MODBUS CONVERTER

2399

ANSI X3.28 to MODBUS RTU INTERFACE

- Converts ANSI commands into Modbus RTU messages. *Matches old ANSI commands to new Modbus Devices.*
- Replace old ANSI controllers without software changes. *Saves time and many thousands of dollars.*
- Compatible with all Modbus RTU Slave Devices. *Conversion table handles all Modbus devices*
- Control Modbus RTU devices with simple ASCII command strings. *Easy control of Modbus RTU devices from a PC or laptop.*
- Both serial ports provide RS-232 and 2 or 4-wire RS-485 signals. *Choice of signal types fits your existing system.*
- Operates on +5 to 32 Vdc or 115 VAC power. *Uses existing DC power or AC power with the included AC power supply.*
- Plug-in screw terminal strips for easy wire connections. *No special tools or soldering required.*

☑ *RoHS Compliant*

DESCRIPTION

ICS's 2399 is a multi-function interface that converts ANSI commands into Modbus RTU packets for controlling Modbus RTU Slave Devices. The 2399 accepts the ANSI commands as X3.28 packets or with the XonXoff protocol. The 2399 also operates as a serial to Modbus converter to control Modbus RTU Devices with simple command strings.

Typical applications are replacing obsolete ANSI process controllers like the Watlow 942 or 980 series with a modern Modbus controller or the controlling Modbus Slave devices from a computer or laptop COM port.

2399 ANSI X3.28 Converter

Process System Obsolescence

Many semiconductor and other process control systems were built with process controllers that use the ANSI command set. These ANSI controllers are now obsolete and have become difficult if not impossible to repair. Direct replacement of the controller is not possible as ANSI controllers are no longer being produced. Migration to the Modbus protocol is almost impossible as even a small change to the system software can be a nightmare. These systems were designed years ago and often cannot be reprogrammed without a major design effort. The code maybe proprietary, the programming tool lost and/or the original programmer or team is gone. Vendor upgrades often cost 10s of thousands of dollars and replacement systems can run well over $100,000.

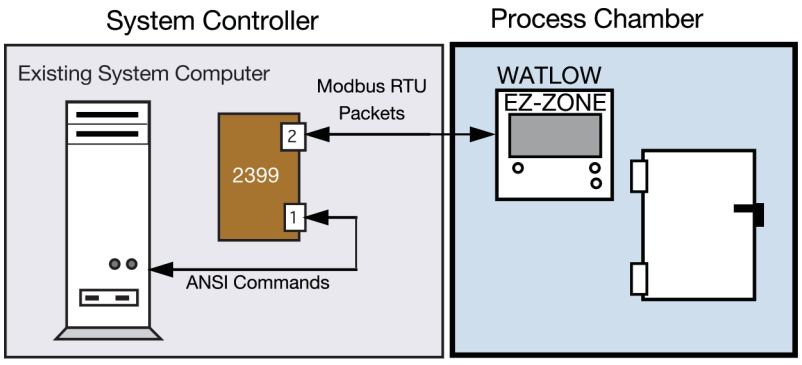
The 2399 Solution

ICS's 2399, with its ability to mimic the old ANSI process controller, provides an economical way to update old systems with a modern Modbus controller at a fraction of the cost of a vendor upgrade or system replacement.

The 2399 can be used to replace an obsolete ANSI controller with a new Modbus controller as shown on the right or used to replace multiple ANSI controllers with a multi-channel Modbus controller like Watlow's MLS300 shown in Figure 2. Multiple 2399s can be used on a RS-485 network to control multiple Modbus devices.

The user programs the 2399 Command Conversion Table by listing the old ANSI commands with the equivalent register numbers in the new Modbus controller. The old ANSI controller is then replaced by the new Modbus controller. The 2399 is inserted in the serial path between the existing system computer and the new Modbus controller as shown in Figure 1 below. The system then runs as it did originally without the need to change the system controller software.

The 2399 is a small, metal enclosed converter that can be DIN Rail or panel mounted. It operates on 5 to 32 Vdc and includes a 115 VAC power adapter. The 2399's serial ports are both RS-232 and RS-485 capable.



2399 used to update a legacy X3.28 manufacturing system

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Direct Control (SCPI) Mode

Configuring the 2399 and using it for direct control of Modbus devices is done with the 2399 in the SCPI Mode. SCPI stands for Standard Commands for Programmable Instruments and is the command syntax used in most test instruments. In the SCPI Mode, the 2399 accepts setup commands and simple ASCII string type commands to control Modbus RTU Slave Devices. The setup commands include loading the ANSI Command Conversion Table. All setup values are saved in non-volatile EEPROM.

In the SCPI Mode, the 2399 can be used as a Serial to Modbus RTU Interface to control a Modbus device. The serial commands sent to the 2399 are ASCII strings that provide full control for reading and writing to registers, for coils and for discrete inputs. They can be entered using any terminal emulation program like Hyperterm or RealTerm or as part of an application program. The 2399 converts the command into a Modbus packet, adds the checksum and transmits it to the Modbus device. Received packets are validated and any response data is returned to the host controller or PC. Any errors or exception messages are captured in an Modbus Error Register that can be queried by the user. Multiple Modbus devices can be addressed on an RS-485 network.

ANSI Controller Replacement

The 2399 uses the user's Command Conversion Table to mimic the old ANSI controller and operate the new Modbus device. Filling in the table is a three step process. The user first determines which ANSI commands the system is using by spying on the system and recording the serial traffic to the old ANSI controller. The commands are then entered into an Excel spreadsheet along with their equivalent register number in the new Modbus controller. Register types and 2399 command mode are added to the spreadsheet. The spreadsheet information is then uploaded into the 2399 and saved. The 2399's serial ports are configured and the 2399 is connected to the new Modbus Controller .

ICS provides two utility programs to simplify configuring and testing the 2399. The 2399Ser_Kybd program can be used for direct control of the 2399, for loading small ANSI Command Tables and for exercising the 2399 with ANSI commands to test the command conversions before going live with the existing system controller. The 2399Ser_Kybd program lets the user switch between the X3.28 or XonXoff and SCPI Modes to test the commands and make any necessary corrections. When done, the 2399 is switched to the X3.28 or XonXoff mode and connected to the system controller for a live test.

ICS's supplies a 239x Table Loader utility program for loading the 2393's ANSI Command Table from an Excel csv file. This provides a fast upload experience for the user and is less error prone than manually loading each line in the Command Table. Other benefits are ease of multiple uploads, configuration control and setup documentation.

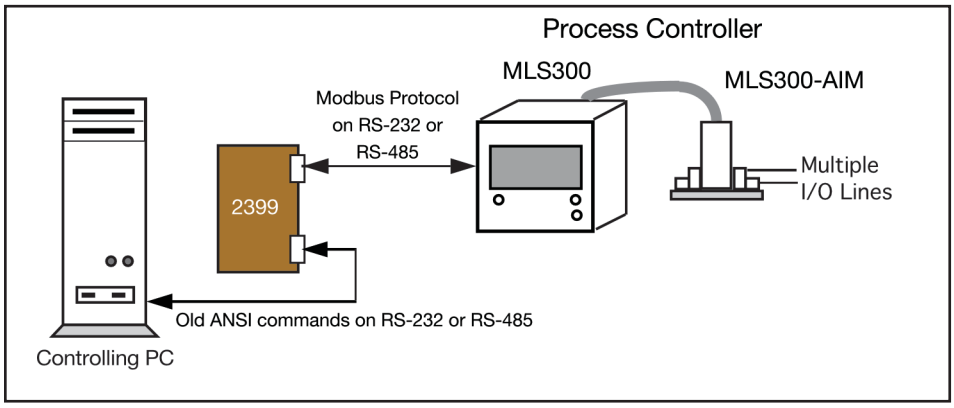

Figure 2 Using a 2399 to drive a Watlow MLS300 multi-channel controller

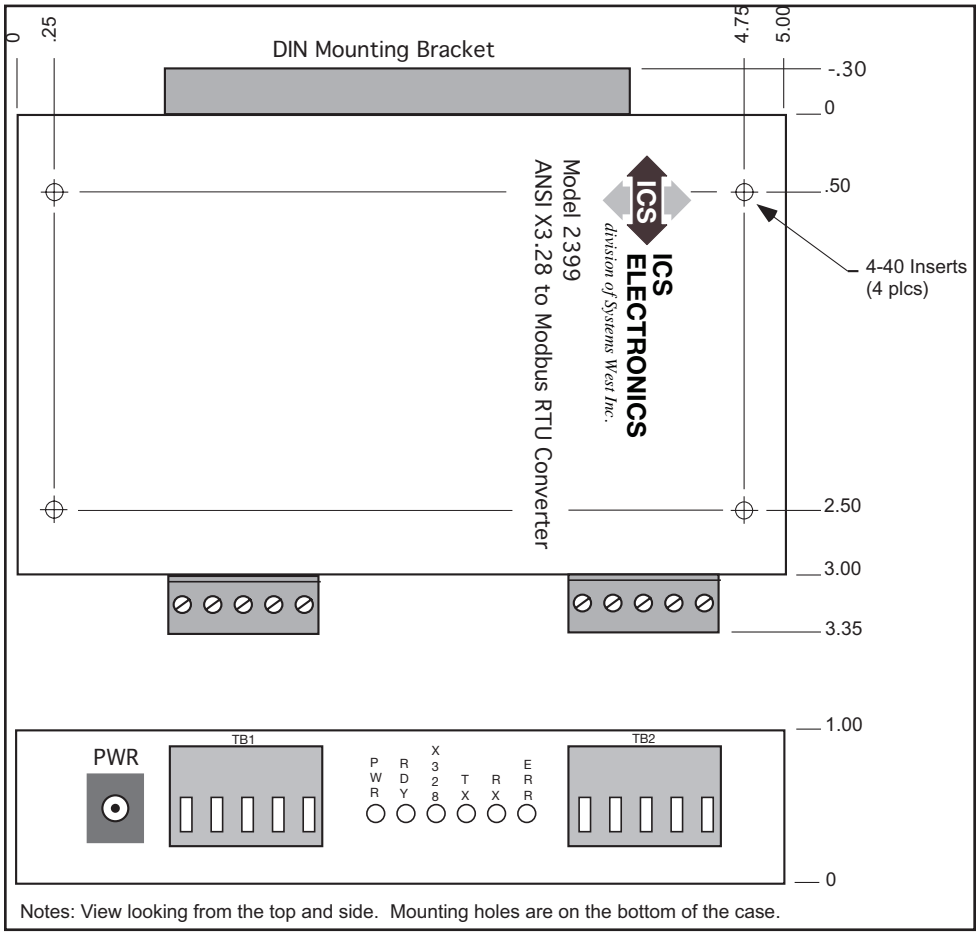

Figure 3 2399 Outline Dimensions

X3.28 and XonXoff Modes

In the X3.28 or XonXoff Mode, the 2399 appears as the old ANSI device to the controlling computer. It accepts ANSI commands and converts them into Modbus RTU packets that read from or write to registers in a Modbus RTU slave device. Modbus device responses are returned to the user in the ANSI format.

SCPI Mode

The 2399 accepts serial commands on Port 1 to configure the 2399 and to control one or multiple Modbus RTU devices. See the commands in the ASCII-Modbus Command Table.

Status Reporting Structure
IEEE-488.2 Status Byte, ESR, Modbus Error, Questionable and Operational Registers.

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

SCPI Commands
The 2399 conforms to the SCPI 1994.0 Specification and uses SCPI commands to set:
- X3.28 Address (Port 1)
- Baud rate
- Data bits
- Stop bits
- Parity
- Talk Format
- RS-485 TX signal tristate enable

X3.28 and XonXoff Mode

The 2399 recognizes its address and accepts serial ANSI commands on Port 1. It provides Modbus RTU packets communication to the Modbus device connected to Port 2. Port 1 protocol can be ANSI X3.28 or Watlow Xon-Xoff. Address 32 enables the 2399 to accept addresses 0-31 and adjust the Modbus register number for multi-channel Modbus devices.

Address Capability

Port 1	0-31 [0] ANSI 32 enables Multi-address mode
Port 2	1-255 [1] Modbus

Targeted Device
Any

ANSI Command Table
100 Commands

Address Capability

Port 2	1-255 [1]

Serial Interfaces

Each port individually configurable for single-ended RS-232 and 2 or 4-wire differential RS-485 signals. Signal selection made by jumpers on the 2399. Internal termination network provided for the RS-485 RX signal pair.

RS-232 Signals	TxD, RxD, and gnd
RS-485 Signals	Tx and Rx pairs RS-422 compatible
Baud Rates:	300, 600, 1.2K, 2.4K, 4.8K, 9.6K, 19.2K and 38.4K baud.
Data Bits	7 or 8 bits
Parity	Odd, even or none
Stop Bits	1 or 2
Buffers	1024 bytes
Defaults	9600,8,1 and none

ASCII-Modbus Commands

Complete set of Modbus RTU commands for direct conrol of Modbus devices including: reading/writing integer, coils and floating point registers, reading discretes and inputs. Floating Point conversion meets IEEE-754.

Cmd	Code	Function
C n	-	Sets Device Address
RC? reg, n	0x01	Reads coils *n* from register *reg*
RI? reg, n	0x02	Reads Discrete Inputs *n* from register *reg*
R? reg, n	0x03	Reads *n* words starting with register *reg*
RF? reg	0x03	Reads floating point value from register *reg* and *reg+1*
RR? reg,n	0x04	Reads *n* words starting with register *reg*
RE?	0x07	Reads Exception value
WC reg,b	0x05	Writes boolean *b* to coil
W reg, w	0x06	Writes word *w* to a single register *reg*
WB reg, n, w...w	0x10	Writes multiple words *n* to a single register *reg*
WF reg, n	0x16	Writes a floating point value *n* to register *reg* and *reg+1*
L w	0x08	Performs loopback test
D time		Sets serial timeout in ms
E?		Queries Modbus Error Register

Indicators

PWR	On when power applied.
RDY	Passed self test.
X328	In X3.28 or XonXoff Mode.
TX	Transmitting on Port 1.
RX	Listening on Port 1 or addressed in X3.28 Mode.
ERR	On when an error detected.

Physical

Size, L x W x H
5.08 x 3.0 x 1.0 inches
(129 x 76.2 x 25.4 mm)

Mounting Options
Panel mount with 4-40 screws
DIN Rail, 35 mm DN Rail

Connectors:

Serial:	Removable 5-pin screw terminal strips for AWG wire sizes 12-26

LED Indicators:
PWR, RDY, X3.28, TALK, LSTN, ERR

Temperature:

Operation	-10° C to +55° C
Storage	-40° C to +85° C

Humidity:
0-90% RH without condensation

Power: +5 to + 32 Vdc at 0.25 VA

Weight:

2399 only	0.69 lb. (0.31 kg)
Shipping	2 lb. (0.9 kg)

Supplied Accessories

Power Adapter 115±10% VAC, 60 Hz (std.)
Instruction Manual
Plug-in Terminal Strips

Optional Accessories

116159 Serial Adapter Cable, 4 inches long with DE-9P plug for RS-232 signals.

ORDERING INFORMATION

	Part Number
ANSI X3.28 to Modbus RTU Converter (includes Power Adapter, Mating Terminal Strips, Manual and Configuration Disk)	2399
ANSI X3.28 to Modbus RTU Converter (spare unit)	116162
Serial Adapter Cable, 239x to DE-9P for RS-232 signals. 4 inch long	116159