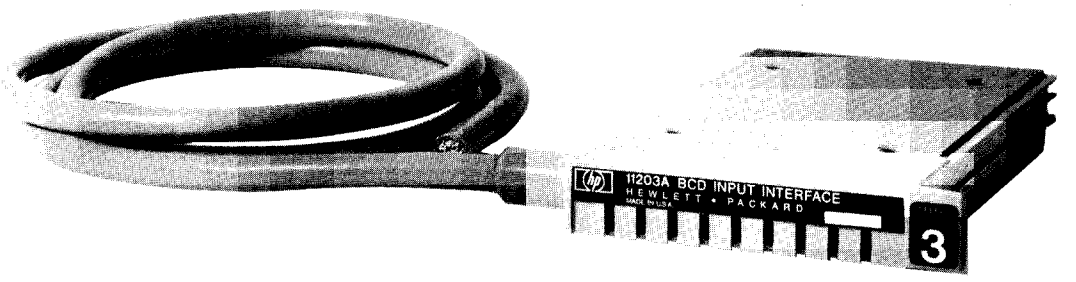
INSTALLATION and SERVICE MANUAL



HEWLETT-PACKARD
11203A BCD INPUT INTERFACE

HEWLETT–PACKARD CALCULATOR PRODUCTS DIVISION
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(For World-wide Sales and Service Offices see rear of manual.)

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Chapter 1
GENERAL INFORMATION

INTRODUCTION

The -hp- 11203A BCD Interface provides a 9800-Series Calculator with an interface to any of a variety of instruments having parallel Binary Coded Decimal outputs. A direct interface is possible to many of the latest -hp- digital voltmeters, frequency counters, etc; see 'Interface Options', page 1-3. When used with an appropriate Peripheral Control Block or Extended I/O ROM, the interface can transfer data points up to nine digits long and also function, range, sign, and overload information to the calculator.

THE PERIPHERAL CONTROL BLOCK

Each calculator must have an appropriate peripheral control block when using this interface. The manual supplied with the block describes how to control and input data from peripheral equipment. Here is a list of currently available blocks:

Model 9810A:

- 11264A PC Block (general P.C. operations)
- 11262A or 11266A PC Combination Blocks
- 11252A PC 2 Block (advanced peripheral control)

Model 9820A or 9821A:

- 11220A PC 1 Block (general PC operations; special plotter and typewriter functions)
- 11224A PC 2 Block (advanced peripheral control)

Model 9830A:

- 11272B Extended I/O ROM (general I/O routines)

Refer to the PC Block or Extended I/O ROM Operating Manual for a description of the calculator input operations and data format(s) which are available.

HARDWARE DESCRIPTION

The interface consists of a circuit card inside a case (which plugs into any one of the calculator I/O connectors) and a 1.82 meter shielded cable. One end of the cable is connected to the circuit card and the other end is unterminated.

TECHNICAL SPECIFICATIONS

Logic Levels

Levels are standard (control lines) or low power (data lines) transistor-transistor logic with binary '1' state high ($>+2.0$ volts) and binary '0' state low (<0.7 volts) on all lines. The interface card can be especially wired for inverted levels (see 'Installation Considerations').

INTRODUCTION

(Continued)

Input Format

Data is serialized on the card into a sixteen-character sequence as follows: Function code, delimiter, mantissa sign, nine digits of data, exponent sign, overload, exponent, and delimiter.

- The first delimiter separates function code and data into separate registers.
- The second delimiter terminates the entry sequence.
- Overload condition sets the most significant exponent digit to eight and sets exponent sign positive. (i.e., a large positive exponent is output).
- All unused data lines must be connected for zeros (grounded on + true card).

Codes

- Data – '1248' Binary Coded Decimal weighting. Binary codes 0 through 9 are entered as decimal numbers. Binary code 14 or 15 is accepted and entered as a decimal point, if it occurs in a data string.
- Function and Exponent – '1248' Binary Coded Decimal weighting: codes 0 through 9 decimal only.
- Mantissa Sign – One binary bit: '0' gives positive mantissa, '1' gives negative mantissa.
- Exponent Sign – One binary bit: '0' gives positive exponent, '1' gives negative exponent unless overload condition exists.
- Overload – One binary bit: '1' gives overload condition.

Data-Sample Control Lines

- Control 1 – Normal control line: leading edge should initiate the data sample, and the trailing edge is triggered by the Flag returning low from the BCD source.
- Control 2 – A negative-going command from the interface signals the BCD source to initiate a data sample. Control 2 can be used if the BCD source returns Flag high to recognize control command.
- Flag – Returned low by the BCD source to signal that the data sample is complete and data is ready.

Power

The 11203A is powered from the calculator.

Temperature Range

0°C to 45°C ambient.

Dimensions

12.06 cm (4¾") x 15.87 cm (6¼") with a 1.82 meter (6') unterminated cable.

INTERFACE OPTIONS

Each of the following options consists of a standard BCD Interface which is prewired with a connector suitable for use with the indicated -hp- instrument. A wiring diagram and operating instructions for each of these options is supplied with the optional interface.

Table 1-1. Available Interface Options

11203A–	Interfaces with:
Option A01	5326/5327 Counter
Option A02	5300 Counter System
Option A03	3480A/B DVM (3482A or 3484A Plug-in)
Option A04	3450A/B DVM
Option A05	3575A Gain-Phase Meter
Option A06	3480A/B DVM (3485A Scanner Plug-in)
Option A07	3490A DVM
Option A08	3470A DVM
Option A13	4270A Capacitance Bridge

INSTALLATION CONSIDERATIONS

SELECT CODE

Since all peripheral devices are connected to the calculator in a party-line fashion, each device must have a unique address so that the calculator can specify which device must respond to each operation. This address, or 'select code', consists of a one-digit number and is preset on the interface card.

Although the 11203A Interface is set to respond to select code 3 when supplied, you can set any one of eight other codes by following this procedure:

1. Switch the calculator and the peripheral device OFF.
2. Disconnect the interface from the calculator. Remove the four screws located on the top of the card assembly. Then turn the card over and lift off the bottom cover.
3. Locate the Select Code Switch (see Figure 1-1). Raise the hinged cover on the switch. Using a small, flat-blade screwdriver, *carefully rotate* the selector-tab until it is positioned at the desired select code number. Numbers are printed on the side and on the top cover of the switch ('0' is unusable). Before closing the cover, be sure the slot in the selector-tab is at a right angle to the length of the switch.

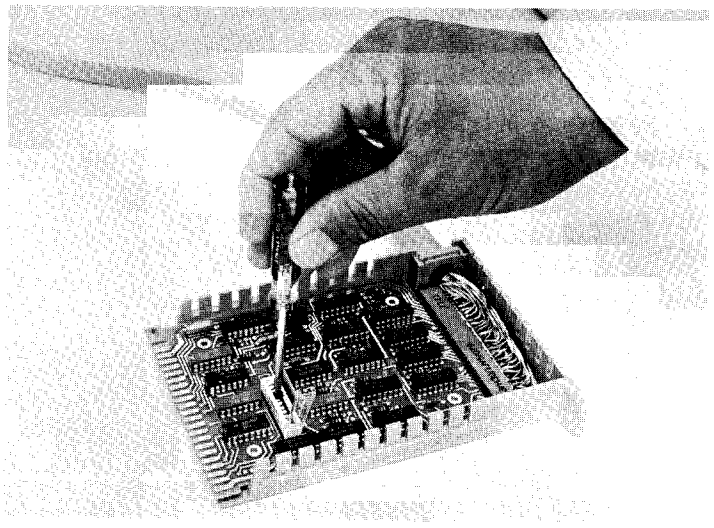


Figure 1-1. Setting the Select Code

INSTALLATION CONSIDERATIONS

(Continued)

THE + AND – REFERENCE LINES

One of the reference lines (see the upper-right corner of the circuit diagram) *must* be connected to ground – the line grounded depends upon the input logic level used.

- When positive-true logic is used, the '–' line must be grounded and the '+' line must be left open.
- When using negative-true logic, the '+' line must be grounded and the '–' line must be left open.

Pin 3B on the card-to-cable connector (XA1) may be used for connecting the correct reference line to ground.

LOGIC LEVELS

The BCD Interface is wired for positive-true logic (i.e., '1' state = ≥2v, '0' state = ≤0.7v) on all data input lines.

The data logic can be rewired to respond to negative-true logic (i.e., '1' state = ≤0.7v, '0' state = ≥2v) by removing one lead of each of the resistors, R7 through R14 and R16 through R20, from the '+' pad and soldering the lead to the '–' pad. Likewise, the Flag line can be rewired to respond to a positive data-ready signal from the BCD source by relocating the lead for R1. Also, the control lines can be rewired to give a positive-edge for a sample command by relocating the leads for R2 or R3.

NOTE

When rewiring the data input lines, be sure to connect the correct reference line to ground (see the preceding paragraph).

MAXIMUM DATA-ENTRY RATE

The maximum data-entry rate depends upon the calculator, the peripheral device, and the program execution time. Here is a list of maximum rates possible with current system configuration:

Table 1-2. Data-Entry Rates

Calculator (ROM Block)	Maximum Rate (samples/sec.)
9810A (Any PC Block)	40
9820A (PC 1)	4
9820A (PC 2)	20
9821A (PC 1)	4
9821A (PC 2)	20
9830A (Extended I/O)	18

STABILITY OF INPUT DATA

Since the interface does not provide buffer-storage of input data, the BCD data must be held stable for the entire data-input sequence. The time needed for input data to remain stable depends upon the data-entry rate. For instance, if the system is sampling at 40 samples per second, the data must remain on the lines for a minimum of 25 msec, whereas a sample rate of 4 samples per second requires that each data sample remain stable for not less than 250 msec.

PROGRAMMING UNUSED INPUT LINES

The following table lists the sequence in which data is input and identifies the wires on the interface cable.

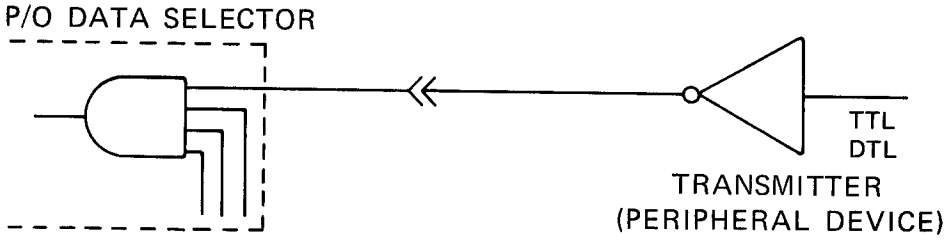
Input Sequence	Data Item	Cable Wire Color for BCD Line† '8'	'4'	'2'	'1'
1	Function Code	903	98	92	6
2	Comma*	–	–	–	–
3	Polarity	–	–	–	901
4	Digit 1 (MSD)	946	935	926	918
5	Digit 2	947	936	927	923
6	Digit 3	948	937	928	924
7	Digit 4	956	938	934	925
8	Digit 5	912	902	91	5
9	Digit 6	904	93	7	4
10	Digit 7	905	94	8	3
11	Digit 8	906	95	9	2
12	Digit 9	907	96	90	1
13	Exponent Sign	–	–	–	916
14	Overload	–	–	–	914
15	Exponent Digit	908	97	913	0
16	Delimiter*	–	–	–	–

The interface transfers data beginning with the most significant digit. If less than 9 digits of data are used, leading zeros should be programmed by connecting the most significant digit (MSD) lines to ground. Also, if any of the lines for function, polarity, overload, or range are not used, each must be connected to ground.

RECOMMENDED INPUT CIRCUITS

Data Lines

Each data input line is connected to a TTL AND gate which is a part of the data selector. To ensure proper operation, the transmitting circuit (on the peripheral end of the cable) must allow the receiver to source .4ma max. The input voltage must not exceed 5.5V. Typical data transmitter circuits are shown below:



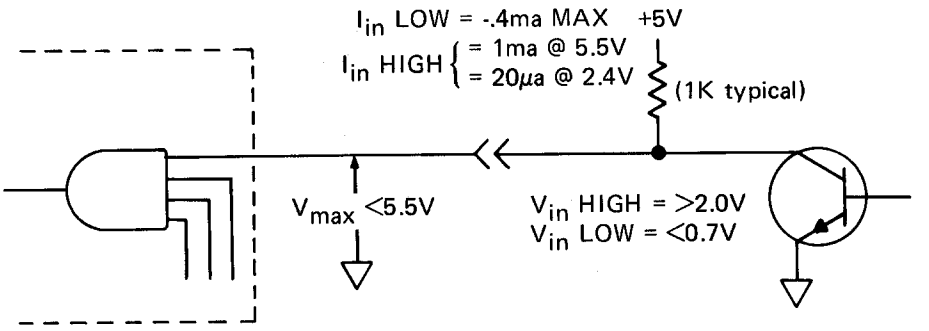
P/O Figure 1-2. Typical Data Input Circuits

*These characters are generated by the interface.

†Wire color code is the same as resistor color code: first number identifies base color, second number identifies wider strip, third number identifies narrower strip (e.g., 924 = white, red, yellow).

INSTALLATION CONSIDERATIONS

(Continued)



P/O Figure 1-2. Typical Data Input Circuits

Flag Line

The flag receiver consists of two TTL inverters (P/O TI 7405N). For proper operation the transmitting circuit must allow the receiver to source at least 3.2 ma and the input voltage must not exceed 5.5v. A typical flag transmitter circuit is shown below:

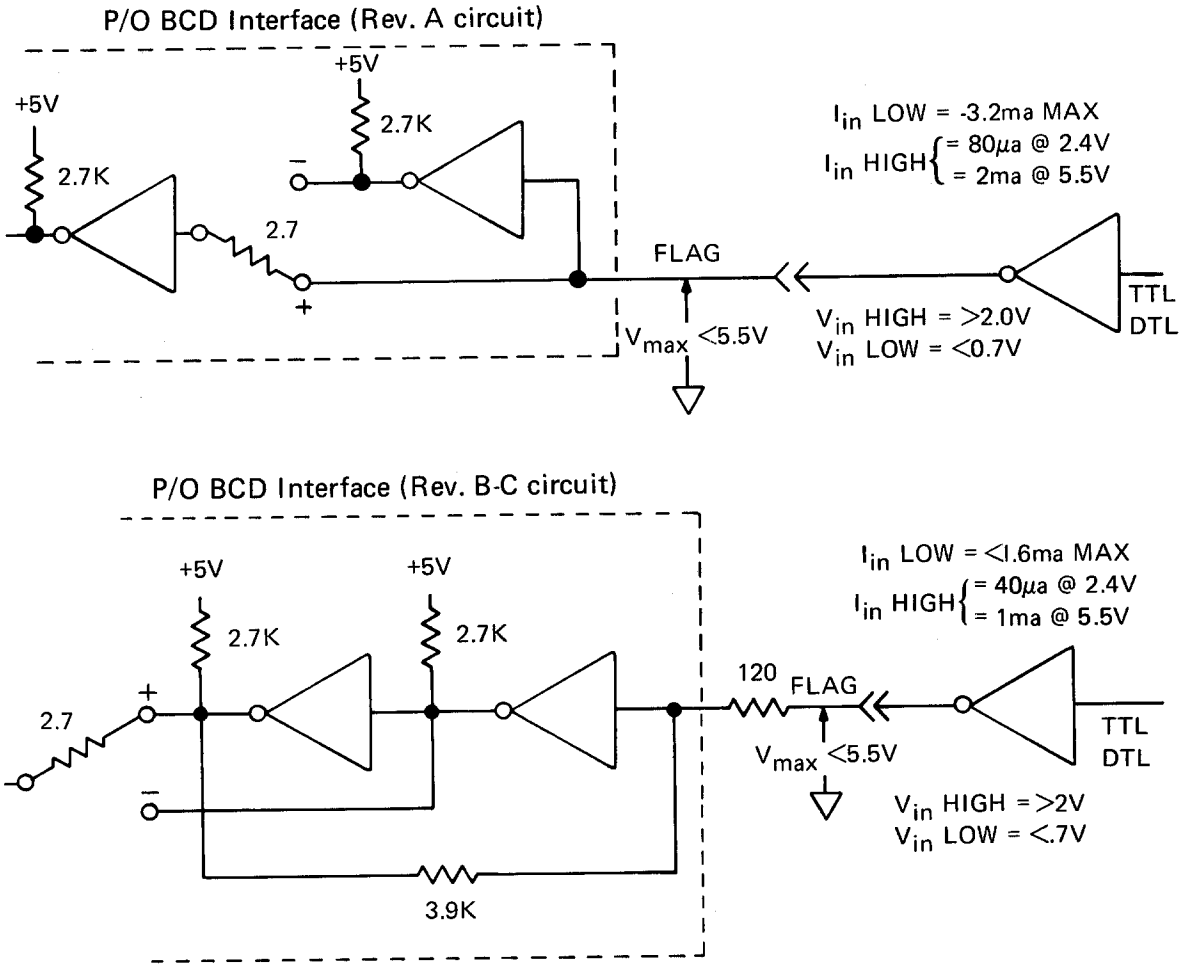


Figure 1-3. Typical Flag Circuit

Chapter 2
OPERATING INSTRUCTIONS

GETTING STARTED

Many instruments which offer BCD output are available and can be used with the 11203A Interface. When considering using an instrument in your calculator system, however, be sure to verify its operating characteristics with those of the 11203A Interface. See 'Installation Considerations', page 1-4.

This chapter describes how to control one of the most popular BCD Interface applications: the -hp- 3480 Digital Voltmeter. Although your application may be considerably different from controlling a DVM, the calculator operations will probably be quite similar.

EQUIPMENT SETUP

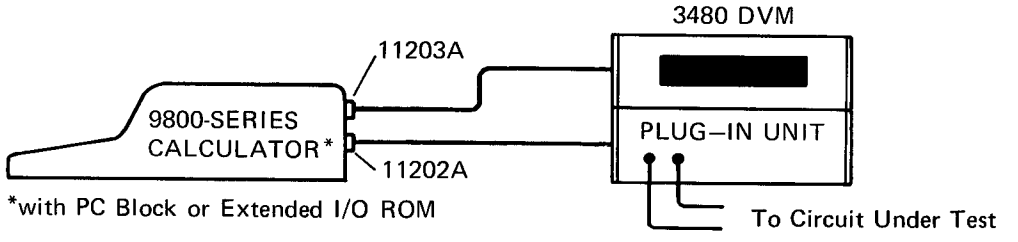


Figure 2-1. Typical Calculator/DVM System Configuration

As shown above, the 11203A Interface is connected to the 3480 mainframe (BCD output), and enables the calculator to initiate a data sample and input the reading. The 11202A I/O Interface, if used, is connected to the Remote Control jack on the DVM's plug-in unit, and enables the calculator to set plug-in unit controls.

FUNCTION CONTROL (When using an 11202A)

The following tables list the function control characters used to set range, filter and function controls on 3480 plug-in units.

Table 2-1. Control Characters for 3482/3484 Plug-in Units

DVM Function	ASCII Character (Binary Code) 100mv/100Ω Range	1V/1KΩ Range	1000V/10MΩ Range	
DC (filter out)	EOT (0000100)	@ (1000000)	NULL	(0000000)
DC (filter A)	WRU (0000101)	A (1000001)	SOM	(0000001)
DC (filter B)	RU (0000110)	B (1000010)	EOA	(0000010)*
AC (ac coupled)	DC_4 (0010100)	P (1010000)	DC_0	(0010000)
AC (dc coupled)	FF (0001100)	H (1001000)	FE_0	(0001000)*
OHMS	$ (0100100)	(1100000)*	(SPACE)	(0100000)

*These characters cannot be output with a Model 20 or 21 Calculator, when using a 11220A PC 1 Block.

GETTING STARTED

(Continued)

Table 2-2. Control Characters for 3485 Plug-in Unit

	ASCII Character (Binary Code)	
DVM Function	Separate Function	Step/Function
.1V (filter out)	NULL (0000000)	0 (0110000)
1.0V (filter out)	SOM (0000001)	1 (0110001)
10V (filter out)	EOA (0000010)*	2 (0110010)
.1V (filter in)†	EOT (0000100)	4 (0110100)
1.0V (filter in)†	WRU (0000101)	5 (0110101)
10V (filter in)†	RU (0000110)	6 (0110110)
HOME	CR (0001101)	

FUNCTION CODES

One of the following codes is input with each data reading to indicate the current DVM function setting.

Function	Code**
DC Volts	0
AC Volts (DC)	1
Ohms	2
AC Volts (AC)	3

MODEL 10 OPERATION

The 9810A Calculator requires the use of a Peripheral Control Block when controlling any device via the 11203A and/or 11202A Interfaces. For more information on the following operations, see your PC Block Operating Manual.

DATA INPUT

This command causes the DVM to take a data sample and output the reading to the calculator. Result:

temporary z	(number from Y)
accumulator y	(function code)
keyboard x	(data reading)

Notice that the calculator does an ↑ operation before entering the data reading.

*This character cannot be output with the Model 20 or 21 Calculator, unless a PC 2 Block is used.

†There must be at least a 300msec delay between instructions after programming a 'filter in' function; this is due to the DVM response time.

**The code is always '0' when a 3482A or 3485A Plug-in unit is used.

If continuous data samples are required, and the function code information is not needed, program A below could be used to initiate, print, and store 10 data readings.

The CEO Output Command (PC 2 Only)

This command outputs a CEO signal (data sample command) to the peripheral device. Usually, the CEO signal is sent as part of the Data Input command.

As an example, suppose program A is to be used when the DVM sample period is long (say about .3 seconds). By sending a data sample command and doing some time-consuming operations before the data is input, program execution time is shortened (see program B below).

Program A

```
0000--CLR---20
0001--  1 ---01
0002--XTO---23
0003--  + ---33
0004--  a ---13
0005--  a ---13
0006--PNT---45
0007--FMT---42
0008--  3 ---03
0009--  3 ---03
0010--  . ---21
0011--PNT---45
0012--PNT---45
0013--XTO---23
0014--IND---31
0015--  a ---13
0016--  1 ---01
0017--  0 ---00
0018--  UP--27
0019--  a ---13
0020--X<Y---52
0021--  1 ---01
0022--END---46
```

Input data

Program B

```
0000--CLR---20
0001--FMT---42
0002--  6 ---06
0003--  3 ---03
0004--SFL---54
0005--  1 ---01
0006--XTO---23
0007--  + ---33
0008--  a ---13
0009--  a ---13
0010--PNT---45
0011--FMT---42
0012--  3 ---03
0013--  3 ---03
0014--  . ---21
0015--PNT---45
0016--PNT---45
0017--XTO---23
0018--IND---31
0019--  a ---13
0020--  1 ---01
0021--  0 ---00
0022--  UP--27
0023--  a ---13
0024--X<Y---52
0025--  1 ---01
0026--END---46
```

Output data-sample command

Takes about .3 sec.

Input data

MODEL 10 OPERATION

(Continued)

PLUG-IN CONTROL

FMT 4 SELECT CODE FMT CONTROL CHARACTER FMT

This command sets the DVM plug-in unit to the range, filter, and function controls indicated by the output control character. For example, the following program segment sets the 3484A Plug-in unit to the 100 mv range (filter out), inputs a data reading, and prints the data.

```
0100--FMT---42
0101--  4 ---04
0102--  1 ---01
0103--FMT---42
0104--RUP---22
0105--FMT---42
0106--FMT---42
0107--  3 ---03
0108--  3 ---03
0109--  . ---21
0110--PNT---45
```

set 100 mv range

EOT

Input data

The WRITE BYTE Command (PC 2 Only)

FMT 6 SELECT CODE x→( )

This command converts the decimal number in X to its equivalent 8-bit binary form and outputs the byte. The number in X can be any integer from 0 to 255 (see the table of decimal-binary equivalent forms in your PC Block Operating Manual).

The following program segment outputs the byte '00100100' (ASCII '$') to set the 3484A Plug-in unit to the Ohms range.

```
0100--  3 ---03
0101--  6 ---06
0102--FMT---42
0103--  6 ---06
0104--  1 ---01
0105--XTO---23
```

MODEL 20 or 21 OPERATION

Except where noted, the following operations can be performed using either a PC 1 or PC 2 Block. See your PC Block Operating Manual for information on formatting.

DATA INPUT

RED <select code>, <list>

Data is input by executing a READ statement. For example, execute this line to initiate and store a data reading*:

select code

```
FMT *; RED 3,A,B
```

The function code is stored in A and the data is stored in B.

Remember that a READ statement cannot be executed from the keyboard when using a PC 1 Block.

If continuous data samples are required, the method shown below could be used to obtain 100 data readings*:

```
0:
FMT *;1→B
1:
RED 3,A,RB;JMP (
B+1→B)=101
2:
END
```

PLUG-IN CONTROL

FMT " <control character> ", 2; WRT <select code>

The range, function, and filter controls are set by sending control characters to the DVM plug-in unit. For example, to set the Ohms range on the 3484 Plug-in unit, this line could be used to output a '$' character:

```
FMT "$",2;WRT 3
```

The WRITE BYTE Statement (PC 2 Only)

WTB <select code> , <decimal number>

The <decimal number> is the decimal equivalent of the ASCII character to be output and can be expressed as a positive integer, a variable (by using a register name), or an expression. The number must be an integer from 0 to 255. The decimal equivalents of ASCII output characters are listed in your PC Block Operating Manual.

For example, the following statement outputs the character 'A' to set the 1v range:

```
WTB 1,65
```

*The FORMAT statement is not needed to specify free-field format if the PC 1 Block is used.

MODEL 30 OPERATION

The statements available with the Extended I/O ROM are used to control and receive data from the DVM.

DATA INPUT

ENTER (select code, format) variable list

For example, the following lines input and store 10 data readings (the function code is always stored in A). The '*' character specifies free-field input format.

```
10 FOR I=1 TO 10
20 ENTER (5,*)A,B[I]
30 NEXT I
```

See Chapter 3 of the Extended I/O ROM Operating Manual for other uses of the ENTER statement.

PLUG-IN CONTROL

WBYTE decimal number

The ASCII equivalent of the decimal number specified is output. For example, execute this line to output binary '01000001' (ASCII 'A') to set the 1v range:

```
30 WRITE (1,*)WBYTE65
```

Chapter 3
SERVICE

This chapter contains a description of interface operation and instructions to help you troubleshoot and repair the interface circuits. A complete circuit diagram and list of replaceable parts are at the back of this chapter.

If you have difficulty repairing the interface or if you would rather have -hp- repair it, contact the nearest Sales and Service Office for assistance; office locations are listed at the back of this manual.

When ordering a replacement interface circuit board, specify -hp- Part No. 11203-66591.

CALCULATOR I/O LINES

Here is a definition of each calculator interface line used with the 11203A Interface:

NOTE

A bar above each line name indicates that the line goes low (0v) when pulsed '1'. All other lines go high (+5v) when pulsed '1'.

COϕ, CO1, CO2, CO3 — **Peripheral Address Lines** — used to address the correct device.

$\overline{CEO}$ — **Control Enable Line** — provides the correct timing for interface operations.

$\overline{DI\phi}$, $\overline{DI1}$, $\overline{DI2}$, $\overline{DI3}$, $\overline{DI4}$, $\overline{DI5}$ — **Calculator Data Input Lines** — data is transferred in bit-parallel, character-serial, ASCII code.

SIϕ — **Service Interrupt Line** — a logic '1' (high) indicates that the terminal is busy.

$\overline{SIH}$ — **Calculator Service Inhibit Line** — a continuous clock that indicates when the calculator is busy and cannot input data.

$\overline{STP}$ — **Calculator Stop Line** — indicates whenever the STOP key is pressed. An STP signal terminates any I/O operation.

THEORY OF OPERATION

GENERAL THEORY

The BCD Interface converts positive-true* BCD coded data to negative-true ASCII coded data which is usable by 9800-Series calculators. A simplified block diagram of the interface is shown on the next page.

*The interface can be set to respond to negative-true BCD data; see NOTE 4 on the circuit diagram foldout.

THEORY OF OPERATION

(Continued)

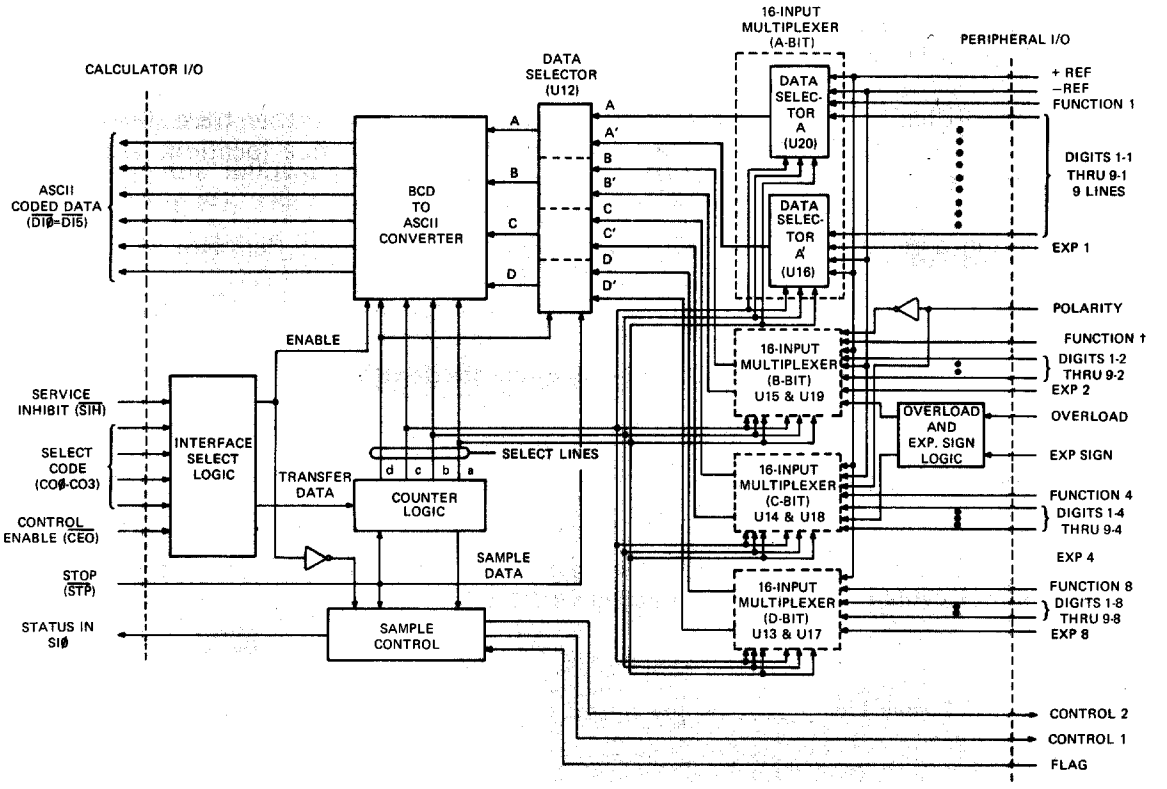


Figure 3-1. BCD Interface Block Diagram

Each data input operation consists of a series of 16 identical calculator I/O signals. The instruction which tells the peripheral to take a data sample is initiated by the first I/O signal. Then, after the peripheral has placed data on the BCD lines, the interface converts the first character (the function code) to ASCII and transmits it to the calculator. After accepting the first character, the calculator outputs the remaining 15 signals. Each of those signals causes the interface to send another ASCII-coded character to the calculator. The data input sequence is shown in the table on page 1-5.

You may wish to refer to the circuit diagram foldout while reading the following detailed theory sections.

INTERFACE SELECT LOGIC

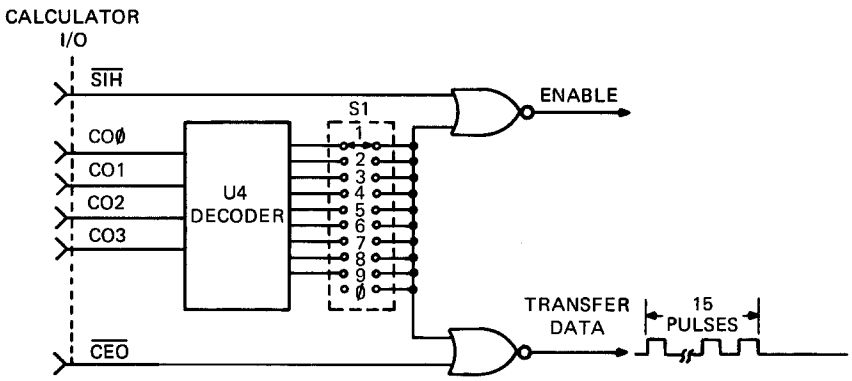


Figure 3-2. Interface Select Logic

The interface select logic generates two 'clock' signals: Enable and Transfer Data. Those signals are present only when the decoded select code signal (CO∅-CO3) corresponds to the setting of S1 and when the appropriate calculator I/O signal ($\overline{SIH}$ or $\overline{CEO}$) is present. The Transfer Data signal clocks the counter (U6). The Enable signal is used to control the data selectors and the SI∅ signal.

U4 is a 4-line to 10-line decoder which converts the 4-line BCD select code signal to a low output on one of 10 output lines.

COUNTER (see Figure 3-3)

U6 is a 4-bit binary counter which provides control of data selectors U12-U20, the BCD to ASCII converter, and the Sample Control logic. The first Transfer Data pulse sets the counter to state 1 (binary 0001). This state causes a Data Request pulse to be sent to the Sample Control logic. Then after BCD data is ready, each successive Transfer Data pulse clocks the counter through its remaining 15 states, to binary 0000.

Counter outputs a, b, and c are buffered and used to control data-input selectors U13-U20 (see Figure 3-1). Data selectors U8 and U12 also use the counter outputs.

The LCP line is low whenever the counter returns to state 0. The STP signal, which is present whenever the calculator STOP key is pressed, resets the counter to state 0.

THEORY OF OPERATION

(Continued)

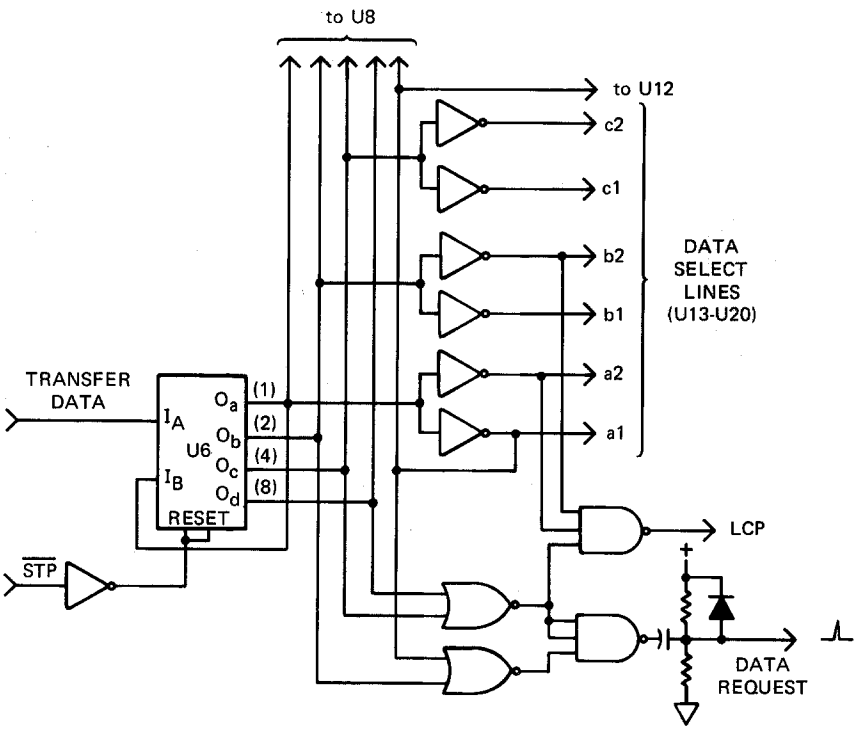


Figure 3-3. Counter Logic

SAMPLE CONTROL

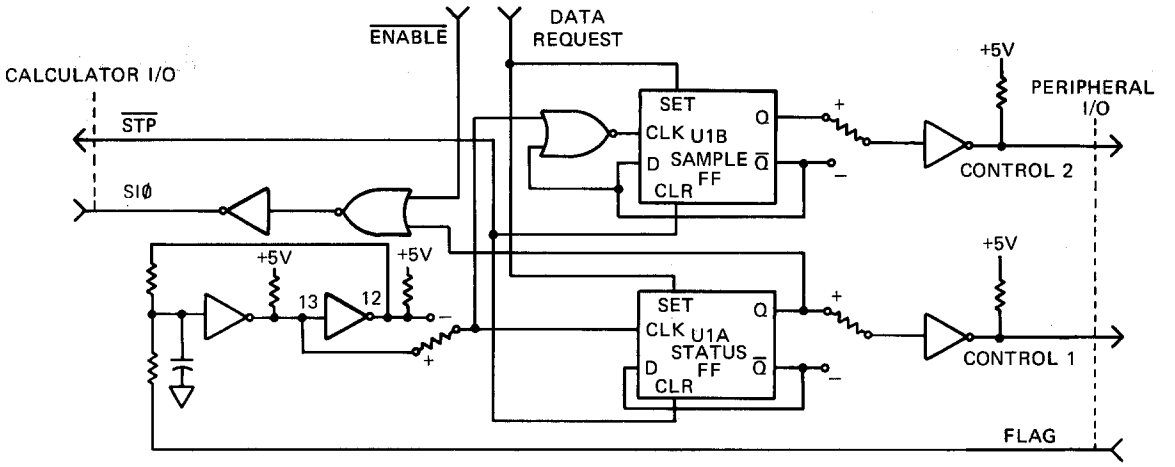


Figure 3-4. Sample Control Logic

The Data Request signal causes the Control 1 and Control 2 lines to go low, which instructs the peripheral to take a data sample. The Flag signal, which the peripheral transmits after it has placed BCD data on the interface input lines, resets the Sample and Status flip-flops and causes an SIØ signal to be output (a low SIØ line indicates that the interface is not busy). The sample control logic timing sequence is shown in Figure 3-5.

Either the Control 1 or the Control 2 line may be used to signal the peripheral device. As shown in the Figure 3-5, the Control 1 line remains low until a falling edge is seen on the Flag line; whereas, the Control 2 line remains low only until the Flag line goes high. Thus, the Control 1 line can be used when the peripheral device must maintain a low level during the entire data sampling period. Also, the Control 1 line *must* be used when the Flag line is held high during the entire data sample period.

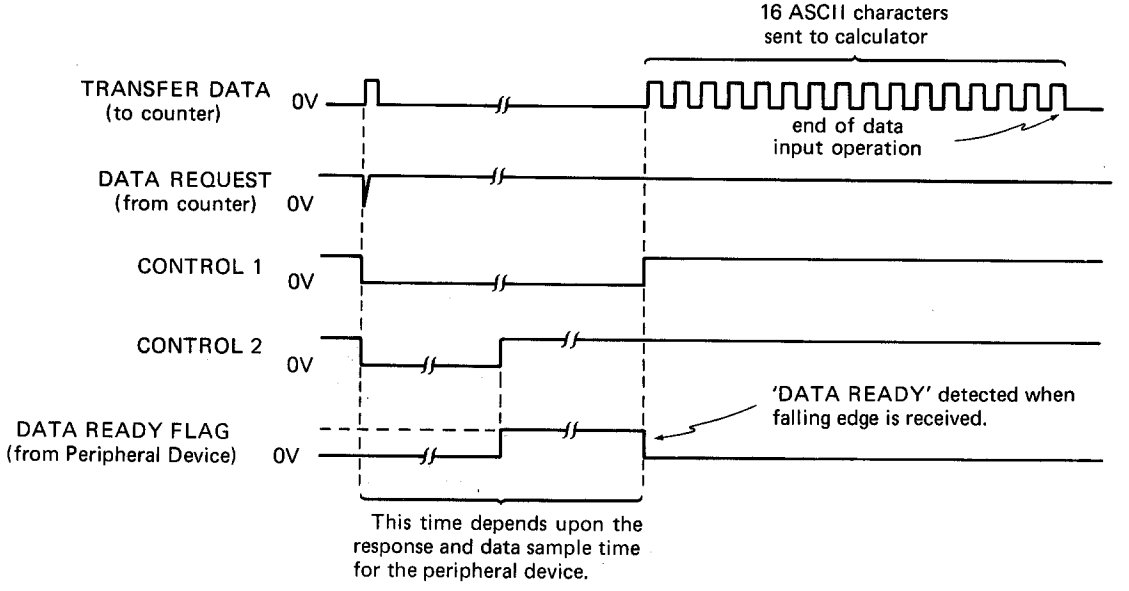


Figure 3-5. Input Timing Diagram

DATA SELECTORS (see Figure 3-1)

Each data selector (U13-U20) is an eight-line multiplexer. The binary state of select lines a, b, and c determine which input line level is output. Each pair of data selectors is wired as a 16-line, two-output multiplexer, and is used to select the desired bit for each digit of BCD data.

U12 is a quad, two-input multiplexer which selects data from either the ABCD or A'B'C'D' inputs. Counter output d determines which 4-bit byte is selected. The selected byte is output whenever an Enable pulse is present.

THEORY OF OPERATION

(Continued)

BCD TO ASCII CONVERTER

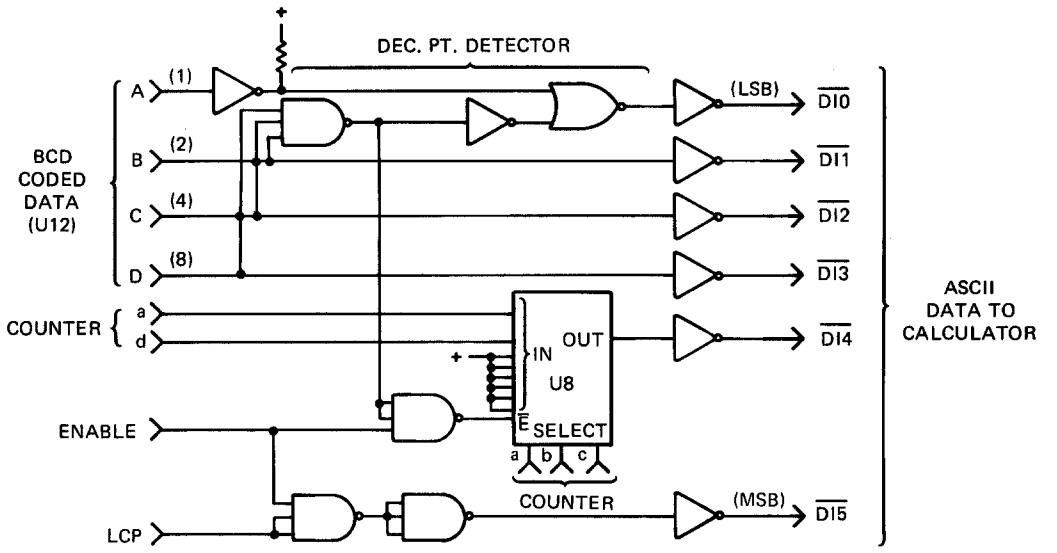


Figure 3-6. BCD to ASCII Converter

Each byte selected by U12 is inverted and output on calculator-input lines $\overline{DI0}$-$\overline{DI3}$. Eight-line multiplexer U8 controls the $\overline{DI4}$ line. The LCP signal causes a most-significant bit to be output on the last clock pulse, which outputs a terminating delimiter.

The decimal point detector circuit monitors input data and outputs an ASCII decimal point if a BCD-coded '14' or '15' is input.

NOTE

If consecutive BCD-coded 14's and/or 15's are input when using a Model 20 or 21 Calculator, the calculator will halt immediately.

OVERLOAD DETECTOR (see Figure 3-1)

The overload and exponent sign logic (U9A, U9C, and U10B) outputs a large positive exponent whenever the Overload line is high. If the Exponent Sign line is also high (indicating a negative exponent) the overload signal still causes a large positive exponent to be output.

NOTE

For proper operation the correct reference line must be grounded (i.e., the '—' line must be grounded for positive-true logic and the '+' line must be grounded for negative-true logic). The other line must be left open.

TROUBLESHOOTING and REPAIR

The following procedures assume that the calculator, ROM block(s) and peripheral device are operating correctly. If necessary, disconnect the interface from the calculator and perform all other applicable system test procedures *before* assuming that the interface is defective.

BROKEN TRACE REPAIR

If one or more internal traces are open or have high resistance, the trace should be bridged, using insulated wire, on the back of the board whenever possible.

CAUTION

TO HELP PREVENT DAMAGE TO THE MULTILAYER CIRCUIT BOARD, USE A LOW-TEMPERATURE SOLDERING IRON WHEN REPLACING PARTS.

EQUIPMENT REQUIRED

1) The Calculator:
   - 9810A with an 11264A (or equivalent) PC Block
   - 9820A with an 11220A or 11224A PC Block
   - 9821A with an 11220A or 11224A PC Block
   - 9830A with an 11272 Extended I/O ROM
2) An -hp- 180A Oscilloscope (or equivalent) or
3) An -hp- 10525A Logic Probe (or equivalent)
4) A test connector (see page 3-11)
5) An -hp- 5061-0726 Board Extender (optional)

EQUIPMENT SETUP

1) Switch the calculator OFF, disconnect the BCD Interface and remove the four screws which secure the cover of the interface card. Then remove the circuit board and cable.
2) If the board extender is *not* available:
   a) Remove the four screws which secure the calculator top cover, and remove the top cover.
   b) Plug the circuit board into the top I/O connector, as shown in Figure 3-7. Be sure that the board is plugged in with the circuit side *up* and that the interface is *not* connected to a peripheral device!

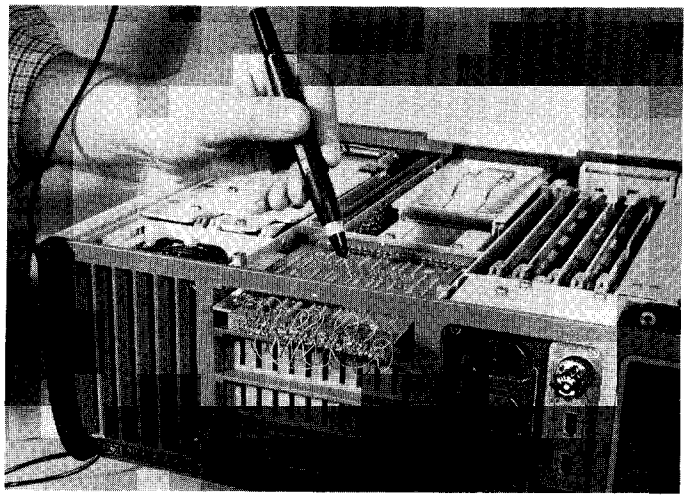


Figure 3-7. Troubleshooting the Interface

TROUBLESHOOTING and REPAIR

(Continued)

3) If the board extender is available:

   a) Plug the board extender into the calculator top I/O connector.

   b) Plug the circuit board into the board extender, as shown in Figure 3-8. Be sure that the interface is *not* connected to a peripheral device!

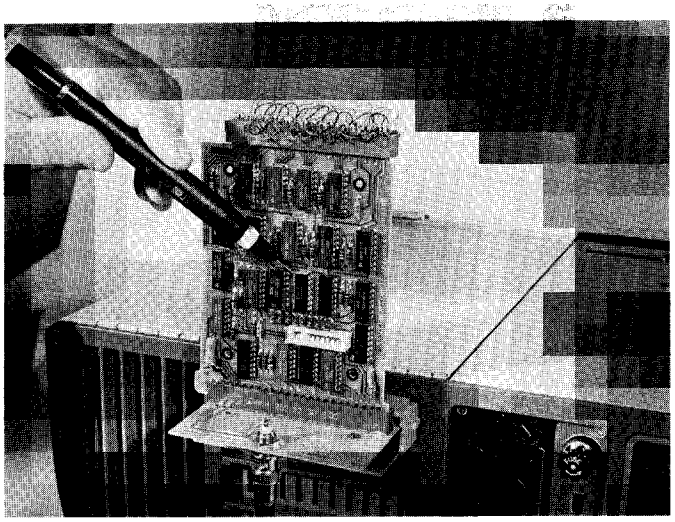


Figure 3-8. Troubleshooting with the Board Extender

PRELIMINARY CHECK

1) Install the test connector onto the interface board, as shown in Figure 3-8. This connector provides hard-wired data and function inputs, to eliminate the need for a cable and peripheral device. If the connector is not available, one can be made by using the diagram on page 3-11.

2) Switch the calculator ON. Then load and run the appropriate program shown on the next page.

NOTE

If the interface is wired for negative-true data logic (see NOTE 4 on the circuit diagram), the alternate printout or display should appear. Also, see the NOTE on page 3-11.

Model 10 Program:

```
0000--FMT---42
0001--  4  ---04
0002--  .  ---21
0003--  0  ---00
0004--  .  ---21
0005--  7  ---07
0006--FMT---42
0007--  3  ---03
0008--  3  ---03
0009--  .  ---21
0010--XEY---30
0011--PNT---45
0012--XEY---30
0013--PNT---45
0014--PNT---45
0015--GTO---44
0016--  6  ---06
0017--END---46
```

Correct Printout:

```
     9.0000000
 609.6969690
```

Alternate Printout:

```
          6.0000000
-9.696969600 09
```

Model 20 or 21 Program:

```
0:
FMT *;RED 3,A,B⊢
1:
FXD 7;PRT A;FLT
8;PRT B⊢
2:
SPC 2;GTO 0⊢
3:
END ⊢
```

Correct Printout:

```
          9.0000000
 6.09696969E 02
```

Alternate Printout:

```
          6.0000000
-9.69696960E 09
```

Model 30 Program:

```
 10 ENTER (3,*)A,B
 20 DISP A,B
 30 WAIT 1000
 40 GOTO 10
 50 END
```

Correct Display:

```
9          609.696969
```

Alternate Display:

```
6         -9696969600
```

TROUBLESHOOTING and REPAIR

(Continued)

TROUBLESHOOTING HINTS

1) If the test program does not continually print or display the correct data, press STOP and check the select code switch setting (the programs specify select code 3). Also, rotate the selector-tab back and forth to ensure proper switch contact (the switch may be intermittent).
2) If the program runs but the data is not correct, start the program and:
   a) check the output of each data selector (U13-U20). Each output should change states at least once during each data input cycle.
   b) Check the output of U12. All outputs should change states.
   c) Check U8 and each gate of the BCD to ASCII converter. None of the calculator data-input lines ($\overline{DI0}$-$\overline{DI5}$) should be held low continually.
3) If the program does not run at all, check the control logic in this order:
   a) Interface select logic
   b) Counter logic (see Figure 3-9)
   c) Sample control logic (see Figures 3-4 and 3-5).

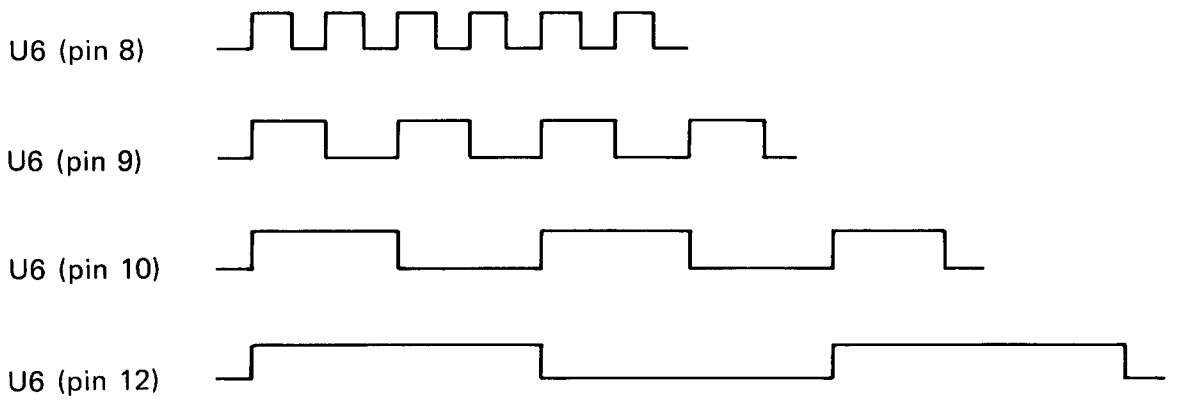


Figure 3-9. Counter Output Waveforms.

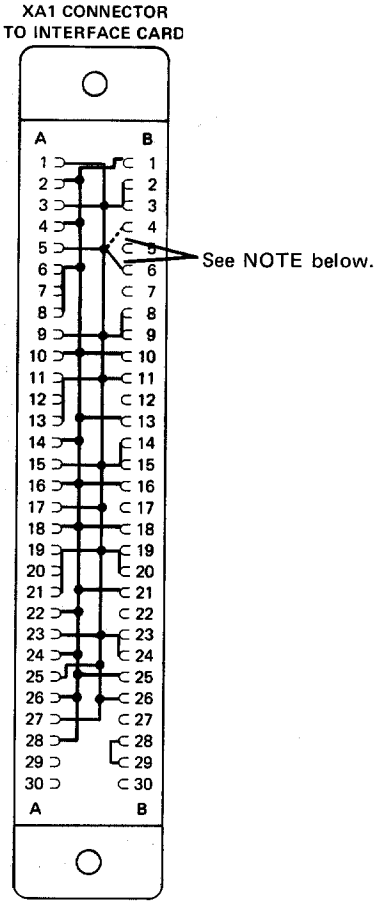


Figure 3-10. Test Connector Wiring Diagram

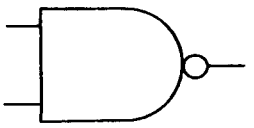
NOTE

When using this connector, resistors R1, 2, and 3 must be wired to the '+' pads on the interface circuit board.

When using the connector with an interface that is wired for negative-true data logic (see NOTE 4 on the circuit diagram), disconnect the wire from pin 2B and move the wire from 6B to 4B.

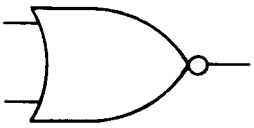
LOGIC SYMBOLS

LOW = 0V to +0.5V.
HIGH = 2.4V to 5.5V.



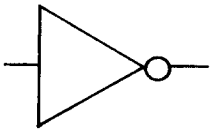
NAND GATE

All inputs must be HIGH to produce a LOW output.



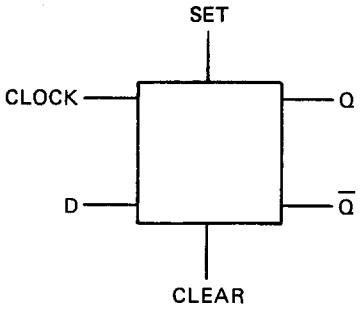
NOR GATE

If any input is HIGH, output will be LOW.



INVERTER

If input is HIGH, output is LOW, or LOW input produces HIGH output.

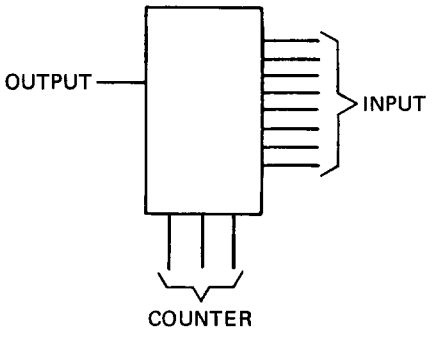


FLIP-FLOP
(positive-edge triggered)

Low input to Set sets Q HIGH.
Low input to Clear sets Q LOW.

TRUTH TABLE

Input (D)	Q	$\overline{Q}$
L	L	H
H	H	L

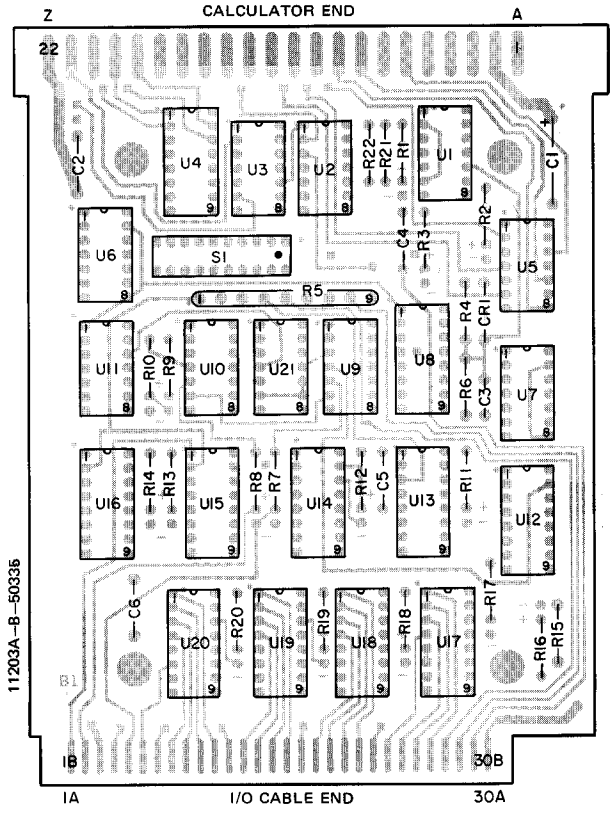


DATA SELECTOR

One of the input signals is passed to the output, depending upon the state of the counter.

REPLACEABLE PARTS LIST

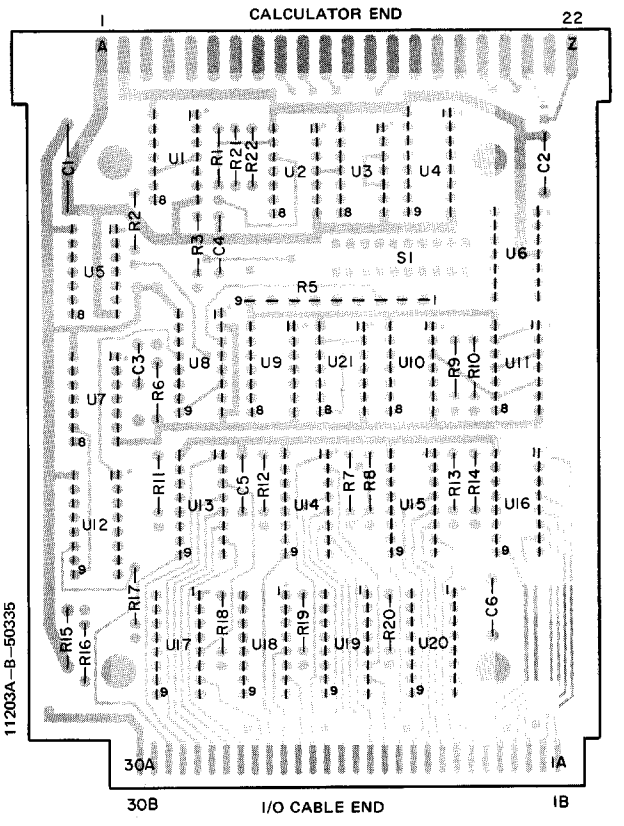
REF DESIG	-hp- PART NO.	TQ	DESCRIPTION
	11200-04101	1	Cover – I/O
	11203-61601	1	Cable Assembly
A1	11203-66591	1	P.C. Assembly, BCD Interface
C1	0180-0228	1	C – Fixed: 22uf,15V
C2	0160-3847	4	C – Fixed: .01uf,25V
C3	0160-0362	1	C – Fixed: 510pf,300V
C4–C6	0160-3847		C – Fixed: .01uf,25V
CR1	1901-0040	1	Diode – Si: .05A,30V
R1–R3	0684-0271	16	R – Fixed: 2.7Ω,10%,1/4 w
R4	0698-4427	1	R – Fixed:1650Ω,1%,1/8 w
R5	1810-0041	1	Ntwk – Encap res; 2.7KΩ per element
R6	0698-3152	1	R – Fixed: 3480Ω,1%,1/8 w
R7–R14	0684-0271		R – Fixed: 2.7Ω,10%,1/4 w
R15	0684-3321	1	R – Fixed: 3300Ω,10%,1/4 w
R16–R20	0684-0271		R – Fixed: 2.7Ω,10%,1/4 w
R21	0684-1211	1	R – Fixed: 120Ω,10%,1/4 w
R22	0684-3921	1	R – Fixed: 3900Ω,10%,1/4 w
S1	3101-1677	1	Switch,10 position
U1	1820-0596	1	IC – DM74L74N
U2	1820-0175	2	IC – SN7405N
U3	1820-0584	2	IC – DM74L02N
U4	1820-0627	1	IC – U7893L0159X
U5	1820-0175		IC – SN7405N
U6	1820-0443	1	IC – SN74L93N
U7,U21	1820-0587	2	IC – DM74L10N
U8	1820-0658	9	IC – U7893L1259X
U9	1820-0586	2	IC – DM74L04N
U10	1820-0584		IC – DM74L02N
U11	1820-0586		IC – DM74L04N
U12	1820-0710	1	IC – U7893L2259X
U13–U20	1820-0658		IC – U7893L1259X
	5040-5911	1	Bottom Cover
	7120-2940	1	Label, Select Code (one set)
	7120-3093	1	Plate, ID
XA1	1251-3334	1	Connector,P.C. (60 contact)



COMPONENT SIDE

A1

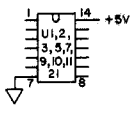
-hp- Part No. 11203–66591 Rev B

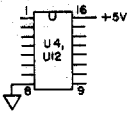


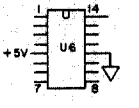
CIRCUIT SIDE

A1

-hp- Part No. 11203–66591 Rev B







SCHEMATIC NOTES:

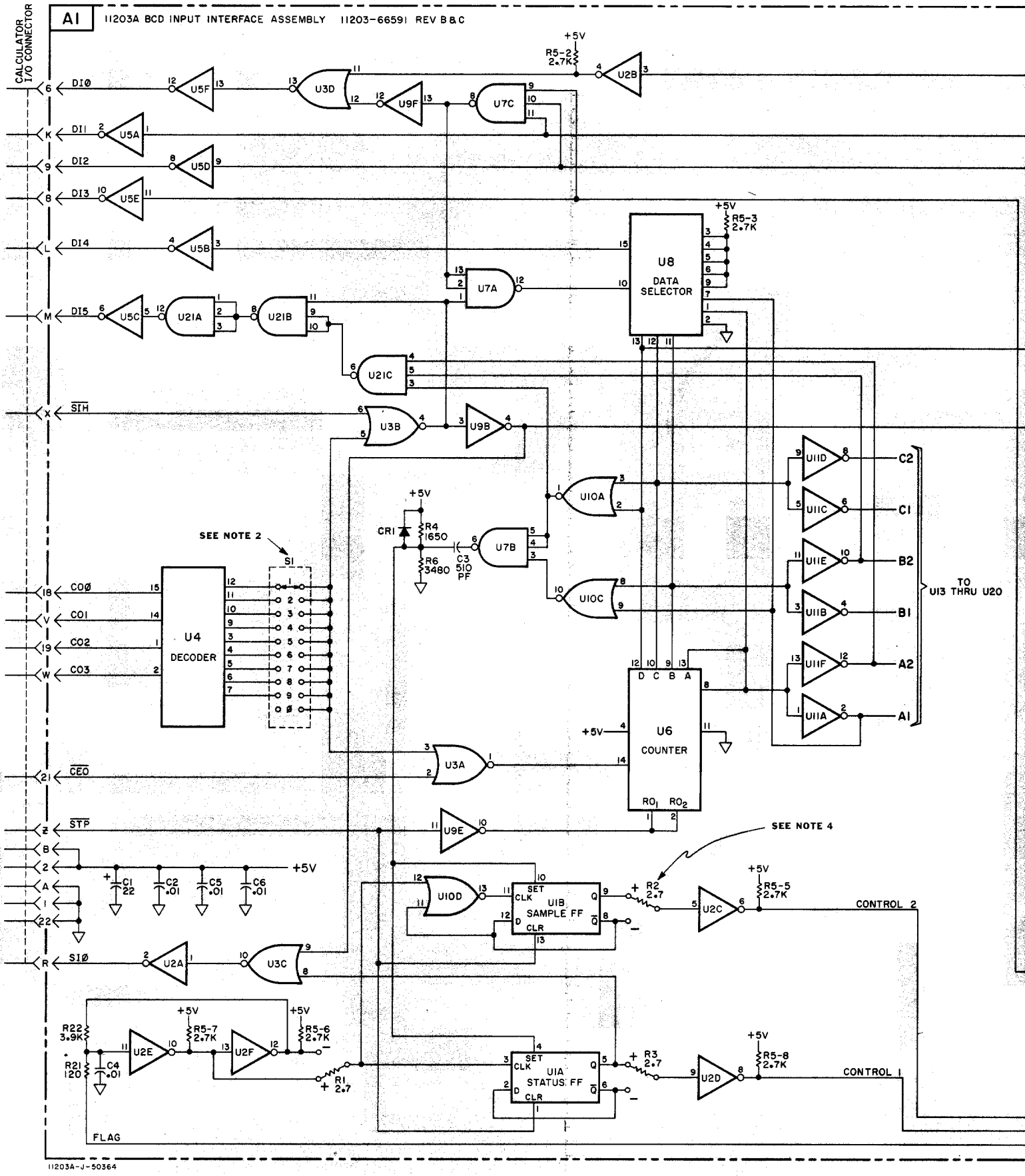
NOTE 1: Unless indicated otherwise, resistor values are shown in ohms and capacitor values are shown in microfarads.

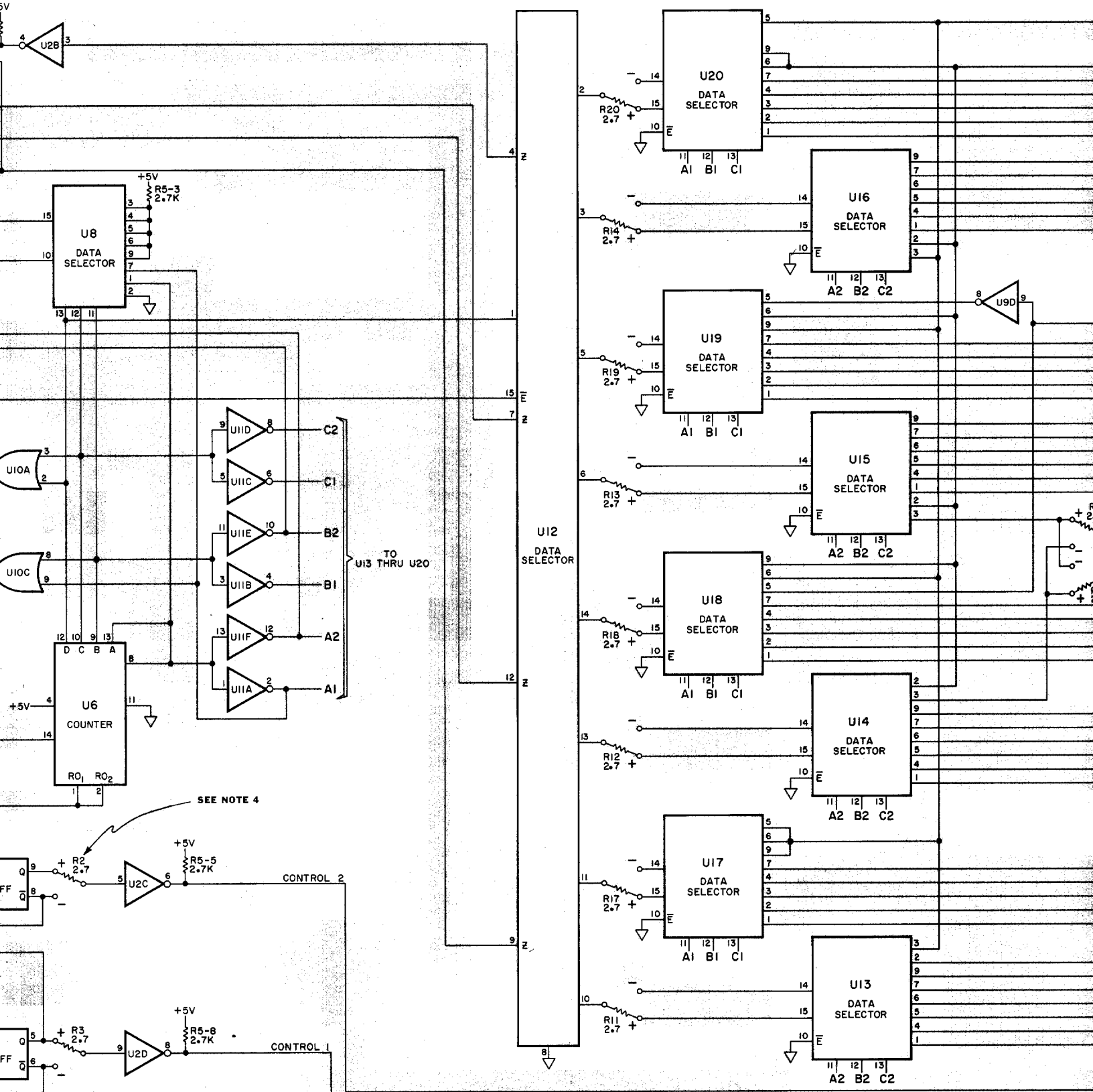
NOTE 2: S1 sets the interface select code (position '0' is not used). See page 1-3 before changing the setting of this switch.

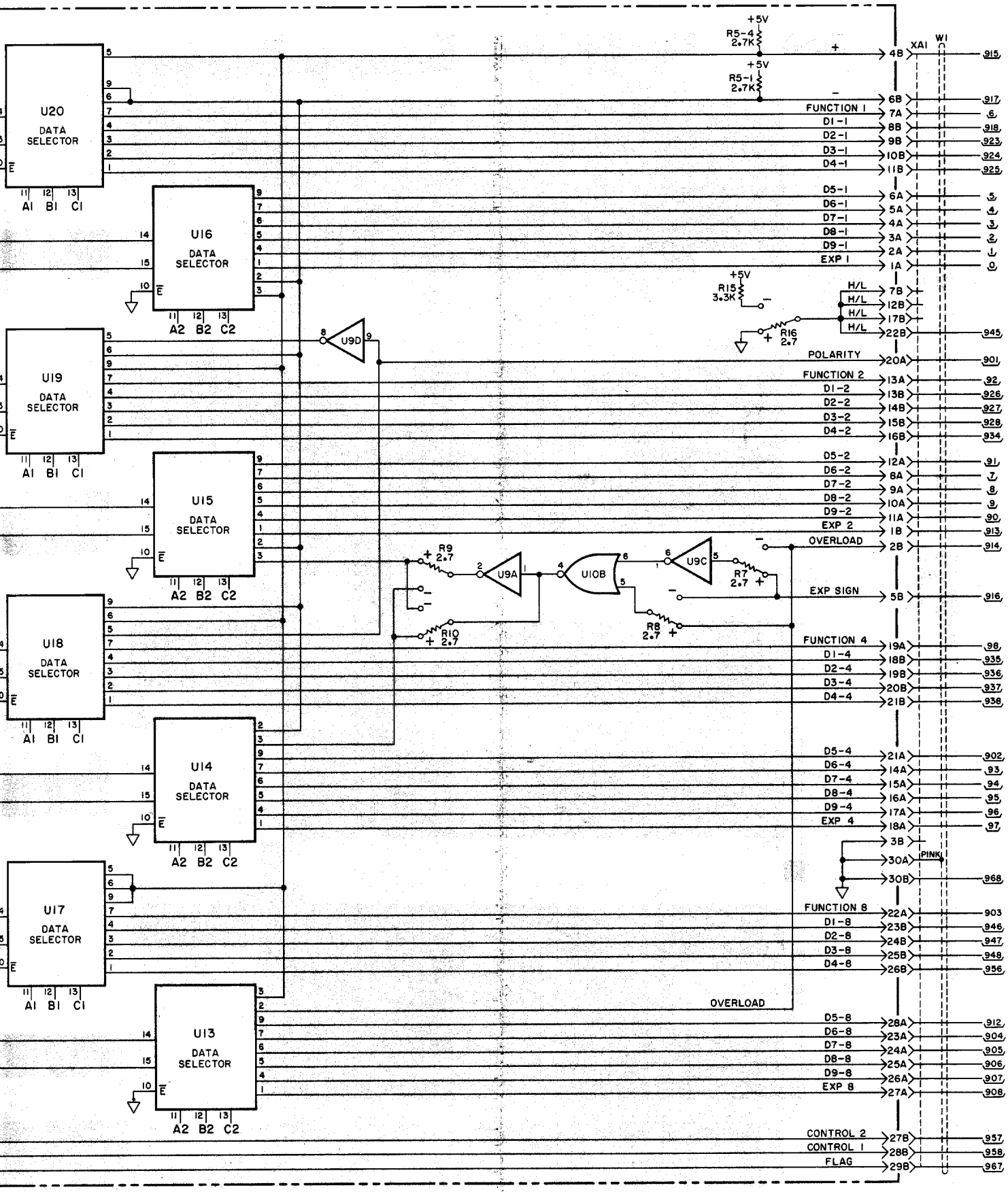
NOTE 3: Wire color code is the same as the resistor color code: First color indicates the base color, second color indicates the wider strip, and third color indicates the narrower strip (e.g., 924 = white, red, yellow).

NOTE 4: Connect R7-R14 and R16-R20 to the '—' pads for negative-true data logic. Connect R1 to the '—' pad for negative-true Flag logic. Connect R2 and R3 to the '—' pads for positive-true Control logic. See 'Installation Considerations' (page 1-4) for further information.

NOTE 5: Interface cards supplied before January 1973 contain the 'Revision A' PC board and are compatible with a 9810, 9820, or 9821 Calculator only. Cards supplied after January 1973 contain the 'Revision B or C' PC board, which permits the interface to be usable with either a 9810, 9820, 9821 or 9830 Calculator. Interfacing requirements for all boards are identical.


A1
11203A BCD INPUT INTERFACE ASSEMBLY 11203-66591 REV B&C
CALCULATOR I/O CONNECTOR
DI0
DI1
DI2
DI3
DI4
DI5
SIH
CO0
CO1
CO2
CO3
CEO
STP
SI0
FLAG
+5V
R5-2 2.7K
R5-3 2.7K
R5-5 2.7K
R5-6 2.7K
R5-7 2.7K
R5-8 2.7K
U2A
U2B
U2C
U2D
U2E
U2F
U3A
U3B
U3C
U3D
U4 DECODER
U5A
U5B
U5C
U5D
U5E
U5F
U6 COUNTER
U7A
U7B
U7C
U8 DATA SELECTOR
U9B
U9E
U9F
U10A
U10B
U10C
U10D
U11A
U11B
U11C
U11D
U11E
U11F
U21A
U21B
U21C
SEE NOTE 2
SEE NOTE 4
S1
CR1
R1 2.7
R2 2.7
R3 2.7
R4 1650
R6 3480
R21 120
R22 3.9K
C1 22
C2 .01
C3 510 PF
C4 .01
C5 .01
C6 .01
SET
CLK
CLR
D
Q
UIA STATUS FF
UIB SAMPLE FF
CONTROL 1
CONTROL 2
C2
C1
B2
B1
A2
A1
TO U13 THRU U20
11203A-J-50364


U2B
+5V
R5-3
2.7K
U8
DATA
SELECTOR
U10A
U10C
U11D
U11C
U11E
U11B
U11F
U11A
C2
C1
B2
B1
A2
A1
TO
U13 THRU U20
U6
COUNTER
D C B A
RO1 RO2
+5V
SEE NOTE 4
R2
2.7
U2C
R5-5
2.7K
CONTROL 2
R3
2.7
U2D
R5-8
2.7K
CONTROL 1
U12
DATA
SELECTOR
U20
R20
2.7
U16
R14
2.7
U19
R19
2.7
U15
R13
2.7
U18
R18
2.7
U14
R12
2.7
U17
R17
2.7
U13
R11
2.7
A1 B1 C1
A2 B2 C2
U9D



CIRCUIT DIAGRAM (Rev. B and C Boards Only)

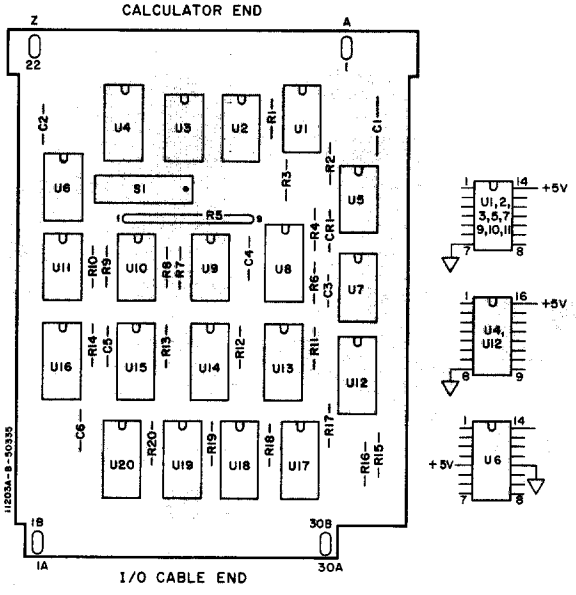
MANUAL CHANGES

The following component locator and circuit diagram apply to 11203A Interface circuit boards with 'REV A' designation. Those boards were delivered before January 1973.

A Rev. B or C circuit board can be used to replace a defective Revision A board. The reverse situation is not possible in all cases, however, since the Revision A board is not compatible with the 9830A Calculator. Otherwise, interfacing specifications and requirements are identical for Revision A, B, and C boards.

REPLACEABLE PARTS LIST

REF DESIG	-hp- PART NO.	TQ	DESCRIPTION
	11200-04101	1	Cover – I/O
	11203-61601	1	Cable Assembly
A1	11203-66591	1	P.C. Assembly, BCD Interface
C1	0180-0228	1	C – Fixed: 22uf,15V
C2	0160-3847	4	C – Fixed: .01uf,25V
C3	0160-0362	1	C – Fixed: 510pf,300V
C4–C6	0160-3847		C – Fixed: .01uf,25V
CR1	1901-0040	1	Diode – Si: .05A,30V
R1–R3	0684-0271	16	R – Fixed: 2.7Ω,10%,1/4 w
R4	0698-4427	1	R – Fixed:1650Ω,1%,1/8 w
R5	1810-0041	1	Ntwk – Encap res; 2.7KΩ per element
R6	0698-3152	1	R – Fixed: 3480Ω,1%,1/8 w
R7–R14	0684-0271		R – Fixed: 2.7Ω,10%,1/4 w
R15	0684-3321	1	R – Fixed: 3300Ω,10%,1/4 w
R16–R20	0684-0271		R – Fixed: 2.7Ω,10%,1/4 w
R21	0684-1211	1	R – Fixed: 120Ω,10%,1/4 w
R22	0684-3921	1	R – Fixed: 3900Ω,10%,1/4 w
S1	3101-1677	1	Switch,10 position
U1	1820-0596	1	IC – DM74L74N
U2	1820-0175	2	IC – SN7405N
U3	1820-0584	2	IC – DM74L02N
U4	1820-0627	1	IC – U7893L0159X
U5	1820-0175		IC – SN7405N
U6	1820-0443	1	IC – SN74L93N
U7	1820-0587	1	IC – DM74L10N
U8	1820-0658	9	IC – U7893L1259X
U9	1820-0586	2	IC – DM74L04N
U10	1820-0584		IC – DM74L02N
U11	1820-0586		IC – DM74L04N
U12	1820-0710	1	IC – U7893L2259X
U13–U20	1820-0658		IC – U7893L1259X
	5040-5911	1	Bottom Cover
	7120-2940	1	Label, Select Code (one set)
	7120-3093	1	Plate, ID
XA1	1251-3334	1	Connector,P.C. (60 contact)



A1

hp Part No. 11203-66591

SCHEMATIC NOTES:

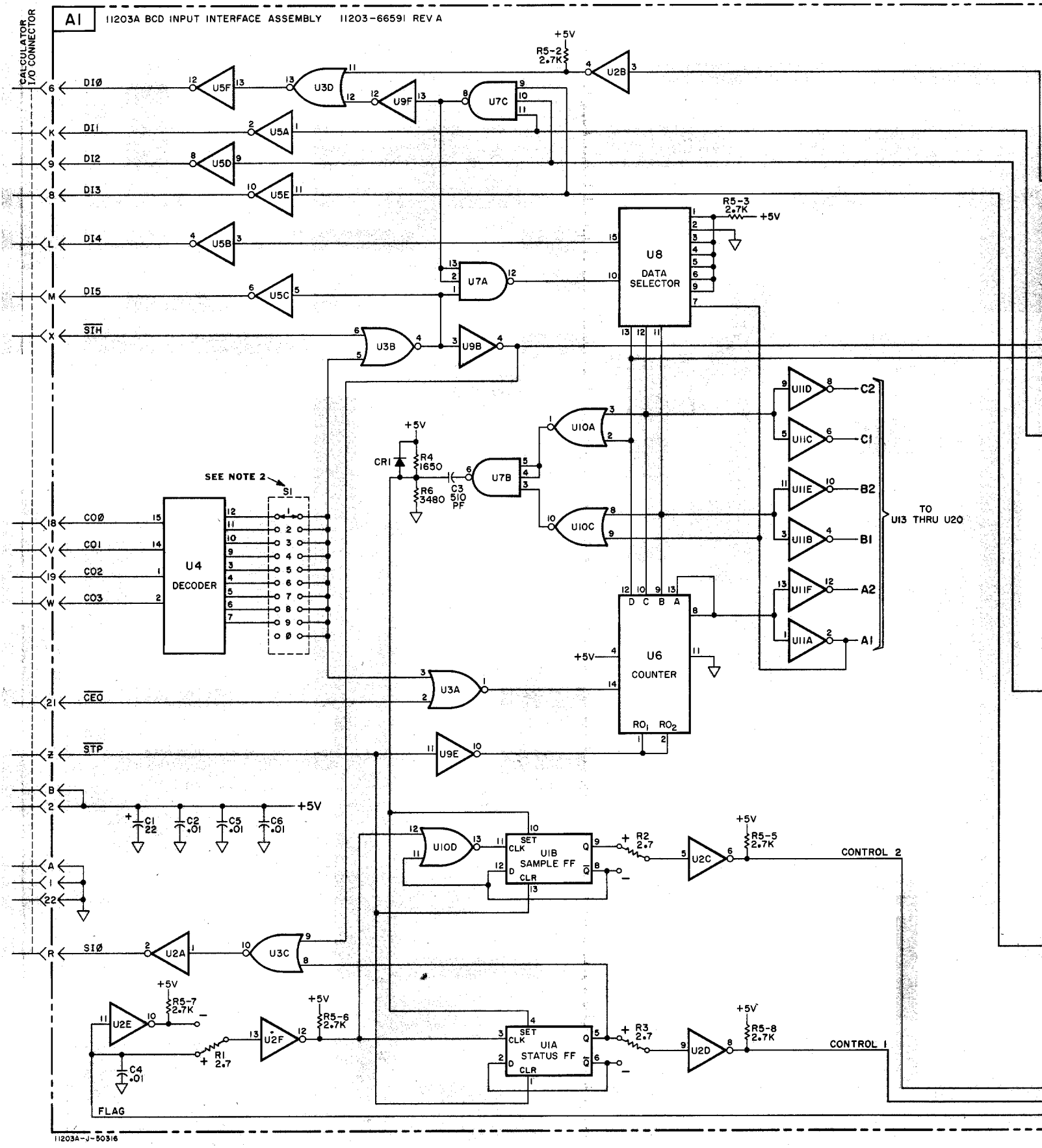
NOTE 1: Unless indicated otherwise, resistor values are shown in ohms and capacitor values are shown in microfarads.

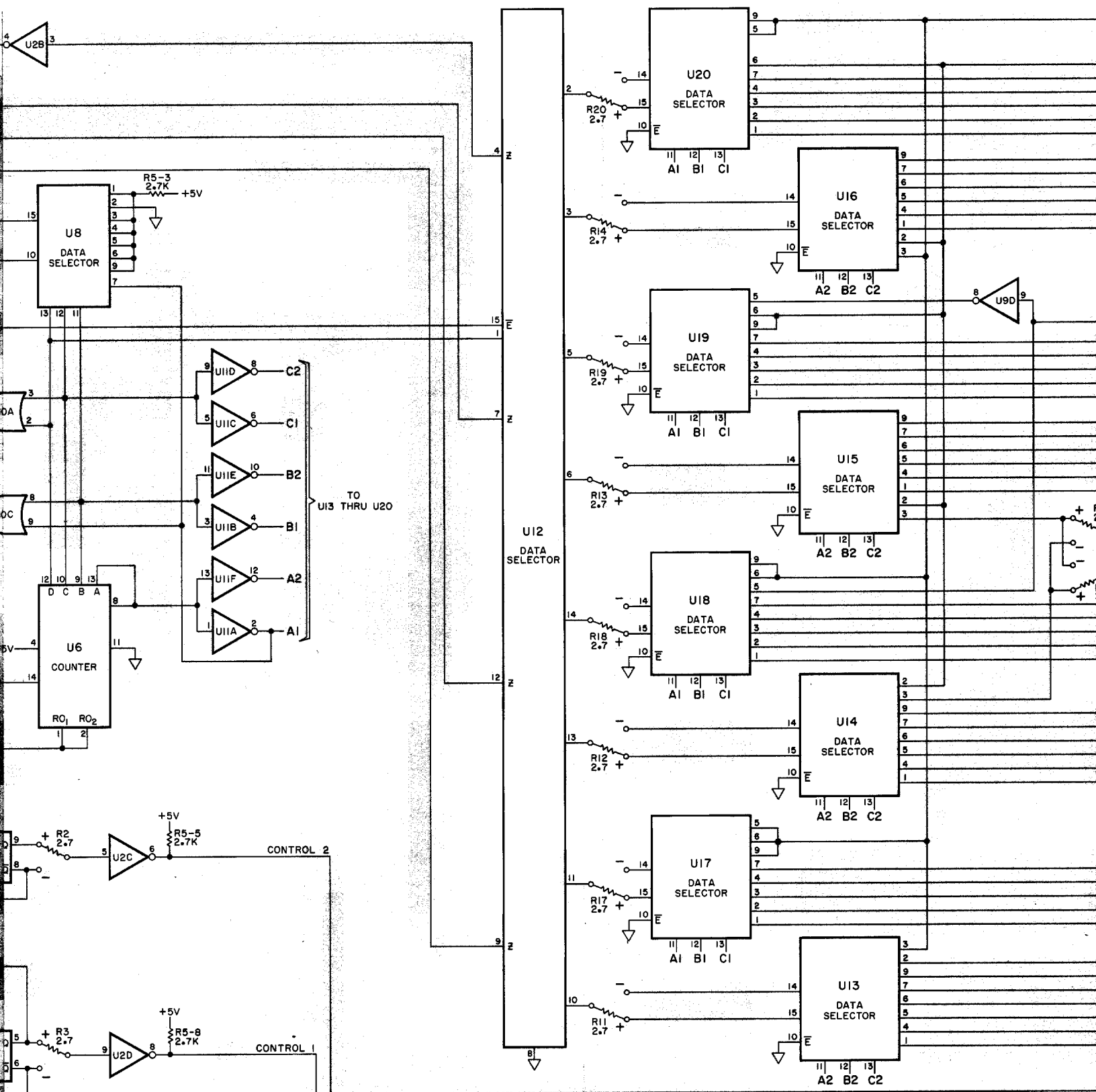
NOTE 2: S1 sets the interface select code (position '0' is not used). See page 1-3 before changing the setting of this switch.

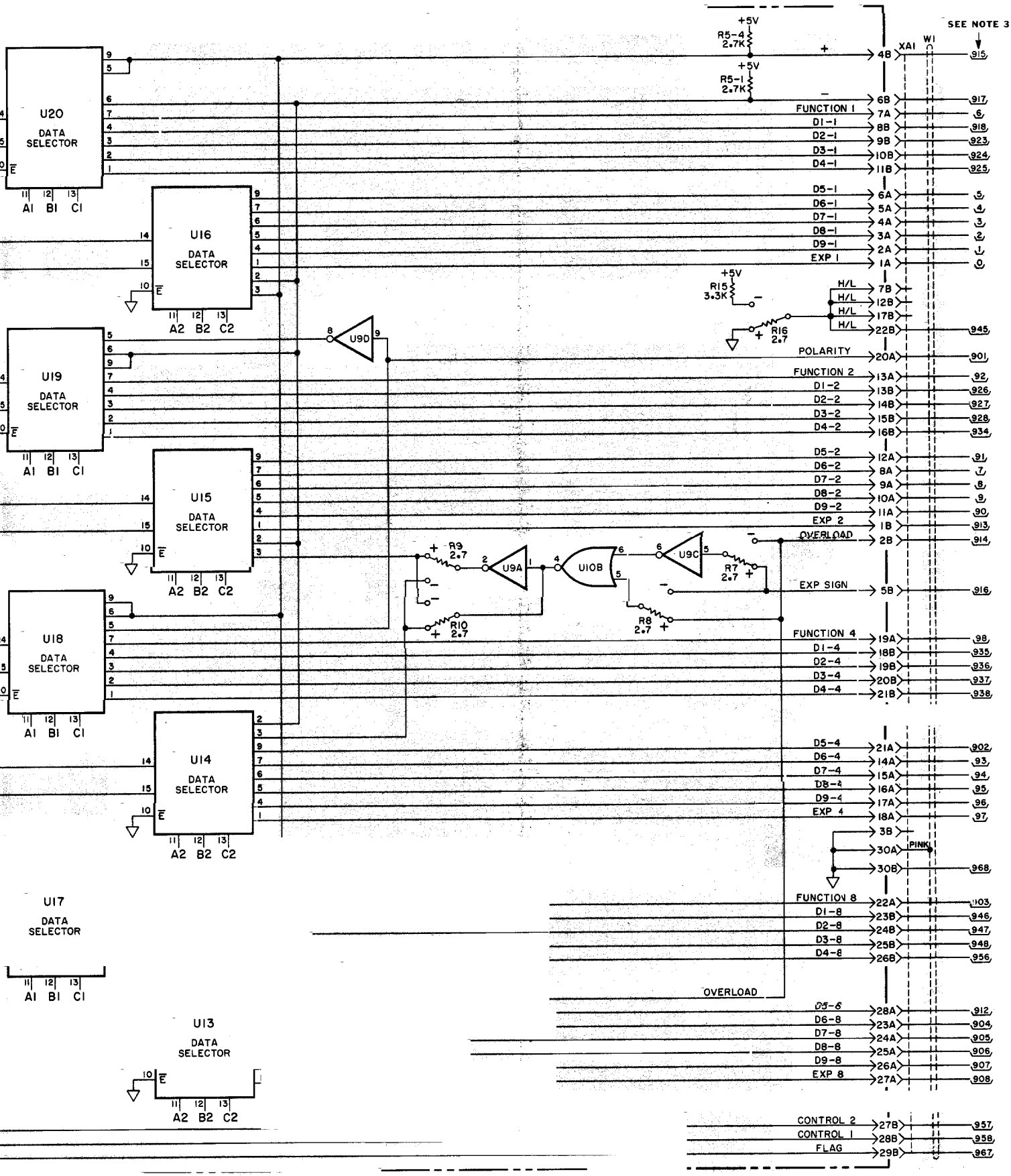
NOTE 3: Wire color code is the same as the resistor color code: First color indicates the base color, second color indicates the wider strip, and third color indicates the narrower strip (e.g., 924 = white, red, yellow).

NOTE 4: Connect R7-R14 and R16-R20 to the '—' pads for negative-true data logic. Connect R1 to the '—' pad for negative-true Flag logic. Connect R2 and R3 to the '—' pads for positive-true Control logic. See 'Installation Considerations' (page 1-4) for further information.

NOTE 5: Interface cards supplied before January 1973 contain the 'Revision A' PC board and are compatible with a 9810, 9820, or 9821 Calculator only. Cards supplied after January 1973 contain the 'Revision B or C' PC board, which permits the interface to be usable with either a 9810, 9820, 9821 or 9830 Calculator. Interfacing requirements for all boards are identical.


A1
11203A BCD INPUT INTERFACE ASSEMBLY 11203-66591 REV A
CALCULATOR I/O CONNECTOR
DIØ
DI1
DI2
DI3
DI4
DI5
SIH
COØ
CO1
CO2
CO3
CEO
STP
SIØ
+5V
R5-2 2.7K
R5-3 2.7K
U8 DATA SELECTOR
U7A
U7B
U7C
U9F
U9B
U9E
U3A
U3B
U3C
U3D
U4 DECODER
SEE NOTE 2
S1
CR1
R4 1650
R6 3480
C3 510 PF
U10A
U10B
U10C
U10D
U11A
U11B
U11C
U11D
U11E
U11F
C2
C1
B2
B1
A2
A1
TO U13 THRU U20
U6 COUNTER
D C B A
RO1 RO2
C1 22
C2 .01
C5 .01
C6 .01
U10D
U1B SAMPLE FF
SET CLK D CLR Q
R2 2.7
U2C
R5-5 2.7K
CONTROL 2
U2A
U2E
U2F
R5-7 2.7K
R5-6 2.7K
R1 2.7
C4 .01
FLAG
U1A STATUS FF
R3 2.7
U2D
R5-8 2.7K
CONTROL 1
11203A-J-50316


U2B
U8
DATA SELECTOR
R5-3 2.7K
+5V
U11D
U11C
U11E
U11B
U11F
U11A
C2
C1
B2
B1
A2
A1
TO U13 THRU U20
U6
COUNTER
D C B A
RO1 RO2
U12
DATA SELECTOR
U20
U16
U19
U15
U18
U14
U17
U13
U9D
R20 2.7
RI4 2.7
RI9 2.7
RI3 2.7
RI8 2.7
RI2 2.7
RI7 2.7
RI1 2.7
A1 B1 C1
A2 B2 C2
R2 2.7
U2C
R5-5 2.7K
CONTROL 2
R3 2.7
U2D
R5-8 2.7K
CONTROL 1



CIRCUIT DIAGRAM (Rev. A Boards Only)

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