

# NETWORK INTERFACES

## 8013 LAN TO PARALLEL DIGITAL INTERFACE

### DESCRIPTION

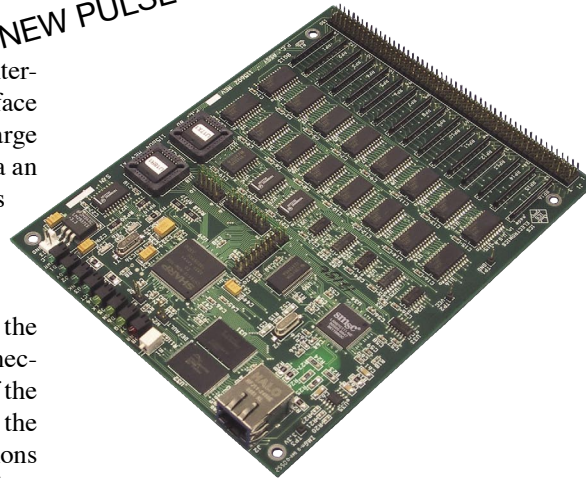
ICS's Model 8013 Ethernet <-> Parallel Interface Board provides a 128 line digital interface that can be used to interface devices with a large number of digital signals to the computer via an 10 or 100 Mb Ethernet network. The 8013's high-power TTL level signals can easily drive small relays or other 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, displays or large signal arrays.

### 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.

### NEW PULSE COMMANDS



8013 Interface Card

### 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.

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

- **VXI-11.3 Compatible**  
*Works with the newest test systems and any computer.*
- **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.*
- **Configurable with a web browser, with a windows configuration program or with RPC calls.**  
*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 4813 GPIB and 2313 Serial boards.**  
*Easy conversion path.*

 **ROHS Compliant**

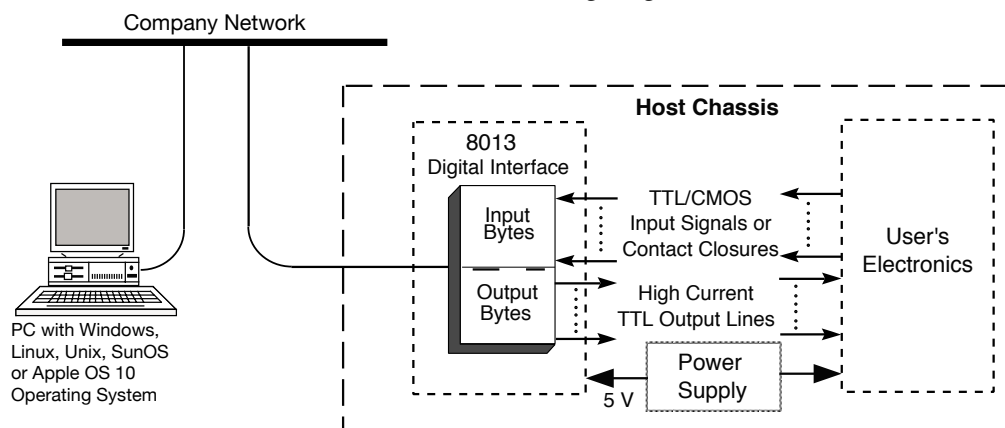


Figure 1 A typical 8013 Application

 **ICS ELECTRONICS**  
*division of Systems West Inc.*

7034 Commerce Circle  
Pleasanton, CA 94588  
Phone: 925.416.1000  
Fax: 925.416.0105  
Web: [www.icselect.com](http://www.icselect.com)

8013: APPLICATION

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 data 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.

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.

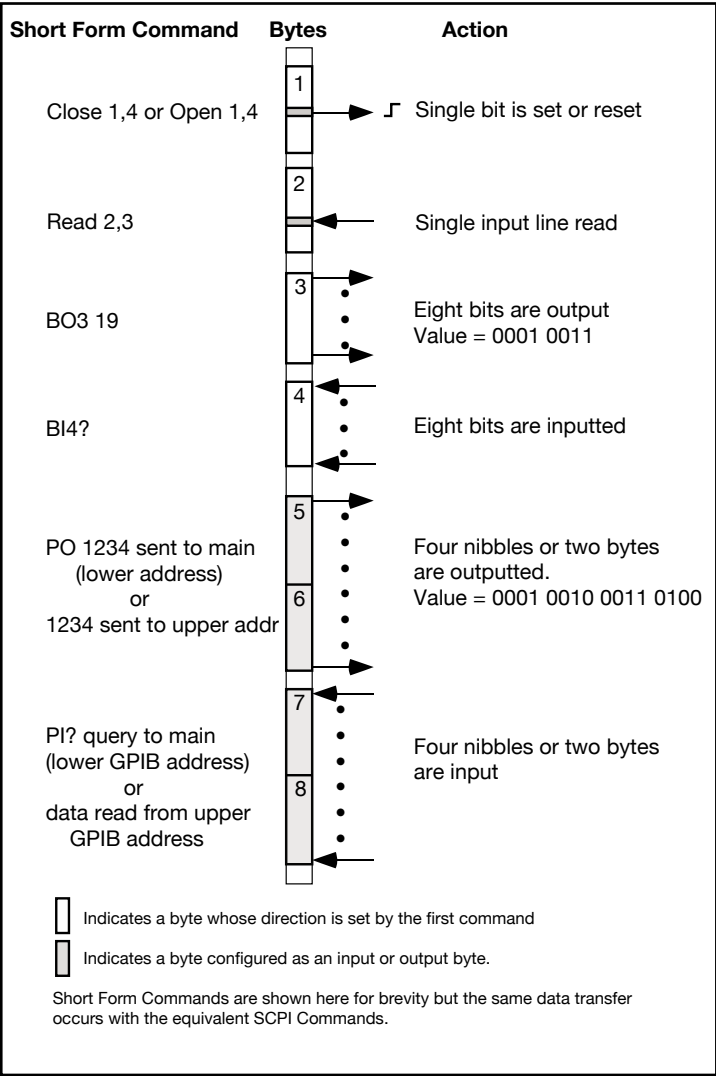


Figure 2 8013 Digital Interface Data Transfer Methods

When outputting data 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.

## 8013: APPLICATION

### 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.

### Firmware 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	<b>System Settings</b>	
:ERRor?		
:VERSion?		
CONFigure	<b>Configure I/O</b>	
[: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	<b>Bit Commands</b>	
: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	<b>Input Data</b>	
[:DIGital]		
:DATA		
[:VALue]?		PI?
:PORT?	number or <channel list>	BI?
:PORTn?		BlIn?
:POLarity?		IPn
:RESet:EDR		ER
:BIT?	0-1	READ?
:BYTe?	0-255	BREAD?
[SOURce]	<b>Output Data</b>	
[:DIGital]		
:DATA		
[:VALue]	0-255	PO
:PORTn	0-255	BOOn
:POLarity	0-255	OPn
:STRobe		SP
CALibrate	<b>Calibrate Configuration</b>	
:IDN	string (72 char max)	
:DATE	mm/dd/yy	
:DEFault		
:LOCK	1(On)  0(Off) [0]	

Figure 3 8013 SCPI Command Tree

## 8013: APPLICATION

### Easy Programmability

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](http://www.icselect.com/ab_note).

### VXI-11 Advantages

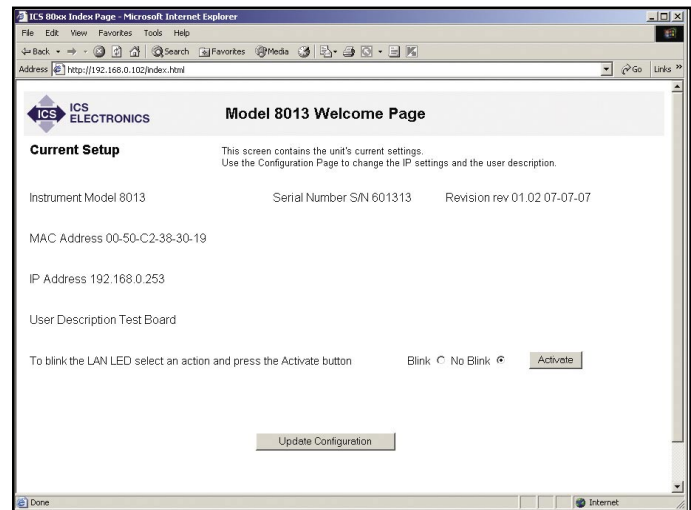
The 8013 is a VXI-11.3 compliant interface and fits in with today's new test equipment architectures that use TCP/IP networks. Because the 8013 is VXI-11.3 compliant it can be controlled by a very wide range of applications and programming languages. VXI-11 is a communication standard developed in conjunction with the VISA Specification. An VXI-11.3 interface like the 8013 can be controlled in Windows systems by programs that make VISA or SICL library calls and in UNIX/LINUX or similar operating system with RPC calls. The VXI-11 specification provides an RPCL (Remote Procedure Call Library) that can be used by virtually any operating system to control the 8013. While a VXI-11 .3 interface like the 8013 will operate in an LXI system, LXI devices are limited to Windows operating systems with VISA libraries and require IVI drivers.

### Easy Network Setup

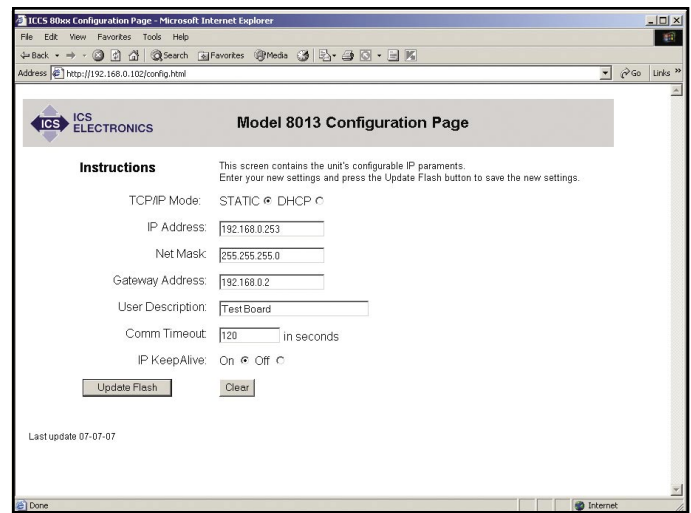
There are three ways to set the 8013's network settings. The 8013 includes an internal WebServer that with HTML web pages that can be accessed by a web browser from any computer. The web pages let any user change the 8013's network settings. Secondly, ICS supplies a windows based configuration utility 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.

### 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.



8013 Welcome Page



8013 Configuration Page

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.

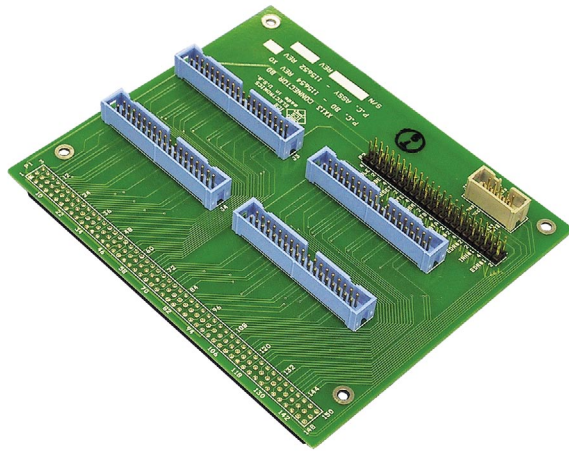
### 8013 Connections

The 8013 has three connectors: Digital Interface, Ethernet connection and J3 for power.

The Digital Interface connector, J1, is a 150-pin connector with 3 rows of 50 pins/row on 0.1 inch centers. The standard 8013 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 8013 that breaks the 128 lines into four 32 line groups on 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 vertical connector and sits on top of the 8013 board.

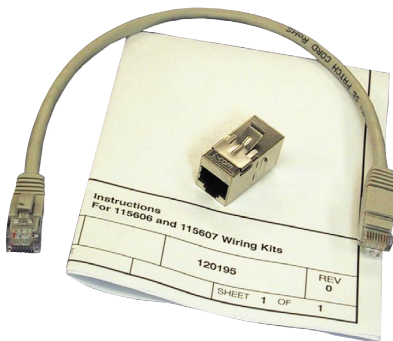
When piggybacked on a larger PC board, the 8013 adds less than 0.750 of height to the PC board assembly.





**Connector Board**

The Ethernet connector, J2, is a standard RJ-45 connector for a standard Ethernet cable. Use an ICS Wiring Kit to extend the Ethernet connection to the rear panel of the host chassis or mount the 8013 so that its Ethernet connector is accessible from 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 extending the 8013's Ethernet connector to the rear panel of the host chassis



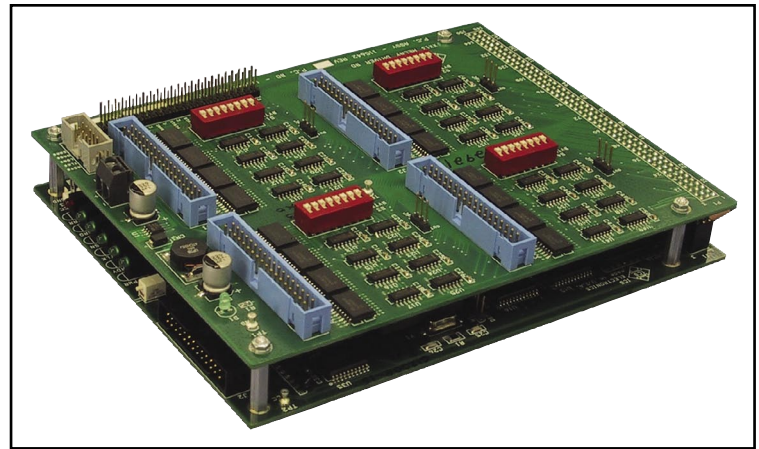
**ICS Wiring Kit  
with 1 foot cable**

Power connector J3 is a small two pin connector located near the front of the board next to the PWR LED. Power can be applied to the 8013 by connecting the DC power source to J3 or to pins on the Digital Interface connector, J1.

### Available Relay Driver Boards

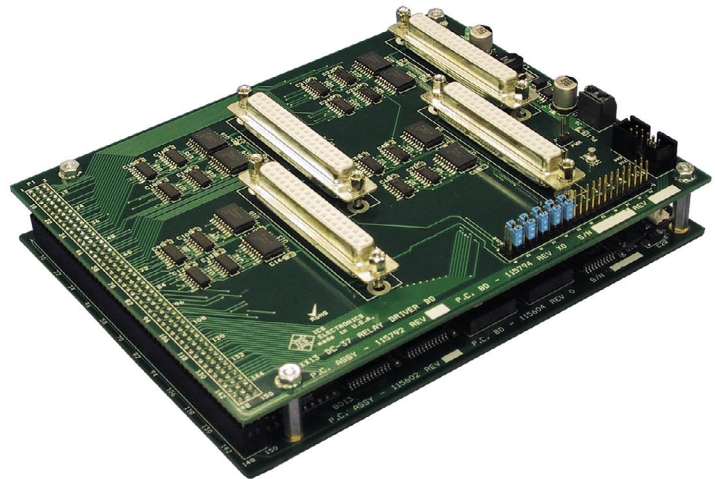
Two Relay Driver Boards are available for the 8013. Both boards sit on top of the 8013 board and include an internal 5 V power supply that powers the 8013 from the relay power supply. The relay drivers on both boards are disabled at power turn-on time and are only enabled when the output signals have been configured and are stable.

The 4813 Relay Driver Board has 128 sink-type relay drivers that switch up to 48 volts and sink up to 500 mA of current. Four 36-pin headers have 32 relay drivers outputs (4 bytes) on each header. One byte or 8-bits on each header can be converted to a standard 8013 I/O signals and used as inputs or outputs. Each



**8013 with Relay Driver Board**

header has an unused signal line that a user can jumper to any 8013 handshake line. 36-conductor flat-ribbon cables and mating solder-pin connectors are available for connecting to the user's relay board.



**8013 with DC Relay Driver Board**

The new DC-37 Relay Driver Board has 64 sink-type relay drivers that can switch up to 48 volts and sink up to 500 mA of current and 64 direct 8013 I/O lines. The DC-37 Relay Driver Board has four DC-37 male connectors with 16 relay driver outputs and 16 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 board.



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

8013: ORDERING GIUDE

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
— Select one mating digital IO connector - solder pins, short connector	(1)	902308
— or solder pins, tall connector	(1)	902331
— Select the 4813 Relay Driver Board with 128 drivers	(1)	115640 (See Note 1)
— 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 1)
— Select a chassis LANWiring 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)	115160
— Select digital IO connector with solder pins for the mating PC board	(1)	902307
— Select a chassis LANWiring 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.

ORDERING INFORMATION	Part Number
Ethernet to Parallel Digital Digital Interface Board (Includes Instruction Manual and Configuration Disk)	8013
Ethernet to Parallel Digital Digital Interface Board (Board only)	115602
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
4813 Relay Driver Board with 128 relay drivers	115640
4813 DC Relay Driver Board with 64 relay drivers	115790
4813 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 for 115656 cable	902332
Mating DC-37P Connector for DC Relay Driver Board and hood	902047 and 902105

Supported Standards	Signal Characteristics	Controls and Indicators
<b>VXI-11 Capabilities</b> 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  <b>VXI-11.3 Functions</b> All VXI-11.3 functions including device read, write, local, remote, clear, trigger, readstb, lock and unlock.  <b>RPC Protocol</b> Conforms to ONC RPC Version 2, VXI-11  <b>Ethernet Interface</b> 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]  <b>WebServer Capabilities</b> Provides the following HTML 4.01 compatible web pages: Welcome Configuration Confirmation Reboot  <b>IEEE 488.2 Capabilities:</b> Runs all required 488.2 Common Commands, incorporates an extended IEEE-488.2 Status Reporting Structure and the Message Exchange Protocol.  <b>SCPI Capabilities:</b> Incorporates the SCPI Command Tree shown in Figure 2. Complies with SCPI version 1994.0	<p>The 8013's parallel I/O signals have the following electrical characteristics. All time delays listed here are maximums, all pulse widths are minimums.</p> <p><b>Inputs</b> 128 Digital I/O ,           2 Status and Reset Inputs <b>Input Logic</b> High =&gt; +2.0 V @ ±10 μA               Low = &lt;0.8 V @ 250 μA <b>Levels</b> with 33 Kohm pullup to +5 Vdc for sensing contacts.           Max High = 5.5 V</p> <p><b>Input Timing</b> 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</p> <p><b>Output Logic Levels</b> High =&gt;3 V with 3 mA source                       High =&gt;2 V with 24 mA source                       Low = 0.0 to +0.55 Vdc, 48 mA sink</p> <p><b>Output Timing</b> 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</p> <p><b>Data Stb Trigger Remote Reset</b> Output pulse width, 5 μs.                                   Output pulse width, 5 μs                                   Output level asserted when in the remote state                                   Output pulse width, 70 μs when 8013 reset.</p>	<p><b>CONTROLS</b> LAN Rst Board edge push-button</p> <p><b>LEDs</b> 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</p> <p><b>Physical</b> <b>Size, L x W x H</b> 7.0 x 5.5 x 0.55 inches (178 x 140 x 14 mm)</p> <p><b>Material</b> PCB FR406 Fiberglass Components RoHS compatible Construction Lead Free</p> <p><b>Connector and Headers</b> Digital I/O: 150-pin, 3 row male conn Ethernet: RJ-45</p> <p><b>Temperature</b> Operation -10° C to +70° C Storage -20° C to +85° C</p> <p><b>Humidity</b> 0-90% RH without condensation</p> <p><b>Power</b> +5 Vdc @ 500 mA (typ)</p> <p><b>Included Accessories</b> Instruction Manual Support CD with sample programs LAN Crossover Cable</p> <p><b>Available Accessories</b> 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 4813 Relay Driver Board, P/N 115490 4813 DC-37 Relay Driver Board, P/N 115790</p>

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