	—	—	Return 0
40742	Accessory Status	RO	WORD [0:6]	0: Exercise In Progress
				1: In Phase Monitor Active
				2: Load Control In Progress
				3: Peak Shaving In Progress
				4: Loaded Test Occurring
				5: Unloaded Test Occurring
				6: Auto-Loaded Test Occurring
40743	DIP Switch Position	RO	WORD [0:4]	0: Maintenance Mode
				1: Password Disabled
				2: Spare 3 On
				3: Spare 4 On
40744	Reserved for future use	—	—	Return 0
40750	Disconnect from N Before Transfer N->E Delay #1	RW	WORD	0-3600 Sec
40751	Disconnect from N Before Transfer N->E Delay #2	RW	WORD	0-3600 Sec
40752	Disconnect from N Before Transfer N->E Delay #3	RW	WORD	0-3600 Sec
40753	Disconnect from N Before Transfer N->E Delay #4	RW	WORD	0-3600 Sec
40754	Disconnect from N Before Transfer N->E Delay #5	RW	WORD	0-3600 Sec
40755	Disconnect from N Before Transfer N->E Delay #6	RW	WORD	0-3600 Sec
40756	Disconnect from N Before Transfer N->E Delay #7	RW	WORD	0-3600 Sec
40757	Disconnect from N Before Transfer N->E Delay #8	RW	WORD	0-3600 Sec
40758	Disconnect from N Before Transfer N->E Delay #9	RW	WORD	0-3600 Sec
40759	Connect to E After Transfer N->E Delay #1	RW	WORD	0-3600 Sec
40760	Connect to E After Transfer N->E Delay #2	RW	WORD	0-3600 Sec
40761	Connect to E After Transfer N->E Delay #3	RW	WORD	0-3600 Sec
40762	Connect to E After Transfer N->E Delay #4	RW	WORD	0-3600 Sec
40763	Connect to E After Transfer N->E Delay #5	RW	WORD	0-3600 Sec
40764	Connect to E After Transfer N->E Delay #6	RW	WORD	0-3600 Sec
40765	Connect to E After Transfer N->E Delay #7	RW	WORD	0-3600 Sec
40766	Connect to E After Transfer N->E Delay #8	RW	WORD	0-3600 Sec
40767	Connect to E After Transfer N->E Delay #9	RW	WORD	0-3600 Sec
40768	Disconnect from E Before Transfer E->N Delay #1	RW	WORD	0-3600 Sec
40769	Disconnect from E Before Transfer E->N Delay #2	RW	WORD	0-3600 Sec
40770	Disconnect from E Before Transfer E->N Delay #3	RW	WORD	0-3600 Sec
40771	Disconnect from E Before Transfer E->N Delay #4	RW	WORD	0-3600 Sec
40772	Disconnect from E Before Transfer E->N Delay #5	RW	WORD	0-3600 Sec
40773	Disconnect from E Before Transfer E->N Delay #6	RW	WORD	0-3600 Sec
40774	Disconnect from E Before Transfer E->N Delay #7	RW	WORD	0-3600 Sec

Register	Data Description	Access	Data Type	Range/Units
40775	Disconnect from E Before Transfer E->N Delay #8	RW	WORD	0-3600 Sec
40776	Disconnect from E Before Transfer E->N Delay #9	RW	WORD	0-3600 Sec
40777	Connect to N After Transfer E->N Delay #1	RW	WORD	0-3600 Sec
40778	Connect to N After Transfer E->N Delay #2	RW	WORD	0-3600 Sec
40779	Connect to N After Transfer E->N Delay #3	RW	WORD	0-3600 Sec
40780	Connect to N After Transfer E->N Delay #4	RW	WORD	0-3600 Sec
40781	Connect to N After Transfer E->N Delay #5	RW	WORD	0-3600 Sec
40782	Connect to N After Transfer E->N Delay #6	RW	WORD	0-3600 Sec
40783	Connect to N After Transfer E->N Delay #7	RW	WORD	0-3600 Sec
40784	Connect to N After Transfer E->N Delay #8	RW	WORD	0-3600 Sec
40785	Connect to N After Transfer E->N Delay #9	RW	WORD	0-3600 Sec
40786	Number of Loads to Add to E w/ N->E	RW	WORD	1-9
40787	Number of Loads to Add to N w/ E->N	RW	WORD	1-9
40788-408799	Reserved for future use	—	—	Return 0 (all registers)
40800-40864	Common Event Alarms	RW	WORD*65 [0:15]	0-12: Msg Code of defined common alarm
				13: 0=Not audible alarm; 1 = Audible alarm
				14: 0=Not assigned to DCA #2; 1= Assigned to DCA #2
				15: 0=Not assigned to DCA #1; 1= Assigned to DCA #1
40900	Reserved for future use	—	—	Return 0
40901	Reserved for future use	—	—	Return 0
40902	Reserved for future use	—	—	Return 0
40903	Reserved for future use	—	—	Return 0
40905	Enabled / Loaded / Interval Code / Repeat Rate Next Cal. Event	RW	WORD [0:7]	0: 0 = Disabled; 1 = Enabled
				1: 0 = Unloaded; 1 = Loaded
				2-3: Interval Code (00 = DMO; 01 = day; 10 = week; 11 = month)
				4-7: Repeat Rate (1-12)
				8: 0 = Not Running; 1 = Running (read only)
40906	Start Time Next Cal. Event	RW	WORD	Minutes since midnight
40907	Start Date Next Cal. Event	RW	WORD [0:15]	0-4: Day of Month
				5-8: Month of Year
				9-15: Year + 2000 (2000-2128)
40908	Run Time Next Cal. Event	RW	WORD	1-5999 Minutes
40909	Reserved for future use	—	—	Return 0
40910	Enabled / Loaded / Interval Code / Repeat Rate Exer. Event #1	RW	WORD [0:7]	0: 0 = Disabled; 1 = Enabled
				1: 0 = Unloaded; 1 = Loaded
				2-3: Interval Code (00 = DMO; 01 = day; 10 = week; 11 = month)
				4-7: Repeat Rate (1-12)
				8: 0 = Not Running; 1 = Running (read only)
				9: 0 = N source; 1 = E source (Gen-Gen Only)
40911	Start Time Exer. Event #1	RW	WORD	Minutes since midnight
40912	Start Date Exer. Event #1	RW	WORD [0:15]	0-4: Day of Month
				5-8: Month of Year (Jan = 1, Feb = 2,… Dec = 12)
				9-15: Year + 2000 (2001-2128)
40913	Run Time Exer. Event #1	RW	WORD	1-5999 Minutes

Register	Data Description	Access	Data Type	Range/Units
40914-40994	Exer. Events #2-#21 (same as above)	RW	WORD * 80	Same structure as Exer. Event #1
40995-40999	Reserved for future use	—	—	Return 0 (all registers)
41010	Last Outage Time	RO	WORD	Minutes since midnight
41011	Last Outage Date	RO	WORD [0:15]	0-4: Day of Month
				5-8: Month of Year
				9-15: Year + 2000 (2000-2128)
41012-41013	Duration of Last Outage	RO	WORD * 2	Minutes
41110-41119	Designation	RW	WORD * 10	20 ASCII characters
41120-41129	Load Description	RW	WORD * 10	20 ASCII characters
41130-41139	Branch Description	RW	WORD * 10	20 ASCII characters
41140-41149	Location	RW	WORD * 10	20 ASCII characters
41150-41154	ATS Serial Number	RW	WORD * 5	10 ASCII characters
41155	Password for registers 41150-41154	WO	WORD	0 - 32768
41156-41160	Controller Serial Number (FACTORY ONLY)	RW	WORD * 5	10 ASCII characters
41161	Password for registers 41156-41160	WO	WORD	0 - 32768 (FACTORY ONLY)
41162-41166	Contactor Serial Number	RW	WORD * 5	10 ASCII characters
41167	Password for registers 41162-41166	WO	WORD	0 - 32768
41168-41187	Reserved for future use	—	—	Return 0 (all registers)
41200	1500 Code Revision	RO	WORD [0:15]	0-7: Minor Version
				8-15: Major Version
41201	FPGA Revision	RO	WORD	0-7: Minor Version
				8-15: Major Version
41202	MAC Address (least significant bits only)	RO	WORD [0:14]	Bits 0-14 only
41250	Time	RW	WORD	Minutes since midnight
41251	Date (day)	RW	WORD [0:15]	0-4: Day of Month
	Date (month)			5-8: Month of Year (Jan = 1, Feb = 2,… Dec = 12)
	Date (year)			9-15: Year + 2000 (2001-2128)
41252	Adjust for daylight savings time	RW	WORD [0]	0: 0 = do not adjust; 1 = adjust
41253	Date to move clock forward (day of week)	RW	WORD [0:9]	0-2: Day of Month (Sun = 0, Mon = 1, … Sat = 6)
	Date to move clock forward (month)			3-6: Month of Year (Jan = 1, Feb = 2, … Dec = 12)
	Date to move clock forward (week of month)			7-9: Week of Month (1 - 4 only)
41254	Date to move clock backward (day of week)	RW	WORD [0:9]	0-2: Day of Month (Sun = 0, Mon = 1, … Sat = 6)
	Date to move clock backward (month)			3-6: Month of Year (Jan = 1, Feb = 2, … Dec = 12)
	Date to move clock backward (week of month)			7-9: Week of Month (1 - 4 only)
41255-41260	Reserved for future use	—	—	Return 0 (all registers)

Register	Data Description	Access	Data Type	Range/Units
41300-41301	Minutes not in Preferred Total	RO	WORD * 2	minutes (most significant word first)
41302-41303	Minutes not in Preferred since Reset	RO	WORD * 2	minutes (most significant word first)
41304-41305	Minutes in Standby Total	RO	WORD * 2	minutes (most significant word first)
41306-41307	Minutes in Standby since Reset	RO	WORD * 2	minutes (most significant word first)
41308-41309	Minutes of Operation Total	RO	WORD * 2	minutes (most significant word first)
41310-41311	Minutes of Operation since Reset	RO	WORD * 2	minutes (most significant word first)
41312	Switch Transfers Total	RO	WORD	
41313	Switch Transfers since Reset	RO	WORD	
41314	Failures to Transfer Total	RO	WORD	
41315	Failures to Transfer since Reset	RO	WORD	
41316	Loss of Preferred Transfers Total	RO	WORD	
41317	Loss of Preferred Transfers since Reset	RO	WORD	
41318	Transfer Time N->E	RO	WORD	milliseconds
41319	Transfer Time E->N	RO	WORD	milliseconds
41320	Last Maintenance Date	RO	WORD [0:15]	0-4: Day of Month
				5-8: Month of Year (Jan = 1, Feb = 2,… Dec = 12)
				9-15: Year + 2000 (2001-2128)
41321	Proprietary	—	—	
41322	Proprietary	—	—	
41323-41330	Reserved for Future Use	—	—	
41350	Maintainance/Test and Manual Operations	WO	WORD [0:9]	0: Reset Maintainance Records
				1: Start Peak Shave
				2: End Peak Shave
				3: Start Remote Loaded Test
				4: Start Remote Unloaded Test
				5: Reserved for future use (always 0)
				6: End Remote Test
				7: Force Transfer to OFF
				8: Resume Program Trans. Operation
				9: End Current Time Delay
41351	Auto-Load Run Time	WO	WORD	Minutes (sending any non-zero value starts test)
41352	Clear Event Log	WO	WORD [0]	0: 1=Clear Log
41353	Reserved for future use	—	—	Return 0
42150-42249	Events 0 - 19	RO	WORD * 100	Time, Date, Code, Param1, Param2
42250-42349	Events 20 - 39	RO	WORD * 100	Time, Date, Code, Param1, Param2
42350-42449	Events 40 - 59	RO	WORD * 100	Time, Date, Code, Param1, Param2
42450-42549	Events 60 - 79	RO	WORD * 100	Time, Date, Code, Param1, Param2
42550-42649	Events 80 - 99	RO	WORD * 100	Time, Date, Code, Param1, Param2
42650-42749	Reserved for future use	—	—	Return 0 (all registers)

Register	Data Description	Access	Data Type	Range/Units
42750	Event Window Start Time	RW	WORD	Minutes since midnight
42751	Event Window Start Date	RW	WORD [0:15]	0-4: Day of Month
				5-8: Month of Year (Jan = 1, Feb = 2,… Dec = 12)
				9-15: Year + 2000 (2000-2128)
42752	Event Window End Time	RW	WORD	Minutes since midnight
42753	Event Window End Date	RW	WORD [0:15]	0-4: Day of Month
				5-8: Month of Year (Jan = 1, Feb = 2,… Dec = 12)
				9-15: Year + 2000 (2000-2128)
42754	Number of Events in Window	RO	WORD	
42755-42854	Windowed Events 0 - 19	RO	WORD* 100	Time, Date, Code, Param1, Param2
42900-42949	Reserved for Future Use	—	—	Return 0 (all registers)
43400	Calibrate L1L2 Normal Source Voltage	WO	WORD	Volts * 10
43401	Password for 43400	WO	WORD	0 - 32768
43402	Calibrate L2L3 Normal Source Voltage	WO	WORD	Volts * 10
43403	Password for 43402	WO	WORD	0 - 32768
43404	Calibrate L3L1 Normal Source Voltage	WO	WORD	Volts * 10
43405	Password for 43404	WO	WORD	0 - 32768
43406	Calibrate L1L2 Emergency Source Voltage	WO	WORD	Volts * 10
43407	Password for 43406	WO	WORD	0 - 32768
43408	Calibrate L2L3 Emergency Source Voltage	WO	WORD	Volts * 10
43409	Password for 43408	WO	WORD	0 - 32768
43410	Calibrate L3L1 Emergency Source Voltage	WO	WORD	Volts * 10
43411	Password for 43410	WO	WORD	0 - 32768
43412	Calibrate L1L0 Normal Source Voltage	WO	WORD	Volts * 10
43413	Password for 43412	WO	WORD	0 - 32768
43414	Calibrate L2L0 Normal Source Voltage	WO	WORD	Volts * 10
43415	Password for 43414	WO	WORD	0 - 32768
43416	Calibrate L3L0 Normal Source Voltage	WO	WORD	Volts * 10
43417	Password for 43416	WO	WORD	0 - 32768
43418	Calibrate L1L0 Emergency Source Voltage	WO	WORD	Volts * 10
43419	Password for 43418	WO	WORD	0 - 32768
43420	Calibrate L2L0 Emergency Source Voltage	WO	WORD	Volts * 10
43421	Password for 43420	WO	WORD	0 - 32768
43422	Calibrate L3L0 Emergency Source Voltage	WO	WORD	Volts * 10
43423	Password for 43422	WO	WORD	0 - 32768
43424	Calibrate L1 Current	WO	WORD	Amps
43425	Password for 43424	WO	WORD	0 - 32768
43426	Calibrate L2 Current	WO	WORD	Amps
43427	Password for 43426	WO	WORD	0 - 32768
43428	Calibrate L3 Current	WO	WORD	Amps
43429	Password for 43428	WO	WORD	0 - 32768
43450	Key Press Status	RO	WORD [0:3]	One bit per button
43500	User Defined Value	RW	WORD	For internal use
43501	User Defined Value	RW	WORD	For internal use
43502	User Defined Value	RW	WORD	For internal use

Register	Data Description	Access	Data Type	Range/Units
43503	User Defined Value	RW	WORD	For internal use
43504	User Defined Value	RW	WORD	For internal use
43505	User Defined Value	RW	WORD	For internal use
43506	User Defined Value	RW	WORD	For internal use
43507	User Defined Value	RW	WORD	For internal use
43508	User Defined Value	RW	WORD	For internal use
43509	User Defined Value	RW	WORD	For internal use
49999	Device ID	RO	WORD	Series 1500 ATS Controller = 0x17

5.4.4 Event Codes

Event codes are used in the following registers:

- Programmable inputs and outputs, registers 40108-40153
- Common event alarms, registers 40800-40864
- Event log registers 42150-42649

Code	Description
1	End Time Delay Button
2	Test Button
3	Exercise Button
4	Lamp Test Button
5	Service Required Reset
6	Maintenance DIP Switch Changed State
7	Password DIP Switch Changed State
8	Spare DIP Switch Changed State
9	Spare DIP Switch Changed State
10	Supervised Transfer Switch Changed State
11-26	Reserved
27	New I/O Module Detected
28-32	Reserved
33	No Output Function Defined
34	Preferred Source Available
35	Standby Source Available
36	Contactor in Preferred Position
37	Contactor in Standby Position
38	Contactor in Off Position
39	Contactor in Source N Position
40	Contactor in Source E Position
41	Not in Auto
42	Load Control Active
43	Low Battery on Standby Source
44	Exerciser Started
45	Test Mode Active
46	Peak Shave Active
47	Non--Emergency Transfer
48	Back-up Battery Low
49	Maintenance Mode Active
50	Load Bank Activate
51	Start Source N Generator
52	Start Source E Generator
53	In Phase Monitor Waiting for Synch

Code	Description
54	Common Alarm
55	Source N Under Voltage
56	Source N Over Voltage
57	Source N Voltage Unbalanced
58	Source N Loss of Phase
59	Source N Phase Rotation Error
60	Source N Over Frequency
61	Source N Under Frequency
62	Source E Under Voltage
63	Source E Over Voltage
64	Source E Voltage Unbalanced
65	Source E Loss of Phase
66	Source E Phase Rotation Error
67	Source E Over Frequency
68	Source E Under Frequency
69	Failure to Acquire Standby
70	Failure to Acquire Preferred
71	Failure to Transfer
72	I/O Module Comms Lost
73	Audible Alarm Status
74	Aux. Switch Fault
75	Aux. Switch Open
76	Load Control Output #0
77	Load Control Output #1
78	Load Control Output #2
79	Load Control Output #3
80	Load Control Output #4
81	Load Control Output #5
82	Load Control Output #6
83	Load Control Output #7
84	Load Control Output #8
85	Modbus Controlled RDO #1
86	Modbus Controlled RDO #2
87	Modbus Controlled RDO #3
88	Modbus Controlled RDO #4
89	3 Source System Disable Output
90	Common Alarm 2
91	Audible Alarm Has Been Silenced
92-98	Reserved for future use
99	No Input Function Defined
100	Forced Transfer to Off

Code	Description
101	Peak Shave Mode
102	Inhibit Transfer
103	Remote End Time Delay
104	Remote Test
105	Low Battery Voltage
106	Remote Common Alarm
107	Bypass Contactor Disable
108	3 Source System Disable Input
109	Remote Monitor Input #1
110	Remote Monitor Input #2
111	Remote Monitor Input #3
112	Remote Monitor Input #4
113-119	Reserved for future use
120	System Ready
121	Critical Service Required
122	Non--Critical Service Required
123	System Parameter Changed
124	Source N Available
125	Source E Available
126	Over Frequency
127	Under Frequency
128	Loss of Phase
129	Phase Rotation Error
130	Over Voltage L1--L2
131	Over Voltage L2--L3
132	Over Voltage L3--L1
133	Under Voltage L1--L2
134	Under Voltage L2--L3
135	Under Voltage L3--L1
136	Voltage Unbalanced
137	History Log Saved

Code	Description
138-147	Reserved
148	Inphase Synching
149-174	Reserved for future use
175	Auto Loaded Test Complete
176-200	Reserved for future use
201	Transfer Mode Changed
202	Default History Loaded
203	Reserved for future use
204	Default Settings Loaded
205	MLB Programmable Input Changed
206	MLB Programmable Output Changed
207	Exercise Loaded Changed
208	Test Loaded Changed
209	One/Two Week Exercise Changed
210	Disable Exercise Changed
211	Preferred Source Changed
212	Default Settings Loaded
213-214	Reserved for future use
215	Backup Parameter File Loaded
216	Backup History File Loaded
217-222	Reserved for future use
223	Modbus Force Transfer to Off
224	Modbus Peak Shave
225	Modbus System Test
226-247	Reserved for future use
248	Battery Backup Output Changed
249-250	Reserved for future use
251	A USB Device Has Been Connected
252	A USB Device Has Been Disconnected

6.1 Specifications

The DXPower™ 1000 controller's Modbus® communication capability:

- Supports industry-standard Modbus® RTU protocol.
- Can use Modbus® TCP protocol with the addition of a Modbus/Ethernet converter.
- Connects to a Modbus® master singly over an RS-232 line.
- Uses RS-485 connections to connect to a Modbus® master singly or over an RS-485 network.
- Connects to an Ethernet network using a Modbus/Ethernet converter.
- Uses standard baud rates of 9600 or 19200.

6.2 Hardware Connections

⚠ DANGER

Hazardous voltage.
Will cause severe injury or death.

Disconnect all power sources before opening the enclosure.

NOTICE

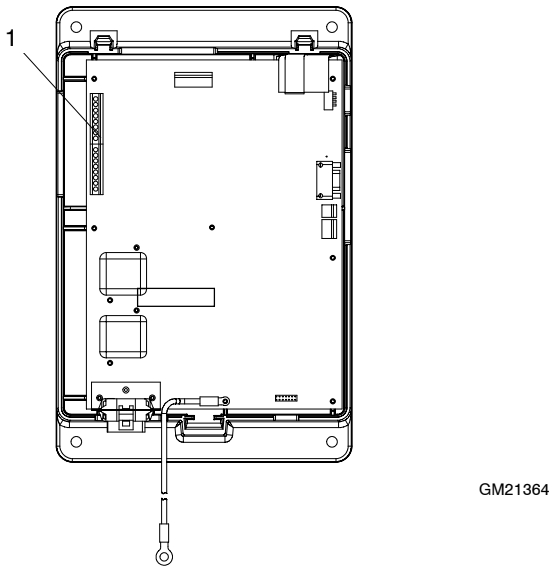
Electrostatic discharge damage. Electrostatic discharge (ESD) damages electronic circuit boards. Prevent electrostatic discharge damage by wearing an approved grounding wrist strap when handling electronic circuit boards or integrated circuits. An approved grounding wrist strap provides a high resistance (about 1 megohm), *not a direct short*, to ground.

Note: Install communication conductors in raceways, cables, or conduit separate from AC power conductors.

The controller uses a non-isolated RS-485 port with connection speeds of 9.6 kbps and 19.2 kbps.

Connection Procedure

1. Disconnect power to the transfer switch by opening switches or circuit breakers before opening the enclosure.
2. Open the controller housing and locate terminal strip TB1. See Figure 6-1.
3. Connect the Modbus® input and output to the terminals shown in Figure 6-2. Use #12–24 AWG twisted-pair shielded cable; Belden cable #9841 or equivalent is recommended. Connect A to negative (–), B to positive (+), and the shield to ground as shown in Figure 6-2.
4. Tighten the connections to 0.5 Nm (4.4 in. lbs.).
5. Replace the controller housing cover.
6. Close and lock the transfer switch enclosure door before reconnecting the power.



1. Terminal strip TB1 (inputs, output, Modbus connections)

Figure 6-1 ATS Controller, Cover Removed

Modbus® is a registered trademark of Schneider Electric.

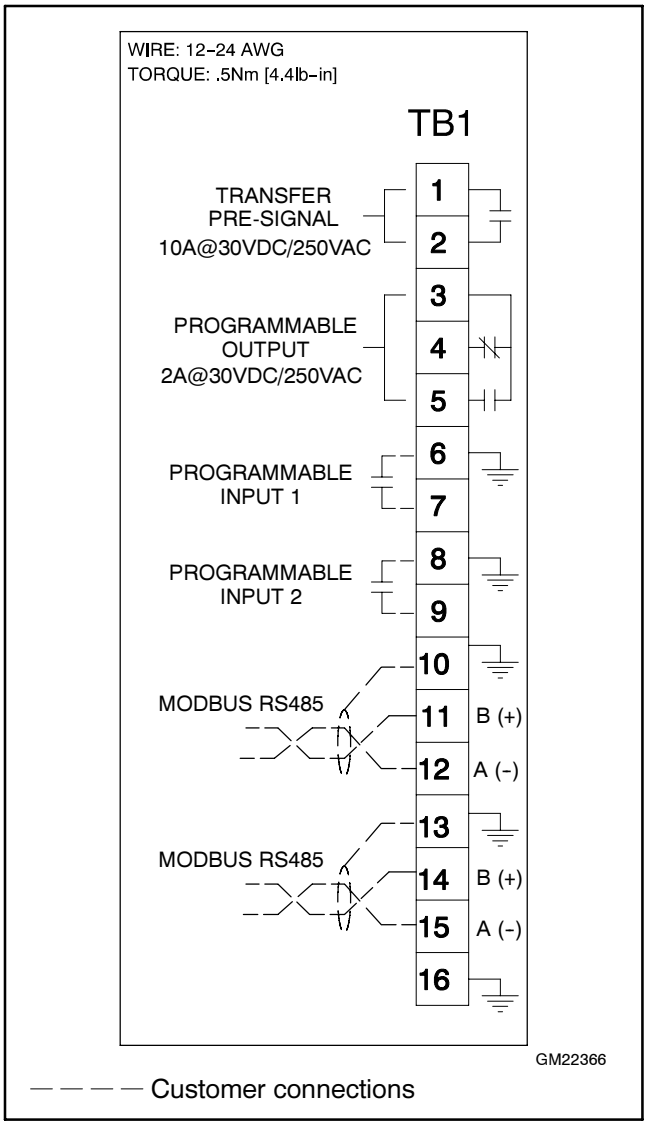


Figure 6-2 Terminal Strip TB1 Connections

6.3 Controller Setup

Use a personal computer (PC) running the ATS Controller Setup Program to set the address and baud rate of the Modbus® network interface port. Refer to the Setup Program Operation Manual for instructions for using the program, including creating data windows.

Follow the instructions in the Setup Program Operation Manual to use the Network Interface Port data window to check and set the address and baud rate of the Modbus® network interface port to match the other devices in the network. See Figure 6-3.

The Network Interface Port display window shows the address and baud rate of the Modbus® network interface port.

Use the Network Interface Port setup window to set the Modbus® network interface port to communicate with the other devices in the network. See Figure 6-4.

Choose a unique network address for each device in the network. Type in the address or use the up and down arrows. Choose the baud rate from the drop-down list. Allowable baud rates are 9600 and 19200 baud. Select the baud rate to match the other devices on the network.

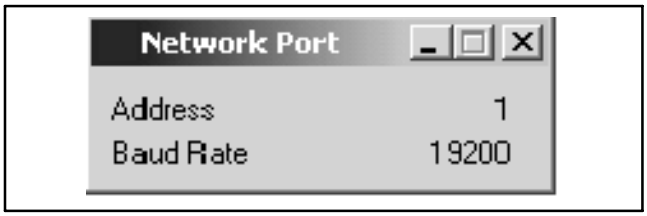


Figure 6-3 Network Interface Port Display Window

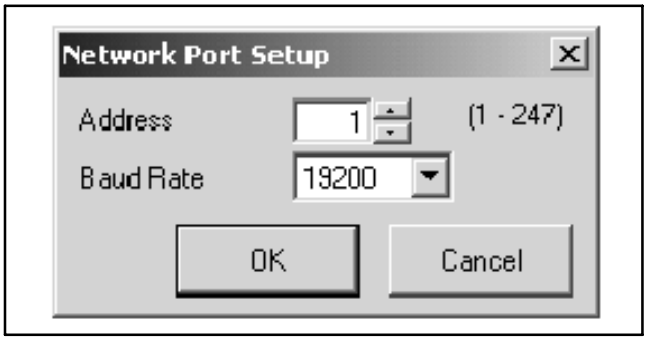


Figure 6-4 Network Interface Port Setup Window

Modbus® is a registered trademark of Schneider Electric.

6.4 Modbus Registers

Refer to Section 1.3 for definitions of terms and symbols used in the register tables.

Time delays, setpoints, inputs and outputs, and other user-defined parameters are programmed using the Setup Program. Refer to the Setup Program Operation Manual for instructions. See the List of Related Materials for document part numbers.

6.4.1 Guide to the Register Map

Description	Registers
Monitoring	40001-40021
Setup	40022-40030
Time Delays	400032-40044
Trip Point Settings	40045-40064
Outputs (Event code)	40066-40089
Inputs (Event code)	40090-40099
Event History	40150-40550
I/O Status	40600-40605
Active Time Delay	40650-40652
Accessories	40740-40742
DIP Switch Positions	40743
Pre/Post Transfer Delays	40750-40785
Common Alarms	40800-40864
Exerciser	40900-40994
Last Outage	41010-41013
Customer-Defined Descriptions *	41110-41149
Code Versions	41200-41205
Time/Date	41250-41254
Maintenance History	41300-41351
Disable Manual Exercise	41352
Device ID	49999
* Descriptions entered through Setup or Monitor III software.	

6.4.2 Modbus Registers

Register	Data Description	Access	Data Type	Range/Units
40001	System Overview	RO	Word[0:14]	0-1: Contactor Position (00 = Off; 01 = Normal; 10 = Emerg; 11 = Fault)
				2: Preferred Source (0 = Source1; 1= Source2)
				3-12: Top Event on Warning Stack
				13: Preferred Source Available (0 = No, 1 = Yes)
				14: Standby Source Available (0 = No, 1 = Yes)
40002	SourceA Line-Neutral L1-L0	RO	Word	Volts AC * 10
40003	SourceA Line-Neutral L2-L0	RO	Word	Volts AC * 10
40004	SourceA Line-Neutral L3-L0	RO	Word	Volts AC * 10
40005	SourceB Line-Neutral L1-L0	RO	Word	Volts AC * 10
40006	SourceB Line-Neutral L2-L0	RO	Word	Volts AC * 10
40007	SourceB Line-Neutral L3-L0	RO	Word	Volts AC * 10
40008	SourceA Line Voltage L1-L2	RO	Word	Volts AC * 10
40009	SourceA Line Voltage L2-L3	RO	Word	Volts AC * 10
40010	SourceA Line Voltage L3-L1	RO	Word	Volts AC * 10
40011	SourceB Line Voltage L1-L2	RO	Word	Volts AC * 10
40012	SourceB Line Voltage L2-L3	RO	Word	Volts AC * 10
40013	SourceB Line Voltage L3-L1	RO	Word	Volts AC * 10
40014	SourceA Frequency	RO	Word	Hz * 10
40015	SourceB Frequency	RO	Word	Hz * 10
40016	*Reserved for future use*			Return 0
40017	*Reserved for future use*			Return 0
40018	*Reserved for future use*			Return 0
40019	*Reserved for future use*			Return 0
40020	*Reserved for future use*			Return 0
40021	*Reserved for future use*			Return 0
40022	Source Phase Sequence Actual	RO	Word[0:3]	0-1: SourceA 01 = ABC; 00 = CBA; 10 = N/A; 11 = ERR
				2-3: SourceB 01 = ABC; 00 = CBA; 10 = N/A; 11 = ERR
40023	Source Phase Sequence Expected	RW	Word[0]	0: 1 = ABC; 0 = CBA
40024	SourceA Nominal Voltage	RW	Word	Volts AC * 10
40025	SourceB Nominal Voltage	RW	Word	Volts AC * 10
40026	SourceA Nominal Frequency	RW	Word	Hz * 10
40027	SourceB Nominal Frequency	RW	Word	Hz * 10
40028	SourceA Number of Phases	RW	Word	1 or 3
40029	SourceB Number of Phases	RW	Word	1 or 3
40030	Rated Amperage	RW	Word	0-4000
40032	SourceA Engine Start Time Delay (ID 0x0001)	RW	Word	0-6 sec
40033	SourceB Engine Start Time Delay (ID 0x0002)	RW	Word	0-6 sec
40034	SourceA Ext Engine Start Time Delay (ID 0x0003)	RW	Word	0-5999 sec
40035	SourceB Ext Engine Start Time Delay (ID 0x0004)	RW	Word	0-5999 sec
40036	SourceA Engine Cooldown Time Delay (ID 0x0005)	RW	Word	0-5999 sec
40037	SourceB Engine Cooldown Time Delay (ID 0x0006)	RW	Word	0-5999 sec
40038	Preferred to Standby Time Delay (ID 0x0007)	RW	Word	0-5999 sec
40039	Standby to Preferred Time Delay (ID 0x0008)	RW	Word	0-5999 sec
40040	Off to Preferred Time Delay (ID 0x0009)	RW	Word	0-5999.9 sec * 10
40041	Off to Standby Time Delay (ID 0x000A)	RW	Word	0-5999.9 sec * 10
40042	Acquire Standby Source (ID 0x000B)	RW	Word	1-5999 sec

Register	Data Description	Access	Data Type	Range/Units
40043	InPhase Monitor Synch (ID 0x000C)	RW	Word	1-5999 sec
40044	*Reserved for future use*			Return 0
40045	SourceA Over Volt Dropout Trip Point	RW	Word	(105 - 135) % of rated source voltage
40046	SourceA Over Volt Pickup Trip Point	RW	Word	(95 - 100)% of over voltage dropout point
40047	SourceA Under Volt Pickup Trip Point	RW	Word	(85 - 100) % of rated source voltage
40048	SourceA Under Volt Dropout Trip Point	RW	Word	(75 - 98) % of overvoltage pickup point
40049	SourceA Voltage Debounce Time	RW	Word	Sec * 10 (0.1-9.9)
40050	SourceB Over Volt Dropout Trip Point	RW	Word	(105 - 135) % of rated source voltage
40051	SourceB Over Volt Pickup Trip Point	RW	Word	(95 - 100)% of over voltage dropout point
40052	SourceB Under Volt Pickup Trip Point	RW	Word	(85 - 100) % of rated source voltage
40053	SourceB Under Volt Dropout Trip Point	RW	Word	(75 - 98) % of overvoltage pickup point
40054	SourceB Voltage Debounce Time	RW	Word	Sec * 10 (0.1-9.9)
40055	SourceA Over Freq Dropout Trip Point	RW	Word	(101 -105) % of overfreq pickup point
40056	SourceA Over Freq Pickup Trip Point	RW	Word	(105 - 120) % of rated source freq
40057	SourceA Under Freq Dropout Trip Point	RW	Word	(95 - 99) % of underfreq pickup point
40058	SourceA Under Freq Pickup Trip Point	RW	Word	(80 - 95)% of rated system frequency
40059	SourceA Freq Dropout Time	RW	Word	Sec * 10 (0.1-15.0)
40060	SourceB Over Freq Dropout Trip Point	RW	Word	(101 -105) % of overfreq pickup point
40061	SourceB Over Freq Pickup Trip Point	RW	Word	(105 - 120) % of rated source freq
40062	SourceB Under Freq Dropout Trip Point	RW	Word	(95 - 99) % of underfreq pickup point
40063	SourceB Under Freq Pickup Trip Point	RW	Word	(80 - 95)% of rated system frequency
40064	SourceB Freq Dropout Time	RW	Word	Sec * 10 (0.1-15.0)
40065	ATS Controller Output	RW	Word	Event Code (see Section 6.4.3)
40066	I/O Module 1 Output 1	RW	Word	Event Code (see Section 6.4.3)
40067	I/O Module 1 Output 2	RW	Word	Event Code (see Section 6.4.3)
40068	I/O Module 1 Output 3	RW	Word	Event Code (see Section 6.4.3)
40069	I/O Module 1 Output 4	RW	Word	Event Code (see Section 6.4.3)
40070	I/O Module 1 Output 5	RW	Word	Event Code (see Section 6.4.3)
40071	I/O Module 1 Output 6	RW	Word	Event Code (see Section 6.4.3)
40072	I/O Module 2 Output 1	RW	Word	Event Code (see Section 6.4.3)
40073	I/O Module 2 Output 2	RW	Word	Event Code (see Section 6.4.3)
40074	I/O Module 2 Output 3	RW	Word	Event Code (see Section 6.4.3)
40075	I/O Module 2 Output 4	RW	Word	Event Code (see Section 6.4.3)
40076	I/O Module 2 Output 5	RW	Word	Event Code (see Section 6.4.3)
40077	I/O Module 2 Output 6	RW	Word	Event Code (see Section 6.4.3)
40078	I/O Module 3 Output 1	RW	Word	Event Code (see Section 6.4.3)
40079	I/O Module 3 Output 2	RW	Word	Event Code (see Section 6.4.3)
40080	I/O Module 3 Output 3	RW	Word	Event Code (see Section 6.4.3)
40081	I/O Module 3 Output 4	RW	Word	Event Code (see Section 6.4.3)
40082	I/O Module 3 Output 5	RW	Word	Event Code (see Section 6.4.3)
40083	I/O Module 3 Output 6	RW	Word	Event Code (see Section 6.4.3)
40084	I/O Module 4 Output 1	RW	Word	Event Code (see Section 6.4.3)
40085	I/O Module 4 Output 2	RW	Word	Event Code (see Section 6.4.3)
40086	I/O Module 4 Output 3	RW	Word	Event Code (see Section 6.4.3)
40087	I/O Module 4 Output 4	RW	Word	Event Code (see Section 6.4.3)
40088	I/O Module 4 Output 5	RW	Word	Event Code (see Section 6.4.3)
40089	I/O Module 4 Output 6	RW	Word	Event Code (see Section 6.4.3)
40090	TSI1 Event	RW	Word	Event Code (see Section 6.4.3)
40091	TSI2 Event	RW	Word	Event Code (see Section 6.4.3)
40092	I/O Module 1 Input 1	RW	Word	Event Code (see Section 6.4.3)
40093	I/O Module 1 Input 2	RW	Word	Event Code (see Section 6.4.3)
40094	I/O Module 2 Input 1	RW	Word	Event Code (see Section 6.4.3)
40095	I/O Module 2 Input 2	RW	Word	Event Code (see Section 6.4.3)
40096	I/O Module 3 Input 1	RW	Word	Event Code (see Section 6.4.3)

Register	Data Description	Access	Data Type	Range/Units
40097	I/O Module 3 Input 2	RW	Word	Event Code (see Section 6.4.3)
40098	I/O Module 4 Input 1	RW	Word	Event Code (see Section 6.4.3)
40099	I/O Module 4 Input 2	RW	Word	Event Code (see Section 6.4.3)
40150	Events 0 - 19	RO	Word*100	Time, Date, Code (see Section 6.4.3), Param1, Parma2
40250	Events 20 - 39	RO	Word*100	Time, Date, Code (see Section 6.4.3), Param1, Parma2
40350	Events 40 - 59	RO	Word*100	Time, Date, Code (see Section 6.4.3), Param1, Parma2
40450	Events 60 - 79	RO	Word*100	Time, Date, Code (see Section 6.4.3), Param1, Parma2
40550	Events 80 - 99	RO	Word*100	Time, Date, Code (see Section 6.4.3), Param1, Parma2
40600	SCRDOs (software-controlled relay driver outputs)	RW	Word[0:1]	X0 = Off; X1 = On; 0X = Unassigned; 1X = Assigned
40601	MLB (main logic board) I/O Status	RO	Word [0:4]	One bit per I/O: Bit 0=Programmable Output Bit 1=Programmable Input #1 Bit 2=Programmable Input #2 Bit 3=Fixed Output LSDO Bit 4=Fixed Output Source 2 Engine Start
40602	I/O Module1 I/O Status	RO	Word [0:7]	For each I/O module: Bit 0=Programmable Output #1 Bit 1=Programmable Output #2 Bit 2=Programmable Output #3 Bit 3=Programmable Output #4 Bit 4=Programmable Output #5 Bit 5=Programmable Output #6 Bit 6=Programmable Input #1 Bit 7=Programmable Input #2
40603	I/O Module2 I/O Status	RO	Word [0:7]	
40604	I/O Module3 I/O Status	RO	Word [0:7]	
40605	I/O Module4 I/O Status	RO	Word [0:7]	
40650	Active Time Delay Number	RO	Word	
40651	Active Time Delay Remaining	RO	Word	Seconds
40652	Active Time Delay Preset	RO	Word	Seconds
40740	Accessory Setup	RW	Word[0:15]	0: Enable Engine Start Extended Time Delay
				1: Reserved for future use (always 0)
				2: Enable In Phase Monitor
				3: Reserved for future use (always 0)
				4: Commit to Transfer
				5: Peak Shave Delay Bypass
				6-7: Reserved for future use (always 0)
				8: In Phase Transition Angle (0=Lagging; 1=Leading)
				9-15: In Phase Transition Angle
40741	No. of I/O Modules	RW	Word	1-4
40742	Accessory Status	RO	Word[0:4]	0: Exercise In Progress
				1: In Phase Monitor Active
				2: Load Shed In Progress
				3: Peak Shaving In Progress
				4: Test Occurring
40743	DIP Switch Position	RO	Word[0:4]	0: Transfer Inhibited
				1: Loaded/Unloaded Test
				2: Exercise Inhibited
				3: Loaded/Unloaded Exercise (Push Button Only) (0=Unloaded; 1=Loaded)
				4: Exercise Interval (Push Button Only) (0=1 week; 1=2 week)

Register	Data Description	Access	Data Type	Range/Units
40750	Before Transfer to Source 1 Mtr Load Discon. Output	RW	Word	0-3600 Sec
40751	Before Transfer Source 1 Delay #1	RW	Word	0-3600 Sec
40752	Before Transfer Source 1 Delay #2	RW	Word	0-3600 Sec
40753	Before Transfer Source 1 Delay #3	RW	Word	0-3600 Sec
40754	Before Transfer Source 1 Delay #4	RW	Word	0-3600 Sec
40755	Before Transfer Source 1 Delay #5	RW	Word	0-3600 Sec
40756	Before Transfer Source 1 Delay #6	RW	Word	0-3600 Sec
40757	Before Transfer Source 1 Delay #7	RW	Word	0-3600 Sec
40758	Before Transfer Source 1 Delay #8	RW	Word	0-3600 Sec
40759	After Transfer to Source 1 Mtr Load Discon. Output	RW	Word	0-3600 Sec
40760	After Transfer Source 1 Delay #1	RW	Word	0-3600 Sec
40761	After Transfer Source 1 Delay #2	RW	Word	0-3600 Sec
40762	After Transfer Source 1 Delay #3	RW	Word	0-3600 Sec
40763	After Transfer Source 1 Delay #4	RW	Word	0-3600 Sec
40764	After Transfer Source 1 Delay #5	RW	Word	0-3600 Sec
40765	After Transfer Source 1 Delay #6	RW	Word	0-3600 Sec
40766	After Transfer Source 1 Delay #7	RW	Word	0-3600 Sec
40767	After Transfer Source 1 Delay #8	RW	Word	0-3600 Sec
40768	Before Transfer to Source 2 Mtr Load Discon. Output	RW	Word	0-3600 Sec
40769	Before Transfer Source 2 Delay #1	RW	Word	0-3600 Sec
40770	Before Transfer Source 2 Delay #2	RW	Word	0-3600 Sec
40771	Before Transfer Source 2 Delay #3	RW	Word	0-3600 Sec
40772	Before Transfer Source 2 Delay #4	RW	Word	0-3600 Sec
40773	Before Transfer Source 2 Delay #5	RW	Word	0-3600 Sec
40774	Before Transfer Source 2 Delay #6	RW	Word	0-3600 Sec
40775	Before Transfer Source 2 Delay #7	RW	Word	0-3600 Sec
40776	Before Transfer Source 2 Delay #8	RW	Word	0-3600 Sec
40777	After Transfer to Source 2 Mtr Load Discon. Output	RW	Word	0-3600 Sec
40778	After Transfer Source 2 Delay #1	RW	Word	0-3600 Sec
40779	After Transfer Source 2 Delay #2	RW	Word	0-3600 Sec
40780	After Transfer Source 2 Delay #3	RW	Word	0-3600 Sec
40781	After Transfer Source 2 Delay #4	RW	Word	0-3600 Sec
40782	After Transfer Source 2 Delay #5	RW	Word	0-3600 Sec
40783	After Transfer Source 2 Delay #6	RW	Word	0-3600 Sec
40784	After Transfer Source 2 Delay #7	RW	Word	0-3600 Sec
40785	After Transfer Source 2 Delay #8	RW	Word	0-3600 Sec
40800-40864	Common Event Alarms	RW	Word * 65 [0:15]	0-14: Event code of defined common alarm (DCA) (see Section 6.4.3)
				15: 0=Not assigned to DCA; 1= Assigned to DCA
40900	Plant Exerciser Mode	RW	Word	0 = Push Button Mode; 1 = Calendar Only; 2 = Calendar w/ Override
40901	Length Push Button Exercise	RW	Word	1-5999 Minutes
40902	Time of Push Button Exercise	RO	Word	Minutes since midnight
40903	Initial Date of Push Button Exercise	RO	Word [0:15]	0-4: Day of Month
				5-8: Month of Year
				9-15: Year + 2000 (2000-2127)

Register	Data Description	Access	Data Type	Range/Units
40905	Enabled / Loaded / Interval Code / Repeat Rate Next Cal. Event	RW	Word[0:8]	0: 0 = Disabled; 1 = Enabled
				1: 0 = Unloaded; 1 = Loaded
				2-3: Interval Code (00 = DMO; 01 = day; 10 = week; 11 = month)
				4-7: Repeat Rate (1-12)
				8: 0 = Not Running; 1 = Running (read only)
40906	Start Time Next Cal. Event	RW	Word	Minutes since midnight
40907	Start Date Next Cal. Event	RW	Word[0:15]	0-4: Day of Month
				5-8: Month of Year
				9-15: Year + 2000 (2000-2127)
40908	Run Time Next Cal. Event	RW	Word	1-5999 Minutes
40910	Enabled / Loaded / Interval Code / Repeat Rate Exer. Event #1	RW	Word[0:8]	0: 0 = Disabled; 1 = Enabled
				1: 0 = Unloaded; 1 = Loaded
				2-3: Interval Code (00 = DMO; 01 = day; 10 = week; 11 = month)
				4-7: Repeat Rate (1-12)
				8: 0 = Not Running; 1 = Running (read only)
40911	Start Time Exer. Event #1	RW	Word	Minutes since midnight
40912	Start Date Exer. Event #1	RW	Word[0:15]	0-4: Day of Month
				5-8: Month of Year
				9-15: Year + 2000 (2000-2127)
40913	Run Time Exer. Event #1	RW	Word	1-5999 Minutes
40914-40994	Exer. Events #2-#21 (same as above)	RW	Word * 80	Same structure as Exer. Event #1
41010	Last Outage Time	RO	Word	Minutes since midnight
41011	Last Outage Date	RO	Word [0:15]	0-4: Day of Month
				5-8: Month of Year
				9-15: Year + 2000 (2000-2127)
41012-41013	Duration of Last Outage	RO	Word * 2	Minutes
41110-41119	Designation	RW	Word * 10	20 ASCII characters
41120-41129	Load Description	RW	Word * 10	20 ASCII characters
41130-41139	Branch Description	RW	Word * 10	20 ASCII characters
41140-41149	Location	RW	Word * 10	20 ASCII characters
41200	ATS Controller Code Revision	RO	Word[0:15]	0-7: Minor Version
				8-15: Major Version
41201	PIC Code Revision	RO	Word[0:15]	0-7: Minor Version
				8-15: Major Version
41202	I/O Module1 Code Revision	RO	Word[0:15]	0-7: Minor Version (return 0 if not installed)
				8-15: Major Version (return 0 if not installed)
41203	I/O Module2 Code Revision	RO	Word[0:15]	0-7: Minor Version (return 0 if not installed)
				8-15: Major Version (return 0 if not installed)
41204	I/O Module3 Code Revision	RO	Word[0:15]	0-7: Minor Version (return 0 if not installed)
				8-15: Major Version (return 0 if not installed)
41205	I/O Module4 Code Revision	RO	Word[0:15]	0-7: Minor Version (return 0 if not installed)
				8-15: Major Version (return 0 if not installed)
41250	Time	RW	Word	Minutes since midnight
41251	Date (day)	RW	Word [0:15]	0-4: Day of Month
	Date (month)			5-8: Month of Year
	Date (year)			9-15: Year + 2000 (2000-2127)
41252	Adjust for daylight savings time	RW	Word [0]	0: 0 = do not adjust; 1 = adjust

Register	Data Description	Access	Data Type	Range/Units
41253	Date to move clock forward (day)	RW	Word [0:15]	0-4: Day of Month
	Date to move clock forward (month)			5-8: Month of Year
	Date to move clock forward (year)			9-15: Year + 2000 (2000-2127)
41254	Date to move clock backward (day)	RW	Word [0:15]	0-4: Day of Month
	Date to move clock backward (month)			5-8: Month of Year
	Date to move clock backward (year)			9-15: Year + 2000 (2000-2127)
41300-41301	Minutes not in Preferred Total	RO	Word * 2	minutes (most significant word first)
41302-41303	Minutes not in Preferred since Reset	RO	Word * 2	minutes (most significant word first)
41304-41305	Minutes in Standby Total	RO	Word * 2	minutes (most significant word first)
41306-41307	Minutes in Standby since Reset	RO	Word * 2	minutes (most significant word first)
41308-41309	Minutes of Operation Total	RO	Word * 2	minutes (most significant word first)
41310-41311	Minutes of Operation since Reset	RO	Word * 2	minutes (most significant word first)
41312	Switch Transfers Total	RO	Word	
41313	Switch Transfers since Reset	RO	Word	
41314	Failures to Transfer Total	RO	Word	
41315	Failures to Transfer since Reset	RO	Word	
41316	Loss of Preferred Transfers Total	RO	Word	
41317	Loss of Preferred Transfers since Reset	RO	Word	
41318	Transfer Time N->E	RO	Word	milliseconds
41319	Transfer Time E->N	RO	Word	milliseconds
41320	System Start Date	RO	Word [0:15]	0-4: Day of Month
				5-8: Month of Year
				9-15: Year + 2000 (2000-2127)
41321	Last Maintenance Date	RO	Word [0:15]	0-4: Day of Month
				5-8: Month of Year
				9-15: Year + 2000 (2000-2127)
41350	Maintenance/Test & Manual Actions	WO	Word [0:9]	0: Reset Maintenance Records
				1: Start Peak Shave
				2: End Peak Shave
				3: Start Remote Test
				4: End Remote Test
				5: Force Transfer to OFF
				6: Resume Program Trans. Operation
				7: End Current Time Delay
				8: Remote Manual Exercise Start
41351	Clear Event Log	WO	Word[0]	0: 1=Clear Log
41352	Disable Manual Exercise	RW	Word[0]	0: 0=Enabled; 1=Disabled
49999	Device ID	RO	Word	DXPower ®1000 ATS controller= 19

6.4.3 Event Codes

Event codes are used in the Event History registers 40150-40599.

Code	Description
1	End Time Delay Button
2	Test Button
3	Exercise Button
4	Lamp Test Button
5	Service Required Reset
6	Exerciser Set
7	Maintenance DIP Switch
8	Exerciser Loaded DIP Switch
9	Test Loaded DIP Switch
10	One/Two Week DIP Switch
11	Disable Exercise DIP Switch
12	Supervised Switch in Manual
13	Supervised Immediate Transfer
14	Supervised Switch in Auto
15	Source N Preferred
16	Source E Preferred
17-45	*Reserved*
46	I/O Module Timeout
47	I/O Module Bus Error
48-54	*Reserved for future use*
55	No Function Defined
56	Preferred Source Available
57	Standby Source Available
58	Contactor in Preferred Position
59	Contactor in Standby Position
60	Contactor in Off Position
61	Contactor in Source N Position
62	Contactor in Source E Position
63	Not in Auto
64	Load Control Active
65	Low Battery on Standby Source
66	Exerciser Started
67	Test Mode Active
68	Peak Shave Active
69	Non-Emergency Transfer
70	Load Bank Activate
71	Start Source N Generator
72	Start Source E Generator
73	In Phase Monitor Waiting for Synch
74	Common Alarm
75	Source N Under Voltage
76	Source N Over Voltage
77	Source N Loss of Phase
78	Source N Phase Rotation Error
79	Source N Over Frequency
80	Source N Under Frequency
81	Source E Under Voltage
82	Source E Over Voltage
83	Source E Loss of Phase
84	Source E Phase Rotation Error
85	Source E Over Frequency
86	Source E Under Frequency
87	Failure to Acquire Standby
88	Failure to Transfer
89	I/O Module Comms Lost
90	I/O Module Not Found
91	I/O Module Not Installed
92	Aux. Switch Fault
93	Aux. Switch Open
94	Load Control Output #0
95	Load Control Output #1
96	Load Control Output #2
97	Load Control Output #3
98	Load Control Output #4
99	Load Control Output #5
100	Load Control Output #6
101	Load Control Output #7
102	Load Control Output #8
103	Modbus Controlled RDO #1
104	Modbus Controlled RDO #2
105	Modbus Controlled RDO #3
106	Modbus Controlled RDO #4
107	3 Source System Disable
108-114	*Reserved for future use*
115	No Function Defined
116	Forced Transfer to Off
117	Peak Shave Mode
118	Inhibit Transfer
119	Remote End Time Delay
120	Remote Test
121	Low Battery Voltage
122	Remote Common Alarm
123	Bypass Contactor Disable
124	3 Source System Disable
125-131	*Reserved for future use*
132	Contactor Moved
133	EEPROM Access Warning
134	Internal Fault
135	System Ready
136	Critical Service Required
137	Non-Critical Service Required
138	System Parameter Changed
139	Source N Available
140	Source E Available
141	Over Frequency Source E
142	Under Frequency Source E
143	Loss of Phase Source E
144	Phase Rotation Error Source E
145	Over Voltage L1-L2 Source E
146	Over Voltage L2-L3 Source E

Code	Description
147	Over Voltage L3-L1 Source E
148	Under Voltage L1-L2 Source E
149	Under Voltage L2-L3 Source E
150	Under Voltage L3-L1 Source E
151-201	*Reserved*
202	Partial Meter Read
203-209	*Reserved for future use*
210	History Read from EEPROM
212	DCA Read from EEPROM
213	Exercise Time Updated
214	Network Settings Updated
211	Settings Read from EEPROM
215	Transfer Mode Changed
216	Default History Loaded
217	Default Settings Loaded
218	Default Common Alarms Loaded
219-222	*Reserved for future use*
223	Modbus Force Transfer to Off
224	Modbus Peak Shave
225	Modbus System Test

Notes

7.1 Introduction

The MATS and MATS+ ATS controllers use KBUS protocol for communication. Modbus®/KBUS converter kits are required for Modbus communication with these controllers. See Figure 7-1.

Installing the Modbus®/KBUS converter kit allows this controller to communicate with a personal computer running Monitor III software. For other Modbus applications, the Modbus master must be programmed to read the Modbus registers shown in this manual. A system designer trained in the application of Modbus® protocol must write and thoroughly test the program before implementation.

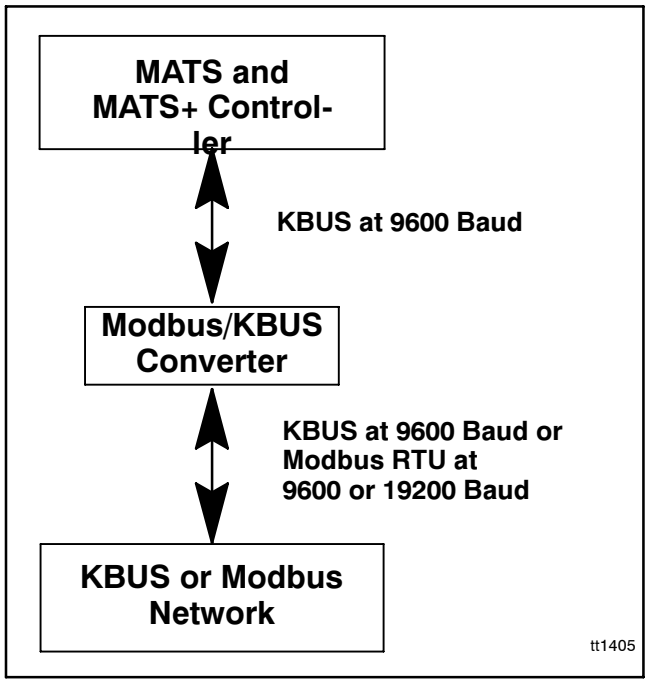


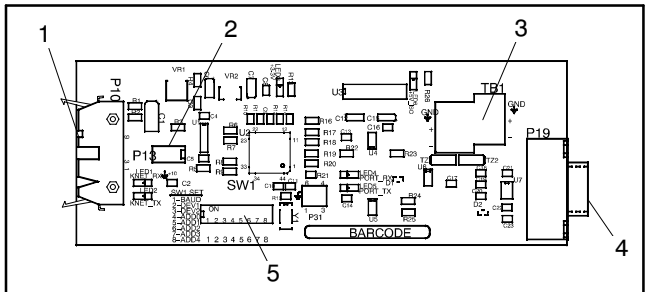
Figure 7-1 Modbus/KBUS Converter Function

7.2 Hardware and Connections

Modbus/KBUS converter kit GM41143-KP3 replaces RS-232 and RS-485 communication modules and allows the selection of either KBUS or Modbus communication. Figure 7-2 shows the Modbus/KBUS converter circuit board. See Figure 7-4 and Figure 7-3 for the converter location inside the controller.

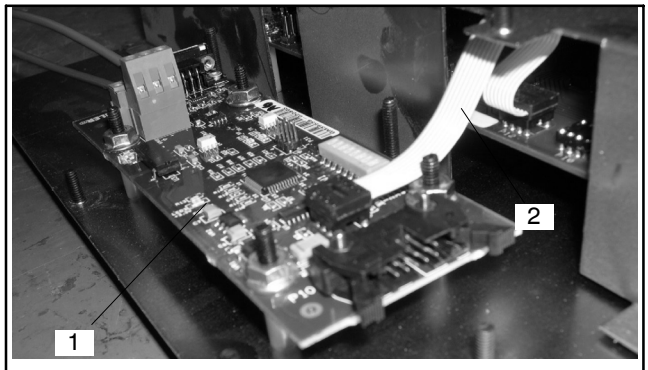
If your device is equipped with an RS-232/RS-485 communication module, remove the old communication module and ribbon cable before installing the new Modbus/KBUS converter and ribbon cable.

Refer to Installation Instructions TT-1405, provided with the converter kit, for converter installation and connection instructions. Set the converter DIP switches for baud rate, device type, and network address as described in TT-1405.



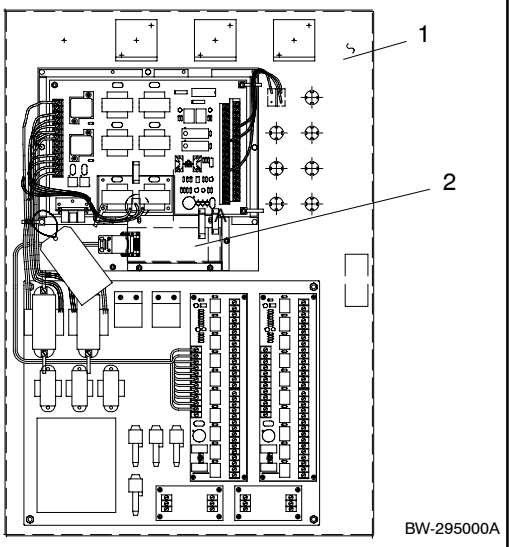
1. P10, ribbon cable connection for 340 generator set and power monitor
2. P13, ribbon cable connection for ATS controller
3. RS-485 connection TB1
4. RS-232 connection P19
5. DIP switches 1–8

Figure 7-2 Modbus/KBUS Converter Board



1. Circuit board
2. Ribbon cable

Figure 7-3 Modbus/KBUS Converter Kit, Installed



1. ATS enclosure door
2. Converter module location

Figure 7-4 Modbus/KBUS Converter Location

7.3 Controller Setup

Configure the controller for remote communications by setting the parameters shown in Figure 7-5. See TT-1405 and the controller Operation Manual for more information.

Device	Menu or Index	Parameter	Setting
MATS or MATS+ATS Controller	Index 13, Remote Control and Monitoring Settings	Remote Control, On-Line?	YES
		Local, LAN, Remote, or Remote Area Network	Select the appropriate setting for your connection type. Use Local for Ethernet connections. See TT-1405 for more information.
		Address	Any *
		Baud rate	9600 †

* The network address for Series 340 devices is set using DIP switches on the converter module and will override the network address on the controller.

† This baud rate must be set at 9600 to match the KBUS side of the Modbus/KBUS converter. It may be different from the Modbus baud rates of other devices in the system.

Figure 7-5 Controller Settings for Modbus Communication

7.4 Modbus Registers

Refer to Section 1.3 for definitions of terms and symbols used in the register tables.

Register	Data Description	Access	Data Type	Range/Units
40001				
40002	System Time	RW	WORD	
40003	Day of Week	RW	WORD	
40004	Month	RW	WORD	1-12
40005	Day	RW	WORD	1-31
40006	Year	RW	WORD	
40007	Week of Month	RW	WORD	
40008	Time Not In Normal Since Reset	RO	WORD	hrs
40009	Time In Emergency Since Reset			hrs
40010	Days of Operation Since Reset			days
40011	Transfers Since Reset			
40012	Month of Reset			1-12
40013	Day of Reset			1-31
40014	Year of Reset			
40015	Time Not In Normal	RO	WORD	hrs
40016	Time In Emergency	RO	WORD	hrs
40017	Days of Operation	RO	WORD	days
40018	Transfers	RO	WORD	
40019	Month in Operation	RO	WORD	1-12
40020	Day in Operation	RO	WORD	1-31
40021	Year in Operation	RO	WORD	
40022	Voltage A-B Normal	RO	WORD	volts
40023	Voltage B-C Normal	RO	WORD	volts
40024	Voltage C-A Normal	RO	WORD	volts
40025	Freq. A-C Normal	RO	WORD	hz
40026	Voltage A-B Emerg.	RO	WORD	volts
40027	Voltage B-C Emerg.	RO	WORD	volts
40028	Voltage C-A Emerg.	RO	WORD	volts
40029	Freq. A-C Emerg.	RO	WORD	hz
40030	Exerciser Time Remaining	RO	WORD	
40031	Month of Last Exercise	RO	WORD	1-12
40032	Day of Last Exercise	RO	WORD	1-31
40033	Year of Last Exercise	RO	WORD	
40034	Time of Last Outage	RO	WORD	
40035	Month of Last Outage	RO	WORD	1-12
40036	Day of Last Outage	RO	WORD	1-31
40037	Year of Last Outage	RO	WORD	
40038	Duration of Last Outage	RO	WORD	
40039	History Event #1 Code	RO	WORD	code
40040	History Event #2 Code	RO	WORD	code
40041	History Event #2 Month	RO	WORD	1-12
40042	History Event #2 Day	RO	WORD	1-31
40043	History Event #2 Year	RO	WORD	
40044	History Event #3 Code	RO	WORD	code
40045	History Event #3 Month	RO	WORD	1-12
40046	History Event #3 Day	RO	WORD	1-31
40047	History Event #3 Year	RO	WORD	
40048	History Event #4 Code	RO	WORD	code
40049	History Event #4 Month	RO	WORD	1-12
40050	History Event #4 Day	RO	WORD	1-31
40051	History Event #4 Year	RO	WORD	
40052	Alert Code	RO	WORD	Alert Code

Register	Data Description	Access	Data Type	Range/Units
40064	Status	RO	WORD[0-7]	0-1: Sw. Position (00=undefined; 01=Normal; 10=Emerg.; 11=undefined)
				2: Normal Source Available
				3: Emerg. Source Available
				4-5: Prog. Mode Sw. (00=Off; 01=Remote; 10=Local; 11= undefined)
				6: Test Sw. In Auto
				7: Manual Transfer Mode
40066	Settings	RW	WORD[0-7]	0: Plant Exerciser Enabled
				1: Load Shed Enabled
				2: In Phase Monitor Enabled
				3: Area Protection Enabled
				4: Normal Phase Sequence (0=ABC; 1=BAC)
				5: Emerg. Phase Sequence (0=ABC; 1=BAC)
				6: Normal Number of Phases (0=Single; 1=Three)
				7: Emerg. Number of Phases (0=Single; 1=Three)
400677	Settings	RW	WORD[4-6]	4: Extended Time Delays Enabled
				5: Manual Override Enabled
				6: Load Transfer Enabled
40078	Off to Emergecny Time Delay	RW	WORD	0-5940 seconds; 0x7FFF if NOT MATS+
40079	Off to Normal Time Delay	RW	WORD	0-5940 seconds; 0x7FFF if NOT MATS+
40080	Engine Start Time Delay	RW	WORD	
40081	Normal to Emerg. Time Delay	RW	WORD	
40082	Emerg. To Normal Time Delay	RW	WORD	
40083	Engine Cooldown Time Delay	RW	WORD	
40084	Before Emerg. Time Delay	RW	WORD	
40085	After Emerg. Time Delay	RW	WORD	
40086	Sequence to Emerg. Time Delay	RW	WORD	
40087	Return to Emerg. Loads	RW	WORD	(1-9)
40088	Before Normal Time Delay	RW	WORD	
40089	After Normal Time Delay	RW	WORD	
40090	Sequence to Normal Time Delay	RW	WORD	
40091	Return to Normal Loads	RW	WORD	(1-9)
40092	Over Voltage Dropout Normal	RW	WORD	
40093	Over Voltage Pickup Normal	RW	WORD	
40094	Under Voltage Pickup Normal	RW	WORD	
40095	Under Voltage Dropout Normal	RW	WORD	
40096	Over Frequency Dropout Normal	RW	WORD	
40097	Over Frequency Pickup Normal	RW	WORD	
40098	Under Frequency Pickup Normal	RW	WORD	
40099	Under Frequency Dropout Normal	RW	WORD	
40100	Over Voltage Dropout Emerg.	RW	WORD	
40101	Over Voltage Pickup Emerg.	RW	WORD	
40102	Under Voltage Pickup Emerg.	RW	WORD	
40103	Under Voltage Dropout Emerg.	RW	WORD	
40104	Over Frequency Dropout Emerg.	RW	WORD	
40105	Over Frequency Pickup Emerg.	RW	WORD	
40106	Under Frequency Pickup Emerg.	RW	WORD	
40107	Under Frequency Dropout Emerg.	RW	WORD	
40108	System Voltage Normal	RW	WORD	
40109	System Frequency Normal	RW	WORD	
40110	System Voltage Emerg.	RW	WORD	
40111	System Frequency Emerg.	RW	WORD	

Register	Data Description	Access	Data Type	Range/Units
40120-40124	Designation	RW	WORD*5	9 chars, 1 per byte, first char = LSB, last byte ignored
40125-40134	Load Description	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40135-40144	Location	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40145-40153	Branch	RW	WORD*9	18 chars, 1 per byte, first char = LSB
40154-40171	Options	RW	WORD*18	36 chars, 1 per byte, first char = LSB
40172-40174	Serial No.	RW	WORD*3	6 chars, 1 per byte, first char = LSB
40175-40177	Controller Serial No.	RW	WORD*3	6 chars, 1 per byte, first char = LSB
40178-40179	Swich Size in Amps	RW	WORD*2	4 chars, 1 per byte, first char = LSB
40180	Number of Poles	RW	WORD	1 char, first char = LSB
40194	Calendar Start Time #1	RW	WORD	
40195	Calendar Run Time #1	RW	WORD	
40196	Calendar Start Time #2	RW	WORD	
40197	Calendar Run Time #2	RW	WORD	
40198	Calendar Start Time #3	RW	WORD	
40199	Calendar Run Time #3	RW	WORD	
40200	Calendar Start Time #4	RW	WORD	
40201	Calendar Run Time #4	RW	WORD	
40202	Calendar Start Time #5	RW	WORD	
40203	Calendar Run Time #5	RW	WORD	
40204	Day of Week #1 (Calendar)	RW	WORD	
40205	First Week of Month #1 (Calendar)	RW	WORD	
40206	Second Week of Month #1 (Calendar)	RW	WORD	
40207	Day of Week #2 (Calendar)	RW	WORD	
40208	First Week of Month #2 (Calendar)	RW	WORD	
40209	Second Week of Month #2 (Calendar)	RW	WORD	
40210	Day of Week #3 (Calendar)	RW	WORD	
40211	First Week of Month #3 (Calendar)	RW	WORD	
40212	Second Week of Month #3 (Calendar)	RW	WORD	
40213	Day of Week #4 (Calendar)	RW	WORD	
40214	First Week of Month #4 (Calendar)	RW	WORD	
40215	Second Week of Month #4 (Calendar)	RW	WORD	
40216	Day of Week #5 (Calendar)	RW	WORD	
40217	First Week of Month #5 (Calendar)	RW	WORD	
40218	Second Week of Month #5 (Calendar)	RW	WORD	
40219	Day of Week #1 (14-day)	RW	WORD	
40220	Second Day of Week #1 (14-day)	RW	WORD	
40221	Week #1 (14-day)	RW	WORD	
40222	Day of Week #2 (14-day)	RW	WORD	
40223	Second Day of Week #2 (14-day)	RW	WORD	
40224	Week #2 (14-day)	RW	WORD	
40225	Day of Week #3 (14-day)	RW	WORD	
40226	Second Day of Week #3 (14-day)	RW	WORD	
40227	Week #3 (14-day)	RW	WORD	
40228	Day of Week #4 (14-day)	RW	WORD	
40229	Second Day of Week #4 (14-day)	RW	WORD	

Register	Data Description	Access	Data Type	Range/Units
40230	Week #4 (14-day)	RW	WORD	
40231	Day of Week #5 (14-day)	RW	WORD	
40232	Second Day of Week #5 (14-day)	RW	WORD	
40233	Week #5 (14-day)	RW	WORD	
40234	First Day of Week #1 (7-day)	RW	WORD	
40235	Second Day of Week #1 (7-day)	RW	WORD	
40236	First Day of Week #2 (7-day)	RW	WORD	
40237	Second Day of Week #2 (7-day)	RW	WORD	
40238	First Day of Week #3 (7-day)	RW	WORD	
40239	Second Day of Week #3 (7-day)	RW	WORD	
40240	First Day of Week #4 (7-day)	RW	WORD	
40241	Second Day of Week #4 (7-day)	RW	WORD	
40242	First Day of Week #5 (7-day)	RW	WORD	
40243	Second Day of Week #5 (7-day)	RW	WORD	
40300	Timed Run Time	RW	WORD	minutes

7.5 M340/M340+ Alert Codes

Alert Code	Description
1	N Overvoltage AB
2	N Overvoltage BC
3	N Overvoltage CA
4	N Undervoltage AB
5	N Undervoltage BC
6	N Undervoltage CA
7	N Overfrequency
8	N Underfrequency
9	N Phase Loss
10	E Overvoltage AB
11	E Overvoltage BC
12	E Overvoltage CA
13	E Undervoltage AB
14	E Undervoltage BC
15	E Undervoltage CA
16	E Overfrequency
17	E Underfrequency
18	E Phase Loss
19	N Overvoltage 1-phase
20	N Undervoltage 1-phase
21	N Overfrequency 1-phase
22	N Underfrequency 1-phase
23	E Overvoltage1-phase
24	E Undervoltage1-phase
25	E Overfrequency 1-phase
26	E Underfrequency 1-phase
27	Aux. Sw. Fault
28	Double Aux. Sw. Fault
29	Transfer Hang
30	Power Down Error
31	RAM Error
32	Memory Error
33	Manual Transfer
34	Remote Fault #1
35	Remote Fault #2

8.1 Introduction

The Power Monitor uses KBUS protocol for communication. The Modbus®/KBUS converter kit is required for Modbus communication with these devices. See Figure 8-1.

Installing the Modbus®/KBUS converter kit allows this controller to communicate with a personal computer running Monitor III software. For other Modbus applications, the Modbus master must be programmed to read the Modbus registers shown in this manual. A system designer trained in the application of Modbus® protocol must write and thoroughly test the program before implementation.

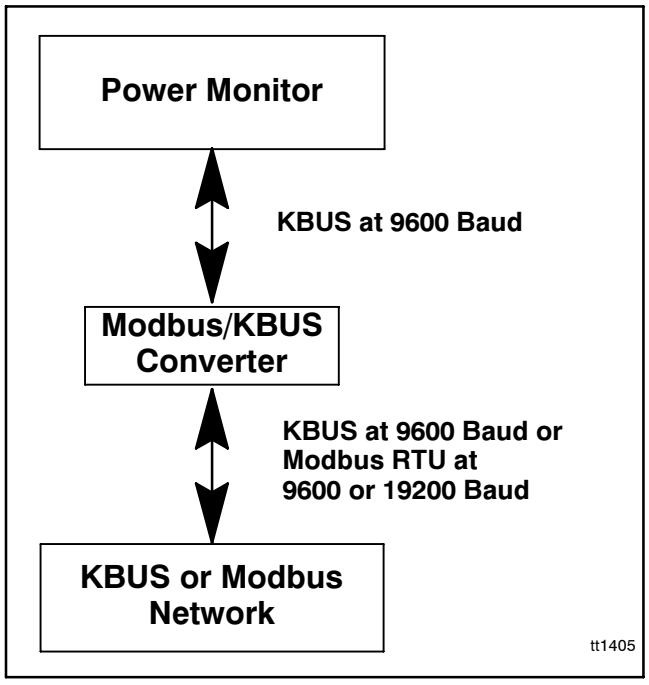


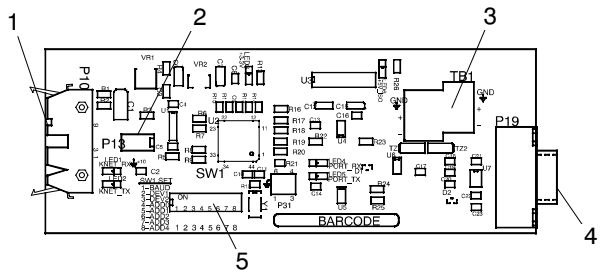
Figure 8-1 Modbus/KBUS Converter Function

8.2 Hardware and Connections

The Modbus/KBUS converter kit GM41143-KP3 replaces RS-232 and RS-485 communication modules and allows the selection of either KBUS or Modbus communication. Figure 8-2 shows the Modbus/KBUS converter circuit board. See Figure 8-3 for the converter location inside the controller.

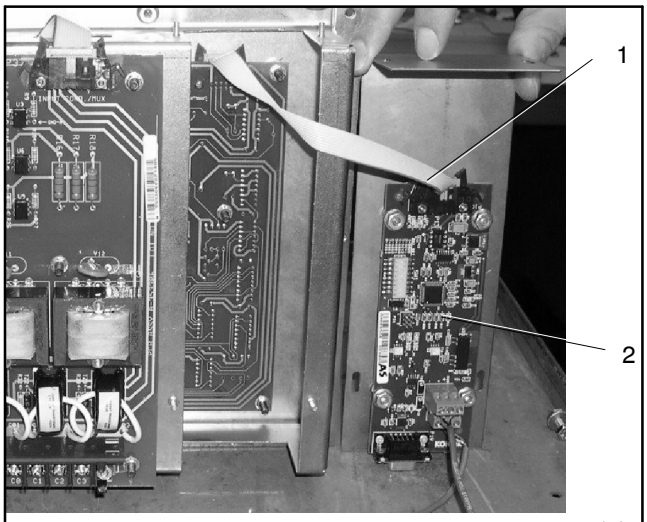
If your device is equipped with an RS-232/RS-485 communication module, remove the old communication module and ribbon cable before installing the new Modbus/KBUS converter and ribbon cable.

Refer to Installation Instructions TT-1405, provided with the converter kit, for converter installation and connection instructions. Set the converter DIP switches for baud rate, device type, and network address as described in TT-1405.



1. P10, ribbon cable connection for 340 generator set and power monitor
2. P13, ribbon cable connection for ATS controller
3. RS-485 connection TB1
4. RS-232 connection P19
5. DIP switches 1–8

Figure 8-2 Modbus/KBUS Converter Board



1. Ribbon cable
2. Converter board

Figure 8-3 Converter Module Location for the Power Monitor

8.3 Device Setup

Configure the power monitor for remote communications by setting the parameters shown in Figure 8-4. See TT-1405 and the controller Operation Manual for more information.

Device	Menu or Index	Parameter	Setting
Power monitor	Menu 8, Remote Control	On Line	YES
		Local, LAN, Remote, or Remote Area Network	Select the appropriate setting for your connection type. Use Local for Ethernet connections. See TT-1405 for more information.
		Address	Any *
		Baud rate	9600 †

* The network address is set using DIP switches on the converter module and will override the network address on the controller.

† This baud rate must be set at 9600 to match the KBUS side of the Modbus/KBUS converter. It may be different from the Modbus baud rates of other devices in the system.

Figure 8-4 Controller Settings for Modbus Communication

8.4 Power Monitor Modbus Registers

Refer to Section 1.3 for definitions of terms and symbols used in the register tables.

Register	Data Description	Access	Data Type	Range/Units
40001				
40002	System Time	RW	WORD	
40003	Day of Week	RW	WORD	
40004	Month	RW	WORD	1-12
40005	Day	RW	WORD	1-31
40006	Year	RW	WORD	
40007	Week of Month	RW	WORD	
40008	Voltage L1-L2	RO	WORD	volts
40009	Voltage L2-L3	RO	WORD	volts
40010	Voltage L3-L1	RO	WORD	volts
40011	Frequency	RO	WORD	hz * 10
40012	Voltage L1-L0	RO	WORD	volts
40013	Voltage L2-L0	RO	WORD	volts
40014	Voltage L3-L0	RO	WORD	volts
40015	Alert Code	RO	WORD	Alert Code
40016	Analog Input #1 Percentage	RO	WORD	% * 10
40017	Analog Input #2 Percentage	RO	WORD	% * 10
40019	Power Supply Voltage	RO	WORD	Vdc * 10
40020	L1 Current	RO	WORD	amps
40021	L2 Current	RO	WORD	amps
40022	L3 Current	RO	WORD	amps
40023	Power Factor	RO	WORD	* 100
40024	Total Real Power	RO	WORD	kW
40025	Total Imaginary Power	RO	WORD	kVAR
40026	PF Lead/Lag	RO	WORD[0]	0: 0 = leading; 1 = lagging
40030	System Status	RO	WORD[0:7]	0-1: Switch Position (00=off; 01=Normal; 10=Emerg; 11=Undefined)
				2-3: Contactor Position (00=off; 01=Normal; 10=Emerg; 11=Undefined)
				4-5: Program Mode (00=off; 01=Remote; 10=Local; 11=Undefined)
				6: Test Mode Timed
				7: Test Mode Active
				8-15: Unused

Register	Data Description	Access	Data Type	Range/Units
40040	Aux 1 Delay Time	RW	WORD	sec
40041	Aux 2 Delay Time	RW	WORD	sec
40042	Aux 3 Delay Time	RW	WORD	sec
40043	Aux 4 Delay Time	RW	WORD	sec
40044	Aux 5 Delay Time	RW	WORD	sec
40045	Aux 6 Delay Time	RW	WORD	sec
40046	System Voltage	RW	WORD	volts, 105-14600
40047	System Frequency	RW	WORD	hz, 48-62
40048	ATS Rating	RW	WORD	A, 0-3000
40049	Connection	RW	WORD[0:1]	0: 0=wye; 1=delta
				1: 0=single phase; 1=three phase
40056-40057	Time in Normal	RO	WORD*2	hours * 10
40058-40059	Time in Off	RO	WORD*2	hours * 10
40060-40061	Time in Emergency	RO	WORD*2	hours * 10
40062	Shutdown #1 Code	RO	WORD	code
40063	Shutdown #1 Month	RO	WORD	1-12
40064	Shutdown #1 Day	RO	WORD	1-31
40065	Shutdown #1 Year	RO	WORD	
40066	Shutdown #2 Code	RO	WORD	code
40067	Shutdown #2 Month	RO	WORD	1-12
40068	Shutdown #2 Day	RO	WORD	1-31
40069	Shutdown #2 Year	RO	WORD	
40070	Shutdown #3 Code	RO	WORD	code
40071	Shutdown #3 Month	RO	WORD	1-12
40072	Shutdown #3 Day	RO	WORD	1-31
40073	Shutdown #3 Year	RO	WORD	
40074	Shutdown #4 Code	RO	WORD	code
40075	Shutdown #4 Month	RO	WORD	1-12
40076	Shutdown #4 Day	RO	WORD	1-31
40077	Shutdown #4 Year	RO	WORD	
40095-40099	Designation	RW	WORD*5	9 chars, 1 per byte, first char = LSB, last byte ignored
40100-40109	Load Description	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40110-40119	Location	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40120-40132	Model No.	RW	WORD*13	26 chars, 1 per byte, first char = LSB
40133-40140	Spec. No.	RW	WORD*8	16 chars, 1 per byte, first char = LSB
40141-40143	Serial No.	RW	WORD*3	6 chars, 1 per byte, first char = LSB
40144-40146	Controller Serial No.	RW	WORD*3	6 chars, 1 per byte, first char = LSB
40147-40156	Analog Input #1 Description	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40157-40166	Analog Input #2 Description	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40167-40176	Auxiliary 1 Description	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40177-40186	Auxiliary 2 Description	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40187-40196	Auxiliary 3 Description	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40197-40206	Auxiliary 4 Description	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40207-40216	Auxiliary 5 Description	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40217-40226	Auxiliary 6 Description	RW	WORD*10	20 chars, 1 per byte, first char = LSB
40300	Timed Run Time	RW	WORD	minutes

8.5 Alert Codes

Alert Code	Description
0	Auxiliary 1
1	Auxiliary 2
2	Auxiliary 3
3	Auxiliary 4
4	Auxiliary 5
5	Auxiliary 6
6	Test Mode Active
7	Internal Error
8	System Ready
9	Power Down Error

Appendix A Abbreviations

The following list contains abbreviations that may appear in this publication.

A, amp	ampere
ABDC	after bottom dead center
AC	alternating current
A/D	analog to digital
ADC	analog to digital converter
adj.	adjust, adjustment
ADV	advertising dimensional drawing
AHWT	anticipatory high water temperature
AISI	American Iron and Steel Institute
ALOP	anticipatory low oil pressure
alt.	alternator
Al	aluminum
ANSI	American National Standards Institute (formerly American Standards Association, ASA)
AO	anticipatory only
API	American Petroleum Institute
approx.	approximate, approximately
AR	as required, as requested
AS	as supplied, as stated, as suggested
ASE	American Society of Engineers
ASME	American Society of Mechanical Engineers
assy.	assembly
ASTM	American Society for Testing Materials
ATDC	after top dead center
ATS	automatic transfer switch
auto.	automatic
aux.	auxiliary
A/V	audiovisual
avg.	average
AVR	automatic voltage regulator
AWG	American Wire Gauge
AWM	appliance wiring material
bat.	battery
BBDC	before bottom dead center
BC	battery charger, battery charging
BCA	battery charging alternator
BCI	Battery Council International
BDC	before dead center
BHP	brake horsepower
blk.	black (paint color), block (engine)
blk. htr.	block heater
BMEP	brake mean effective pressure
bps	bits per second
br.	brass
BTDC	before top dead center
Btu	British thermal unit
Btu/min.	British thermal units per minute
C	Celsius, centigrade
cal.	calorie
CARB	California Air Resources Board
CB	circuit breaker
cc	cubic centimeter
CCA	cold cranking amps
ccw.	counterclockwise
CEC	Canadian Electrical Code
cert.	certificate, certification, certified
cfh	cubic feet per hour
cfm	cubic feet per minute
CG	center of gravity
CID	cubic inch displacement
CL	centerline
cm	centimeter
CMOS	complementary metal oxide substrate (semiconductor)
cogen.	cogeneration
com	communications (port)
coml	commercial
Coml/Rec	Commercial/Recreational
conn.	connection
cont.	continued
CPVC	chlorinated polyvinyl chloride
crit.	critical
CRT	cathode ray tube
CSA	Canadian Standards Association
CT	current transformer
Cu	copper
cu. in.	cubic inch
cw.	clockwise
CWC	city water-cooled
cyl.	cylinder
D/A	digital to analog
DAC	digital to analog converter
dB	decibel
dBA	decibel (A weighted)
DC	direct current
DCR	direct current resistance
deg., °	degree
dept.	department
dia.	diameter
DI/EO	dual inlet/end outlet
DIN	Deutsches Institut fur Normung e. V. (also Deutsche Industrie Normenausschuss)
DIP	dual inline package
DPDT	double-pole, double-throw
DPST	double-pole, single-throw
DS	disconnect switch
DVR	digital voltage regulator
E, emer.	emergency (power source)
EDI	electronic data interchange
EFR	emergency frequency relay
e.g.	for example *(exempli gratia)*
EG	electronic governor
EGSA	Electrical Generating Systems Association
EIA	Electronic Industries Association
EI/EO	end inlet/end outlet
EMI	electromagnetic interference
emiss.	emission
eng.	engine
EPA	Environmental Protection Agency
EPS	emergency power system
ER	emergency relay
ES	engineering special, engineered special
ESD	electrostatic discharge
est.	estimated
E-Stop	emergency stop
etc.	et cetera (and so forth)
exh.	exhaust
ext.	external
F	Fahrenheit, female
fglass.	fiberglass
FHM	flat head machine (screw)
fl. oz.	fluid ounce
flex.	flexible
freq.	frequency
FS	full scale
ft.	foot, feet
ft. lb.	foot pounds (torque)
ft./min.	feet per minute
g	gram
ga.	gauge (meters, wire size)
gal.	gallon
gen.	generator
genset	generator set
GFI	ground fault interrupter
GND, ⏚	ground
gov.	governor
gph	gallons per hour
gpm	gallons per minute
gr.	grade, gross
GRD	equipment ground
gr. wt.	gross weight
H x W x D	height by width by depth
HC	hex cap
HCHT	high cylinder head temperature
HD	heavy duty
HET	high exhaust temperature, high engine temperature
hex	hexagon
Hg	mercury (element)
HH	hex head
HHC	hex head cap
HP	horsepower
hr.	hour
HS	heat shrink
hsg.	housing
HVAC	heating, ventilation, and air conditioning
HWT	high water temperature
Hz	hertz (cycles per second)
IC	integrated circuit
ID	inside diameter, identification
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
IMS	improved motor starting
in.	inch
in. H_2O	inches of water
in. Hg	inches of mercury
in. lb.	inch pounds
Inc.	incorporated
ind.	industrial
int.	internal
int./ext.	internal/external
I/O	input/output
IP	iron pipe
ISO	International Organization for Standardization
J	joule
JIS	Japanese Industry Standard

k	kilo (1000)
K	kelvin
kA	kiloampere
KB	kilobyte (2^{10} bytes)
kg	kilogram
kg/cm^2	kilograms per square centimeter
kgm	kilogram-meter
kg/m^3	kilograms per cubic meter
kHz	kilohertz
kJ	kilojoule
km	kilometer
kOhm, kΩ	kilo-ohm
kPa	kilopascal
kph	kilometers per hour
kV	kilovolt
kVA	kilovolt ampere
kVAR	kilovolt ampere reactive
kW	kilowatt
kWh	kilowatt-hour
kWm	kilowatt mechanical
L	liter
LAN	local area network
L x W x H	length by width by height
lb.	pound, pounds
lbm/ft^3	pounds mass per cubic feet
LCB	line circuit breaker
LCD	liquid crystal display
ld. shd.	load shed
LED	light emitting diode
Lph	liters per hour
Lpm	liters per minute
LOP	low oil pressure
LP	liquefied petroleum
LPG	liquefied petroleum gas
LS	left side
L_{wa}	sound power level, A weighted
LWL	low water level
LWT	low water temperature
m	meter, milli (1/1000)
M	mega (10^6 when used with SI units), male
m^3	cubic meter
m^3/min.	cubic meters per minute
mA	milliampere
man.	manual
max.	maximum
MB	megabyte (2^{20} bytes)
MCM	one thousand circular mils
MCCB	molded-case circuit breaker
meggar	megohmmeter
MHz	megahertz
mi.	mile
mil	one one-thousandth of an inch
min.	minimum, minute
misc.	miscellaneous
MJ	megajoule
mJ	millijoule
mm	millimeter
mOhm, mΩ	milliohm
MOhm, MΩ	megohm
MOV	metal oxide varistor
MPa	megapascal
mpg	miles per gallon
mph	miles per hour
MS	military standard
m/sec.	meters per second
MTBF	mean time between failure
MTBO	mean time between overhauls
mtg.	mounting
MW	megawatt
mW	milliwatt
μF	microfarad
N, norm.	normal (power source)
NA	not available, not applicable
nat. gas	natural gas
NBS	National Bureau of Standards
NC	normally closed
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
Nm	newton meter
NO	normally open
no., nos.	number, numbers
NPS	National Pipe, Straight
NPSC	National Pipe, Straight-coupling
NPT	National Standard taper pipe thread per general use
NPTF	National Pipe, Taper-Fine
NR	not required, normal relay
ns	nanosecond
OC	overcrank
OD	outside diameter
OEM	original equipment manufacturer
OF	overfrequency
opt.	option, optional
OS	oversize, overspeed
OSHA	Occupational Safety and Health Administration
OV	overvoltage
oz.	ounce
p., pp.	page, pages
PC	personal computer
PCB	printed circuit board
pF	picofarad
PF	power factor
ph., ∅	phase
PHC	Phillips head crimptite (screw)
PHH	Phillips hex head (screw)
PHM	pan head machine (screw)
PLC	programmable logic control
PMG	permanent-magnet generator
pot	potentiometer, potential
ppm	parts per million
PROM	programmable read-only memory
psi	pounds per square inch
pt.	pint
PTC	positive temperature coefficient
PTO	power takeoff
PVC	polyvinyl chloride
qt.	quart, quarts
qty.	quantity
R	replacement (emergency) power source
rad.	radiator, radius
RAM	random access memory
RDO	relay driver output
ref.	reference
rem.	remote
Res/Coml	Residential/Commercial
RFI	radio frequency interference
RH	round head
RHM	round head machine (screw)
rly.	relay
rms	root mean square
rnd.	round
ROM	read only memory
rot.	rotate, rotating
rpm	revolutions per minute
RS	right side
RTV	room temperature vulcanization
SAE	Society of Automotive Engineers
scfm	standard cubic feet per minute
SCR	silicon controlled rectifier
s, sec.	second
SI	*Systeme international d'unites,* International System of Units
SI/EO	side in/end out
sil.	silencer
SN	serial number
SPDT	single-pole, double-throw
SPST	single-pole, single-throw
spec, specs	specification(s)
sq.	square
sq. cm	square centimeter
sq. in.	square inch
SS	stainless steel
std.	standard
stl.	steel
tach.	tachometer
TD	time delay
TDC	top dead center
TDEC	time delay engine cooldown
TDEN	time delay emergency to normal
TDES	time delay engine start
TDNE	time delay normal to emergency
TDOE	time delay off to emergency
TDON	time delay off to normal
temp.	temperature
term.	terminal
TIF	telephone influence factor
TIR	total indicator reading
tol.	tolerance
turbo.	turbocharger
typ.	typical (same in multiple locations)
UF	underfrequency
UHF	ultrahigh frequency
UL	Underwriter's Laboratories, Inc.
UNC	unified coarse thread (was NC)
UNF	unified fine thread (was NF)
univ.	universal
US	undersize, underspeed
UV	ultraviolet, undervoltage
V	volt
VAC	volts alternating current
VAR	voltampere reactive
VDC	volts direct current
VFD	vacuum fluorescent display
VGA	video graphics adapter
VHF	very high frequency
W	watt
WCR	withstand and closing rating
w/	with
w/o	without
wt.	weight
xfmr	transformer

Appendix B Noise and Wiring Practices

Electrical noise is an unwanted electrical signal that can cause errors in measurement, loss of control, malfunctions in microprocessor-based control systems, errors in data transfer between systems over communication links, or reductions in system performance.

Good system design and wiring practices can minimize noise levels and the effects of noise.

Noise, because of its random nature, is typically characterized by frequency distribution. Many noise sources are broad-spectrum, that is, they produce many frequencies distributed over a wide range. Broad-spectrum noise is particularly troublesome because it cannot be removed easily by filtering, and because it can affect a variety of systems in unpredictable ways. One common source of broad-spectrum noise is a switch, which can produce voltage and current changes when an electrical circuit is connected and disconnected.

Coupling is the transfer of signals between separate circuits. Signals from one circuit become noise in another. The amount of coupling is cumulative and is a function of the proximity of the circuits, their orientation, exposed area, and length of run. Minimize coupling by the following:

- Isolating circuits from each other by using separate raceways or conduit
- Separating circuits from each other by locating them as far apart as possible
- Enclosing circuits with a grounded metallic shield such as an enclosure, metallic conduit, or cable shield
- Running conductors perpendicular, rather than parallel, to each other
- Running wires loosely and randomly rather than bundling them tightly together
- Twisting a circuit's wires together in pairs

In an industrial environment, there are typically five types of circuits with different noise emission and rejection capabilities. The five types of circuits are as follows:

- **High-Power Distribution.** Circuits to high-power loads such as large electric motors and heaters can emit transient high levels of broad-spectrum noise. Loads on high-power distribution circuits are nearly immune to noise.
- **General Purpose Power Distribution.** Circuits to medium-power loads such as lighting, offices, light-duty equipment, and small motors such as fans and pumps can emit transient, medium levels of broad-spectrum noise. Some electronic equipment, such as computers, emits constant levels of broad-spectrum noise in addition to transient broad-spectrum noise. Loads on general-purpose circuits, except for sensitive electronic equipment, are nearly immune to noise.
- **Control.** Control circuits include DC circuits and 120 VAC maximum AC circuits that operate at a low power level (less than 1 W). Typical circuits include circuits to switches, actuators, and dry-contact relays, including the generator engine-start circuit. Control circuits emit transient low levels of broad-spectrum noise and are fairly immune to noise.
- **Analog.** Analog circuits are low-voltage DC circuits that convey measurement information as relatively small changes in current or voltage. Typical circuits include those connected to the controller's analog inputs. Analog circuits create the lowest noise levels and are the most sensitive to noise.
- **Communication and Signaling.** Communication and signaling circuits are low-voltage circuits that convey information. Typical circuits include RS-232 and RS-485 serial communication lines, telephone lines, and computer network lines. These circuits create noise with frequencies related to the communication signaling rate. These circuits have some level of built-in noise immunity. Typical systems will detect or correct errors caused by noise below certain levels, but with a corresponding reduction in the data transfer rate.

When planning an installation, separate all of these types of circuits as much as possible to minimize the hazards of insulation failure, accidental miswiring, and noise coupling. For best results, install control circuits, analog circuits, and communication and signaling circuits separately. Combining circuit types is unavoidable in the controller's enclosure and some other areas.

Note: It is very important to isolate high- and medium-power circuits in raceways or conduit separate from the other types of circuits.

Appendix C 550 Controllers, Versions Below 2.10

This section contains Modbus® registers for Digital 550 controller with application code versions numbered below 2.10 (for example, code version number 1.34). See Section 2.4 for instructions to determine the application code version number for your controller.

Guide to the Register Map

Description	Registers
Monitoring	40001-40083
Electrical Output	40001-40027
Reserved	40028-40032
Engine Status	40033-40054
Reserved	40055-40060
Analog Input Status	40061-40068
Reserved	40069-40076
Digital Input status	40077-40078
Reserved	40079-40083
Maintenance	40084-40112
Time/Date	40113-40115
Time Delay Settings	40116-40124
Settings and Setpoints	40125-40146
Factory Setup	40147-40226
Digital Input Setup	40227-40499
Analog Input Setup	40500-40739
Remapped Registers *	40740-40837
Relay Driver Output Status	40838-40839
Relay Driver Output Setup	40840-40870
Event History	40871-41270
Miscellaneous Strings	41271-41295
Reserved and Write-Only Registers	41296-41308

Modbus Registers

Register	Parameter	Access	Data Type	Range/Units
40001	L1 – L2 Voltage	RO	WORD	Volts AC
40002	L2 – L3 Voltage	RO	WORD	Volts AC
40003	L3 – L1 Voltage	RO	WORD	Volts AC
40004	L1 – L0 Voltage	RO	WORD	Volts AC
40005	L2 – L0 Voltage	RO	WORD	Volts AC
40006	L3 – L0 Voltage	RO	WORD	Volts AC
40007	L1 Current	RO	WORD	Amps AC
40008	L2 Current	RO	WORD	Amps AC
40009	L3 Current	RO	WORD	Amps AC
40010	Frequency	RO	WORD	Hz x 100
40011	Total kW	RO	WORD	kW
40012	Percent Of Rated kW	RO	WORD	% Rated kW
40013	Total Power Factor	RO	SWORD	PF x 100
40014	L1 kW	RO	WORD	kW
40015	L1 Power Factor	RO	SWORD	PF x 100
40016	L2 kW	RO	WORD	kW
40017	L2 Power Factor	RO	SWORD	PF x 100
40018	L3 kW	RO	WORD	kW
40019	L3 Power Factor	RO	SWORD	PF x 100
40020	Total kVAR	RO	SWORD	kVAR
40021	L1 kVAR	RO	SWORD	kVAR
40022	L2 kVAR	RO	SWORD	kVAR
40023	L3 kVAR	RO	SWORD	kVAR
40024	Total kVA	RO	WORD	kVA
40025	L1 kVA	RO	WORD	kVA
40026	L2 kVA	RO	WORD	kVA
40027	L3 kVA	RO	WORD	kVA
40028	*Reserved for Future Use*	RO	WORD	
40029	*Reserved for Future Use*	RO	WORD	
40030	*Reserved for Future Use*	RO	WORD	
40031	*Reserved for Future Use*	RO	WORD	
40032	*Reserved for Future Use*	RO	WORD	
40033	Oil Pressure*	RO	WORD	kPa/psi
40034	Coolant Temperature*	RO	SWORD	°C/° F
40035	Engine Speed*	RO	WORD	rpm
40036	Local Battery Voltage*	RO	WORD	Volts DC x 10
40037	Fuel Pressure*	RO	WORD	kPa/psi (ECM only)
40038	Fuel Temperature*	RO	SWORD	°C/°F (ECM only)
40039	Fuel Rate*	RO	WORD	Liters/Hour x 100/Gallons/Hour x 100 (ECM only)
40040	Used Last Run*	RO	WORD	Liters/Gallons (ECM only)
40041	Coolant Pressure*	RO	WORD	kPa/psi (ECM only)
40042	Coolant Level*	RO	WORD	% x 10 (ECM only)
40043	Oil Temperature*	RO	SWORD	°C/°F (ECM only)
40044	Oil Level*	RO	WORD	% x 10 (ECM only)
40045	Crankcase Pressure*	RO	WORD	kPa/psi (ECM only)
40046	Ambient Temperature*	RO	SWORD	°C/°F (ECM only)
40047	ECM Battery Voltage*	RO	WORD	Volts DC x 10 (ECM only)
40048	ECM Status	RO	WORD	0 = ECM-Equipped, 1 = Non-ECM
40049	*Reserved for Future Use*	RO	WORD	
40050	*Reserved for Future Use*	RO	WORD	
40051	*Reserved for Future Use*	RO	WORD	
40052	*Reserved for Future Use*	RO	WORD	
40053	*Reserved for Future Use*	RO	WORD	
*0x7FD6 = data unavailable. 0x7FFF = data is out of range.				

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Register	Parameter	Access	Data Type	Range/Units
40054	System Event Stack	RO	7 WORDS	Word #1: System Events 0-15 Word #2: System Events 16-31 Word #3: System Events 32-47 Word #4: System Events 48-63 Word #5: System Events 64-79 Word #6: System Events 80-95 Word #7: System Events 96-99 (bits 4-15 unused) Event exists if individual bit is set. Refer to Message Codes Section in this Appendix for message codes and descriptions.
40061	Analog Input 00(Battery voltage)*	RO	WORD	Volts DC
40062	Analog Input 01*	RO	WORD	User-Defined
40063	Analog Input 02*	RO	WORD	User-Defined
40064	Analog Input 03*	RO	WORD	User-Defined
40065	Analog Input 04*	RO	WORD	User-Defined
40066	Analog Input 05*	RO	WORD	User-Defined
40067	Analog Input 06*	RO	WORD	User-Defined
40068	Analog Input 07*	RO	WORD	User-Defined
40069	*Reserved for Additional Input*	RO	WORD	
40070	*Reserved for Additional Input*	RO	WORD	
40071	*Reserved for Additional Input*	RO	WORD	
40072	*Reserved for Additional Input*	RO	WORD	
40073	*Reserved for Additional Input*	RO	WORD	
40074	*Reserved for Additional Input*	RO	WORD	
40075	*Reserved for Additional Input*	RO	WORD	
40076	*Reserved for Additional Input*	RO	WORD	
40077-40078	Digital Input Status	RO	2 WORDS	Input is high if individual bit is set. 40077 Word #1 Digital Inputs 0-15: Bit 0 Remote start contacts Bit 1 Emergency stop Bit 2 Low coolant level Bit 3 Digital Input #1 Bit 4 Digital Input #2 Bit 5 Digital Input #3 Bit 6 Digital Input #4 Bit 7 Digital Input #5 Bit 8 Digital Input #6 Bit 9 Digital Input #7 Bit 10 Digital Input #8 Bit 11 Digital Input #9 Bit 12 Digital Input #10 Bit 13 Digital Input #11 Bit 14 Digital Input #12 Bit 15 Digital Input #13
				40078 Word #2 Digital Inputs 16-23 (Bits 8-15 Unused): Bit 0 Digital Input #14 Bit 1 Digital Input #15 Bit 2 Digital Input #16 Bit 3 Digital Input #17 Bit 4 Digital Input #18 Bit 5 Digital Input #19 Bit 6 Digital Input #20 Bit 7 Digital Input #21 Bit 8 Unused Bit 9 Unused Bit 10 Unused Bit 11 Unused Bit 12 Unused Bit 13 Unused Bit 14 Unused Bit 15 Unused
40079	*Reserved for Future Use*	RO	WORD	
40080	*Reserved for Future Use*	RO	WORD	
40081	*Reserved for Future Use*	RO	WORD	
40082	*Reserved for Future Use*	RO	WORD	

*0x7FD6 = data unavailable. 0x7FFF = data is out of range.

Register	Parameter	Access	Data Type	Range/Units
40083	*Reserved for Future Use*	RO	WORD	
40084	Total Number Of Starts	RO	WORD	Starts
40085	Total Run Time Hours	RO	LONG	Hrs. x 100 (LSW First)
40087	Total Run Time Loaded Hours	RO	LONG	Hrs. x 100 (LSW First)
40089	Total Run Time Unloaded Hours	RO	LONG	Hrs. x 100 (LSW First)
40091	Total Run Time kW Hours	RO	LONG	kW Hrs. (LSW First)
40093	RTSM (Run Time Since Maintenance) Total Hours	RO	LONG	Hrs. x 100 (LSW First)
40095	RTSM Loaded Hours	RO	LONG	Hrs. x 100 (LSW First)
40097	RTSM Unloaded Hours	RO	LONG	Hrs. x 100 (LSW First)
40099	RTSM kW Hours	RO	LONG	kW Hrs. (LSW First)
40101	Last Maintenance Date	RO	2 WORDS	Day| Month, Year
40103	Operating Days Since Maint.	RO	WORD	Days
40104	Number Of Starts Since Maint.	RO	WORD	Starts
40105	Last Start Date	RO	2 WORDS	Day| Month, Year
40107	Last Start Time	RO	WORD	Hr. |Min.
40108	Last Run Length	RO	WORD	Hrs. x 100
40109	Last Run Loaded	RO	WORD	0 = Unloaded, 1 = Loaded
40110	Timed Run Time	RW	WORD	Hr. | Min.
40111	Timed Run Remaining	RO	WORD	Hr. | Min.
40112	Is Timed Run Active	RO	WORD	1 = True, 0 = False
40113	Current Date	RW	2 WORDS	Day| Month, 2 Digit Year | Day Of Week (0 = Sunday)
40115	Current Time (24 Hr. Clock)	RW	WORD	Hr.|Min.
40116	Time Delay Engine Start	RW	WORD	Min. | Sec.
40117	Time Delay Starting Aid	RW	WORD	Min. | Sec.
40118	Time Delay Crank On	RW	WORD	Min. | Sec.
40119	Time Delay Crank Pause	RW	WORD	Min. | Sec.
40120	Time Delay Engine Cooldown	RW	WORD	Min. | Sec.
40121	Time Delay Crank Cycles	RW	WORD	Cycles
40122	Time Delay Overvoltage	RW	WORD	Min. | Sec.
40123	Time Delay Undervoltage	RW	WORD	Min. | Sec.
40124	Time Delay Load Shed kW	RW	WORD	Min. | Sec.
40125	Operating Mode	RW	WORD	1 = Standby, 2 = Prime Power
40126	System Voltage	RW	WORD	Volts AC
40127	System Frequency	RW	WORD	Hz
40128	System Phase	RW	WORD	1 = 3 Phase Delta, 2 = 3 Phase Wye, 3 = Single Phase
40129	kW Rating	RW	WORD	kW
40130	Load Shed Output	RW	WORD	% of kW Rating
40131	Overvoltage	RW	WORD	% of System Voltage
40132	Undervoltage	RW	WORD	% of System Voltage
40133	Overfrequency	RW	WORD	% of System Frequency
40134	Underfrequency	RW	WORD	% of System Frequency
40135	Overspeed	RW	WORD	Hz
40136	Battery Voltage	RW	WORD	Volts DC x 10
40137	Low Battery Voltage	RW	WORD	Volts DC x 10
40138	High Battery Voltage	RW	WORD	Volts DC x 10
40139	Metric Units	RW	WORD	1 = True, 0 = False
40140	NFPA 110 Defaults Enabled	RW	WORD	1 = True, 0 = False
40141	Rated Current	RO	WORD	Amps AC
40142	*Reserved for Future Use*	RO	WORD	
40143	*Reserved for Future Use*	RO	WORD	
40144	*Reserved for Future Use*	RO	WORD	
40145	*Reserved for Future Use*	RO	WORD	
40146	*Reserved for Future Use*	RO	WORD	
40147	Final Assembly Date	RO	2 WORDS	Day| Month, Year
40149	Final Assembly Clock No.	RO	LONG	99999 Max (LSW First)
*0x7FD6 = data unavailable. 0x7FFF = data is out of range.				

Register	Parameter	Access	Data Type	Range/Units
40151	Total Operating Days	RO	WORD	Days
40152	Model No.	RO	13 WORDS	26 Character String
40165	Spec. No.	RO	8 WORDS	16 Character String
40173	Genset Serial No.	RO	10 WORDS	20 Character String
40183	Alternator Part No.	RO	10 WORDS	20 Character String
40193	Engine Part Number	RO	10 WORDS	20 Character String
40203	Control No.	RO	LONG	(LSW First)
40205	Code Version	RO	3 WORDS	6 Character String
40208	Setup Lock	RO	WORD	1 = Locked, 0 = Unlocked
40209	Engine Model Number	RO	4 WORDS	8 Character String (ECM only)
40213	Engine Serial Number	RO	5 WORDS	10 Character String (ECM only)
40218	Unit Number	RO	5 WORDS	10 Character String (ECM only)
40223	ECM Serial Number	RO	4 WORDS	8 Character String (ECM only)
40227-40499:	**Digital Inputs**	RW	13 WORDS PER INPUT	For each digital input: Word #1: Enabled (1 = True, 0 = False | Function Code Word #2: Inhibit Time (Min.|Sec.) Word #3: Delay Time (Min.|Sec.) Words #4-13: 10 words for 20-character description string. Refer to the Function Codes section in this Appendix for digital input function codes.
40227	Digital Input 01	RW	13 WORDS	
40240	Digital Input 02	RW	13 WORDS	
40253	Digital Input 03	RW	13 WORDS	
40266	Digital Input 04	RW	13 WORDS	
40279	Digital Input 05	RW	13 WORDS	
40292	Digital Input 06	RW	13 WORDS	
40305	Digital Input 07	RW	13 WORDS	
40318	Digital Input 08	RW	13 WORDS	
40331	Digital Input 09	RW	13 WORDS	
40344	Digital Input 10	RW	13 WORDS	
40357	Digital Input 11	RW	13 WORDS	
40370	Digital Input 12	RW	13 WORDS	
40383	Digital Input 13	RW	13 WORDS	
40396	Digital Input 14	RW	13 WORDS	
40409	Digital Input 15	RW	13 WORDS	
40422	Digital Input 16	RW	13 WORDS	
40435	Digital Input 17	RW	13 WORDS	
40448	Digital Input 18	RW	13 WORDS	
40461	Digital Input 19	RW	13 WORDS	
40474	Digital Input 20	RW	13 WORDS	
40487	Digital Input 21	RW	13 WORDS	
Note: *Cannot read past end of block*				
40500-40739:	**Analog Inputs**	RW	16 WORDS	For each analog input: Word #1: Warning/Shutdown Enable [bits 8,9] (1 = True, 0 = False) | Inhibit Time (Sec.) Word #2: Warn Time (Sec) | Sdwn Time (Sec.) Word #3: Lower Warn Limit Word #4: Upper Warn Limit Word #5: Lower Sdwn Limit Word #6: Upper Sdwn Limit Words #7-16: 10 words for 20-character description string
40500	Analog Input 01 *(ECM only)*	RW	16 WORDS	
40516	Analog Input 02 *(ECM only)*	RW	16 WORDS	
40532	Analog Input 03	RW	16 WORDS	
40548	Analog Input 04	RW	16 WORDS	
40564	Analog Input 05	RW	16 WORDS	
40580	Analog Input 06	RW	16 WORDS	
40596	Analog Input 07	RW	16 WORDS	
Note: *Cannot read past end of block*				
40612	*Reserved for additional analog input*	RO	16 WORDS	For each analog input: Word #1: Warning/Shutdown Enable [bits 8,9] (1 = True, 0 = False) | Inhibit Time (Sec.) Word #2: Warn Time (Sec) | Sdwn Time (Sec.) Word #3: Lower Warn Limit Word #4: Upper Warn Limit Word #5: Lower Sdwn Limit Word #6: Upper Sdwn Limit Words #7-16: 10 words for 20-character description string
40628	*Reserved for additional analog input*	RO	16 WORDS	
40644	*Reserved for additional analog input*	RO	16 WORDS	
40660	*Reserved for additionalanalog input*	RO	16 WORDS	
40676	*Reserved for additional analog input*	RO	16 WORDS	
40692	*Reserved for additional analog input*	RO	16 WORDS	
40708	*Reserved for additionalanalog input*	RO	16 WORDS	
40724	*Reserved for additional analog input*	RO	16 WORDS	
*0x7FD6 = data unavailable. 0x7FFF = data is out of range.				

Register	Parameter	Access	Data Type	Range/Units
Note: *Cannot read past end of block*				
40740–40837:	**Defined Common Faults**	RW	1 WORD per DCF	For all DCFs: Selected (1 = True, 0 = False) | Setpoint (Analog inputs only)
40740	Emergency Stop	RW	1 WORD	
40741	Overspeed	RW	1 WORD	
40742	Overcrank	RW	1 WORD	
40743	High Coolant Temperature Shutdown	RW	1 WORD	
40744	Oil Pressure Shutdown	RW	1 WORD	
40745	Low Coolant Temperature	RW	1 WORD	**Note:** DCF and RDO on ECM only
40746	Low Fuel	RW	1 WORD	
40747	High Coolant Temperature Warning	RW	1 WORD	
40748	Oil Pressure Warning	RW	1 WORD	
40749	Master Not In Auto	RW	1 WORD	
40750	NFPA 110 Fault	RW	1 WORD	
40751	Low Battery Voltage	RW	1 WORD	
40752	High Battery Voltage	RW	1 WORD	
40753	Battery Charger Fault	RW	1 WORD	
40754	System Ready	RW	1 WORD	
40755	Loss of ECM Comm	RW	1 WORD	**Note:** DCF and RDO on ECM only
40756	No Oil Pressure Signal	RW	1 WORD	
40757	High Oil Temperature Shutdown	RW	1 WORD	
40758	No Coolant Temperature Signal	RW	1 WORD	
40759	Low Coolant Level	RW	1 WORD	
40760	Speed Sensor Fault	RW	1 WORD	
40761	Locked Rotor	RW	1 WORD	
40762	Master Switch Error	RW	1 WORD	
40763	Master Switch Open	RW	1 WORD	
40764	Master Switch Off	RW	1 WORD	
40765	AC Sensing Loss	RW	1 WORD	
40766	Overvoltage	RW	1 WORD	
40767	Undervoltage	RW	1 WORD	
40768	Weak Battery	RW	1 WORD	
40769	Overfrequency	RW	1 WORD	
40770	Underfrequency	RW	1 WORD	
40771	Load Shed kW Overload	RW	1 WORD	
40772	Load Shed kW Underfrequency	RW	1 WORD	
40773	Over Current	RW	1 WORD	
40774	EPS Supplying Load	RW	1 WORD	
40775	Internal Fault	RW	1 WORD	
40776	Engine Cooldown Delay	RW	1 WORD	
40777	Engine Start Delay	RW	1 WORD	
40778	Starting Aid	RW	1 WORD	
40779	Generator Running	RW	1 WORD	
40780	Air Damper Control	RW	1 WORD	
40781	Ground Fault	RW	1 WORD	
40782	EEPROM Write Failure	RW	1 WORD	
40783	Critical Overvoltage	RW	1 WORD	
40784	Alternator Protect Shutdown	RW	1 WORD	
40785	Air Damper Indicator	RW	1 WORD	
40786	Digital Input 01	RW	1 WORD	
40787	Digital Input 02	RW	1 WORD	
40788	Digital Input 03	RW	1 WORD	
40789	Digital Input 04	RW	1 WORD	
40790	Digital Input 05	RW	1 WORD	
40791	Digital Input 06	RW	1 WORD	
*0x7FD6 = data unavailable. 0x7FFF = data is out of range.				

Register	Parameter	Access	Data Type	Range/Units
40792	Digital Input 07	RW	1 WORD	
40793	Digital Input 08	RW	1 WORD	
40794	Digital Input 09	RW	1 WORD	
40795	Digital Input 10	RW	1 WORD	
40796	Digital Input 11	RW	1 WORD	
40797	Digital Input 12	RW	1 WORD	
40798	Digital Input 13	RW	1 WORD	
40799	Digital Input 14	RW	1 WORD	
40800	Digital Input 15	RW	1 WORD	
40801	Digital Input 16	RW	1 WORD	
40802	Digital Input 17	RW	1 WORD	
40803	Digital Input 18	RW	1 WORD	
40804	Digital Input 19	RW	1 WORD	
40805	Digital Input 20	RW	1 WORD	
40806	Digital Input 21	RW	1 WORD	
40807	Analog Input 01	RW	1 WORD	**Note:** Non-zero setpoint values apply only to Analog Inputs 1-7.
40808	Analog Input 02	RW	1 WORD	
40809	Analog Input 03	RW	1 WORD	
40810	Analog Input 04	RW	1 WORD	
40811	Analog Input 05	RW	1 WORD	
40812	Analog Input 06	RW	1 WORD	
40813	Analog Input 07	RW	1 WORD	
40814	*Reserved for Additional Input*	RO	1 WORD	
40815	*Reserved for Additional Input*	RO	1 WORD	
40816	*Reserved for Additional Input*	RO	1 WORD	
40817	*Reserved for Additional Input*	RO	1 WORD	
40818	*Reserved for Additional Input*	RO	1 WORD	
40819	*Reserved for Additional Input*	RO	1 WORD	
40820	*Reserved for Additional Input*	RO	1 WORD	
40821	*Reserved for Additional Input*	RO	1 WORD	
40822 through 40837	*Reserved for Future Use*	RO		
Note: *Cannot read past end of block*				
40838	RDO Status - RDO1 -> RDO16	RO*	1 WORD	Output is high if individual bit is set. Bit 0 = RDO 1 *Software-controlled RDOs are RW.*
40839	RDO Status - RDO17 -> RDO31	RO*	1 WORD	Output is high if individual bit is set. Bit 0 = RDO 17 *Software-controlled RDOs are RW.*
Note: *Cannot read past end of block*				
*0x7FD6 = data unavailable. 0x7FFF = data is out of range.				

Register	Parameter	Access	Data Type	Range/Units
40840	Relay Driver Output 01	RW	1 WORD	For RDOs: Message Code | Setpoint **Note:** Non-zero setpoint values apply only to RDOs assigned to analog inputs. See the Message Codes section in this Appendix for message codes.
40841	Relay Driver Output 02	RW	1 WORD	
40842	Relay Driver Output 03	RW	1 WORD	
40843	Relay Driver Output 04	RW	1 WORD	
40844	Relay Driver Output 05	RW	1 WORD	
40845	Relay Driver Output 06	RW	1 WORD	
40846	Relay Driver Output 07	RW	1 WORD	
40847	Relay Driver Output 08	RW	1 WORD	
40848	Relay Driver Output 09	RW	1 WORD	
40849	Relay Driver Output 10	RW	1 WORD	
40850	Relay Driver Output 11	RW	1 WORD	
40851	Relay Driver Output 12	RW	1 WORD	
40852	Relay Driver Output 13	RW	1 WORD	
40853	Relay Driver Output 14	RW	1 WORD	
40854	Relay Driver Output 15	RW	1 WORD	
40855	Relay Driver Output 16	RW	1 WORD	
40856	Relay Driver Output 17	RW	1 WORD	
40857	Relay Driver Output 18	RW	1 WORD	
40858	Relay Driver Output 19	RW	1 WORD	
40859	Relay Driver Output 20	RW	1 WORD	
40860	Relay Driver Output 21	RW	1 WORD	
40861	Relay Driver Output 22	RW	1 WORD	
40862	Relay Driver Output 23	RW	1 WORD	
40863	Relay Driver Output 24	RW	1 WORD	
40864	Relay Driver Output 25	RW	1 WORD	
40865	Relay Driver Output 26	RW	1 WORD	
40866	Relay Driver Output 27	RW	1 WORD	
40867	Relay Driver Output 28	RW	1 WORD	
40868	Relay Driver Output 29	RW	1 WORD	
40869	Relay Driver Output 30	RW	1 WORD	
40870	Relay Driver Output 31	RW	1 WORD	
Note: *Cannot read past end of block*				
40871	Event History, Page 1 (1-10)	RO	40 WORDS	For event history: Message code|Setpoint* Hr.|Min. Day|Month, Year * Analog Inputs only See the Message Codes section inthis Appendix for message codes ***Note:*** *Message code = 0xFFat end of history.*
40911	Event History, Page 2 (11-20)	RO	40 WORDS	
40951	Event History, Page 3 (21-30)	RO	40 WORDS	
40991	Event History, Page 4 (31-40)	RO	40 WORDS	
41031	Event History, Page 5 (41-50)	RO	40 WORDS	
41071	Event History, Page 6 (51-60)	RO	40 WORDS	
41111	Event History, Page 7 (61-70)	RO	40 WORDS	
41151	Event History, Page 8 (71-80)	RO	40 WORDS	
41191	Event History, Page 9 (81-90)	RO	40 WORDS	
41231	Event History, Page 10 (91-100)	RO	40 WORDS	
Note: *Cannot read past end of block*				
41271	Designation	RW	5 WORDS	9-Character String
41276	Load	RW	10 WORDS	20-Character String
41286	Location	RW	10 WORDS	20-Character String
Note: *Cannot read past end of block*				
41296-41305	*Reserved for Future Use*	RO	WORD	
Note: *Cannot read past end of block*				
41306	Start Timed Run	WO	WORD	1 = Start, 0 = No Start
41307	Stop Timed Run	WO	WORD	1 = Stop, 0 = No Stop
41308	Reset Maintenance Records	WO	WORD	1 = Reset, 0 = No Reset
*0x7FD6 = data unavailable. 0x7FFF = data is out of range.				

Message Codes: Event History, Common Fault, and RDO Byte Summary

Code	Display Message
0	Emergency Stop
1	Overspeed
2	Overcrank
3	High Coolant Temperature Shutdown
4	Oil Pressure Shutdown
5	Low Coolant Temperature **Note:** DCF and RDO on ECM only
6	Low Fuel
7	High Coolant Temperature Warning
8	Oil Pressure Warning
9	Master Not In Auto
10	NFPA 110 Fault
11	Low Battery Voltage
12	High Battery Voltage
13	Battery Charger Fault
14	System Ready
15	Loss of ECM Comm **Note:** DCF and RDO on ECM only
16	No Oil Pressure Signal
17	High Oil Temperature Shutdown
18	No Coolant Temperature Signal
19	Low Coolant Level
20	Speed Sensor Fault
21	Locked Rotor
22	Master Switch Error
23	Master Switch Open
24	Master Switch Off
25	AC Sensing Loss
26	Overvoltage
27	Undervoltage
28	Weak Battery
29	Overfrequency
30	Underfrequency
31	Load Shed kW Overload
32	Load Shed kW Underfrequency
33	Over Current
34	Emergency power supply (EPS) Supplying Load
35	Internal Fault
36	Engine Cooldown Delay
37	Engine Start Delay
38	Starting Aid
39	Generator Running
40	Air Damper Control
41	Ground Fault
42	EEPROM Write Failure
43	Critical Overvoltage
44	Alternator Protect Shutdown
45	Air Damper Indicator
46	Digital Input 01
47	Digital Input 02
48	Digital Input 03
49	Digital Input 04
50	Digital Input 05
51	Digital Input 06
52	Digital Input 07
53	Digital Input 08
54	Digital Input 09
55	Digital Input 10
56	Digital Input 11
57	Digital Input 12
58	Digital Input 13
59	Digital Input 14
60	Digital Input 15
61	Digital Input 16
62	Digital Input 17
63	Digital Input 18
64	Digital Input 19
65	Digital Input 20
66	Digital Input 21
67	Analog Input 01
68	Analog Input 02
69	Analog Input 03
70	Analog Input 04
71	Analog Input 05
72	Analog Input 06
73	Analog Input 07
74–81	*Reserved for Future Use*

The following system message codes cannot be defined as common faults but can be assigned to RDOs and are referenced in the event stack and history.

Message Code	Description
82	Defined Common Fault
83	Software-Controlled RDO #1
84	Software-Controlled RDO #2
85	Software-Controlled RDO #3
86	Software-Controlled RDO #4
87–98	*Reserved*

The following system message codes cannot be defined as common faults or assigned to RDOs but can be referenced in the event stack and history.

Message Code	Description
99	Genset Parameter Warning
100	Genset S/N Mismatch Warning
101	Genset S/N Mismatch Shutdown

Function Codes: Digital Auxiliary Input

Code	Name	Notes
1	Warning	
2	Shutdown Type A	
3	Shutdown Type B	
4	Voltage Raise	
5	Voltage Lower	
6	VARPf Mode	
7	Remote Shutdown	
8	Remote Reset	
9	Air Damper	
10	Low Fuel	
11	Field Over Voltage	
12	Idle Mode	*ECM only*
13	Battle Switch	
14	Ground Fault	
15	Bat Chgr Fault	
16	High Oil Temperature	
17	Low Coolant Lvl	
18	Low Coolant Temperature	*ECM only. Not user-assignable.*

Notes

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