



GE Power Management Control System



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Technical Note #50

GE Power Management Control System

RS-485 Repeaters Qualified For Use With PMCS Modbus Networks

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Subject: Using RS-485 repeaters PMCS Modbus network can be extended from 32 device nodes to 128 nodes and cable length of up to 16000 Ft. This note provides qualification information on repeaters that have been tested and qualified for use with PMCS Modbus.

Applies To: PMCS system Modbus Networks.

Minimum Specification & Qualification Requirements

Power Supply	Built in or adapter. 120 Vac (+/- 10V), 60 Hz (optional 240 Vac 50 Hz)
Surge Suppression	Recommended on both host and remote ends
Operating Temp.	0 to 70C (32 to 158F)
Drive Modules	32
Drive Distance	4000 Ft
Bus Direction Control	Transparent both direction control
Optical Isolation	Yes. At least 500 Vdc (common mode). 1500 Vac or higher for 1 minute
Baud Rates	Minimum range of 4800 to 38.4K baud per second
Connector	2 or 4 wire screw terminal block for RS485
Half / Full Duplex	Half or full duplex
Visual Indicators	Host (receive), remote (transmit) and power indicators
Installation	Panel mounted (preferred) or desk top
FCC Approved	Class A

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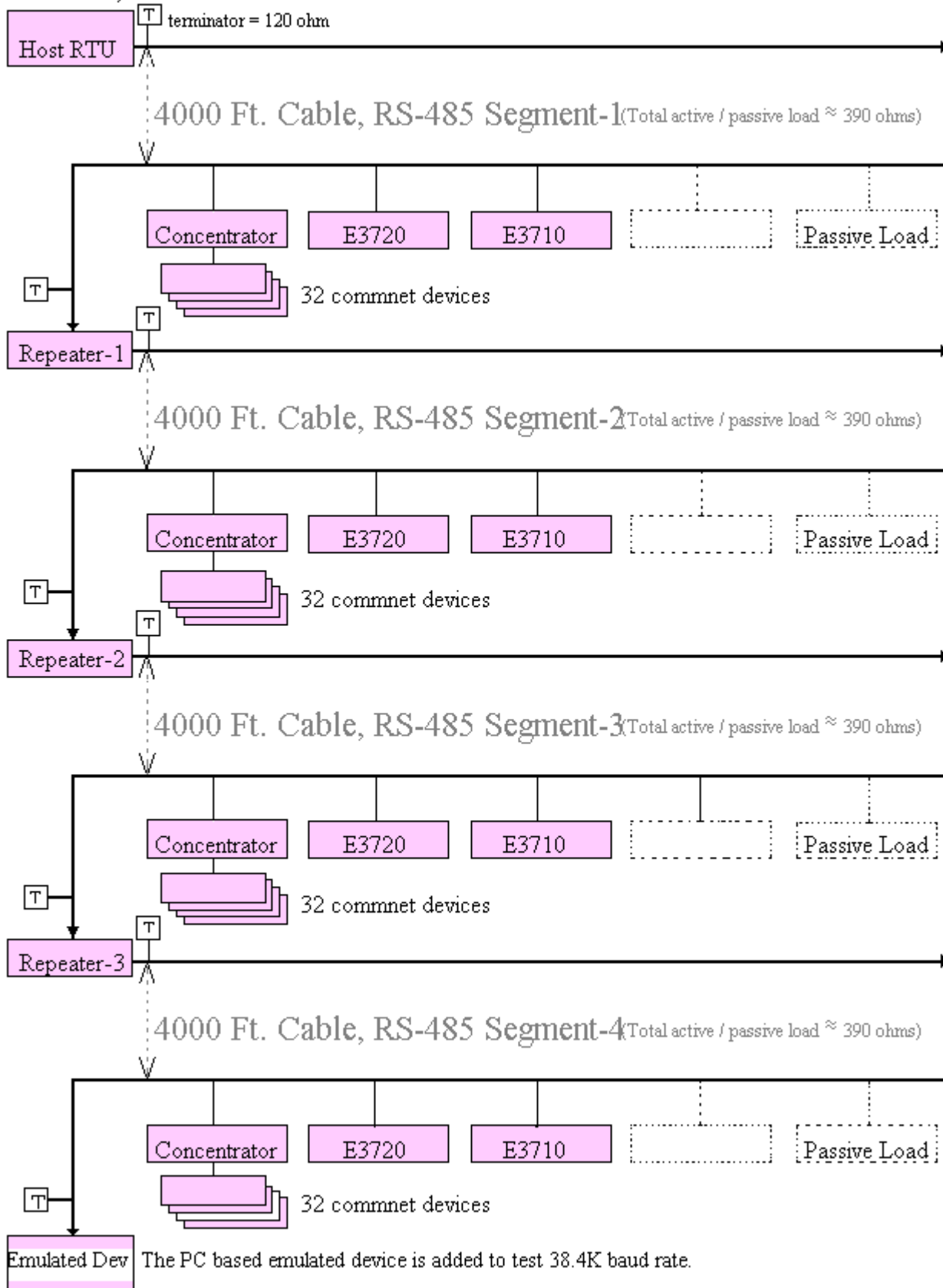
Overall pass/fail criteria are summarized here. The system shall be in no way effected by a repeater. When online with repeaters, there shall be no CRC errors, less than a 2% (<.2% is typical) time-out rate for the DDE server, and no Modbus device may be declared dead due to connected repeaters.

All wave forms transmitted from the repeaters must be EIA-485 compliant (delta voltages and rise/fall times). See Figure-2 for the wave form requirements.

RTU & Device Network Setup

Windows-NT PC with PMCS-5.1 to be used as Remote Terminal Unit (RTU), RS-232 to RS-485 converter, RS-485 communication cable, RS-485 Repeater(s) to be qualified and a digital oscilloscope are required to setup the qualification tests listed in following sections. The network consist of 4 segments each of 4000 Ft. length. Each segment consist of 31 devices and a repeater (counted as one node). If 31 real devices are not available to load a segment to it's full limit, passive resistive load may be added to compensate for actual devices (one device = 12K ohms). Figure-1 provide a general setup information

FIGURE-1, 16000 FT. NETWORK SYSTEM CONFIGURATION



General Test Setup

Use All Register test applications under Microsoft Excel using links with GE's PMCS DDE Server to monitor all connected devices/registers for dynamic values, fixed values, set-points and command coils.

RS-485 Segment Length (Each Segment):	4000 Ft
RS-485 Segment Termination (Both Ends):	120 ohms resister
RS-485 Total Cable Length:	4000 Ft
Modbus Master / DDE Server Name:	GE16MODB.exe (PMCS 5.0)
	GE32MODB.exe (PMCS 5.1)
Modbus Communication Baud Rates:	4800, 9600, 19.2K & 38.4K
Modbus Communication Port:	Use One Port, COM1, 2, 3, etc.
Modbus Communication Port Segments:	Up to 4, varies with tests (see Tests 1-4)
Modbus Protocol Timer Tick Rate:	110 mSec (allowable lowest value)
Modbus Device Communication Time Out:	5000 mSec
Modbus Scan Rate for All Active Devices:	1000 mSec
Modbus / RS485 Cable:	Belden 9841 or Alpha 6412, 16-24 AWG.
Modbus / RS485 Segment Details:	See Individual Tests 1-4.
Active Modbus Concentrators Per Segment:	1 (At least one per RS-485 segment)
Active Commnet Devices On Concentrator:	32 (Use maximum devices to increase Modbus traffic)
Other Active Native Modbus Devices:	1 (At least one per RS-485 segment)
	A PC emulated device (Emulator.Exe and other files) needed for 38.4K baud test.
Three Phase Power Source Voltage Setting:	120 Volts
Device PT Settings:	Any value within 120-600 Volt range
Test Application / Spread Sheet File(s):	"Concntrr.Xls" Modbus Concentrator Devices/Registers "E3710.Xls" for all EPM-3710 Registers "E3720.Xls" for all EPM-3720 Registers "EmulatedRMS6.xls" for 38.4K baud test using PC emulated device.

The voltage settings are not important for communication tests but may be required for powering some devices, e.g. EPM. The Pass/Fail criteria for these communication test is strictly based on IO traffic statistics as reported by DDE Server and already explained in the "Minimum Specification and Qualification Requirement" section.

The above general setup parameters applies to all the 4 tests described in following sections. There may be other setup requirements and individual RS-485 segment details specific to individual tests. Such setup details, if any, are specified with in the individual test description.

The tests and procedures in the following sections identify the steps necessary to qualify the repeater under test. Setup the tests as specified.

All segments should be terminated at both end with standard 120 ohms terminating resister. This is also true for PC Host (RTU) end which is usually connected with an RS-232 to RS-485 converter. Some multiport adapter cards, such as Stargate's ACL II+, have built in terminator. Use appropriate terminator for such cases. For Stargate's ACL II+, use a 360 ohm terminator as it has a built in terminator of 180 ohms.

Test Descriptions

Repeater must meet the minimum specification requirements as specified in "Minimum Specification and Qualification Requirement" section.

Test-1, 4000 Ft With Out A Repeater

The purpose of this test is to establish a base line for a repeater under test. Observe and record Modbus behavior with out the specified repeater. Then perform other tests (Test-2, 3, 4) with the specified repeater and compare the

new results with the base line results observed during this Test-1.

GENERAL

Test Run Time:	20 hours (minimum)
Total Messages Transmitted By Host RTU:	200,000 (minimum)
CRC Errors As % Of Total Txed Messages:	0.0%
Port Errors As % Of Total Txed Messages:	0.0%
Time Outs As % Of Total Txed Messages:	2.0% (maximum)

SEGMENT-1

Active Modbus Concentrators On Segment:	1 (At least one)
Active Commnet Devices On Concentrator:	32 (Use maximum devices to increase Modbus traffic)
Other Active Native Modbus Devices:	1 (At least one)
Wave form's EIA-485 compliance (Host):	Check rise / fall time and compliance (Yes/No)
Wave form's EIA-485 compliance (Device):	Check rise / fall time and compliance (Yes/No)

SEGMENT-2

Not applies to Test-1

SEGMENT-3

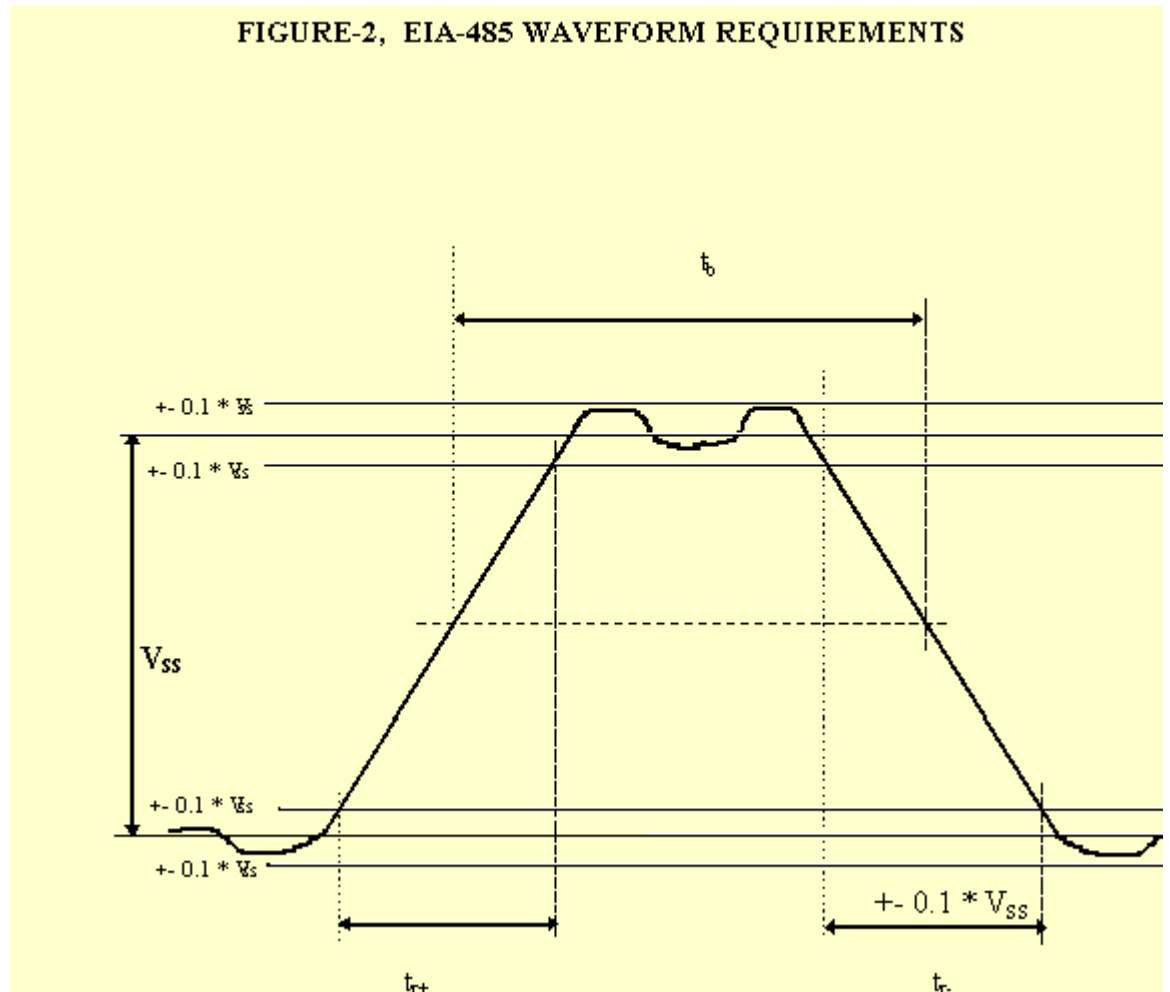
Not applies to Test-1

SEGMENT-4

Not applies to Test-1

Test-2, 3, & 4 8000, 12000 and 16000 Ft With Repeaters

Extend above setup to 4 segments as specified in Figure-1. Repeat above tests for segment 2, 3 and 4. Compare each segment test results with the base line results observed during Test-1. All segment repeaters must meet the minimum specification requirements as specified in "Minimum Specification and Qualification Requirement" section.



QUICK COMPARISON OF RS-485 REPEATERS CONSIDERED FOR QUALIFICATION				
Supplier / Manufacturer	Opto22 (Qualified 1996)	B & B Electronics (Failed)	Black Box (Failed)	Acromag (Qualified 10/97)
Model	AC38A	485OP	IC158A	4SCR-TTM-1
Qualified	Yes, PMCS-5.0	No (see report)	No (see report)	Yes, PMCS-5.1
Power Supply	120Vac 60Hz (240V-50Hz Avl)	Need 9-14Vdc @ 60 -170mA	115Vac 60Hz (230V-50Hz Avl)	115Vac 50/60Hz (230V-50Hz Avl)
Power Dissiptn.
Surge Suppress.	..	Yes	..	RS485 both ends
Opr. Temp.	0C to +70C	-40C to +85C	0-45C/32-110F	-25C to +85C
Drive Modules	32	32	30	32
Drive Distance	3000 Ft	4000 Ft	4000 Ft 64Kbps	4000 Ft
Bus Direction Control	..	Both Directions 1Char Time Out (adjustable)	Transparent to flow control	Both Directions 1Char Time Out
Optical Isolation	Yes	Yes,1500Vac for 1 Min	Yes, 2500Vac 500Vdc (Common Mode)	Yes,1500Vac/Mn 500Vdc (Common Mode)
Baud Rates	Up to 115.2K	Up to 115.2K	Up to 128K	300 - 38.4K
Baud Selection	Switch Selectable
Connector	RS232 D-9 (F), RS422 4 Wire, RS485 2 Wire	RS485 2/4 Wire, 6 Screw Terminal	RS485 4 Wire, 4 Screw Terminal, RJ-45	RS485 2 Wire, Screw Terminal
Half / Full Duplex	Half/Full Host, Half Dup Remote	2 Wire Half Dup, 4 Wire Half / Full, 4 or 2 Wire Convtr	2 Wire Half Dup, 4 Wire Full Dup	Half Duplex
Visual Indicators	Host, Remote, Power & IRQ	..	Host, Remote, Power	Host, Remote, Power & Fault
Dimensions / Installation	10.50" L, 04.38" W, 04.25" H, Panel Mount	3.80" L, 2.40" W, 1.00" H, Desk Top	1.80" H, 5.50" W, 8.50" D, Desk Top	7.00" L, 4.30" W, 2.10" H, Panel Mount
FCC Approved	..	Class A	Class A Part 15	..
Price Repeater	\$365.00	\$129.95	\$255.00	\$255.00
Price Power Unt	Integral	Adapter Included	Adapter Included	Integral
Tel:	800-452-6786	815-433-5100	412-746-5500	248-624-1541

Fax:	800-832-6786 Fax Back, 800-474-6786	815-434-7094	800-321-0746	248-624-9234
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Qualification Report For Opto22 Model AC38A - Qualified 1996

Make: Opto22

Type: Opto-isolated Repeater

Model: AC38A

Qualification Report For B&B Electronics Model 485OP - Failed

Make: B & B Electronics

Type: Opto-isolated Repeater

Model: 485OP

The unit failed to operate right in the beginning. Resulted in undesirable oscillation of the transmission line. The unit might be faulty. It was returned to vender and no further test could be performed due to non availability of an immediate replacement.

Qualification Report For Black Box Model IC158A - Failed

Make: Black Box

Type: Opto-isolated Repeater

Model: IC158A

All wave forms viewed during the tests met EIA-485 standards as specified in Figure-2.

Repeater met all but following minimum requirements.

Operating Temperature	0 to 70C (32 to 158F)
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Also the 0.15% time out percentage was observed with or without a 100 ohm terminating resister. Time outs with the standard 120 ohm terminating resister were much higher than the acceptable limits of 2%. Internal switch selection was provided to fine tune for individual network speed and length situations, which required an understanding of transmission lines.

Qualification Report For Acromag Model 4SCR-TTM-1 - Passed

Make: Acromag

Type: Opto-isolated Repeater

Model: 4SCR-TTM-1

All segment repeaters met the minimum specification requirements as specified in "Minimum Specification and Qualification Requirement" section. An easy to select external baud rate switch is all that need to be set up for different speeds.

Keywords: Repeaters, Optical Isolation, RS-485, Modbus, Terminator, PMCS.

Related Notes: [Application Note 1: Network Cable Requirements.](#)

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