IEEE 488/GPIB BUS INTERFACES

4813
GPIB ⟷ PARALLEL DIGITAL INTERFACE

A flexible interface between the IEEE 488 Bus and devices with digital signals.

DESCRIPTION

The Model 4813 GPIB <-> Digital Interface Board is an IEEE-488.2/GPIB to digital interface with 128 I/O lines that can be used to easily adapt devices with a large number of digital signals to the IEEE-488/GPIB/HP-IP bus. In a typical application, the 4813 is located inside a device or test 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. A 26-pin header on the other end of the 4813 contains the GPIB and address switch input signals. It connects to a companion GPIB Connector/Address Switch Board that mounts on the rear panel of the chassis.

The 4813'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. Use with a 4813 Relay Driver Board to drive high current or high-voltage relays. An Expansion Board adds an additional 128 lines letting the user control up to 256 I/O lines from the GPIB bus.

Versatile Digital Interface

The 4813's digital interface is configured with commands from the GPIB Bus. The configuration commands permit the user to designate the data lines as inputs and/or outputs in 8-bit byte increments, connect bytes into strings, set data polarity, select a data format, and handshake modes. The user can set the output lines to his desired values and save the current configuration in the 4813'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.
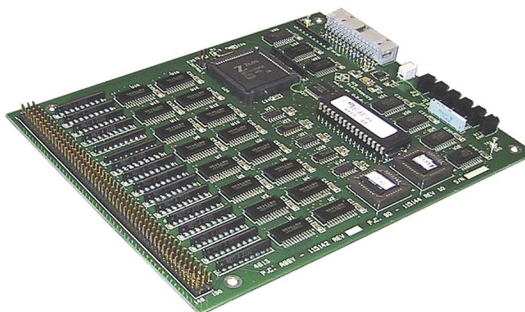
4813 Interface Card

Data Transfer Methods

Data transfer between the computer and the 4813's digital interface can be by individual bits, by bytes or as strings of data values to multiple bytes as shown in Figure 2.

• 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 in one command.

• 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 he configures the board.

The 4813 has three address modes. In the Single Address Mode, the user can set the 4813's configuration and transfer data as described above. In the Dual Primary or Single Primary-Dual Secondary Mode, the lower address behaves like the Single Address Mode. The upper address transparently passes strings of data to the configured output bytes or reads data from configured input bytes. The data is sent or read without having to parse any commands, eliminating the parsing time and speeding up the data transfer.
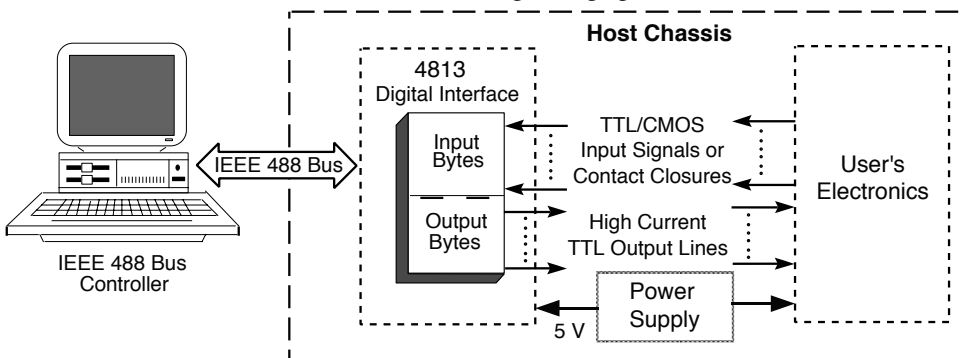
■ Provides a user-definable, 128-line parallel interface with bit, byte, pulse, string and binary data transfer capabilities.
Fully configurable to the user's needs by bus commands.

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

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

■ Companion expansion board adds another 128 I/O lines.
Expanded configuration provides 256 I/O lines.

■ Device configuration, user's IDN message and bus address stored in Flash.
User can easily customize the 4813 configuration as part of his system.

■ New Pulse Commands
Extends the 4813 to control latching relays and other pulse applications.

☑ RoHS Compliant

Figure 1   A typical 4813 Application

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Controlling the Digital Interface Bytes

Figure 2 shows the different ways the 4813 can be used to transfer data. The arrows show the data direction. The user can use SCPI or ICS's Short Form commands to control the digital interface. Short form commands are used in Figure 2 for brevity.

The bit, byte and pulse commands automatically set the data direction for their data bytes. Bit command examples are Close, Open and Read which operate on bits in bytes 1 and 2. All eight bits in byte 3 are written by the BO3 command. Data strobes can be manually generated if needed. Pulse commands can be used to pulse an output bit to its logically on level. 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 1 to n 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.

Binary Data Transfer

The binary data transfer mode can be used to quickly output large blocks of data to test devices. The user configures the desired output bytes, sets the listen format to binary and enables either dual address mode. The 4813 is then addressed at its upper GPIB address and the binary data is outputted to the 4813. The 4813 latches each bus character in a separate output byte and then pulses the data strobe when all bytes have been loaded. This sequence repeats until all of the data has been transferred.

Input Signal Monitoring

The 4813 can monitor up to fifteen of the digital inputs for signal changes and generate an SRQ to notify the Bus Controller when changes occur. Monitoring is done by setting the 4813'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 4813 generates an SRQ to alert the Bus Controller to the event. The user can query the 4813's Questionable Registers to determine the input signal states and which signal(s) changed state. See Application Bulletin 48-18 for more details and a program example.

Controlling the 4813

Figure 3 shows the 4813's configuration and data transfer commands as a SCPI Command Tree. Each SCPI command has a corresponding Short Form command which can be used for quick programming. Most of the functions can also be queried to verify the
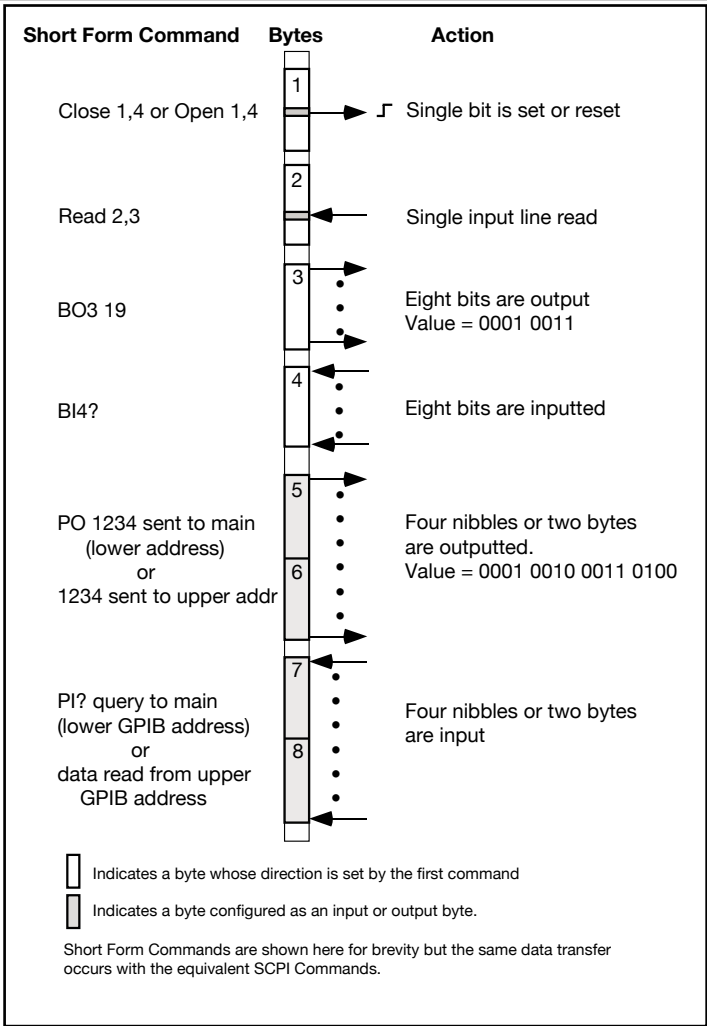

Figure 2   4813 Digital Interface Data Transfer Methods

command setting. (i.e. IPn? reads back the byte's polarity setting)

The ROUTe Bit Commands let the user set/reset individual bits in an output byte and the SOURce Output byte commands latch an 8-bit value into a specific output byte without pre-configuring the bytes. Data Strobes can be manually generated if needed. ROUTe: PULS or ROUTe:PULSe:CHAN commands pulse any output line. Pulse width is set by the ROUTe:PULSe:WIDTh command.

SOURce Output string commands can send strings of data to bytes that have been pre-configured as outputs (with the CONFigure command) and generate a data strobe with a single command. The data format is controlled by the FORmat command. Transparent data transfer is possible in the Dual Address Mode where bytes from the GPIB bus are formatted and outputted to the previously configured output bytes.

SENSe Bit commands read the state of a specific bit in an input byte and the SENSe byte commands read data from a specific byte.

SENSe String Commands read data from bytes that have been pre-configured as input bytes by the CONFigure command. The data format on the GPIB bus is controlled by the FORmat command.

CALibrate Commands let the user personalize the 4813 with his own IDN string, lock settings to prevent changes and reset the unit to the factory settings.

4813 SCPI COMMAND TREE

| SCPI Commands		Short Form Cmds
SYSTem	System-**GPIB Settings**	
:COMM		
:GPIB		
:ADDRESS	\<numeric\>	
:EXT		
:MODE	SINGle l DUAL l SEC	
:ERRor?		
:VERSion?		
CONFigure	**Configure I/O**	
[:DIGital]		
:INPut	\<channel list\>	N
:POLarity	0 l 1	TPn
:HANDshake	\<boolean\>	TBn
:OUTput	\<channel list\>	
:POLarity	0 l 1	LPn
:HANDshake	\<boolean\>	LH
:CLEar	0 l 1	C
:EDR	0 l 1	E
:INHibit	0 l 1	I
:REMote	0 l 1	R
:RESet	0 l 1	X
:STRobe	0 l 1	S
:TRIGger	0 l 1	TR
:ASTATus	0 l 1	A
:BSTATus	0 l 1	B
FORmat		
:TALK	\<ASCii l Hex l HEXL l Table\>	
:TRANSlation	\<16 char string\>	V
:LISTen	\<ASCii l Hex l HEXL l BIN l 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)l 0(Off) [0]	

Figure 3   4813 SCPI Command Tree

4813 Connections

The 4813 has two connectors, for the Digital Interface and one for GPIB signals.

The Digital Interface connector is a 150-pin connector with 3 rows of 50 pins/row on 0.1 inch centers. The standard 4813 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 4813 that breaks the 128 lines into four 32 line groups on 36-pin flat-ribbon headers. The 115650 Connector Board plugs into the 4813 vertical connector and sits on top of the 4813 board.

An optional 4813 board (P/N 115160) is available with a female connector on the circuit side of the board. Figure 5 shows the board dimensions and mounting height for piggy-back applications.
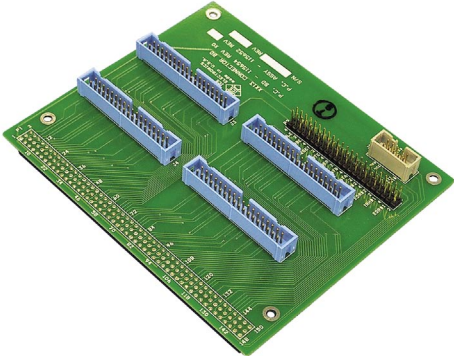
4813 Connector Board

The GPIB connector is a 26-pin header that contains the 4813's GPIB bus and external address switch input signals. When the external address mode is enabled, the 4813 uses the address switch signals to set its GPIB address at power-on time. The GPIB header mates with ICS's GPIB Connector/Address Switch Board Assemblies. The Connector/Address Switch Assemblies are small, business card size PC assemblies that a mount a GPIB connector and an 8-bit Address rocker switch to the rear panel of a chassis.

GPIB Connector/Address Switch Assemblies

The GPIB Connector/Address Switch Assemblies have a flat ribbon cable which plugs into the GPIB header on the 4813. The assemblies are available in two layout styles with user specified cable lengths. See the separate GPIB Connector/Address Switch data sheet for layout styles, mounting dimensions and cable lengths.

4813 Starter Kit

The 4813 Starter Kit includes a 4813 Board, a GPIB Connector/Switch Board Assembly, mating 150-pin connector, a GPIB bus cable, a 488-LPCI or 488-USB2 GPIB Controller, 488.2V3 Drivers and software. There is a limit of one Starter Kit per customer.

4813H - Expanding to 256 I/O Lines

The 4813H is a two board kit that expands the 4813 to 256 I/O lines by connecting a 4813 Master Board to the 4813 Expansion Board. The 4813 Expansion Board is the same size as the original 4813 but has just the digital I/O latches and Digital I/O connector. A small expansion driver board-cable assembly connects the digital I/O latches on the Expansion Board to the microprocessor and GPIB interface on the Master 4813. The 4813 Master Board has special firmware that expands the command set to handle all 256 lines.

The two boards are mounted side-by-side in the host chassis as suggested by the photograph in Figure 4. The Master 4813 Board is shown on the right and the Expansion Board is shown on the left. The GPIB header is at the bottom of the 4813 Master Board. The flat ribbon cable should be kept short so that limits the distance between the two boards to two inches.

Relay Driver Boards

Two Relay Driver Boards are available for the 4813. Both boards sit on top of the 4813 board and include an internal power supply that powers the 4813 from the relay power supply.

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. Up to 32 or the 128 lines can be used as direct 4813 TTL lines. The 4813 Relay Driver Board has four 36 pin headers with 32 relay drivers outputs on each header.

The new DC-37 Relay Driver Board has 64 sink-type relay drivers and 64 direct 4813 TTL I/O lines. The DC-37 Relay Driver Board has four DC-37 connectors with 16 relay drivers and 16 I/O lines on each connector. See the separate data sheets for more information about either board.
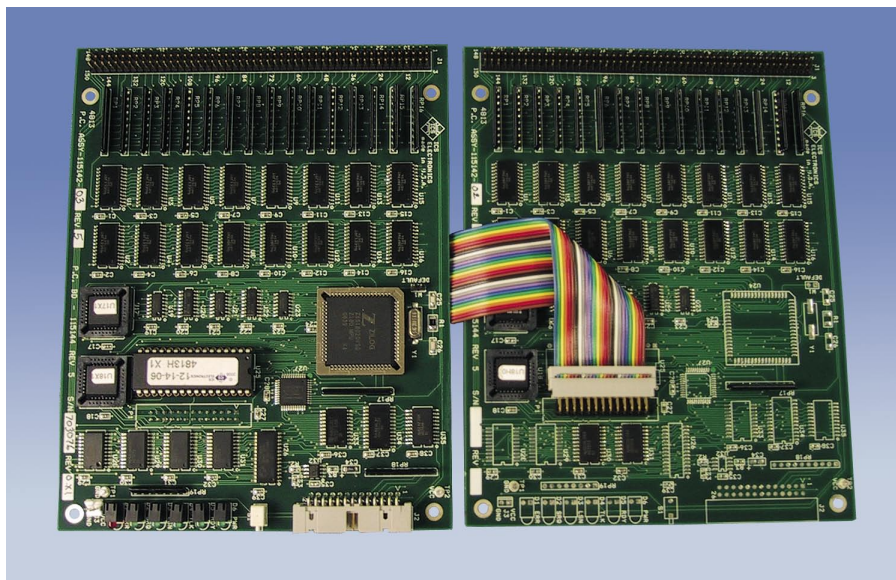

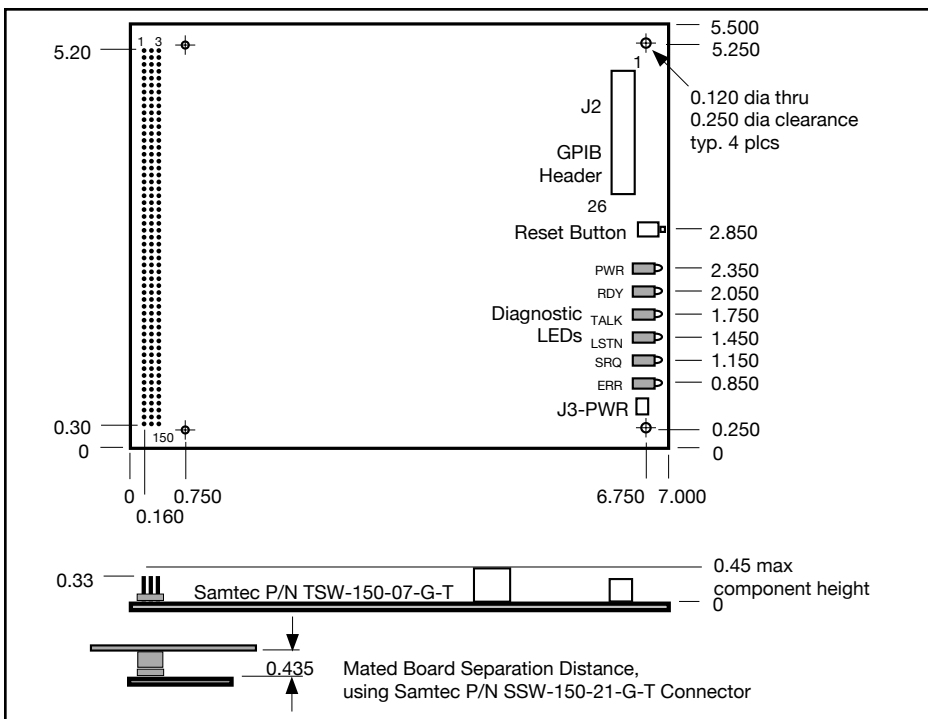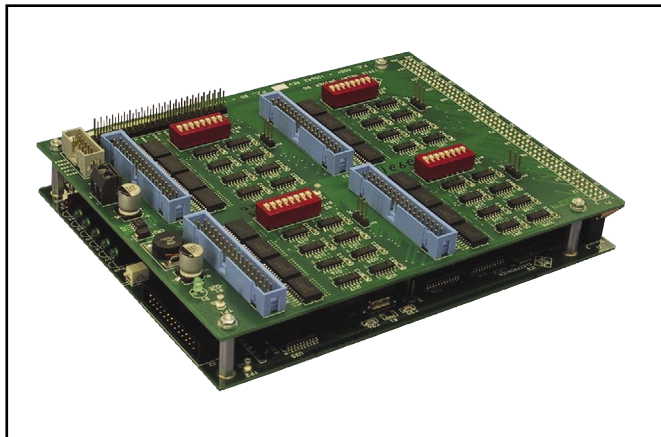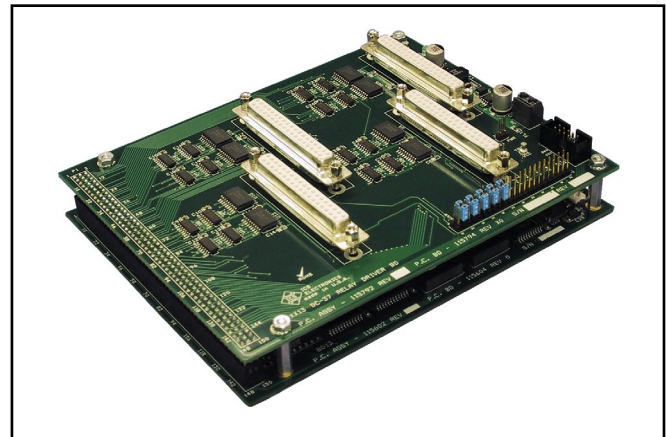**Figure 4   A 4813 and 4813 Expansion Board Set shown side-by-side**

Figure 5   4813 Outline Drawing

4813 Relay Driver Board with 128 drivers

4813 DC-37 Relay Driver Board with 64 drivers

Select from one of the two 4813 board styles and then pick your accessory items.

	Qty	Part Number
Part Selection		
Standard 4813 board with the digital I/O connector on the component side	(1)	4813

Select one mating digital I/O 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 2)

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 2)

Select a GPIB Connector/Address Switch Assembly - Horizontal style   (1)   113640-L
Vertical style   (1)   113642-L
Vertical style w/no sw   (1)   113643-L
Horizontal style w/no sw   (1)   113649-L

4813 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 GPIB Connector/Address Switch Assembly - Horizontal style   (1)   113640-L
Vertical style   (1)   113642-L
Vertical style w/no sw   (1)   113643-L
Horizontal style w/no sw   (1)   113649-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. Headers mate with 115656-L cable and/or 902334 female connector. PCB male header is P/N 902332.

ORDERING INFORMATION

	Part Number
IEEE 488.2 to Parallel Digital Interface Board (Includes Instruction Manual and Configuration Disk)	4813
IEEE 488.2 to Parallel Digital Interface Board (Board only)	115142-01
4813H 256 Line Expansion Kit includes Master Board, Expansion Board and Expansion Driver Board-Cable Assembly	115660
4813 Starter Package with 4813, 488-LPCI (-01) or 488-USB2 (-02), Bus Cable, GPIB Conn/Sw Board and mating connector.	115146
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
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
GPIB Connector/Address Switch Assembly	See separate data sheet

IEEE 488 Bus Interface

The 4813's 488 Bus interface meets IEEE STD 488.1-1987 and has the following capabilities:

SH1, AH1, T6, L4, SR1, PP0, DC1, RL0, DT1, C0 and E2 drivers.

Address Capability

Primary address range: 0-30.

Dual primary addresses or single primary with secondary addresses 0 and 1 for transparent data transfer.

SRQ Generation

SRQs are generated if the unit is not a talker, if SRQs are enabled and if an Enabled Event Status Register bit or if a monitored digital input change occurs. Digital inputs monitored by the Questionable registers.

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 4813 conforms to SCPI 1994.0 Specification.

Table 2   Programmable Functions

GPIB Bus Address
Address mode
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
SOURce output polarities
STATus register configurations

Signal Characteristics

The 4813'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 lines, (256 lines with expansion Bd) 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 input = 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 4813 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 0.6 to 8 ms after receipt of a terminator depending upon transfer method and command.
Pulse Width	10 to 30000 ms in 10 ms steps 50 ms default
Data Stb	Output pulse width, 2-5 μs.
Trigger	Output pulse width, 5 μs
Remote	Output level asserted when in the remote state
Reset	Output pulse width, 270 μs for when 4813 reset.

Reset Inputs

The 4813 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 4813's PCB

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 0.55 inches
(178 x 140 x 9 mm)

Connector and Headers
GPIB/Addr: 26-pin 3M 2526 male connector
Digital I/O: 150-pin, 3 row male Conn.

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

Humidity
0-90% RH without condensation

Power
+5 Vdc @ 440 mA (typical)
880 mA for Expansion Board Kit

Included Accessories

Instruction Manual
Support CD with sample programs
J3 Mating Power Plug

Available Accessories

See the Ordering Guide on page 5 for a complete list of accessory items.

GPIB Connector/Addr Sw Cable Assemblies.
See separate GPIB Conn/Sw data sheet.

Mating short connector, P/N 902308
Mating tall connector, P/N 902331
4813 Relay Driver Board, P/N 115490
4813 DC-37 Relay Driver Bd, P/N 115790
4813 Connector Board