4829A

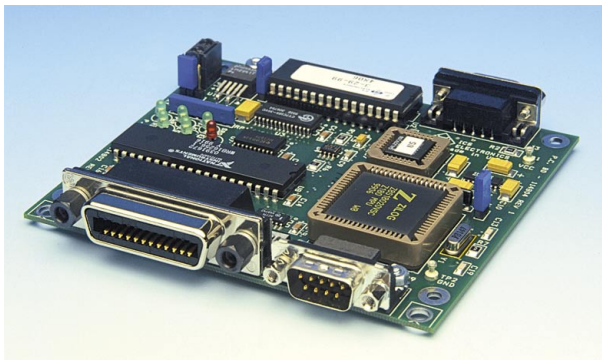
GPIB<->RS-422/RS-485 MODBUS INTERFACE

- Converts simple ASCII commands into Modbus RTU messages.
  Relieves user from having to generate and check RTU packets.
- Expanded Modbus RTU Command Set includes Floating Point commands.
  Controls a wider range of Modbus devices.
- Provides GPIB and RS-232 to RS-422/RS-485 data paths for Modbus RTU devices.
  Use GPIB or RS-232 to control RS-485 Modbus devices.
- IEEE-488.2 Compliant.
  Meets latest GPIB Standards.
- Saves GPIB address, serial settings and user IDN message in nonvolatile memory.
  Personalize the 4829A as part of your system.
- Runs on 5 to 15 Vdc.
  Uses available DC power.
- Mounts directly to host chassis's rear panel.
  Easy installation eliminates extra cables and reduces cost.

RoHS

DESCRIPTION

ICS's 4829A GPIB<->Modbus Interface is an IEEE 488.2/GPIB to Serial Interface that adapts Modbus RTU slave devices with RS-422/S-485 interfaces to the GPIB bus and to RS-232 serial links. The 4829A lets the user send simple read-write messages on the GPIB bus to control and query slave Modbus RTU devices. The 4829A does all of the Modbus packet formatting and handles the response packets. The 4829A also provides all of the required IEEE-488.2 functions and an expanded IEEE-488.2 Status Reporting Structure to report Modbus communication errors. The 4829A also provides a RS-232 to RS-422/RS-485 converter function so that a RS-232 data source can control RS-422/RS-485 Modbus slave devices with the serial Modbus RTU protocol. Typical applications are adding a GPIB interface to a temperature chamber or system using a Watlow EZ Zone or other Modbus RTU slave devices.



4829A Showing Rear Panel Connectors

Installation

The 4829A is a small PC board that is designed to be mounted directly to the rear panel of the host device. It has two connectors that protrude through the rear panel. A standard 24-pin GPIB connector and a DE-9 male serial connector. The connector shells and mounting blocks mate against the rear panel to provide a good EMI/RFI seal. An on-card regulator lets the 4829A run on regulated 5 Vdc power or from unregulated 6 to 15 Vdc power.

Dual Data Paths

Figure 1 shows the 4829A's dual data paths. GPIB messages addressed to the 4829A are converted into serial packets and transmitted as RS-422/RS-485 signals to the Modbus device. Response packets from the Modbus device go to the GPIB's serial input buffer and are converted into RS-232 levels and routed to the rear panel serial port (J2). Response data from the Modbus device is outputted on the GPIB bus when the 4829A is next addressed to talk. Incoming RS-232 packets received at the rear panel serial port are routed to the processor which transmits them as RS-422/RS-485 signals to the Modbus device.

Operation

The user sends GPIB commands to the 4829A that sets the Modbus device address, specifies the device register to be read or written and the data value. The 4829A converts these commands into the Modbus RTU packet format, adds the CRC checksum and transmits the messages to the Modbus device. Received packets are checked and any query response data is outputted to the GPIB bus when the 4829A is next addressed to talk. Modbus communication faults, exception messages and other errors are reported to the user through a Modbus Error Register in the 4829A's Status Structure. The 4829A can be set to generate an SRQ when a Modbus error occurs. The 4829A firmware has an expanded Modbus command set and includes 32-bit floating point commands so it can control newer temperature controllers. The 4829A is fully compatible with other ICS 48x9 interfaces.

The External Serial Port can be used for a direct serial connection to the Modbus device or to monitor the 4829A's serial messages.

Application Note, AB48-25, describes how to use the 4829A to control a Modbus device and includes an example Visual Basic control program.

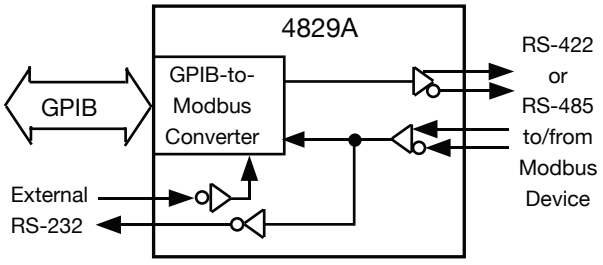


Figure 1 4829A Data Paths

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Configuring

The 4829A's serial configuration, IDN message and GPIB address can be set or queried from the GPIB bus with SCPI commands. There are no jumpers or switches to set. The OEM user can enter his own IDN message to personalize the 4829A as part of the end product. All configuration settings are saved in a Flash memory and are automatically recalled when the 4829A is powered-on or reset. All of the settings, except for the GPIB Address, can be locked so they cannot be accidentally changed by the end-user.

4829A Status Reporting Structure

The 4829A has an expanded IEEE-488.2 Status Reporting Structure that includes a Modbus Error Register. Bit 6 of the ESR Register is set whenever anything is saved in the Modbus Error Register. The user can enable SRQ generation by setting the corresponding bits in the ESE, Operational Enable and SRE enable registers so that a true condition will generate a Service Request and assert the SRQ line. When the appropriate enable bits are set, any Modbus error will set the summary ESR bit in the Status Byte and generate an SRQ. The user can then query the Status Byte and the ESR register to learn the source of the SRQ and read the Modbus Error Register. For more information about the IEEE-488.2 Status Structure, refer to Application Bulletin AB48-11.

Diagnostic LEDs

The 4829A has six diagnostic LEDs that show its status. At power turn-on, the 4829A performs a selftest and then blinks its GPIB address before turning on the RDY LED. Any selftest errors are shown by a blinking LED pattern. The LSTN and TALK LEDs light when the 4829A is addressed to Listen or Talk. The ERR LED lights when the 4829A receives a bad GPIB command or detects a Modbus error or timeout.

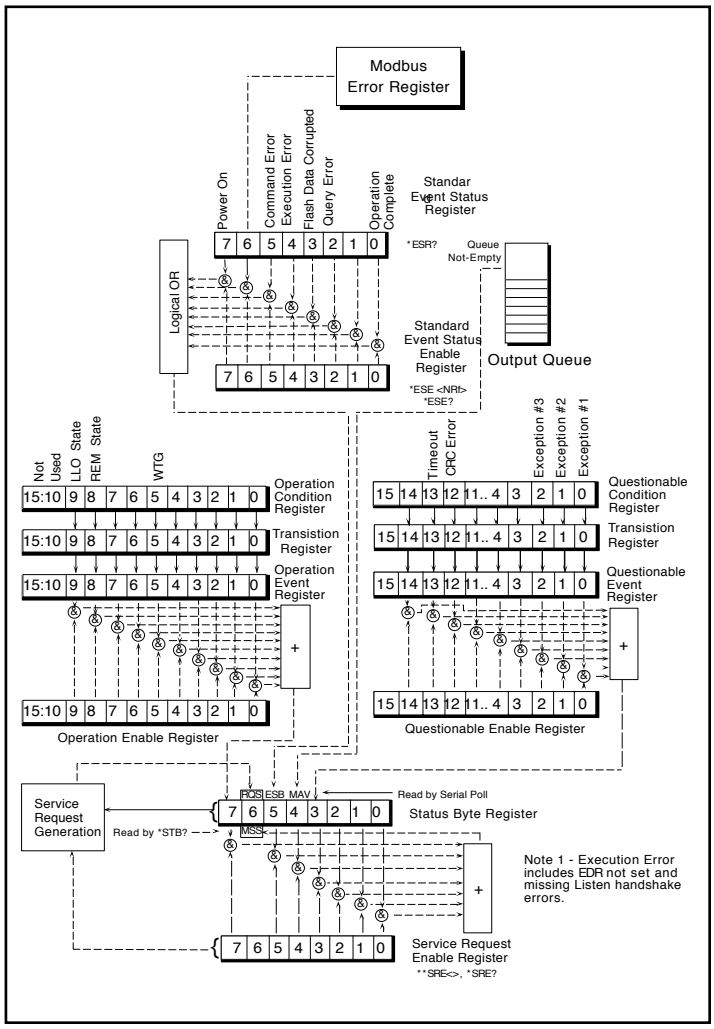


Figure 3 4829A Status Reporting Structure

Temperature Chamber Application - The 4829A automatically responds to all IEEE-488.2 queries and common commands addressed to the chamber. GPIB commands that read from and write data to registers in the Modbus Controller are converted into RTU packets and transmitted to the Modbus Controller. The 4829A handles all of the packet conversion, CRC generation and packet error checking functions. Responses from the Modbus Controller are buffered and outputted to the GPIB controller when the 4829A is next addressed to talk. Any Modbus errors are saved in the Modbus Error Register so they can be read by the GPIB Controller.

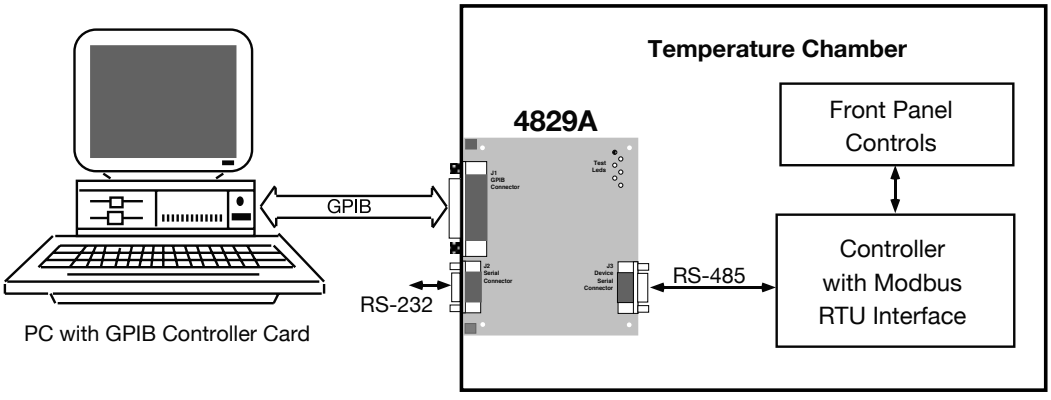


Figure 2 4829A Used in a Temperature Chamber Application

TABLE 1 MODBUS COMMANDS

Syntax	Modbus Code	Meaning
C addr	-	Modbus Address Command. Sets Modbus slave device address for subsequent commands. Value for *addr* is 1 to 255. Default is 1.
RI[?] reg, numip	0x02	Read Discrete Inputs Command. Reads discrete inputs from register *reg*. User specifies the input to read. Values for *reg* are 0 to 32767. Values for *numip* are 1 to 2000. Responses are returned as a bit packed value.
R[?] reg, num	0x03	Read Register Command. Reads one or multiple Modbus device registers. User specifies starting register *reg* and number of registers to be read *num*. The [?] is an optional symbol so programs like ICS's GPIBKybd program can recognize the command as a query and automatically read the response. Values for *reg* are 0 to 32767. Values for *num* are 1 to 64. Responses are returned as 16-bit decimal or HEX values separated by commas. Output format selected with the Format command. R? 0,1 reads Watlow Model Number. Response is 5270 for Watlow Model F4 R? 0,3 reads three successive registers. Response is 5270,0,123 for the Watlow F4 Controller.
RF? reg	0x03	Reads 32-bit floating point value from register *reg* and *reg+1*
RR[?] reg, num	0x04	Read Input Register Command. Reads one or multiple Modbus input registers. User specifies starting register *reg* and number of registers to be read *num*. The [?] is an optional symbol. Values for *reg* are 0 to 32767. Values for *num* are 1 to 64. Responses are returned as 16-bit decimal or HEX values separated by commas. Output format selected with the Format command.
RE[?]	0x07	Read Exception Command. Reads the exception value from the modbus device.
WC reg, boolean	0x05	Write Coil Command. Writes a boolean (on/off) value to a single Modbus device register, *reg*. Values for reg are 0 to 32767. Values for *boolean* are 0/Off or 1/On.
W reg, w	0x06	Write Register Command. Writes a 16-bit value, *w* to a single Modbus device register, *reg*. Values for reg are 0 to 32767. Values for *w* are 0 to 65535.
WB reg, num, w(0)..w(n)	0x10	Write Block Command. Writes multiple 16-bit words, *w(i)* to multiple registers. Starting register, *reg*.. Number, *num* specifies how many words are to be written. Values for *reg* are 0 to 32767. Values for *num* are 1 to 64. Values for *w* are 0 to 65535.
WF reg, n	0x16	Writes a 32-bit floating point value to register *reg* and *reg+1*
L[?] w	0x08	Loopback Command. Writes a 16-bit word, *w*, out to a Modbus device and returns a single response word to the GPIB bus. The question mark is optional. Value for *w* is 0 to 65535.
D time	-	Timeout Command. Sets timeout value of Modbus response message in milliseconds. Timeout is the total time for the message to be received by the 4829 or 4829. Value for *time* is 1 to 65,535 milliseconds. Default is 100.
D?		Queries the current timeout setting.
E?	-	Read Error Command. Reads and clears the Modbus Error Register and bit 6 in the Event Status Register. Returns a error code whose value is 0 to 255. Current error values are: 0 No errors present 1 Exception Code 1 - Illegal command 2 Exception Code 2 - Illegal address 3 Exception Code 3 - Illegal data value 100 CRC Error 101 Timeout Error indicates no characters received in response message. 2nn Partial or corrupted message received. nn is the number of received bytes.

Notes: Integer and register values from 0 to 65,535. Floating Point per IEEE-754.

4829A: SPECIFICATIONS

IEEE 488 Bus Interface

The 4829A's 488 Bus Interface meets IEEE STD 488.1-1987 and has the following capabilities as a GPIB-to-Serial converter:

SH1, AH1, T5, L3, SR1, PP1, DC1
RL0, DT0, C0 and E1/E2 drivers

Bus drivers incorporate power up/down protection to prevent glitching the bus during power turn-on.

Address Capability

Primary addresses 0-30. Address set by GPIB bus command. Address displayed on LED indicators at power turn-on.

SRQ Generation

SRQs are generated per the IEEE-488.2 specification when the unit is not addressed to talk and an enabled bit in the ESR, Questionable or Conditional register becomes set. ESR bits are:

Modbus Error Register set
Serial Buffer full
Command error
Serial error
Execution error
Query error
Power on

Buffers

GPIB Input	2 Kbytes
GPIB Input	1 Kbytes
Serial Input/Output	256 bytes

488.2 Common Commands

*CLS, *ESE, *ESE?, *ESR?, *IDN?, *OPC, *OPC?, *RST, *SAV, *SRE, *SRE?, *STB, *TST?, AND *WAI.

Serial Interface

Rear Panel Connector

Rear panel serial signals conform to EIA Specifications for RS-232 signals. J2 is a DTE type interface with DTR, CTR and RTS signals pulled to +V.

Signals	Txd, Rxd, Gnd
Baud Rates:	300 to 57.6 Kbaud
Data Bits	7 or 8 bits
Parity	Odd, even or none
Stop Bits	1 or 2

Pin#	External J2 (DE-9S Signals		Internal J3 (DE-9S) Signals
1	DCD	open	RX+
2	RxD	←	RX-
3	TxD	→	TX-
4	DTR	←+V	TX+
5	Gnd		Gnd
6	DSR	open	
7	RTS	←+V	
8	CTS	←+V	
9	no connection		

Internal Serial Connector

Internal serial signals are 4-wire or 2-wire RS-485 signals capable of driving 32 RS-422/RS-485 loads. Rx Differential receiver includes a termination network to hold the signals in a mark state when they are not being driven. 4-wire or 2-wire signal selection set by on card jumpers. Signal transmitter can be set for full or half-duplex operation. The baud rate and data character format settings applies to both serial connectors.

Indicators

Six on board LEDs show selftest diagnostics, GPIB address and status.

PWR - On when power applied
RDY - On when Selftest passed
MTA - On when talk address recognized
MLA - On when listen address recognized
SRQ - On when SRQ generated
ERR - On when ESR register bit set

Physical

Size, L x W x H

101.6 x 114.3 x 17.9 mm
(4.0 x 4.5 x 0.7 inches)

Connectors

GPIB:	24-pin IEEE-488 connector with metric lock studs.
Ext. Serial :	9-pin DE shell male connector with 4-40 lock studs.
Int. Device:	9-pin DE shell female connector with 4-40 lock studs.

Construction

Four layer fire-resistant PCB. Connector shells and mounting blocks are connected to chassis ground.

Temperature

Operation	-10° C to +70° C
Storage	-40° C to +85° C

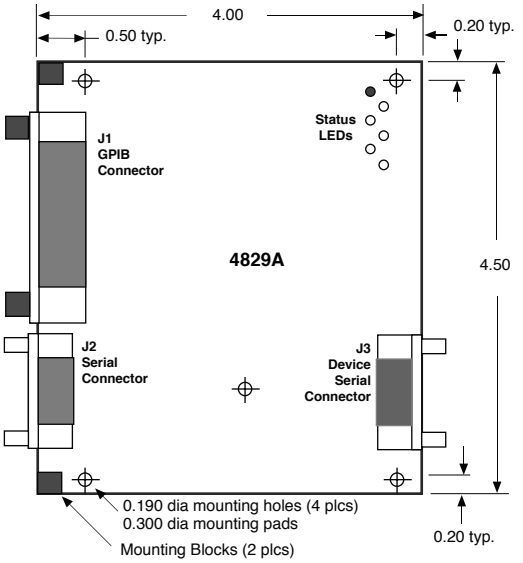
Humidity

0-90% RH without condensation

Power +5 ± 0.2 Vdc or
5.5 to 15 unreg Vdc
500 mA (typ.)

Included Accessories

Instruction Manual
Configuration Disk with sample programs



4829A Outline Dimensions

ORDERING INFORMATION

	Part Number
GPIB - Serial Interface Board (includes Manual and Configuration Disk)	4829A
GPIB - Serial Interface Board (Board only)	115782