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8013/8013V
LAN TO PARALLEL DIGITAL INTERFACE

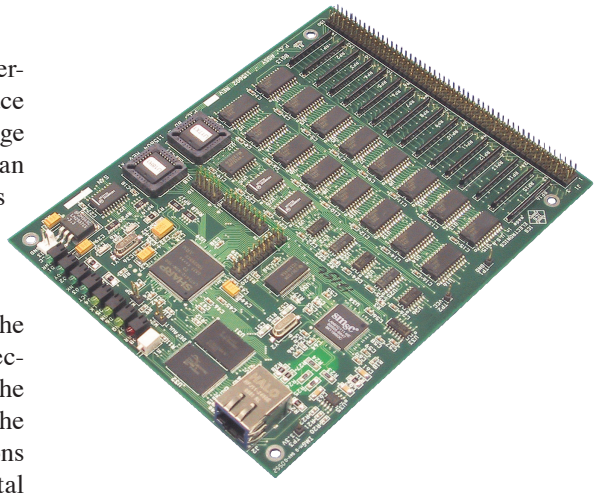
A flexible interface between any computer and devices with digital signals.

- Provides a user-definable, 128-line parallel interface with bit, byte, pulse, string and binary data transfer capabilities. *Fully configurable to the user's needs.*
- Device configuration, user's IDN message and IP address stored in nonvolatile Flash memory *User can easily set the power-on configuration.*
- Two companion Relay Driver Boards for 5-48 volt relays. *Boosts drive signals to control larger relays and solenoids.*
- Ethernet interface is VXI-11.3 Compliant and supports Raw Socket connections. *Works with virtually any computer or test language.*
- Network settings configurable with a web browser or RPC. *Easy network configuration from any computer.*
- Includes ICS's interactive VXI-11 keyboard program. *Easy control without having to write a program.*
- Interchangeable with ICS's 2313 GPIB and 4813 Ethernet boards. *Chose a Serial, GPIB, or Ethernet Interface board.*

ROHS Compliant

DESCRIPTION

ICS's Model 8013 Ethernet <-> Parallel Interface Board provides a 128 line digital interface that can be used to interface devices with a large number of digital signals to the computer via an 10 or 100 Mb Ethernet network. The 8013's high-power TTL level signals can easily drive small relays or other logic elements. In a typical application, the 8013 is located inside the device chassis and is powered by the device's +5 volt power. All digital signal connections are on a 150-pin connector at one end of the card. An RJ-45 header on the other end of the 8013 contains the Ethernet signals. Applications include controlling switching matrices, digital logic, displays or large signal arrays.



8013 Interface Card

Versatile Digital Interface

The 8013's digital interface is configured with commands over the network. The configuration commands permit the user to designate the 128 data lines as inputs and/or outputs in 8-bit byte increments, connect bytes into strings, set data polarity, data format, and handshake modes. The user can set bytes as inputs. Input signals are tristated and are pulled up by 33 kohm resistors to 5 Vdc. The inputs are ideal for reading switches, TTL and CMOS signals.

The user can set the output lines to his desired values and save the current configuration in the 8013's Flash memory. The saved configuration becomes the new power-on configuration. At power turn-on, the Digital I/O lines are initially tristated and then set to the saved configuration. A Stable signal is asserted after the digital I/O lines are configured to enable external logic or relays.

Data Transfer Methods

Data transfer capabilities between the computer and the 8013's digital interface depends upon the link to the 8013. When linked to *inst0* the user can access all setup commands and control the digital interface by individual bits, by bytes, or as strings of data values to multiple bytes as shown in Figure 2. When linked to *inst1* data is transparently transferred to the digital interface.

• Bit commands set or reset specific bits in a byte or query a bit's status. New pulse commands let the user pulse single or multiple output lines at the same time.

• Byte commands set all 8 bits in a specific byte or read data from a byte.

• String transfer commands send strings of data characters to one or more output bytes to make a multi-byte output word or read a string of data from one or more input bytes. The user designates these bytes as inputs or outputs when configuring the board.

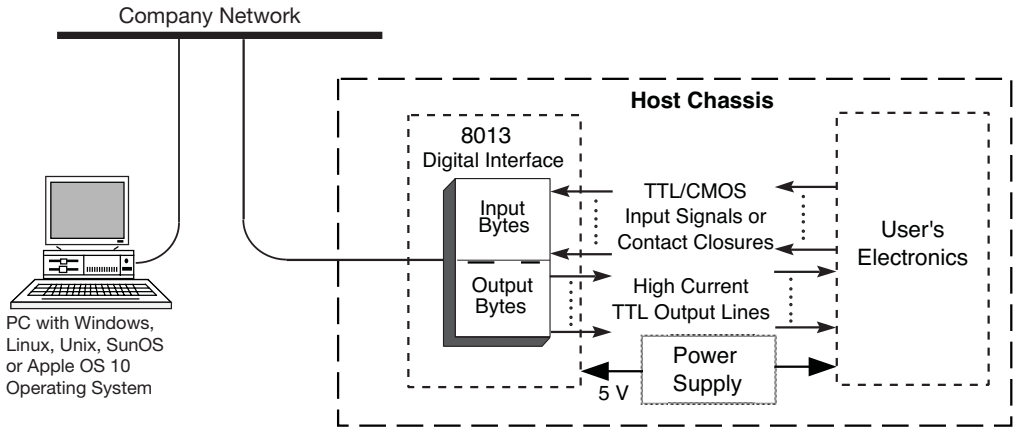


Figure 1 A typical 8013 Application

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7034 Commerce Circle
Pleasanton, CA 94588
Phone: **925.416.1000**
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Web: **www.icselect.com**

Configuring the 8013's Digital Interface

The 8013's digital interface is configured with commands from the host computer. The configuration commands permit the user to set multiple bytes as inputs or as outputs to make a wide date word, to set data polarity, data format, and handshake modes. The Bit and byte commands automatically set their bytes as outputs. String accessed bytes are preset as input or output bytes by the CONFigure command.

Formatting options let the user select a decimal value, hex or binary characters for each byte. An input translation table lets the user create his own input set with special characters when inputting data. When done, the user sets the outputs to their power-on values and saves the current configuration in the 8013's Flash memory as the new power-on configuration.

At power turn-on, the Digital I/O lines are initially tristated and then configured and set to the saved levels after the 8013 passes its self test. The 8013 provides a Stable output signal, which turns on after the 8013's digital lines are configured for controlling power to external devices or to enable external logic. The time from power turn-on to the Stable signal depends on the network settings and network's response to the 8013.

Outputting Data

The 8013 has three ways to control the digital interface and output data as shown in Figure 2:

- Bit commands set, reset or pulse bits in a specific byte.
- Output byte commands set all bits in a byte and latch an output value (0 to 255) into a specific byte. Data Strobes can be manually generated if needed.
- Strings of data can be outputted to multiple bytes with a command or transferred transparently. The 8013 converts the data string characters into packed HEX bytes, latches the data in the configured output bytes 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 characters used in ICS's earlier interfaces.

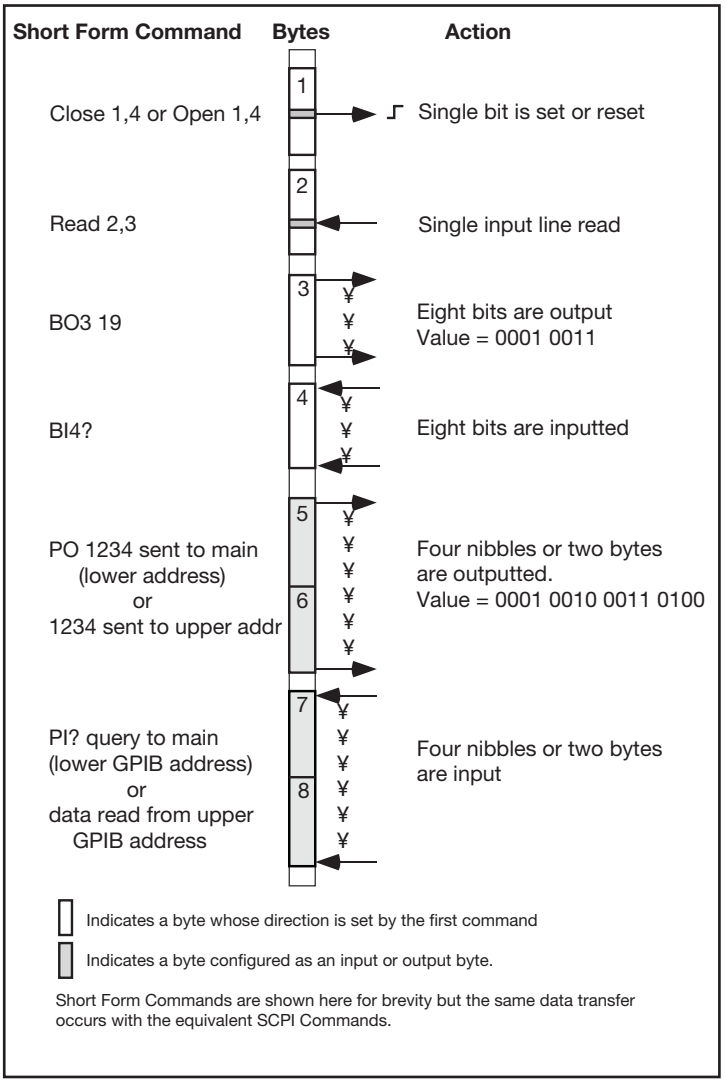


Figure 2 8013 Digital Interface Data Transfer Methods

Reading The Input Signals

The 8013 has three ways to read the digital interface lines and input digital data as shown in Figure 2:

- Bit queries read the status of an individual bit from a specific byte.
- Input byte commands read 8 bits of data from a specific byte.
- Strings of data can be read from multiple bytes with a data transfer command or inputted transparently. These bytes are preset as string input bytes by the CONFigure command. For input strings, the 8013 reads the configured input bytes, converts the data to the selected output format, and outputs it as a string of characters. Data can be inputted with or without handshaking. The input data can be formatted as decimal numbers, as ASCII HEX characters, or into a user selected character set.

Transparent Data Transfer

The user can input and output data without using a string command by linking to the 8013 at *inst1* Data is read from the configured input bytes each time the 8013 receives a *device_read* rpc. The data is input and formatted just as it would be for reading strings of data.

When outputting data sent to *inst1*, the 8013 converts the data and outputs it to the bytes that the user has previously configured as outputs. Data can be outputted with or without handshaking. The 8013 automatically generates a data strobe each time it loads all of the configured output data bytes. Multiple data words can be transmitted by inserting a comma between data words.

Input Signal Monitoring

The 8013 can monitor up to fifteen lines for signal changes and generate the VXI-11 equivalent of an SRQ to notify the Application program when changes occur. Monitoring is done by setting the 8013's Questionable Transition register to detect positive and/or negative signal transitions and enabling bits in the Questionable Event register. When the enabled bit(s) are detected, the 8013 generates a *device_intr_srq* message (SRQ) to alert the Application to the event. The user's Application program can query the 8013's Questionable Condition Register to determine the input signal states and the Event Register to learn which signal changed state. Application Bulletin AB80-4 describes how to use a Reverse Channel for SRQ notification.

SCPI and Short Form Commands

Figure 3 shows the 8013's SCPI Command Tree which contains the configuration and data transfer commands. SCPI commands branch out from a root command. e.g. 'CONF:INP:POL 1' starts with the CONF root word and branches down to INPut and then to POLarity. Most functions can also be queried to verify the command setting. SCPI commands have an advantage in that they are self-documenting and make it easy to maintain your code. Most 8013 SCPI commands also have a corresponding Short Form command for quick programming.

The CONFigure branch assigns the input-output bytes for string data transfer and sets their data polarity and handshaking rules. The CONFigure branch also sets the control signal polarities.

The FORMat branch sets the data conversion method and the characters in the user's Talk conversion table.

The SENSe branch gives the user a way to read digital data from a single byte 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 8013 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 8013 to ICS's factory defaults.

User Customization

The 8013's firmware allows the user to store a custom IDN message and other parameters in the 8013's Flash memory which makes the 8013 appear as part of the OEM's product. The IDN message can be changed to show the OEM's company and product identification including serial number and product revision. A lock function hides the setup variables from the end user and prevents accidental changes to the setup.

The 8013 has an internal WebServer with HTML web pages that the user can customize so that the HTML pages match your company's colors and theme. ICS supplies a utility for uploading your HTML pages and graphics to the 8013. These changes let the end user see your company's logo, name, color and control labels which further personalizes the 8013 as part of your product.

Application Bulletin AB80-5 provides guidelines and detailed directions for how the OEM can customize the 8013's web pages.

8013 SCPI COMMAND TREE

SCPI Commands		Short Form Cmds
SYSTem	**System Settings**	
:ERRor?		
:VERSion?		
CONFigure	**Configure I/O**	
[:DIGital]		
:INPut	<channel list>	N
:POLarity	0 | 1	TPn
:HANDshake	<boolean>	TBn
:OUTput	<channel list>	LN
:POLarity	0 | 1	LPn
:HANDshake	<boolean>	LH
:CLEar	0 | 1	
:EDR	0 | 1	E
:INHibit	0 | 1	I
:REMote	0 | 1	R
:RESet	0 | 1	X
:STRobe	0 | 1	S
:TRIGger	0 | 1	TR
:ASTATus	0 | 1	A
:BSTATus	0 | 1	B
FORmat		
:TALK	<ASCii | Hex | HEXL | Table>	
:TRANSlation	<16 char string>	
:LISTen	<ASCii | Hex | HEXL | 4833>	
ROUTe	**Bit Commands**	
:CLOSe	byte, bit	CLOSE
:OPEN	byte, bit	OPEN
:RESET	byte	BRESET
:PULSe	byte,bit	PL
:CHANnel	number or channel list	PC
:WIDTh	10-30000 [50]	PW
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)| 0(Off) [0]	

Figure 3 8013 SCPI Command Tree

Ethernet Protocols

The 8013 is controlled by commands received over its Ethernet interface. The 8013 supports the VXI-11 and Raw socket (TCP/IP) protocols. The VXI-11 protocol makes it easy to control from a PC or over the company network. VXI-11 operates over Sun RPC and is a more secure protocol that mimics GPIB control of an instrument and provides secure communication over a company network or over the Internet. Raw socket lets you telnet to the unit and is best used with direct PC to instrument connections.

VXI-11 Programming

The 8013 can be easily controlled by several programming techniques and languages because it is a VXI-11.3 instrument. If you program with LabVIEW, National Instruments' VISA supports VXI-11.3 instruments like the 8013. NI's Measurement and Automation Explorer treats the 8013 as a TCP/IP compliant device.

Agilent's VISA library supports VXI-11.3 instruments and the Agilent Connection Manager sees the 8013 as a TCP/IP instrument.

If you are a Visual Basic, VB.Net or C/C++ programmer, you can write your program to call Agilent's or National Instruments' VISA or Agilent's SICL library in the Windows environment.

If you use LINUX or any other flavor of UNIX like SunOS, IBM-AIX, HP-UX, or Apple's OS X, you can communicate with the 8013 through RPC over TCP/IP. RPC (or Remote Procedure Calls) provides an invisible communication medium for the developer. The VXI-11 specification provides an RPCL (Remote Procedure Call Library) that can be used by virtually any operating system to control the 8013.

If you program with Java then you can write a 8013 control program that can be easily moved to many different operating systems. The Java jGpibEnet project on SourceForge was developed using an ICS 8065 Controller.

ICS has several Application Notes that describe how to program VXI-11 devices. These Application Notes are available at http://www.icselect.com/ab_note.

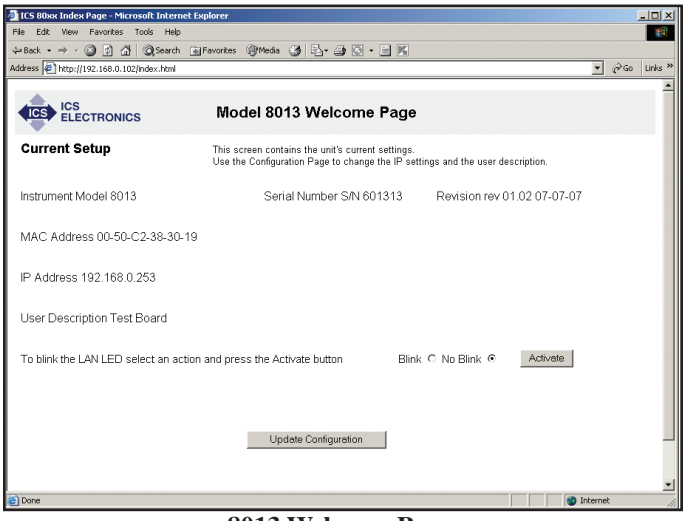
Raw Socket Operation

The 8013's "Raw Socket" connection enables sending commands to the instrument over the LAN connection using TCP/IP. Raw Socket commands can completely control the 8013's digital I/O lines with SCPI and the related Short Form commands. Raw Socket does not support *inst1* data transfers, Service Requests or other VXI-11.3 functions.

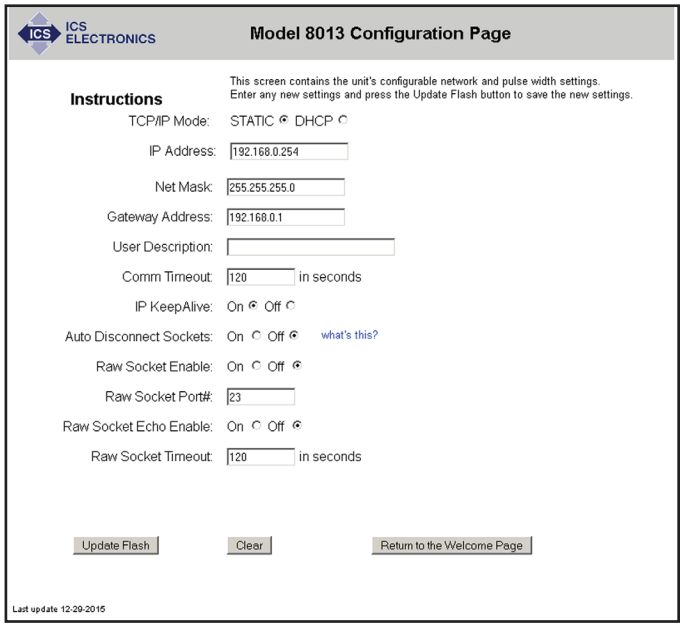
The 8013 is always ready for a telnet connection when Raw Socket is enabled. When connected, the 8013 outputs its IDN message to confirm the connection. All raw socket messages are terminated with a linefeed. Carriage returns and ignored. A backspace character causes the prior character to be deleted. Communication timeout is two minutes and it is recommended that the client issue a Space-BS sequence on an occasional basis, less than the timeout, to reset the timeout counter.

Easy Network Setup

There are three ways to set the 8013's network settings. The 8013 includes an internal WebServer with HTML web pages that can be accessed by a web browser from any computer. The web pages let any user change the 8013's network settings. Secondly, ICS supplies a windows based configuration utility that walks a user through the network setup process. The third method is to use ICS's defined RPC calls to change the 8013's network settings.



8013 Welcome Page



8013 Configuration Page

Interactive Keyboard Control Program

The 8013 includes ICS's VXI-11 Keyboard program for Windows which provides interactive control of VXI-11 instruments from the computer keyboard without having to write a program. The VXI-11 Keyboard program is the ideal utility program for configuring and testing the 8013's connections or for trying out commands before using them in a program.

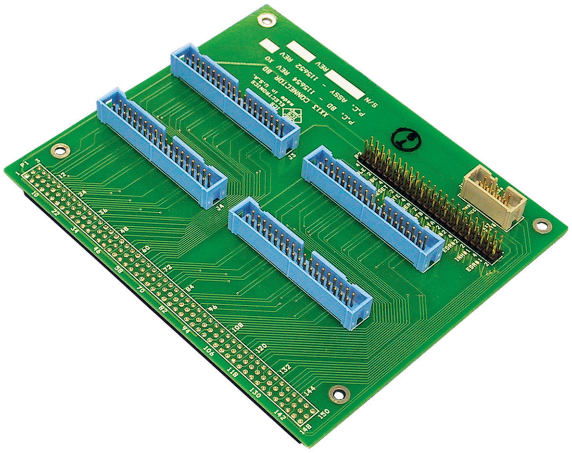
With the VXI-11 Keyboard program you can find and link to the 8013 and control its digital interface. Besides reading and writing data strings, the VXI-11 Keyboard also has controls for Device Clear, Device Trigger, and Serial Poll and for executing command loops.

8013 Connections

The 8013 has three connectors: a Digital Interface, an RJ-45 Ethernet connector and a 2 two-pin power connector. Power can also be applied thru the Digital Interface connector.

The Digital Interface connector, J1, is a 150-pin connector with 3 rows of 50 pins per row on 0.1 inch centers. The standard 8013 board has vertical male pins on the component side of the board. The 8013 is also available with the a female connector on the circuit side for piggy-backing onto a larger PC board. Mating 150-pin connectors are available with two lengths of solder tails.

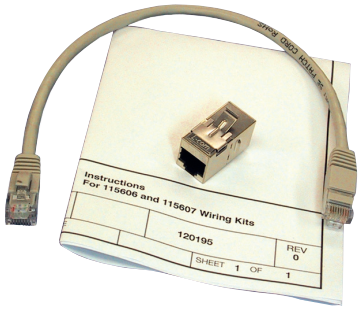
A short Connector Board is available for the 8013 that breaks the 128 digital IO lines into four 32 line groups. It has four 36-pin flat-ribbon headers. The Connector Board also includes a 10-pin header with LED drive signals for remoting the 8013's LEDs. The 115650 Connector Board plugs into the 8013's 150-pin digital connector and sits on top of the 8013 board.



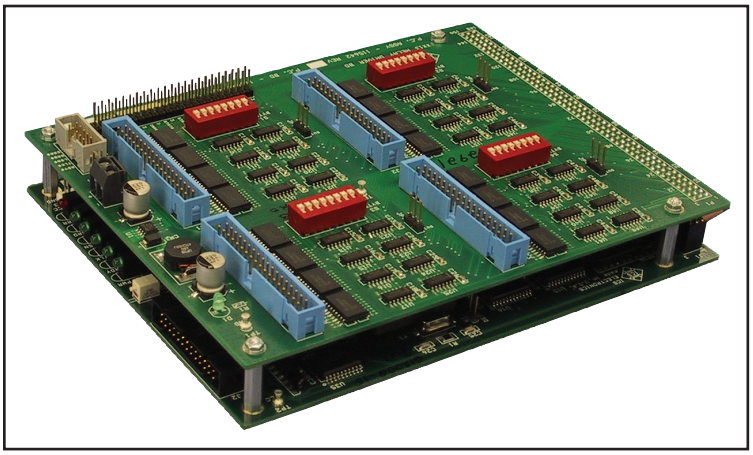
xx13 Connector Board with four ribbon connectors

The Ethernet connector J2 is a standard RJ-45 connector. Its normal orientation is horizontal so that the 8013 can be mounted against the rear panel with the Ethernet connector and LAN Reset button protruding though the rear panel. The 8013 can also be ordered with a vertical Ethernet connector.

When mounting the 8013 inside a chassis, use an ICS Wiring Kit to extend the Ethernet connection to the rear panel of the host chassis. ICS's Wiring Kits provide a short 1 or 2 foot long Cat 5 cable and a shielded bulkhead connector for mounting an Ethernet connector on the rear panel of the host chassis.



ICS Wiring Kit with 1 foot cable



8013 with Relay Driver Board

Available Relay Driver Boards

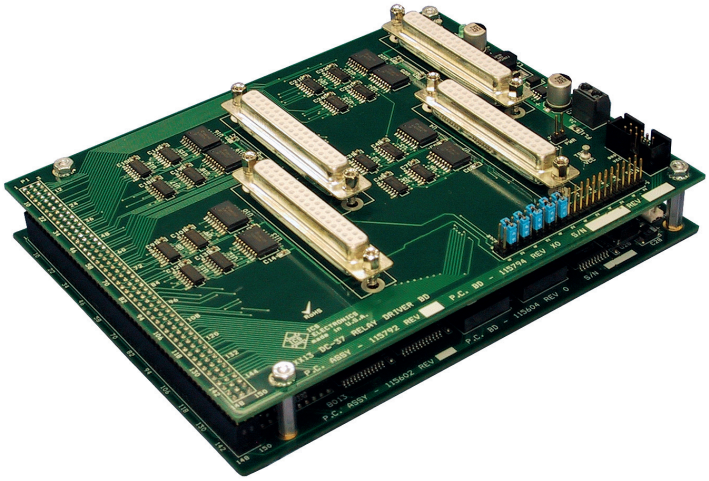
Two Relay Driver Boards are available for the 8013. Both boards sit on top of the 8013 board and include an internal switching power supply that converts a 2.5 VA of the relay power supply voltage into 5 volts to power the 8013.

The relay drivers on both boards are disabled at power turn-on time and are only enabled after the output signals have been configured and are stable.

The xx13DVR Relay Driver Board has 128 sink-type relay drivers that switch up to 48 volts and sink up to 500 mA of current. The board has four 36 pin headers with 32 relay driver outputs on each header. One byte or 8-bits on each header can be routed directly to the 8013 and used for standard TTL I/O signals. 36-conductor flat-ribbon cables and mating solder-pin connectors are available for connecting to an external relay board.

The DC-37 Relay Driver Board has 64 sink-type relay drivers and 64 direct TTL I/O lines. The DC-37 Relay Driver Board has four DC-37 male connectors with 16 relay drivers and 16 TTL I/O lines on each connector. Each DC connector has an unused signal line that a user can jumper to any 8013 handshake line.

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



8013 with DC Relay Driver Board

8013: ORDERING GUIDE

Select from one of the two 8013 board styles and then pick your accessory items.

Part Selection		Qty	Part Number
Standard 8013 board with the digital IO connector on the component side		(1)	8013 or 8013V (Note 2)
Select one mating digital IO connector -	solder pins, short connector	(1)	902308
	solder pins, tall connector	(1)	902331
or			
Select the xx13DVR Relay Driver Board with 128 drivers		(1)	115640 (See Note 1)
or			
Select the DC-37 Relay Driver Board with 64 drivers		(1)	115790
or			
Select the Connector Board with four 36-pin headers		(1)	115650 (See Note 1)
Select a chassis LAN Wiring Kit -	Bulkhead connector and 1 ft long cable	(1)	115606
	Bulkhead connector and 2 ft long cable	(1)	115607
8013 board with the digital IO connector on the circuit side (facing down) for mounting on another PC board.		(1)	115598 or 115599
Select digital IO connector with solder pins for the mating PC board		(1)	902307
Select a chassis LAN Wiring Kit -	Bulkhead connector and 1 ft long cable	(1)	115606
	Bulkhead connector and 2 ft long cable	(1)	115607

Notes:

1. Headers mate with 115656-L cable and/or 902334 female connector. PCB male header is P/N 902332.
2. Relay Driver Boards will not fit on a 8013V board.

ORDERING INFORMATION

	Part Number
Ethernet to Parallel Digital Interface Board (Includes Instruction Manual and Support CD)	8013
Ethernet to Parallel Digital Interface Board with vertical Ethernet connector (Includes Manual and Support CD)	8013V
Ethernet to Parallel Digital Interface Board (Board only)	115602
Ethernet to Parallel Digital Interface Board with digital connector on circuit side (Includes Manual and Support CD)	115598
Ethernet to Parallel Digital Interface Board with digital connector on circuit side (Board only)	115599
Mating digital I/O 150-pin female connector, short solder pins	902308
Mating digital I/O 150-pin female connector, long solder pins	902331
Mating digital I/O 150-pin male connector, short solder pins	902307
Wiring Kit with Shielded Bulkhead Adapter and 1 ft long Ethernet extension cable	115606
Wiring Kit with Shielded Bulkhead Adapter and 2 ft long Ethernet extension cable	115607
Shielded Bulkhead Adapter	902329
xx13DVR Relay Driver Board with 128 relay drivers	115640
DC-37 Relay Driver Board with 64 relay drivers	115790
Connector Board with four 36-pin flat ribbon headers and 10-pin LED drive signal header	115650
Mating female flat-ribbon connector for Relay Driver and Connector Board	902334
Flat-ribbon, 36 conductor cable with female connectors. L=length in cm from 10 to 90 cm	115656-L
PC Header, 36 pins with solder tails for 115656 cable	902332
Mating DC-37P Connector and hood for DC Relay Driver Board	902047 and 902105

Supported Standards

VXI-11 Capabilities
Fully VXI-11.3 compliant

VXI-11.3	Device Interface
Sockets	15 + 1 for UDP
Channel types	Data, Abort and Interrupt
Links	64
Interface Names	inst0 for general use inst1 for transparent data

VXI-11.3 Functions
All VXI-11.3 functions including device read, write, local, remote, clear, trigger, readstb, lock and unlock.

RPC Protocol
Conforms to ONC RPC Version 2, VXI-11

Raw Socket Protocol

Port	23
Echo	None
ICS Prompt	None
Sockets	4
Timeout	120 sec
Terminator	Linefeed
Logon Message	8063 IDN message

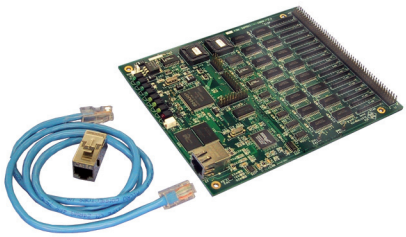
Ethernet Interface

Type	IEEE 802.3 compliant
Speeds	10BaseT (10 Mb/s) 100BaseT (100 Mb/s)
IP Address	Static or DHCP
Factory setting	192.168.0.254 static
Interface name	any [inst0], [inst1]

WebServer Capabilities
Provides the following HTML 4.01 compatible web pages:
- Welcome
- Configuration
- Confirmation
- Reboot

IEEE 488.2 Capabilities:
Runs all required 488.2 Common Commands, incorporates an extended IEEE-488.2 Status Reporting Structure and the Message Exchange Protocol.

SCPI Capabilities:
Incorporates the SCPI Command Tree shown in Figure 2. Complies with SCPI version 1994.0



8013 shown with a short Cat 5 cable and a bulkhead connector

Signal Characteristics

The 8013'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 , 2 Status and Reset Inputs
Input Logic Levels	High = > +2.0 V @ ±10 µA Low = <0.8 V @ 250 µA with 33 Kohm pullup to +5 Vdc for sensing contacts. Max High = 5.5 V
Input Timing	External Data Inhibit line SETS within 1 µs of the active edge of the EDR Input signal and resets after data is loaded. Data loading time for 6 BCD/HEX characters is 0.15 ms (typ.) after the 8013 has been addressed as a Talker
Output Logic Levels	High = >3 V with 3 mA source High =>2 V with 24 mA source Low = 0.0 to +0.55 Vdc, 48 mA sink
Output Timing	Data is transferred to the output 2 to 3 ms after receipt of a message depending upon data transfer mode and command. Pulse width 10 to 30000 ms
Data Stb	Output pulse width, 5 µs.
Trigger	Output pulse width, 5 µs
Remote	Output level asserted when in the remote state
Reset	Output pulse width, 70 µs when 8013 reset.

Table 2 Digital IO Functions

Input Bytes
Input Signal polarity
Input Handshaking
Talk data format
Talk data conversion table
Output Bytes
Output Polarity
Output Handshaking
Listen data format
Control line polarities
SENSe input polarities
STATus register configurations
SOURce output polarities

See Ordering Guide on page 6

Controls and Indicators

CONTROLS
LAN Rst Board edge push-button

LEDs

PWR	Indicates power on
LAN	Unit good and connected to an active network
ACT	Transferring messages to/from the network
RDY	Unit has passed self test
TALK	Unit is addressed to talk
LSTN	Unit is addressed to listen
SRQ	SRQ asserted on GPIB bus
ERR	Blink for a detected soft error or solid On for a command error

Physical

Size, L x W x H
7.0 x 5.5 x 0.55 inches (178 x 140 x 14 mm)

Material

PCB	FR406 Fiberglass
Components	RoHS compatible
Construction	Lead Free

Connector and Headers

Digital I/O:	150-pin, 3 row male conn
Ethernet:	RJ-45
Power:	2-pin AMP connector or pins on J1 (Digital I/O)

Temperature

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

Humidity
0-90% RH without condensation

Power +5 Vdc @ 500 mA (typ.)

Included Accessories

Instruction Manual
Support CD with sample programs
LAN Crossover Cable

Available Accessories

See Ordering Guide on page 5 for a complete list of accessory items.
- Mating short connector, P/N 902308
- Mating tall connector, P/N 902331
- Wiring Kit w/1 ft cable, P/N 115606
- Wiring Kit w/2 ft cable, P/N 115607
- Shielded Bulkhead Adapter, P/N 902329
- xx13DVR Relay Driver Board, P/N 115490
- DC-37 Relay Driver Board, P/N 115790

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