HP 98623A
BCD Interface Card

Installation Note

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PRINTING HISTORY

The Printing History below identifies the Edition of this Manual and any Updates that are included. Periodically, update packages are distributed which contain replacement pages to be merged into the manual, including an updated copy of this Printing History page. Also, the update may contain write-in instructions.

Each reprinting of this manual will incorporate all past updates; however, no new information will be added. Thus, the reprinted copy will be identical in content to prior printings of the same edition with the user-inserted update information. New editions of this manual will contain new information, as well as updates.

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HP 98623
BCD Interface Card
Installation

The HP 98623A BCD Interface card is used to interface the HP 9826A to peripherals such as digital voltmeters and other devices whose output is in binary-coded decimal format. The cable optionally supplied with the interface has a connector at one end that is wired to match the interface. The other end of the cable is unterminated so that a connector can be attached that matches the equipment being connected to the computer.

Interface Card Installation

To install the interface, remove a blank cover from the left rear of the HP 9826A. Program the configuration switches as explained later, then plug the interface card into the LOWER slot in the available space. (The upper slot can be used for other non-I/O options or for a DMA card.) Tighten the two retainer screws to hold the interface in place. Plug in the interface cable, and secure it with the two screws supplied, one on each side of the connector. The 3.5 mm by 10 mm screws (HP part number 0515-0067) have METRIC threads. Attempting to use non-metric screws causes thread damage. Plug the connector at the other end of the interface cable[1] into the peripheral device. Installation is now complete.

Note

Do not touch the printed circuit connector fingers at the edge of the interface card. Fingerprints, skin oils, and other contamination can cause unreliable operation. To clean dirty connector fingers, use a cotton swab dampened in isopropyl alcohol. Be sure the fingers are completely clean and dry before installing the interface.

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1 The HP 98623 is supplied with an unterminated cable. Install a suitable connector with wiring matched to the requirements of the BCD peripheral before installing the interface.

Configuring the Interface Card

Four clusters of configuration switches are provided as shown in Figure 1. They are programmed as follows:

Setting the Select Code

Switch cluster U1 is used to program the interface select code. The switches are configured in a 5-bit binary format, with each bit having the following values:

Bit 0: 0 or 1	Bit 2: 0 or 4	Bit 4: 0 or 16
Bit 1: 0 or 2	Bit 3: 0 or 8	

When each switch is set toward the rear of the computer (0 position) it has a value of zero. In the forward setting (1 position), it takes on its non-zero value. The select code setting is the sum of all non-zero values in the series. For example, to set the interface to select code 19, set bits 0, 1, and 4 to their "1" positions (1 + 2 + 16 = 19).

Setting the Interrupt Level

The interrupt level switch (U2) establishes the interrupt levels supplied to the computer. Set the switches to the required position as indicated in Figure 1, Table 4.

Setting the Peripheral Status Switches

The Peripheral Status Switch cluster (U24) is programmed as follows:

Option Format switch:
The Option Format switch selects between single- and dual-device BCD formats. The formats are shown in Figure 1, Table 5 (single device), and Figure 1, Tables 6 and 7 (dual devices).

Data Logic Sense switches:
The remaining Peripheral Status Switch settings program the logic sense of DATA, SIGN, and OVERLOAD signals. The ON position programs the logic sense to Positive True, Active High for a given line. Setting the switch OFF reverses the logic sense to Negative True, Active Low. Refer to Figure 1, Table 1 for a summary of the Peripheral Status Switch settings and functions.

Setting the Handshake Configuration

The Handshake Configuration Switch cluster (U15) is used to program logic sense and signal type for each of the two Control and Flag lines. The signal lines and switch functions are as follows:

Function Mnemonic	Logic Signal	Switch Function
$\overline{\text{DFLGA}}$	Device Flag A	Flag logic sense from first BCD device.
$\overline{\text{CTLA-2}}$	Device Control A	Control Bit timing, first BCD device.
$\overline{\text{CTLA}}$	Device Control A	Control Bit logic sense, first BCD device.
$\overline{\text{DFLGB}}$	Device Flag B	Flag logic sense from second BCD device.
$\overline{\text{CTLB-2}}$	Device Control B	Control Bit timing, second BCD device.
$\overline{\text{CTLB}}$	Device Control B	Control Bit logic sense, second BCD device.

Signal timing and logic sense are illustrated under Theory of Operation, Handshaking Lines.

Testing the Interface Card

Before you use the interface, or whenever you suspect an interface malfunction, you can use System Diagnostics software to determine that the interface is or is not functioning properly. To perform the diagnostic tests for the HP 98623A interface, remove the interface cable, then install a BCD interface test connector, that is ordered separately. HP part number 98623-67950.
Follow the instructions supplied with the diagnostics program to test the interface.

Service/Repair Procedures

The HP 98623A BCD Interface is not considered to be a field repairable item. Replacement cards can be ordered from your nearest HP Sales and Service office.

Theory of Operation

The interface contains the necessary circuitry to convert internal computer signals and external device signals so that BCD devices can communicate with the computer. All communication with the computer is through the edge connector opposite the cable connector. Signals include handshaking and data paths sufficient to control two BCD devices using a single interface. (The user is responsible for determining the necessary cable and connector configurations for adapting the unterminated cable to the one or two BCD devices being controlled.)

Data Format

Two data formats are available: standard and optional. The standard format, shown in Figure 1 Table 5, consists of a function code digit, a sign bit (SGN1), eight 4-bit BCD magnitude digits, an exponent sign bit (SGN2), a 4-bit BCD exponent digit, and an overload bit that indicates whether the reading is valid or not. The optional format is shown in Figure 1, Tables 6 and 7. Note that no exponent digit is available because the highest bit of input digit 9 (DI9-8) is used as an overload bit for the second device. The exponent sign (SGN2) becomes the sign bit for the second device.

Output Data Lines

Eight output data bits (DO0-DO7) are used to transmit commands and other information to the peripheral device. Data is latched and held until the next output operation. Actual function depends on software implementation in the I/O drivers of the computer operating system.

Preset

The Preset line is activated each time a computer system reset or an interface reset is executed. It is automatically activated when the computer power is turned on. The preset pulse is active low, and lasts 15 microseconds. The handshake flip-flop, data output register, and interrupt enable bit are reset at the same time.

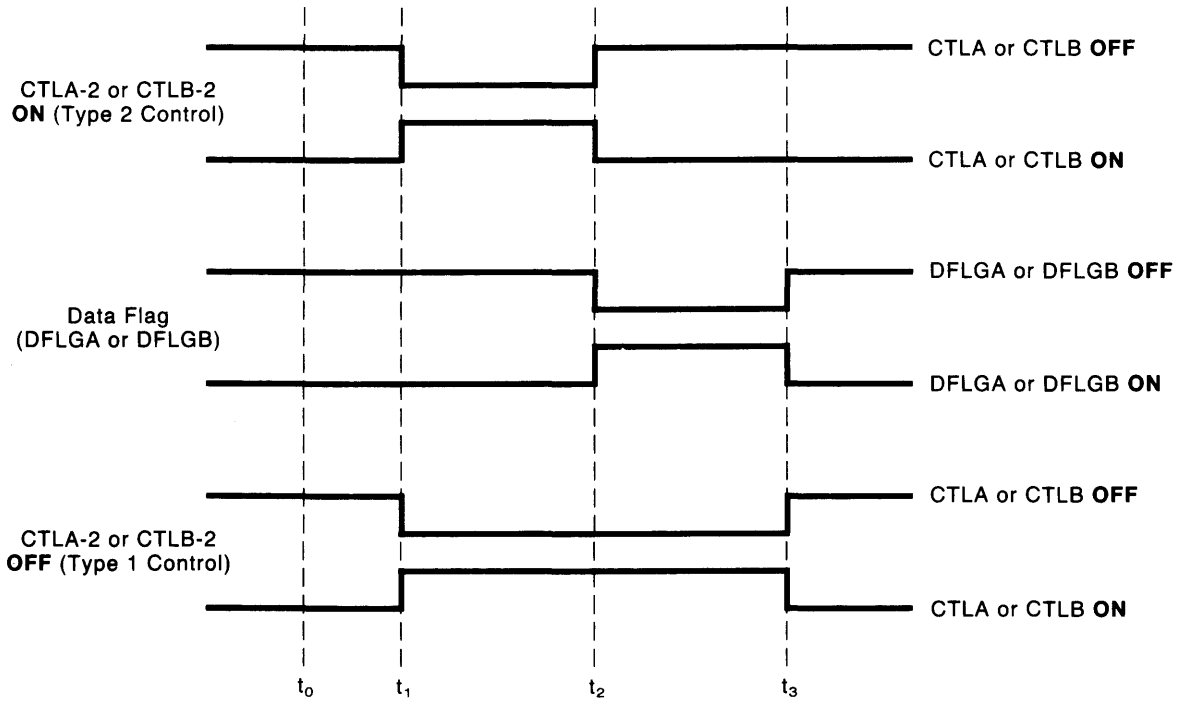
Handshaking Lines

Data interchange between the interface and peripheral(s) is coordinated by the Control ($\overline{CTLA}$ and $\overline{CTLB}$) and Device Flag ($\overline{DFLGA}$ and $\overline{DFLGB}$) bits for devices A and B respectively.

Handshake timing is as follows:

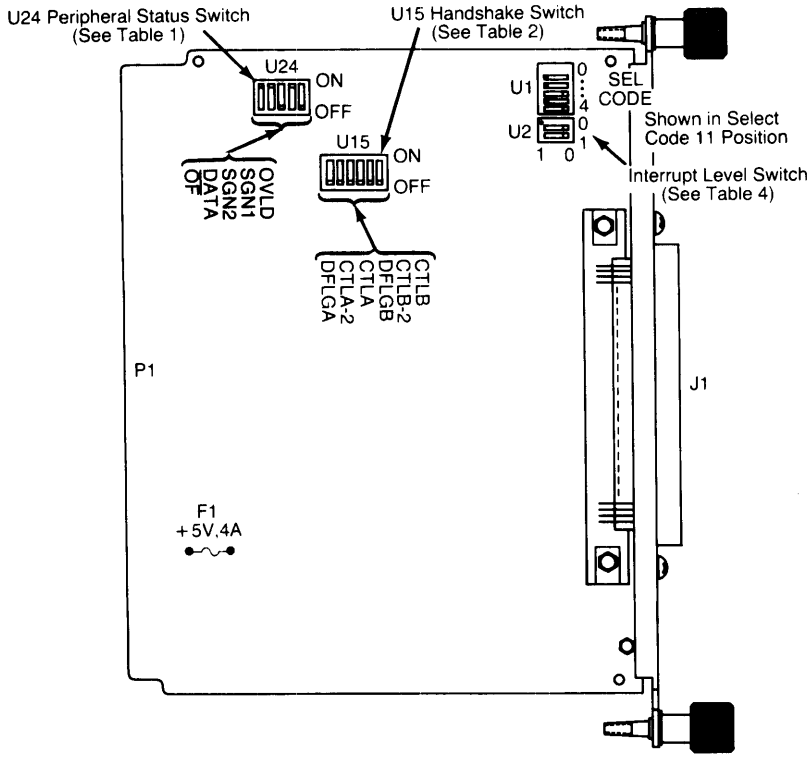
- t_0: Interchange is inactive. Peripheral is ready for new command from Control Bit ($\overline{CTLA}/\overline{CTLB}$).
- t_1: Interface sends Control bit to peripheral device.
- t_2: Peripheral changes flag from "ready" to "busy", indicating that the command has been accepted.
- t_3: Peripheral restores flag to "ready" state indicating the operation is complete. Flag "ready" usually implies valid data is available for input by the interface.

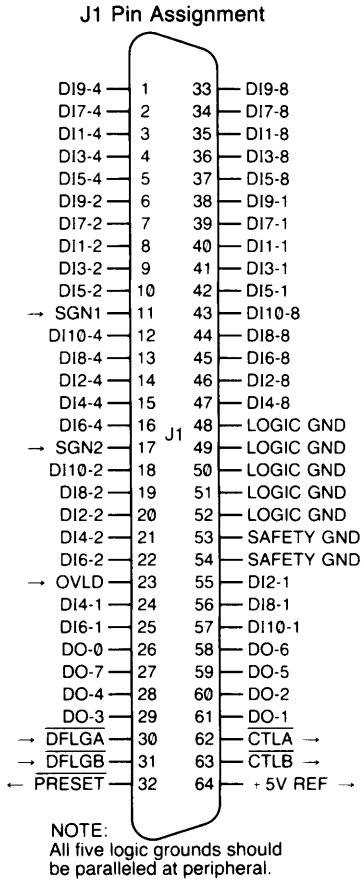
The following timing diagram shows the relationship between CONTROL and FLAG for each handshake configuration option as determined by the switch positions of U15. Timing applies to both A and B device handshake.



Handshake Timing Diagram

When the Control timing switch (CTLA-2/CTLB-2) is OFF (Type 1 timing), the control bit is cleared when the "device ready" (trailing) flag edge is received by the interface. When the Control timing switch is ON (Type 2 timing), the control bit is cleared when the "device busy" (leading) flag edge is received. Switch settings are shown in Table 2, Figure 1.





NOTE:
All five logic grounds should be paralleled at peripheral.

Table 3: BCD Code

Pos. True Logic	ASCII Character
0 0 0 0	0
0 0 0 1	1
0 0 1 0	2
0 0 1 1	3
0 1 0 0	4
0 1 0 1	5
0 1 1 0	6
0 1 1 1	7
1 0 0 0	8
1 0 0 1	9
1 0 1 0	(L.F.) line feed
1 0 1 1	(+) plus
1 1 0 0	(,) comma
1 1 0 1	(−) minus
1 1 1 0	(E) exponent
1 1 1 1	(.) decimal point

Table 1: U24 Peripheral Status Switch

Description	Switch Positions	
	On	Off
Option Format	Std. Format	Option Format
Data	Pos. True, Active High	Inverted
Sign 1	Pos. True, Active High	Inverted
Sign 2	Pos.True, Active High	Inverted
Overload	Pos. True, Active High	Inverted

Table 2: U15 Handshake Switch

Description	Switch Positions	
	On	Off
Device Flag A	Active High, DFLGA	Inverted, $\overline{\text{DFLGA}}$
Control A 1 or 2 (Type)	CTLA-2	CTLA-1
Control A (Std. or Invert)	Active High, CTLA	Inverted, $\overline{\text{CTLA}}$
Device Flag B	Active High, DFLGB	Inverted, $\overline{\text{DFLGB}}$
Control B 1 or 2 (Type)	CTLB-2	CTLB-1
Control B (Std. or Invert)	Active High, CTLB	Inverted, $\overline{\text{CTLB}}$

Table 4: Interrupt Level Switch

Interrupt Level	SW. Settings	
	1	0
3	0	0
4	0	1
5	1	0
6	1	1

Table 5: Standard Format

Name	SGN1	DI1	DI2	DI3	DI4	DI5	DI6	DI7	DI8	Exponent	SGN2	DI9	Comma	OVLD	DI10	Line Feed
Char.	+ −	X	X	X	X	X	X	X	X	E	+ −	X		0 or 8	X	L.F.
Info.		MSD	←						→					0 = $\overline{\text{OVLD}}$ 8 = OVLD		
Code (Pos. True)	+ 1011 − 1101									1110	+ 1011 − 1101		1100	0000 1000		1010

Table 6: Overload Table

Description	OVLD	DI9
No Overload	0	0
1st Device Overload	8	0
2nd Device Overload	0	8
Both Overload	8	8

Table 7: Optional Format (Read Two BCD Devices)

	First Device (FD)						Second Device (SD)									
Name	SGN1	DI4	DI2	DI6	DI8	Comma	SGN2	DI10	DI1	DI5	DI3	DI7	Letter E	OVLD	DI9	Line Feed
Char	+ −	X	X	X	X		+ −	X	X	X	X	X	E	0 or 8	0 or 8	L.F.
Info.		MSD	←		LSD		MSD	←				LSD		FD (see table)	SD	
Code (Pos. True)	+ 1011 − 1101					1100	+ 1011 − 1101						1110			1010

Figure 1

Cable Wiring

The following table shows wire colors, function, and pin number at the interface connector for each signal line in the interface cable assembly.

Wire Color	Pin	Function	Wire Color	Pin	Function
Wht/blu/gra	32	PRESET	White	48	Logic Ground
Gray	62	CTLA	Wht/grn/blu	49	Logic Ground
Wht/gra	63	CTLB	Wht/grn/vio	50	Logic Ground
Wht/brn/gra	30	DFLGA	Wht/grn/gra	51	Logic Ground
Wht/red/gra	31	DFLGB	Wht/blu/vio	52	Logic Ground
Black	40	DI1-1	Wht/blk/grn	25	DI6-1
Brown	8	DI1-2	Wht/blk/blu	22	DI6-2
Red	3	DI1-4	Wht/blk/vio	16	DI6-4
Orange	35	DI1-8	Wht/blk/gra	45	DI6-8
Yellow	55	DI2-1	Wht/brn/red	39	DI7-1
Green	20	DI2-2	Wht/brn/orn	7	DI7-2
Blue	14	DI2-4	Wht/brn/yel	2	DI7-4
Violet	46	DI2-8	Wht/brn/grn	34	DI7-8
Wht/blk	41	DI3-1	Wht/red/orn	56	DI8-1
Wht/brn	9	DI3-2	Wht/red/yel	19	DI8-2
Wht/red	4	DI3-4	Wht/red/grn	13	DI8-4
Wht/orn	36	DI3-8	Wht/red/blu	44	DI8-8
Wht yel	24	DI4-1	Wht/orn/yel	38	DI9-1
Wht/grn	21	DI4-2	Wht/orn/grn	6	DI9-2
Wht/blu	15	DI4-4	Wht/orn/blu	1	DI9-4
Wht/vio	47	DI4-8	Wht/orn/vio	33	DI9-8
Wht/blk/brn	42	DI5-1	Wht/yel/grn	57	DI10-1
Wht/blk/red	10	DI5-2	Wht/yel/blu	18	DI10-2
Wht/blk/orn	5	DI5-4	Wht/yel/vio	12	DI10-4
Wht/blk/yel	37	DI5-8	Wht/yel/gra	43	DI10-8
Orn/red	26	DO-0	Orn/yel	27	DO-7
Orn/brn	61	DO-1	Wht/red/vio	23	OVLD
Blk/red	60	DO-2	Wht/brn/blu	11	SGN1
Blk/orn	29	DO-3	Wht/brn/vio	17	SGN2
Blk/yel	28	DO-4	Wht/orn/gra	64	+5 Ref
Blk/grn	59	DO-5	Bare wire	53,54	Drain
Orn/blu	58	DO-6			

Terminating Unused Lines

Most applications do not utilize all available lines in the interface cable. Unused signal INPUT lines should be connected to logic ground or +5 reference AT THE PERIPHERAL end of the cable. The +5 reference line is connected to the +5 volt interface power supply through a 1000 ohm resistor. The installer must determine which lines should be tied high (+5V) or low (ground), and make the appropriate connections.

Terminating the Interface Cable Shield and Drain wire

Interface cables must be treated as high-frequency transmission lines. To minimize susceptibility to external noise, electrostatic discharges to the peripheral or computer frame, etc., and to

assure reliable behavior, the shield and drain wire should be connected to the peripheral FRAME GROUND by a LOW-IMPEDANCE path. Noise currents are then routed through the shield wires instead of the logic ground wires, minimizing disruption of signals to and from the peripheral.

In applications where strong electromagnetic and/or electrical fields are encountered, additional precautions may be necessary. Power ground loops between the computer and peripheral are not usually a problem in a local system where the computer and peripheral both obtain their power from a common circuit breaker panel. In extended systems or noisy applications, optical isolators are normally used to reduce noise and allow separate grounds.

Safety Precautions

WARNING

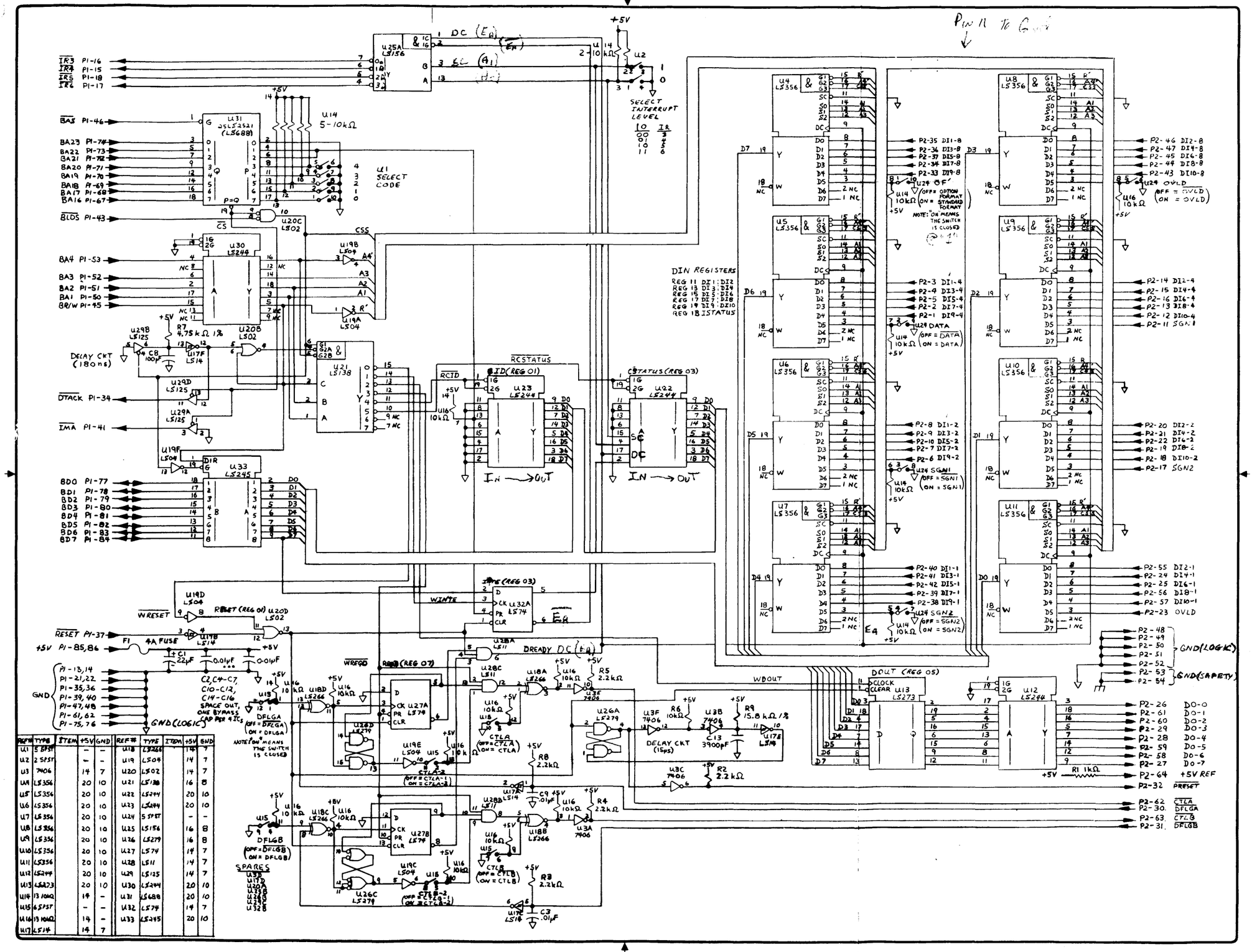
NOT ALL EQUIPMENT MANUFACTURERS USE THE SAME EQUIPMENT GROUNDING TECHNIQUES. BEFORE CONNECTING THE INTERFACE CABLE TO A BCD DEVICE, BE SURE THAT IT IS PROPERLY GROUNDED AS DESCRIBED BELOW. CONNECTIONS TO EITHER UNGROUNDED OR IMPROPERLY GROUNDED EQUIPMENT MAY CAUSE EQUIPMENT DAMAGE OR INJURY DUE TO ELECTRICAL SHOCK.

The HP 9826 Computer is constructed to comply with the electrical safety requirements of IEC Standard 435 for "Type I" equipment. Hence, the HP 9826 provides safety ground through the third pin of its power cord. Therefore, the HP 98623 BCD Interface is designed to operate with equipment that is grounded as follows:

- The equipment frame and any exposed metal parts MUST be connected to SAFETY GROUND by adequate wiring at the peripheral. Do not use the BCD interface cable for safety ground.
- The peripheral's interface circuitry logic ground must be connected to FRAME GROUND or be COMPLETELY ISOLATED from internal circuitry because the logic ground and safety ground are connected in the HP 9826 Computer. Isolated logic grounds for interface circuitry must be able to safely withstand any voltages that may be applied to the peripheral while the peripheral is connected to the HP 9826.
- Peripheral frame ground connections to power line safety ground should never be broken by special adapters that allow the frame grounds to be isolated from safety ground.

If you have any doubts that the peripheral meets all the prescribed requirements, contact the equipment manufacturer for the needed information. **DO NOT CONNECT THE INTERFACE TO ANY EQUIPMENT THAT DOES NOT MEET THESE REQUIREMENTS. SERIOUS INJURY FROM ELECTRICAL SHOCK, OR SEVERE EQUIPMENT DAMAGE MAY RESULT.**

When installing HP computer systems at a new site, check all electrical outlets to be sure that they are properly wired with the safety ground connected to the earth ground terminal. Incorrectly wired outlets cause serious equipment damage.



REF#	TYPE	ITEM	+5V	GND
U1	5 SPST		–	–
U2	2 SPST		–	–
U3	7406		14	7
U4	LS356		20	10
U5	LS356		20	10
U6	LS356		20	10
U7	LS356		20	10
U8	LS356		20	10
U9	LS356		20	10
U10	LS356		20	10
U11	LS356		20	10
U12	LS244		20	10
U13	LS273		20	10
U14	13 10kΩ		14	–
U15	6 SPST		–	–
U16	13 10kΩ		14	–
U17	LS14		14	7

REF#	TYPE	ITEM	+5V	GND
U18	LS266		14	7
U19	LS04		14	7
U20	LS02		14	7
U21	LS138		16	8
U22	LS244		20	10
U23	LS244		20	10
U24	5 SPST		–	–
U25	LS156		16	8
U26	LS279		16	8
U27	LS74		14	7
U28	LS11		14	7
U29	LS125		14	7
U30	LS244		20	10
U31	LS688		20	10
U32	LS74		14	7
U33	LS245		20	10

SPARES
U35
LS17D
LS20A
LS28B
LS28C
LS28D
LS32B

Figure 2. BCD Interface Card Schematic Diagram

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