2313
SERIAL ⟷ PARALLEL DIGITAL INTERFACE

DESCRIPTION

The Model 2313 Serial <-> Digital Interface Board provides 128 programmable data lines for controlling devices, for transferring digital data or for monitoring digital signals. The 2313's serial interface provides all of the functionality of a GPIB interface but allows for control of the digital signals from a RS-232 link or over an RS-422/RS-485 network with baud rates up to 115.2 kbaud. A user setable address lets multiple 2313s be operated on a RS-422/RS-485 network with other RS-485 devices.

The 2313's high-power TTL type signals can easily drive small relays or other logic elements. Applications include controlling switching matrices, displays or large signal arrays.

Versatile Digital Interface

The 2313's digital interface is configured to match the user's electronics with commands from the Serial Interface. The configuration commands permit the user to designate the data lines as inputs and/or outputs in 8-bit byte increments, to connect the bytes into strings, set data polarity, data format, handshake modes and data format. When done, the setup configuration is saved in the 2313's Flash memory and becomes the new power-on configuration. At power turn-on, the Stable output signal goes true after the Digital I/O lines have been configured to avoid glitching sensitive devices like relays or RF switches.

Data Transfer Methods

Data transfer between the serial interface and the 2313's digital interface can be directly to or from specific bytes, as bit commands, or as strings of values to or from one or more bytes. The user can mix methods as he assigns the input and output bytes.
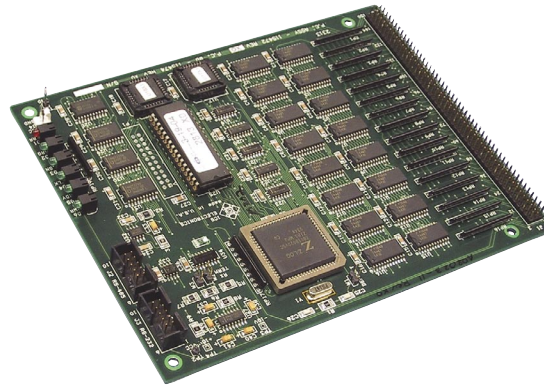
2313 Interface Card

Outputting Data

Direct output byte commands specify a specific byte and the output data value(s). Data strobes can be manually generated if needed. Bit commands can individually set or reset bits in an output byte. When outputting data as strings, the 2313 converts the string of characters into packed HEX bytes, places the data in the configured output latches and generates a data strobe pulse to update the external device. The data strings can be a series of decimal values, ACSII HEX characters, or the 30-3F HEX character set used in ICS's older interfaces.

Reading The Input Signals

Direct input byte commands read data from a specific byte. Bit query commands can read a specific bit from an input byte. When inputting data as strings, the 2313 reads the configured input bytes, converts the data to the selected format, and outputs it serially as a string of characters. Data can be inputted with or without handshaking. The parallel input data can be formatted as decimal numbers, as ASCII HEX characters, or into any user selected character set.

A very flexible serial interface for devices with digital signals.

- Provides a user-definable, 128-line parallel interface with bit, byte, string and binary data transfer capabilities. *Fully configurable to the user's needs by bus commands.*

- Signal monitor feature detects input changes. *Relieves controller of time consuming polling function.*

- Fast RS-232/RS-422/RS-485 interface operates up to 115.2 Kbaud. *Supports network and packet protocols.*

- High-current drivers and input pullup resistors. *Drives more devices, longer lines and inputs CMOS signals or switch contacts.*

- Device configuration, user's IDN message and bus address stored in Flash. *User can easily set the power-on configuration.*

- Two companion Relay Driver Boards drive 5-48 volt relays. *Boosts drive signals to control larger relays and solenoids.*

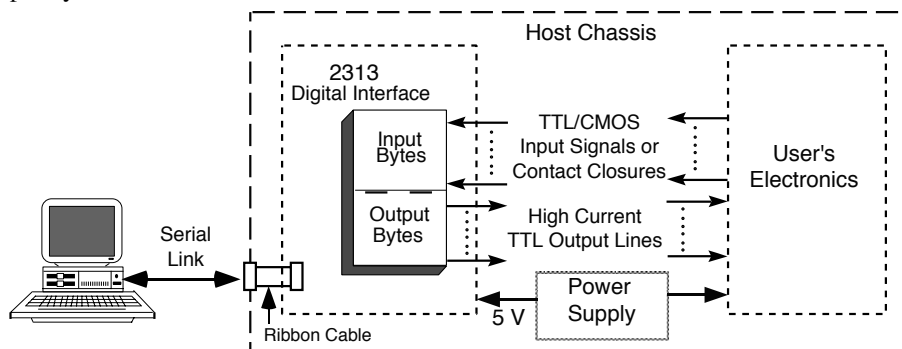- Includes a menu-driven configuration program. *Steps user through configuration choices.*

Figure 1 A typical 2313 Application

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Controlling the Digital Interface Bytes

Figure 2 shows the different ways the 2313 can be used to transfer data. The arrows show the data direction. The bit and byte commands automatically set the data direction for their data bytes. Bit command examples are Close, Open and Read which operate on bytes 1 and 2. All eight bits in byte 3 are written by the BO3 command. Data strobes can be manually generated if needed. All eight bits in byte 4 are read by the BI4? query. The user can set the data polarity on a bit or byte basis for all of the bytes controlled by the bit and byte commands.

String commands can transfer multiple bytes of data at a time. String commands only work on data bytes that are pre-configured as input or output bytes by the CONFigure commands. The user can configure 1 to n bytes as inputs and/or as outputs to make data words up to 128-bits wide. Figure 2 shows two bytes (bytes 5 and 6) configured as outputs and two bytes (bytes 7 and 8) configured as inputs. All 16 bits in bytes 5 and 6 are output by the PO command. A data strobe is automatically generated when data is outputted by a string command The PI? query reads 16 bits of data from bytes 7 and 8. The user can select the data format, data polarity, data strobe polarity and handshaking for the string commands.

The setup configuration and output data values can be saved at any time. The saved configuration and output values become the new power turn-on default values and are restored when the unit is reset or when power is turned on. This allows a user to set the output signal states at power turn-on time.

Input Signal Monitoring

The 2313 can monitor up to fifteen of the digital inputs for signal changes and generate a Service request Message (SRM) to notify the computer when changes occur. Monitoring is done by setting the 2313's Questionable Transition register to detect positive and/or negative signal transitions and enabling bits in the Questionable Event register. Application Bulletin 48-18 describes how to configure the 2313's Status Reporting Structure registers and includes an example program for generating SRQs.

Configuring the 2313

Figure 3 shows the 2313's configuration and data transfer commands as a SCPI Command Tree. Each SCPI command has a corresponding Short Form command for quick programming. Most of the functions can also be queried to verify the command setting. (i.e. N? reads back the talk byte selection)

The SYSTem branch sets the unit's Serial settings which includes character format, baud rate, network address and addressing mode. OFF is the standard asynchronous communication method. RS485 selects full or half duplex operation for the RS-422 transmitter.

The CONFigure branch assigns the bytes for string data transfer and sets their data polarity and handshaking. The CONFigure branch commands are not used to assign byes used by the bit or byte commands. These
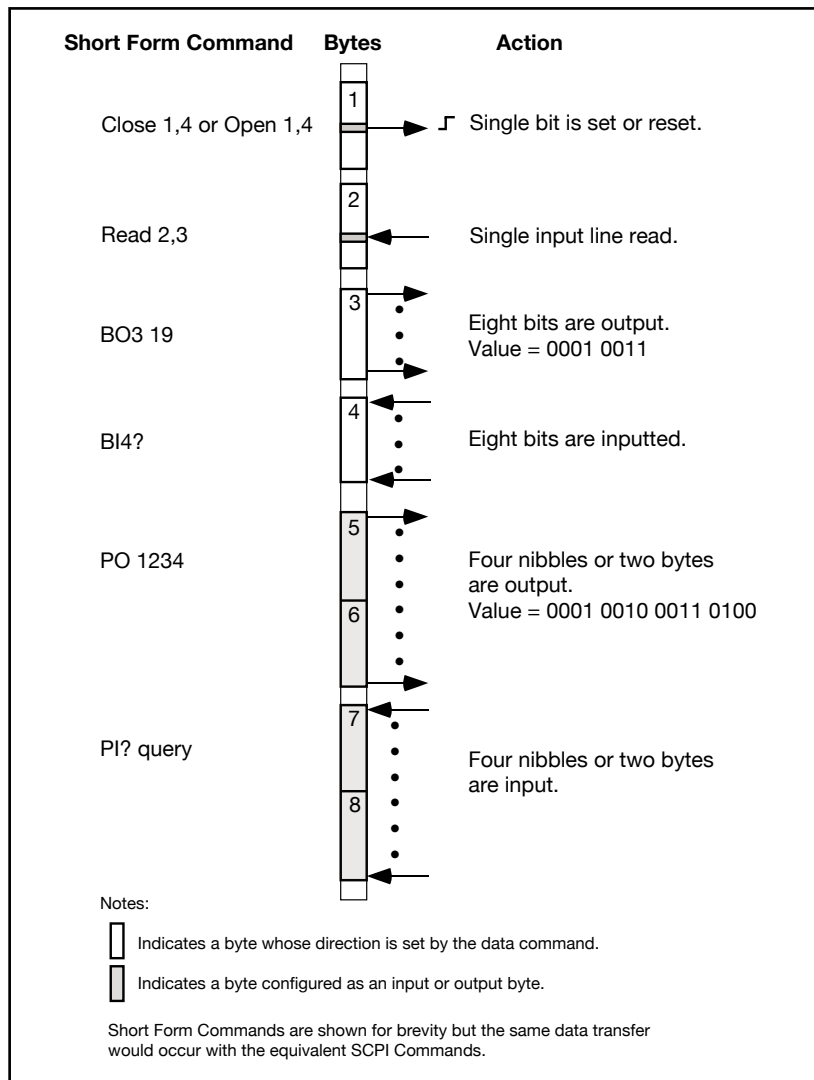
Figure 2   2313 Digital Data Transfer Methods

commands have their own direction and polarity controls and should not be used with the CONFigure commands. The CONFigure branch also sets the control signal polarities.

The FORMat branch sets the data formats for the string commands and the characters used in the user's Talk conversion table.

The ROUTe branch lets the user set or reset individual bits in an output byte. Data polarity is set by the SOURce branch.

The SENSe branch gives the user a way to read digital data from a single byte, from bits or from the configured input bytes. When reading data from a specific byte, input data polarity can be assigned on a bit-by-bit basis.

The SOURce branch provides a way to write values to a byte or to the configured output bytes. When data is outputted to a specific byte, output data polarity can be assigned on a bit-by-bit basis.

The STATus branch (not shown) is used to setup and query the Operational and Questionable registers so that changes in the digital inputs or status inputs can be used to generate 488 Service Requests (SRQs). The Questionable registers can be used to monitor and query the first 15 digital I/O lines. The Operational registers can be used to examine or monitor the two external Status inputs.

The CALibrate branch provides a way to customize the 2313 with the user's own IDN message and to lockout the configuration parameters from being changed by the end user. The DEFault command restores the 2313 to ICS's factory defaults.

Basic Operation

The 2313 is a disciplined device and operates in a half-duplex fashion on RS-232 point-to-point connections and on RS-422/RS-485 point-to-point or network systems. The 2313 has three communication modes: Asynchronous, Network and Packet.

Asynchronous Mode

In the Asynchronous mode, the 2313 only responds when queried unless Service Request Messages (SRMs) are enabled. If SRMs are enabled, they are sent when the enabled event occurs. The Asynchronous mode is selected by disabling the other modes.

For operation under program control, set Echo off and the 2313 will send a prompt character with a linefeed after each command has been completed. The user's program should wait for the prompt or a query response before sending the 2313 a new command to avoid getting out of sync with the 2313. For human operation with a terminal or terminal emulator, set Echo on so that the 2313 will echo back the last command and provide the user with a visual prompt (prompt + carriage return + linefeed) for the next command.

Network and Packet Modes

When the network mode is enabled, the 2313 recognizes commands prefixed with a two-character address sequence as being sent to it. The network address range is 0 to 15. Responses are only sent to queries. When the packet mode is enabled, the 2313 only recognizes packets addressed to it and always replies to each packet. Each packet has an STX start character, the 2313 address, message bytes, ETX stop character and a checksum character.

2313 Connections

The 2313 has four connectors: one for the Digital Interface, two for serial I/O and one for power. The serial connectors are connected to the rear panel with a 10-conductor flat ribbon cable as shown on the next page.

The Digital Interface connector is a 150-pin connector with 3 rows of 50 pins/row on 0.1 inch centers. The standard 2313 board has vertical male pins on the component side of the board. Mating female connectors are available with two lengths of solder tails. A small Connector Board is also available for the 2313 that breaks the 128 lines into four 32 line groups on 36-pin flat-ribbon headers. It also provides a 10-pin header with the LED drive signals for remoting teh 2313's LEDs. The 115650 Connector Board plugs into the 2313's vertical connector and sits on top of the 2313 board.
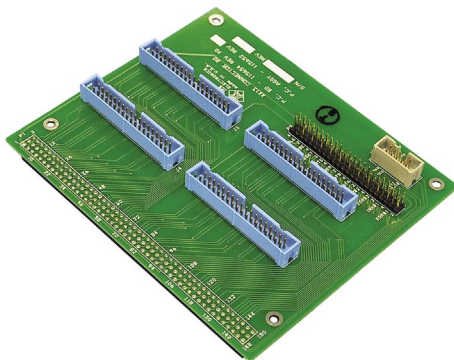

115650 Connector Board

2313 SCPI COMMAND TREE

SCPI Commands		Short Form Cmds
SYSTem	System-**GPIB Settings**	
:COMM		
:SERial		
:EXTernal	[0] I 1	
:BAUD	<numeric> [9600]	
:PARity	EVEN I ODD I [NONE]	
:BITS	7 I [8]	
:SBITs	[1] I 2	
:NETwork	[OFF] I ADDRess I PACKet	
:ADDRess	0-15 [4]	
:UPdate		
:RS485	[0] I 1	
:ERRor?		
:VERSion?		
CONFigure	**Configure I/O**	
[:DIGital]		
:INPut	<channel list>	N
:POLarity	0 I 1	TPn
:HANDshake	<boolean>	TBn
:OUTput	<channel list>	
:POLarity	0 I 1	LPn
:HANDshake	<boolean>	LH
:CLEar	0 I 1	C
:EDR	0 I 1	E
:INHibit	0 I 1	I
:REMote	0 I 1	R
:RESet	0 I 1	X
:STRobe	0 I 1	S
:TRIGger	0 I 1	TR
:ASTATus	0 I 1	A
:BSTATus	0 I 1	B
FORmat		
:TALK	<ASCii I Hex I HEXL I Table>	
:TRANSlation	<16 char string>	V
:LISTen	<ASCii I Hex I HEXL I BIN I 4833>	
ROUTe	**Bit Commands**	
:CLOSe	byte, bit	CLOSE
:OPEN	byte, bit	OPEN
:RESET	byte	BRESET
SENSe	**Input Data**	
[:DIGital]		
:DATA		
[:VALue]?		PI?
:PORT?	number or channel list	BI?
:PORTn?		BIn?
:POLarity?		IPn
:RESet:EDR		ER
:BIT?	0-1	READ?
:BYTe?		
0-255 BREAD?		
[SOURce]	**Output Data**	
[:DIGital]		
:DATA		
[:VALue]	0-255	PO
:PORTn	0-255	BOn
:POLarity	0-255	OPn
:STRobe		SP
CALibrate	**Calibrate Configuration**	
:IDN	string (72 char max)	
:DATe	mm/dd/yy	
:DEFault		
:LOCK	1(On) I 0(Off) [0]	

Figure 3   2313 SCPI Command Tree

Connectors J2 and J3 are 10-pin headers that contain the 2313's serial signals. The signals are selected by plugging the flat-ribbon cable into the appropriate header. The RS-232 signals on J3 are arranged as a standard PC COM port and are listed in Table 1. The RS-422/RS-485 signals are on J2 and are listed in Table 2. An on-card termination network can be connected to the RXD signal pair to properly terminate an RS-485 network.

A 10-conductor flat ribbon cable is used to connect either header to a DE-9 connector that mounts on the rear panel of the host chassis. Order P/N 115476-L with a female DE-9 connector or P/N 115479-L with a male connector. The dash number (L) specifies the cable length in cm. Both cables include two 4-40 lockstuds which can be used to fasten the DE connector to the rear panel.
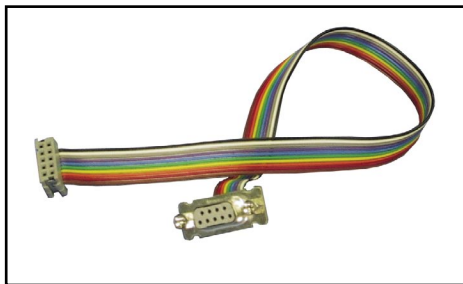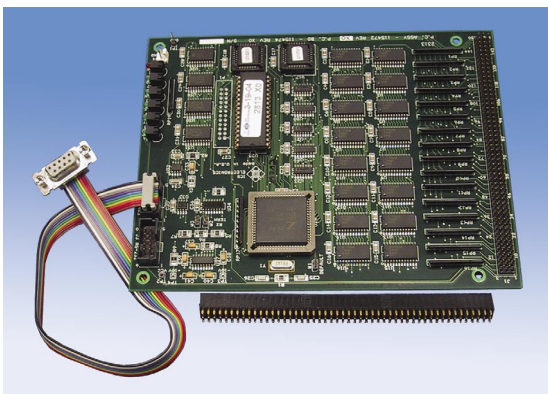

2313's 115476 Serial Cable

J4 is a two pin power connector. Use either J4 or the power pins on the Digital I/O connector, J1 to apply 5 Vdc to the 2313.

2313 Starter Kit

The 2313 Starter Kit includes a 2313 Board, a mating 150-pin connector, a 115476-90 interface cable, and software. Order the 2313 Starter Kit as P/N 115478. Limit of one Starter Kit per customer.

2313 shown with 115476-30 Cable in J2 and a Mating Digital Connector

OEM Customization

OEM customization can be as simple as presetting the I/O configuration and IDN message to the user's requirements prior to shipping or as complex as adding special SCPI commands and functions to the 2313's firmware. Units with preset user configurations are identified with a -6 option code. Units with custom firmware are identified with a -7 option code and their own program number.

Available Relay Driver Boards

Two Relay Driver Boards are available for the 2313. Both boards sit on top of the 2313 board and include an internal power supply that powers the 2313 from the relay power supply. The relay drivers on both boards are disabled at power turn-on time and are only enabled when the output signals have been configured and are stable. Both relay driver boards were originally designed for the 4813 GPIB to digital board but mate with the 2313 since the 2313 has the same physical size and digital I/O connector signal assignments.

The original 4813 Relay Driver Board has 128 sink-type relay drivers that switch up to 48 volts and sink up to 500 mA of current. The 4813 Relay Driver Board has four 36 pin headers with 32 relay drivers outputs on each header. One byte or 8-bits on each header can be converted to a standard TTL signals and used as TTL inputs or outputs. 36-conductor flat-ribbon cables and mating solder-pin connectors are available for connecting to an external relay board.

The new DC-37 Relay Driver Board has 64 sink-type relay drivers and 64 direct 2313 TTL I/O lines. The DC-37 Relay Driver Board has four DC-37 male connectors with 16 relay drivers and 16 I/O lines on each connector. Each DC connector has an unused signal line that a user can jumper to any 2313 handshake line.

See the separate data sheets for more information about either Relay Driver board.

TABLE 1   RS-232 SIGNALS (J3)

Pin	RS-232 Code-Name		Function
1	CF	DCD	Data Carrier Detect input
2	BB	RxD	Receive input
3	BA	TxD	Transmit out
4	CD	DTR	Data Terminal Ready output
5	AB	Gnd	Signal ground
6	-		
7	CA	RTS	Request-to-send output
8	CB	CTS	Clear to send input
9	-		

TABLE 2   RS-422 SIGNALS (J2)

Pin	Signal	Description
4	RXD+	High true serial in
5	RXD-	Low true serial in
8	TXD+	High true serial out
9	TXD-	Low true serial out
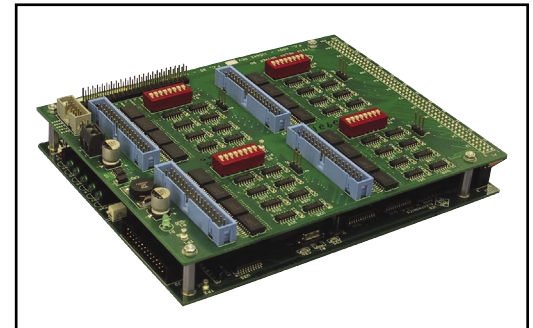
2313 with a 4813 Relay Driver Board
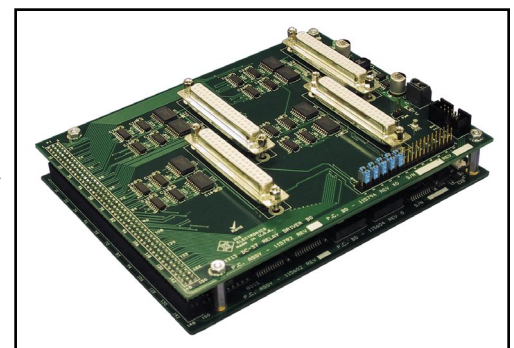
**2313 with a DC-37 Relay Driver Board**

Start with the 2313 board and then pick your accessory items.

Part Selection		Qty	Part Number
Standard 2313 board with the digital I/O connector on the component side		(1)	2313

Select one mating digital IO connector -   Solder pins, short connector   (1)   902308

Solder pins, tall connector   (1)   902331

or

Select the 4813 Relay Driver Board with 128 drivers   (1)   115640 (See Note 3)

or

Select the 4813 DC Relay Driver Board with 64 drivers   (1)   115790

or

Select the 4813 Connector Board with four 36-pin headers   (1)   115650 (See Note 3)

Select a 2313 to Rear Panel Serial Cable Assembly. Cable assembly plus into the RS-232 or RS-422 header on the 2313 PC board. The DE connector mounts on the rear panel of the user's chassis and includes lock studs

DE-9 Female Plug   (1)   115476-L

DE-9 Male Plug   (1)   115479-L

Notes:

1.   -L is the cable length in cm. You can order any length from 10 to 90 cm.
Standard stocked lengths are: 30, 45, 60 and 90 cm. Select an appropriate length as it is best to not have extra cable coiled up in the chassis to minimize EMI pickup.

2.   2313 accepts 4813 Relay Driver and Connector Boards.

3.   Headers mate with 115656-L cable and/or 902334 female connector. PCB male header is P/N 902332.
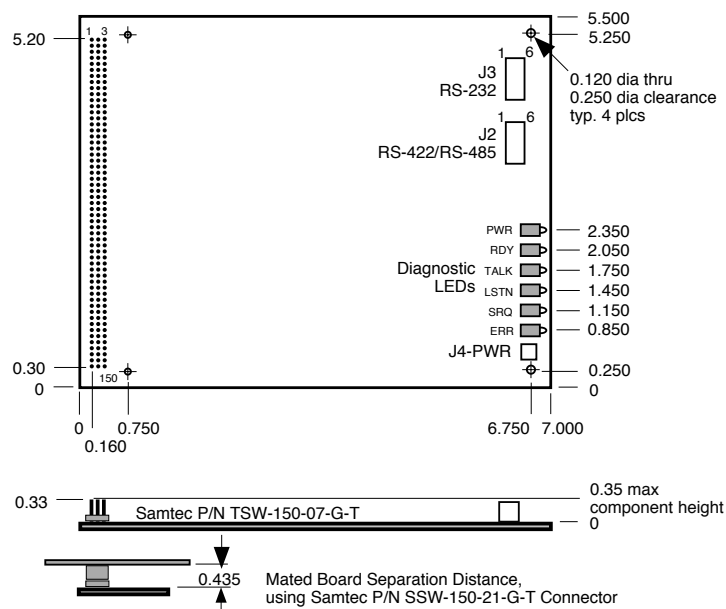
2313 Mounting Dimensions

Serial Interface

Provides RS-232 and RS-485 (RS-422) half duplex asynchronous serial interfaces. Unit automatically responds to the serial interface that receives the command.

RS-232 Interface

Signals: AB, BA, BB, CA, CB, CD and CF

Mode: Half Duplex

RS-422/RS-485 Interface

Signals: TX/RX pair

Modes: Half duplex, Addressed or packets

Addresses: 0 to 15

Termination: 220 ohm load resistor, 1 KΩ pullup/pull down resistors jumpered to RXD signal pair.

Data Rates and Formats

Baud Rate: 1200 to 115.2 Kbaud
Data bits: 7 or 8
Stop bits :   1 or 2
Parity: Odd, Even or None

SRM Generation

SRMs are generated if an Enabled Event Status Register bit or if a monitored digital input change occurs. The SRM message includes the decimal value of the Status Byte Register.

488.2 Common Commands

*CLS, *ESE, *ESE?, *ESR?, *IDN?, *OPC, *OPC?, *RCL, *RST, *SAV, *SRE, *SRE?, *STB, TST? and *WAI

SCPI Commands

Used to set and query all programmable functions. The 2313 conforms to SCPI 1994.0 Specification.

Reset Inputs

The 2313 is reset by a low going pulse on the External Reset input line or by pressing a miniature push-button on front edge of the 2313's PCB

Signal Characteristics

The 2313's parallel I/O signals have the following electrical characteristics. All time delays listed here are maximums, all pulse widths are minimums.

Inputs	128 Digital I/O , power 2 Status and Reset Inputs
Input Logic Levels	High = > +2.0 V @ ±10 μA 5.5 volts max. Low = <0.8 V @ 250 μA with 33 Kohm pullup to +5 Vdc

Input Timing

External Data Inhibit line sets within 1 μs of the active edge of the EDR Input and resets after data is loaded. Data loading time for 6 BCD/HEX characters is 0.15 ms (typ.) after the 2313 is addressed as a Talker

Output Logic Levels	High = >3 V at 3 mA High =>2 V at 24 mA Low = 0.0 to +0.55 Vdc, 48 mA max sink current

Output Timing
Data is transferred to the output 0.6 to 8 ms after receipt of a terminator depending upon transfer method and command.

Data Stb	7 μs wide pulse output
Trigger	7 μs wide pulse output
Remote	Output level asserted when in the remote state
Reset	400 μs wide pulse output when 2313 reset.
Stable	Output asserted when data lines initialized after power turn on.

Diagnostic Indicators

Six on board LEDs

PWR	On when power applied
RDY	On when self test passed
TALK	On when addressed to talk
LSTN	On when addressed to listen
SRQ	On when asserting SRQ line
ERR	On when ESR error bits set

Physical

Size, L x W x H
7.0 x 5.5 x 0.35 inches
(178 x 140 x 9 mm)

Connector and Headers
RS-232:   10-pin, 2x5 male conn
RS-422/RS-485 10-pin, 2x5 male conn
Digital I/O: 150-pin, 3 row male conn
Power: 2-pin AMP connector or pin on J1

Temperature
Operation -10 °C to +70 °C
Storage   -20 °C to +85 °C

Humidity
0-90% RH without condensation

Power   +5 Vdc @ 400 mA (typ)

Included Accessories

Instruction Manual
Support CD with sample programs

Available Accessories

See the Ordering Guide on page 4 for a complete list of accessory items.

Serial flat ribbon cable with DE-9S female connector, 90 cm max., P/N 115476-L

Serial flat ribbon cable with DE-9P male connector, 90 cm max., P/N 115479-L

Mating digital connector, P/N 902308

4813 Relay Driver Board, P/N 115490

4813 DC-37 Relay Driver Board, P/N 115790

ORDERING INFORMATION

	Part Number
Serial to Parallel Digital Interface Board (Includes Instruction Manual and Configuration Disk)	2313
Serial to Parallel Digital Interface Board (Board only)	115472
2313 Starter Kit with 2313, ribbon cable with DE-9 connector and mating connector.	115478
Flat ribbon cable, 10-conductor with DE-9S female connector and lock studs, L = length in cm	115476-L
Flat ribbon cable, 10-conductor with DE-9P male connector and lock studs, L = length in cm	115479-L
Mating digital I/O 150-pin female connector, short solder pins	902308
Mating digital I/O 150-pin female connector, long solder pins	902331