I N T E R F A C E   N O T E S

FOR

DM/PL INTELLIGENT PLOTTERS

FROM

HOUSTON INSTRUMENT

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1.0   APPLE II, APPLE II+, AND APPLE IIE

These interface notes are intended to give an example of a suggested serial interface card setup, a cable, and a program that verifies one way communication between the APPLE II computer and any of Houston Instrument's DMPL Intelligent Plotters using either mode 1 (xon/xoff, hardware) or mode 2 (programmed) handshake. Four serial interface cards are discussed.

The development system for these technical notes consists of a Apple II (48K minimum), two single sided/single density disk drives, Apple DOS version 3.3 operating system, Apple Serial Interface Card, Apple Communications Interface Card, Apple Super Serial Interface Card, California Computer Systems (CCS) Model 7710A Asynchronous Serial Interface Card, and Applesoft Basic.

For Apple II or II+, the serial interface card must be inserted in one of the unused connector slots (except 0 and 6) in the rear of the computer. The Language Card or RAM Card is located in Slot #0. The disk drive card is located in Slot #6.

For Apple IIe the connector slots are numbered 1-7. Any unused connector slot may hold the serial interface card except Slot #3 or #6. If you have the 80-column text card or the expanded memory card in the auxiliary slot do not use Slot #3. The disk drive card is located in Slot #6.

1.1   APPLE SERIAL INTERFACE CARD

1.1.1   Mode 1 (Xon/Xoff, Hardware) Handshake

The Apple Serial Interface Card will not support mode 1 (xon/xoff, hardware) handshake.

1.1.2   Mode 2 (Programmed) Handshake

1.1.2.1 Cable Specifications

DMP-29 and DMP-4x plotters:

```
            APPLE II                Plotter
            DB - 25P                DB - 25S
          male connector        female connector

              pin 2 ------------------- pin 2
              pin 3 ------------------- pin 3
              pin 7 ------------------- pin 7
```

A cable with these specifications is available from Houston Instrument under part number DMP-1401.

DMP-3,4,6,7,8 and 9 plotters

```
            APPLE II                    Plotter
            DB - 25P                    DB - 25S
         male connector             female connector

              pin 2 ------------------- pin 2
              pin 3 ------------------- pin 3
              pin 7 ------------------- pin 7 jumpered to pin 9
                                        (Selects mode 2 handshaking)
                                        pin 6 jumpered to pin 16*
                                        (Selects baud rate -- 2400)
```

*Note: Baud Rate is selected by jumpering Pin 6 to Pin 14, 15, 16, 17,
       18 or 19 as desired.

1.1.2.2 Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The Apple Serial Interface Card will support mode 2 (programmed)
handshake with all DMPL intelligent plotters if the card has PROM P8.
Two PROMs are available with the Apple Serial Interface Card, PROM P8
(P/N 341-0018) and PROM P8A (P/N 341-0048). PROM P8A will only support
output through the serial port making it unusable with DMPL intelligent
plotters. PROM P8 will support both input and output through the serial
port.

The Apple Serial Interface Card has four operating parameters which
are set by dip switches on the card (baud rate, carriage return
delay, line width, and line feed). The card automatically defaults
to no parity, 1 start bit, 8 data bits, and 2 stop bits. The
following example sets a baud rate of 2400. For other baud rates
consult the Apple Serial Interface Card Manual. The baud rate
selected on the card must correspond to the baud rate setting of the
plotter (DMP -29, -4x) or with the cable if it has been hardwired
for a baud rate (DMP-3,4,6,7,8,9).

                    DIP SWITCH SETTINGS

DIP SWITCHES	SETTING	FUNCTION
1	on	baud rate = 2400
2	on	
3	off	
4	on	carriage return delay
5	off	line width = 132 characters
6	off	
7	off	<LF> after <CR>

1.2   APPLE COMMUNICATIONS INTERFACE CARD

1.2.1   Mode 1 (Xon/Xoff, Hardware) Handshake

The Apple Communications Interface Card will not support mode 1
(xon/xoff, hardware) handshake.

1.2.2   Mode 2 (Programmed) Handshake

1.2.2.1 Cable Specifications

DMP-29 and DMP-4x plotters:

```
              APPLE II               Plotter
              DB - 25P               DB - 25S
           male connector        female connector

              pin 2 ------------------ pin 3
              pin 3 ------------------ pin 2
              pin 7 ------------------ pin 7
```

A cable with these specifications is available from Houston
Instrument under part number DMP-1397.

DMP-3,4,6,7,8 and 9 plotters

```
              APPLE II               Plotter
              DB - 25P               DB - 25S
           male connector        female connector

              pin 2 ------------------ pin 3
              pin 3 ------------------ pin 2
              pin 7 ------------------ pin 7 jumpered to pin 9
                                       (Selects mode 2 handshaking)
                                       pin 6 jumpered to pin 15*
                                       (Selects baud rate -- 4800)
```

*Note: Baud Rate is selected by jumpering Pin 6 to Pin 14, 15, 16, 17,
       18 or 19 as desired.

1.2.2.2 Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The Apple Communications Interface Card will support mode 2
(programmed) handshake with all DMPL intelligent plotters. The
Apple Communications Card comes set at 300 baud. The card may be
modified to run at either 1200 or 4800 baud rate by following the
instructions in the Apple Communications Interface Card Installation
and Operating Manual. The baud rate of the card must correspond to
the baud rate setting of the plotter (DMP -29, -4x) or with the
cable if it has been hardwired for a baud rate (DMP-3,4,6,7,8,9). The
card automatically defaults to 8 data bits and 2 stop bits.

1.3   APPLE SUPER SERIAL INTERFACE CARD

1.3.1   Mode 1 (Xon/Xoff, Hardware) Handshake

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1.3.1.1 Cable Specifications

DMP-29 and DMP-4x plotters (xon/xoff):

```
            APPLE II              Plotter
            DB - 25P              DB - 25S
        male connector        female connector

            pin 2 ------------------- pin 2
            pin 3 ------------------- pin 3
            pin 7 ------------------- pin 7
```

A cable with these specifications is available from Houston
Instrument under part number DMP-1401.

DMP-3,4,6,7,8 and 9 plotters (xon/xoff):

```
            APPLE II              Plotter
            DB - 25P              DB - 25S
        male connector        female connector

            pin 2 ------------------- pin 2
            pin 3 ------------------- pin 3
            pin 7 ------------------- pin 7
                                 pin 6 jumpered to pin 16*
                                 (Selects baud rate -- 2400)
```

*Note: Baud Rate is selected by jumpering Pin 6 to Pin 14, 15, 16, 17,
       18 or 19 as desired.

DMP-29 and DMP-4x plotters (hardware):

```
            APPLE II              Plotter
            DB - 25P              DB - 25S
        male connector        female connector

            pin 2 ------------------- pin 3
            pin 5 ------------------- pin 4
            pin 7 ------------------- pin 7
```

A cable with these specifications is available from Houston
Instrument under part number DMP-1400.

DMP-3,4,6,7,8 and 9 plotters (hardware):

DMP-3,4,6,7,8 and 9 plotters are not capable of mode 1 (hardware)
handshaking under the mode 1 select because lines 4 and 20 (RTS,
DTR) are held continually high and are not toggled.

1.3.1.2 Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The Apple Super Serial Card will support mode 1 (xon/xoff)
handshaking with all DMPL intelligent plotters when the jumper block
is installed with the arrow pointing down toward TERMINAL. The
jumper block then acts as a modem eliminator (null modem) making the
Apple Super Serial Card look like a DCE device. Either half or full
duplex may be used.

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The baud rate, data bits, stop bits, parity, line feed disable,
interrupt disable and the mode (communications or printer) are
selected through the dip switches on the card. The following
example sets a baud rate of 2400. For other baud rates consult the
Apple Super Serial Card Installation and Operating Manual or the
Apple Super Serial Reference Card located in the back of the manual.
The baud rate selected on the card must correspond to the baud rate
setting of the plotter (DMP -29, -4x) or with the cable if it has
been hardwired for a baud rate (DMP-3,4,6,7,8,9).

The Apple Super Serial Card will support mode 1 (hardware)
handshaking when the jumper block is installed with the arrow
pointing up toward MODEM. This makes the Super Serial Card look
like a DTE device. DMP-29 and DMP-4x are capable of using mode 1
(hardware) handshake because lines 4 and 20 (RTS, DTR) are toggled
and either of these lines may be used to indicate buffer status.
Either half or full duplex may be used.

DIP SWITCH SETTINGS

DIP SWITCHES	SETTING	FUNCTION
Switch Box 1		
1	off	baud rate = 2400
2	on	
3	off	
4	on	
5	on	selects communications mode
6	on	
7	on	
Switch Box 2		
1	off	8 data bits, 2 stop bits
2	on	
3	on	no parity
4	on	
5	off	<LF> after <CR>
6	off	interrupts
7	off	selects communications mode

1.3.2   Mode 2 (Programmed) Handshake

1.3.2.1 Cable Specifications

DMP-29 and DMP-4x plotters:

```
        APPLE II                 Plotter
        DB - 25P                 DB - 25S
      male connector          female connector

          pin 2 ------------------- pin 2
          pin 3 ------------------- pin 3
          pin 7 ------------------- pin 7
```

A cable with these specifications is available from Houston
Instrument under part number DMP-1401.

DMP-3,4,6,7,8 and 9 plotters

```
            APPLE II                    Plotter
            DB - 25P                    DB - 25S
          male connector            female connector

              pin 2 ------------------- pin 2
              pin 3 ------------------- pin 3
              pin 7 ------------------- pin 7 jumpered to pin 9
                                        (Selects mode 2 handshaking)
                                        pin 6 jumpered to pin 16*
                                        (Selects baud rate -- 2400)
```

*Note: Baud Rate is selected by jumpering Pin 6 to Pin 14, 15, 16, 17, 18 or 19 as desired.

1.3.2.2 Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The Apple Super Serial Card will support mode 2 (programmed) handshake with all DMPL intelligent plotters when the jumper block is installed with the arrow pointing down toward TERMINAL. The jumper block then acts as a modem eliminator (null modem) making the Super Serial Card look like a DCE device. Either half or full duplex may be used.

The baud rate, data bits, stop bits, parity, line feed disable, interrupt disable and the mode (communications or printer) are selected throught the dip switches on the card. The following example sets a baud rate of 2400. For other baud rates consult the Apple Super Serial Card Installation and Operating Manual or the Apple Super Serial Reference Card located in the back of the manual. The baud rate selected on the card must correspond to the baud rate setting of the plotter (DMP -29,-4x) or with the cable if it has been hardwired for a baud rate (DMP-3,4,6,7,8,9).

DIP SWITCH SETTINGS

DIP SWITCHES	SETTING	FUNCTION
Switch Box 1		
1	off	baud rate = 2400
2	on	
3	off	
4	on	
5	on	selects communications mode
6	on	
7	on	
Switch Box 2		
1	off	8 data bits, 2 stop bits
2	on	
3	on	no parity
4	on	
5	off	<LF> after <CR>
6	off	interrupts
7	off	selects communications mode

1.4.1   Mode 1 (Xon/Xoff, Hardware) Handshake

1.4.1.1   Cable Specifications

There are "ROM-Paks" available for the CCS card which support xon/xoff
handshaking. Mode 1 (xon/xoff) handshaking is not recommended with this
card because of potential timing problems.

DMP-29 and DMP-4x plotters (hardware):

                    APPLE II   Plotter
                    DB - 25P   DB - 25S
                  male connector   female connector

                       pin 3 ------------------ pin 3
                       pin 4 ------------------ pin 4
                       pin 7 ------------------ pin 7

A cable with these specifications is available from Houston
Instrument under part number DMP-1398.

DMP-3,4,6,7,8 and 9 plotters (hardware):

DMP-3,4,6,7,8 and 9 plotters are not capable of mode 1 (hardware)
handshaking under the mode 1 select because lines 4 and 20 (RTS,
DTR) are held continually high and are not toggled.

1.4.1.2   Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The CCS card is full duplex and uses pin 4 (RTS) to mode 1 (hardware)
handshake. DMP-29 and DMP-4x will support hardware handshaking using
mode 1 select because lines 4 and 20 (RTS, DTR) are toggled and
either of these lines may be used to indicate buffer status.

The assembly language driver shipped with the CCS card defaults to no
parity, 8 data bits, and 2 stop bits. The baud rate is selected by
setting the four dip switches in the upper right hand corner. The
following example sets a baud rate of 2400. For other baud rate
selections consult the Owner's Manual for the CCS Asynchronous Serial
Interface Card. The baud rate selected on the card must correspond
to the baud rate setting of the plotter (DMP -29, -4x).

```
                    DIP SWITCH SETTINGS

         DIP SWITCHES         SETTING         FUNCTION

              1           off (down)      baud rate = 2400
              2           off (down)
              3           off (down)
              4           on  (up)
```

1.4.2   Mode 2 (Programmed) Handshake

1.4.2.1   Cable Specifications

DMP-29 or DMP-4x plotters:

```
              APPLE II                Plotter
              DB - 25P                DB - 25S
          male connector          female connector

              pin 2 ------------------- pin 2
              pin 3 ------------------- pin 3
pin 4 jumpered to pin 6
              pin 7 ------------------- pin 7
pin 8 jumpered to pin 20
```

A cable with these specifications is available from Houston
Instrument under part number DMP-1399.

DMP-3,4,6,7,8 and 9 plotters:

```
              APPLE II                Plotter
              DB - 25P                DB - 25S
          male connector          female connector

              pin 2 ------------------- pin 2
              pin 3 ------------------- pin 3
pin 4 jumpered to pin 6
              pin 7 ------------------- pin 7 jumpered to pin 9
pin 8 jumpered to pin 20            (Selects mode 2 handshaking)
                                   pin 6 jumpered to pin 16*
                                   (Selects baud rate -- 2400)
```

*Note: Baud Rate is selected by jumpering Pin 6 to Pin 14, 15, 16, 17,
       18 or 19 as desired.

1.4.2.2   Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The CCS Card is a full duplex card that will support mode 2 (programmed)
handshake with all DMPL Intelligent plotters.

The assembly language driver shipped with the CCS card defaults to no parity, 8 data bits, and 2 stop bits. The baud rate is selected by setting the four dip switches in the upper right hand corner. The following example sets a baud rate of 2400. For other baud rate selections consult the Owner's Manual for the CCS Asynchronous Serial Interface Card. The baud rate selected on the card must correspond to the baud rate setting of the plotter (DMP -29, -4x) or with the cable if it has been hardwired for a baud rate (DMP-3,4,6,7,8,9).

<div align="center">DIP SWITCH SETTINGS</div>

DIP SWITCHES	SETTING	FUNCTION
1	off (down)	baud rate = 2400
2	off (down)	
3	off (down)	
4	on (up)	

1.5   COMMUNICATIONS

1.5.1   One Way Communications

The following Basic programs test one way (computer to plotter) communications. The first program specifies the mode 1 (xon/xoff,hardware) handshake select and the second program shows the mode 2 (programmed) handshake select. Using the cable specifications and card set-up specifications for the desired handshake mode, enter and run one of the following programs:

mode 1 (xon/xoff,hardware) handshake select:

```
10 PRINT CHR$(4);"PR#n"
20 PRINT ";: T "
30 PRINT CHR$(4);"PR#0"
40 END
```

mode 2 (programmed) handshake select:

```
10 PRINT CHR$(4);"PR#n"
20 PRINT ";: I 0D 0 T "
30 PRINT CHR$(4);"PR#0"
40 END
```

Note: n in line 10 of each of these programs is the slot number (0-7) where the interface card is located.

Each of these programs will select the plotter and have it perform a self-test. If the plotter does not run a self-test, then some aspect of the computer/plotter communications link is incorrect. Double check the baud rate setting for the interface card and the plotter. The baud rates must agree. Also make sure that the interface card is setup to send 8 bits per character.

1.5.2   Two Way Communications

Listed below are some suggestions as to areas that need to be checked when problems arise in two way communications (computer to plotter and plotter to computer).

For DMP-3,4,6,7,8 and 9 plotters:

The baud rate selected on the interface card and the cabled baud rate for the plotter must agree

The interface card should be able to accept no parity, 8 data bits and 2 stop bits to match plotter defaults

For DMP-29 and DMP-4x plotters:

Baud rate selected on the plotter and interface card must agree

Parity selected on the plotter and interface card must agree

Data bits selected on the plotter and interface card must agree

Stop bits selected on the plotter and interface card must agree

For DMP-4x plotters the default for data sent from the plotter to the computer is no parity, 8 data bits with bit 8 being set to Ø, and 2 stop bits. The UART setup command allows the user to select the type of parity and the number of data bits. The plotter setup must match the interface card setup for these factors. See plotter manual for instructions on using the UART setup command (EU).

For DMP-29 plotters data sent from the plotter to computer is switch selectable for the parity and data bits, with the stop bits being set at 2. Plotter switches need to agree with interface card settings for these items. See plotter manual for details on switch settings.

The self-test on DMP-29 and DMP-4x plotters prints parity, data bits, and UART setup information as well as the baud rate of the plotter. Running a self-test from Local Mode will help assure all of these parameters are correctly set. See plotter manual for details on the self-test information.

2.0   IBM PC

These interface notes are intended to give an example of a suggested cable, a I/O port setup, and a program that verifies one way communication between the IBM PC computer and any of Houston Instrument's DMPL Intelligent Plotters using either Mode 1 (hardware) or Mode 2 (programmed) handshake. Only one serial interface card, the IBM Asynchronous Communications Card, is discussed.

The development system for these technical notes consists of the IBM PC (64K minimum), two single sided/single density disk drives, PCDOS version 1.0, PCDOS version 1.1 or 2.0, IBM Asynchronous Communications Card and IBM PC Advanced Basic.

2.1   IBM ASYNCHRONOUS COMMUNICATIONS CARD

2.1.1   Mode 1 (Xon/Xoff, Hardware) Handshake

2.1.1.1 Cable Specifications

The IBM Asynchronous Communications Card does not support xon/xoff handshaking.

DMP-29 and DMP-4x plotters (hardware):

```
            IBM PC or Plotter          IBM PC or Plotter
                DB - 25S                   DB - 25S
            female connector           female connector

                pin 2 ------------------- pin 3
                pin 3 ------------------- pin 2
                pin 4 ------------------- pin 5
                pin 5 ------------------- pin 4
                pin 7 ------------------- pin 7
        jumpered together:             jumpered together:
        pin 6 to pin 8 to              pin 6 to pin 8 to
        pin 20 to pin 22               pin 20 to pin 22
```

Note: This cable is constructed so either end can be connected to the plotter or computer.

A cable with these specifications is available from Houston Instrument under part number HR29-316.

DMP-3,4,6,7,8 and 9 plotters (hardware):

DMP-3,4,6,7,8 and 9 plotters are not capable of mode 1 (hardware) handshaking under the mode 1 select because lines 4 and 20 (RTS, DTR) are held continually high and are not toggled.

2.1.1.2 Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The IBM Asynchronous Communications Card (serial) will support mode 1 (hardware) handshake with DMP-29 and DMP-4x intelligent plotters under the PCDOS 1.1 or 2.0 operating system. Lines 4 and 20 (RTS, DTR) are toggled on DMP-29 and DMP-4x plotters and either of these lines may be used to indicate buffer status. Hardware handshaking is not supported under <u>PCDOS 1.0</u> operating system.

To configure the system for mode 1 (hardware) handshake the parallel printer output must be redirected to a serial device. The following procedure will set up the PCDOS 1.1 or 2.0 operating system for mode 1 (hardware) handshake.

1. Boot up PCDOS 1.1 or 2.0 operating system.

2. After the system prompt, issue the MODE command to select the baud rate, parity, data bits, and stop bits for Asynchronous Communications Adapters.

    Example -   A> MODE COMn:baud,parity,databits,stopbits,P

        COMn - where n is 1 or 2 (Asynchronous Communications Adapter
             number)
        baud rate = 9600, 4800, 2400, 1200, 600, 300
        parity = N
        databits = 8
        stopbits = 2
        P - this allows timeout errors to be continuously retried.
            Retry loops can be stopped by Ctrl-Break.

    Note: The baud rate in the MODE statement must agree with the
          baud rate setting of the plotter (DMP-29,-4x).

3. After return message, issue the MODE command to redirect parallel printer output to a serial device.

        Example -   A> MODE LPT#:=COMn

        LPT# - where # = 1, 2, or 3 (printer number)
        COMn - where n = 1 or 2 (Asynchronous Communications
               Adapter number)

4. After return message load BASICA.

        Example -   A> BASICA

2.1.2   Mode 2 (Programmed) Handshake

2.1.2.1   Cable Specifications

DMP-29 and DMP-4x plotters:

```
        IBM PC or Plotter          IBM PC or Plotter
            DB - 25S                   DB - 25S
        female connector           female connector


            pin 2 ------------------- pin 3
            pin 3 ------------------- pin 2
            pin 4 ------------------- pin 5
            pin 5 ------------------- pin 4
            pin 7 ------------------- pin 7
     jumpered together:           jumpered together:
     pin 6 to pin 8 to            pin 6 to pin 8 to
     pin 20 to pin 22             pin 20 to pin 22
```

Note: This cable is constructed so either end can be connected to the
      plotter or computer.

A cable with these specifications is available from Houston
Instrument under part number HR29-316.

DMP-3,4,6,7,8 and 9 plotters

```
            IBM PC                     Plotter
            DB - 25S                   DB - 25S
        female connector           female connector


            pin 2 ------------------- pin 3
            pin 3 ------------------- pin 2
            pin 7 ------------------- pin 7 jumpered to pin 9
 pin 4 jumpered to pin 5             (Select Mode 2 handshaking)
        jumpered together:           pin 6 jumpered to pin 16*
        pin 6 to pin 8 to            (Selects baud rate -- 2400)
        pin 20 to pin 22
```

*Note: Baud Rate is selected by jumpering Pin 6 to Pin 14, 15, 16, 17,
       18 or 19 as desired.

2.1.2.2 Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The IBM Asynchronous Interface Card will support mode 2 (programmed)
handshake with all levels of DMPL intelligent plotters using
PCDOS 1.0, 1.1, or 2.0 operating system.

No special procedure is needed to setup PCDOS 1.0, 1.1 or 2.0
operating systems for mode 2 (programmed) handshaking.

2.2   COMMUNICATIONS

2.2.1   One Way Communications

The following Basic programs test one way (computer to plotter)
communications. The first program specifies the mode 1
(xon/xoff,hardware) handshake select and the second program shows
the mode 2 (programmed) handshake select. Using the cable
specifications and card set-up specifications for the desired
handshake mode, enter and run one of the following programs:

Mode 1 (hardware) handshake select:

10 LPRINT ";: T "
20 END

Mode 2 (programmed) handshake select:

10 OPEN "COM1:baud,N,8,2,CS,DS" AS #1
20 PRINT #1,";: I 0D 0 T "
30 END

Note: The baud rate in line 10 of the Mode 2 Basic program must agree
      with the baud rate setting of the plotter (DMP -29, -4x) or
      with the cable if it has been hardwired for a baud rate (DMP-3,4,6,7,8,9

Each of these programs will select the plotter and have it perform a
self-test. If the plotter does not run a self-test, then some aspect of
the computer/plotter communications link is incorrect. Double check the
baud rate setting for the computer and the plotter. The baud rates must
agree. Also make sure that 8 bits per character are being sent from the
computer to the plotter.

2.2.2   Two Way Communications

Listed below are some suggestions as to areas that need to be
checked when problems arise in two way communications (computer to
plotter and plotter to computer).

     For DMP-3,4,6,7,8 and 9 plotters:

          The baud rate selected on the interface card and the cabled
          baud rate for the plotter must agree

          The interface card should be able to accept no parity, 8 data
          bits and 2 stop bits to match plotter defaults

     For DMP-29 and DMP-4x plotters:

          Baud rate selected on the plotter and interface card must agree

          Parity selected on the plotter and interface card must agree

          Data bits selected on the plotter and interface card must agree

          Stop bits selected on the plotter and interface card must agree

For DMP-4x plotters the default for data sent from the plotter to the computer is no parity, 8 data bits with bit 8 being set to 0, and 2 stop bits. The UART setup command allows the user to select the type of parity and the number of data bits. The plotter setup must match the interface card setup for these factors. See plotter manual for instructions on using the UART setup command (EU).

For DMP-29 plotters data sent from the plotter to computer is switch selectable for the parity and data bits, with the stop bits being set at 2. Plotter switches need to agree with interface card settings for these items. See plotter manual for details on switch settings.

The self-test on DMP-29 and DMP-4x plotters prints parity, data bits, and UART setup information as well as the baud rate of the plotter. Running a self-test from Local Mode will help assure all of these parameters are correctly set. See plotter manual for details on the self-test information.

3.0   NORTHSTAR HORIZON

These Interface Notes are intended to give an example of a suggested cable, an I/O port setup, and a program that verifies one way communiciation between the Northstar Horizon computer and any of Houston Instrument's DMPL Intelligent Plotters.

The development system for these technical notes consists of the Northstar Horizon (64k minimum), two double sided / double density disk drives, SAIL CP/M 2.2 operating system, and Microsoft Basic.

3.1   NORTHSTAR HORIZON SERIAL PORT

3.1.1   Mode 1 (Xon/Xoff, Hardware) Handshake

3.1.1.1   Cable Specifications

The North Star Horizon will not support xon/xoff handshaking without software modifications to its BIOS program.

DMP-29 and DMP-4x plotters (hardware):

```
          Northstar Horizon          Plotter
              DB - 25P               DB - 25S
          male connector          female connector

                  pin 3  -----------  pin 3
                  pin 7  -----------  pin 7
                  pin 20 -----------  pin 20
```

A cable with these specifications is available from Houston Instrument under part number DMP-1396.

DMP-3,4,6,7,8 and 9 plotters (hardware):

DMP-3,4,6,7,8 and 9 plotters are not capable of mode 1 (hardware) handshake in mode 1 select because lines 4 and 20 (RTS,DTR) are held continually high and are not toggled.

3.1.1.2   Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The Northstar Horizon will support mode 1 (hardware) handshaking under its S.A.I.L. CP/M operating system with DMP-29 and DMP-4x plotters under the mode 1 select. Lines 4 and 20 (RTS, DTR) are toggled and either of these lines may be used to indicate buffer status.

After the system prompt, type SETSAIL. Select printer type as RS-232 serial. Note that other system related (but not plotter related) questions must be answered during this session. For further information consult the S.A.I.L. CP/M manual for documentation.

3.1.2   Mode 2 (Programmed) Handshake

3.1.2.1 Cable Specifications

DMP-29 and DMP-4x plotters:

```
           Northstar Horizon          Plotter
               DB - 25P               DB - 25S
            male connector         female connector

               pin 2  -----------  pin 2
               pin 3  -----------  pin 3
               pin 7  -----------  pin 7
```

A cable with these specifications is available from Houston Instrument under part number DMP-1401.

DMP-3,4,6,7,8 and 9 plotters:

```
           Northstar Horizon          Plotter
               DB - 25P               DB - 25S
            male connector         female connector

               pin 2  -----------  pin 2
               pin 3  -----------  pin 3
               pin 7  -----------  pin 7 -- pin 9
                              (Select Mode 2 handshaking)
                                      pin 6 -- pin 16*
                              (Selects baud rate -- 2400)
```

*Note: Baud Rate is selected by jumpering Pin 6 to Pin 14, 15, 16, 17, 18 or 19 as desired.

3.1.2.2 Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The Northstar Horizon will support mode 2 (programmed) handshake under its S.A.I.L. CP/M operating system for all DMPL plotters. After the system prompt, type SETSAIL. Select printer type as RS-232 serial. Note that other system related (but not plotter related) questions must be answered during this session. For further information consult the S.A.I.L. CP/M manual for documentation. The baud rate selected during the SETUP must correspond to the baud rate setting of the plotter (DMP -29, -4x) or with the cable if it has been hardwired for a baud rate DMP-3,4,6,7,8,9).

3.2   COMMMUNICATIONS

3.2.1   One Way Communications

The following Basic programs test one way (computer to plotter)
communications. The first program specifies the mode 1
(xon/xoff,hardware) handshake select and the second program shows
the mode 2 (programmed) handshake select. Using the cable
specifications and card set-up specifications for the desired
handshake mode, enter and run one of the following programs:

Mode 1 (xon/xoff,hardware) handshake select:

10 LPRINT ";: T "
20 END

Mode 2 (programmed) handshake select:

10 LPRINT ";:I 0D 0 T "
20 END

Either of these programs will select the plotter and have it perform
a self-test. If the plotter does not run a self-test, then some
aspect in the computer/plotter communications link is incorrect.
Double check the baud rate setting for the computer and the plotter.
The baud rates must agree. Also check to make sure that 8 bits per
character are being sent from the computer to the plotter.

3.2.2   Two Way Communications

Listed below are some suggestions as to areas that need to be
checked when problems arise in two way communications (computer to
plotter and plotter to computer).

    For DMP-3,4,6,7,8 and 9 plotters:

        Setup baud rate for the computer and cabled baud rate for
        the plotter must agree

        Computer should be able to accept no parity, 8 data bits and
        2 stop bits to match plotter defaults

    For DMP-29 and DMP-4x plotters:

        Baud rate selected on the plotter and interface card must agree

        Parity selected on the plotter and interface card must agree

        Data bits selected on the plotter and interface card must agree

        Stop bits selected on the plotter and interface card must agree

For DMP-4x plotters the default for data sent from the plotter to the computer is no parity, 8 data bits with bit 8 being set to Ø, and 2 stop bits. The UART setup command allows the user to select the type of parity and the number of data bits. The plotter setup must match the interface card setup for these factors. See plotter manual for instructions on using the UART setup command (EU).

For DMP-29 plotters data sent from the plotter to computer is switch selectable for the parity and data bits, with the stop bits being set at 2. Plotter switches need to agree with interface card settings for these items. See plotter manual for details on switch settings.

The self-test on DMP-29 and DMP-4x plotters prints parity, data bits, and UART setup information as well as the baud rate of the plotter. Running a self-test from Local Mode will help assure all of these parameters are correctly set. See plotter manual for details on the self-test information.

If buffering problems are encountered running Mode 1 (hardware) handshake, check the UART in the Northstar Horizon. It should be an Intel 8251A, NEC D8251 AC, or compatible chip for proper data transmission.

This chip is available from Houston Instrument under part number MW-56Ø.

4.0   OSBORNE 1

These Interface Notes are intended to give an example of a suggested
cable, an I/O port setup, and a program that verifies one way
communication between the Osborne 1 computer and any of Houston
Instrument's DMPL Intelligent Plotters.

The development system for these technical notes consists of the
Osborne 1 (64k minimum), two single sided / single density disk
drives, CP/M 2.2 operating system, and MicroSoft Basic.

4.1   OSBORNE 1 SERIAL PORT

4.1.1   Mode 1 (Xon/Xoff, Hardware) Handshake

4.1.1.1 Cable Specifications

DMP-29 and DMP-4x plotters(xon/xoff):

```
            Osborne 1                Plotter
            DB - 25P                 DB - 25S
          male connector          female connector


               pin 2. ------------ pin 2
               pin 3  ------------ pin 3
               pin 7  ------------ pin 7
```

A cable with these specifications is available from Houston
Instrument under part number DMP-1401.

DMP-3,4,6,7,8 and 9 plotters (xon/xoff):

```
            Osborne 1                Plotter
            DB - 25P                 DB - 25S
          male connector          female connector


               pin 2  ------------ pin 2
               pin 3  ------------ pin 3
               pin 7  ------------ pin 7
                                   pin 6 jumpered to pin 17*
                            (Selects baud rate -- 1200)
```

*Note: Baud Rate is selected by jumpering Pin 6 to Pin 14, 15, 16,
        17, 18 or 19 as desired.

DMP-29 and DMP-4x plotters (hardware):

```
            Osborne 1                    Plotter
            DB - 25P                     DB - 25S
          male connector            female connector

               pin 3   -----------   pin 3
               pin 7   -----------   pin 7
               pin 20  -----------   pin 20
```

A cable with these specifications is available from Houston
Instrument under part number DMP-1396.

DMP-3,4,6,7,8 and 9 plotters (hardware):

DMP-3,4,6,7,8 and 9 plotters are not capable of mode 1 (hardware)
handshaking using the mode 1 select on the plotter because lines 4
and 20 (RTS, DTR) are held continually high and are not toggled.

4.1.1.2   Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The Osborne I will support mode 1 (xon/xoff) handshake with all
DMPL plotters. It will support mode 1 (hardware) handshake with
DMP-29 and DMP-4x plotters since lines 4 and 20 (RTS,DTR) are
toggled and either of these lines may be used to indicate
buffer status.

Boot up the CP/M operating system. After the system prompt, issue the
SETUP command and the setup chart will appear. Select the Diablo
Xon/Xoff option for mode 1 handshake.

Choose either 300 baud or 1200 baud. The selected baud rate must
agree with the baud rate setting of the plotter (DMP -29,-4x) or
with the cable if it has been hardwired for a baud rate (DMP-3,4,6,7,8,9).

Exit from the setup chart by pressing X and configure the disk that
will boot the system by pressing A for drive A or B for drive B.
Press reset on the Osborne and boot up the system with the disk that
you have just configured. The setup that you have configured is now
in effect.

4.1.2   Mode 2 (Programmed) Handshake

4.1.2.1 Cable Specifications

DMP-29 and DMP-4x plotters:

```
              Osborne 1              Plotter
              DB - 25P               DB - 25S
          male connector         female connector

              pin 2  ------------  pin 2
              pin 3  ------------  pin 3
              pin 7  ------------  pin 7
```

A cable with these specifications is available from Houston
Instrument under part number DMP-1401.

DMP-3,4,6,7,8 and 9 plotters

```
              Osborne 1              Plotter
              DB - 25P               DB - 25S
          male connector         female connector

              pin 2  ------------  pin 2
              pin 3  ------------  pin 3
              pin 7  ------------  pin 7 jumpered to pin 9
                                   (Select mode 2 handshaking)
                                   pin 6 jumpered to pin 16*
                                   (Selects baud rate -- 2400)
```

*Note: Baud Rate is selected by jumpering Pin 6 to Pin 14, 15, 16,
       17, 18 or 19 as desired.

4.1.2.2 Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The Osborne 1 will support mode 2 (programmed) handshake with
all DMPL plotters.

Boot up the CP/M operating system. After the system prompt, issue the
SETUP command and the setup chart will appear. Select the Diablo
Xon/Xoff option for programmed handshake.

Choose either 300 baud or 1200 baud. The selected baud rate must
agree with the baud rate setting of the plotter (DMP -29,-4x) or
with the cable if it has been hardwired for a baud rate
DMP-3,4,6,7,8,9).

Exit from the setup chart by pressing X and configure the disk that
will boot the system by pressing A for drive A or B for drive B.
Press reset on the Osborne and boot up the system with the disk that
you have just configured. The setup that you have configured is now
in effect.

4.2   COMMUNICATIONS

4.2.1   One Way Communications

The following Basic programs test one way (computer to plotter) communications. The first program specifies the mode 1 (xon/xoff,hardware) handshake select and the second program shows the mode 2 (programmed) handshake select. Using the cable specifications and card set-up specifications for the desired handshake mode, enter and run one of the following programs:

Mode 1 (xon/xoff,hardware) handshake select:

```
10 LPRINT ";: T "
20 END
```

Mode 2 (programmed) handshake select:

```
10 LPRINT ";:I ØD Ø T "
20 END
```

Either of these programs will select the plotter and have it perform a self-test. If the plotter does not run a self-test, then some aspect in the computer/plotter communications link is incorrect. Double check the baud rate setting for the computer and the plotter. The baud rates must agree. Also check to make sure that 8 bits per character are being sent from the computer to the plotter.

4.2.2   Two Way Communications

Listed below are some suggestions as to areas that need to be checked when problems arise in two way communications (computer to plotter and plotter to computer).

For DMP-3,4,6,7,8 and 9 plotters:

The baud rate selected on the interface card and the cabled baud rate for the plotter must agree

The interface card should be able to accept no parity, 8 data bits and 2 stop bits to match plotter defaults

For DMP-29 and DMP-4x plotters:

Baud rate selected on the plotter and interface card must agree

Parity selected on the plotter and interface card must agree

Data bits selected on the plotter and interface card must agree

Stop bits selected on the plotter and interface card must agree

For DMP-4x plotters the default for data sent from the plotter to the computer is no parity, 8 data bits with bit 8 being set to 0, and 2 stop bits. The UART setup command allows the user to select the type of parity and the number of data bits. The plotter setup must match the interface card setup for these factors. See plotter manual for instructions on using the UART setup command (EU).

For DMP-29 plotters data sent from the plotter to computer is switch selectable for the parity and data bits, with the stop bits being set at 2. Plotter switches need to agree with interface card settings for these items. See plotter manual for details on switch settings.

The self-test on DMP-29 and DMP-4x plotters prints parity, data bits, and UART setup information as well as the baud rate of the plotter. Running a self-test from Local Mode will help assure all of these parameters are correctly set. See plotter manual for details on the self-test information.

5.0   RADIO SHACK TRS-80 MODEL II

These Interface Notes are intended to give an example of a suggested
cable, a I/O port setup, and a program that verifies one way
communication between the TRS-80 Model II computer and any of
Houston Instrument's DMPL Intelligent Plotters.

The development system for these technical notes consists of the Radio
Shack TRS-80 Model II (64k minimum), one single sided / double
density disk drive, Pickles and Trout CP/M 2.2e operating system,
and MicroSoft Basic.

5.1   TRS-80 SERIAL PORT

5.1.1   Mode 1 (Xon/Xoff, Hardware) Handshake

5.1.1.1 Cable Specifications

DMP-29 and DMP-4x plotters(xon/xoff):

              TRS-80 Model II   Plotter
                 DB - 25P   DB - 25S
              male connector   female connector

                 pin 2   -----------   pin 3
                 pin 3   -----------   pin 2
                 pin 7   -----------   pin 7

A cable with these specifications is available from Houston
Instrument under part number DMP-1397.

DMP-3,4,6,7,8 and 9 plotters (xon/xoff):

              TRS-80 Model II   Plotter
                 DB - 25P   DB - 25S
              male connector   female connector

                 pin 2   -----------   pin 3
                 pin 3   -----------   pin 2
                 pin 7   -----------   pin 7
                                         pin 6 jumpered to pin 17
                                         (Selects baud rate -- 1200)

Note: Baud Rate is selected by jumpering Pin 6 to Pin 14, 15, 16,
      17, 18 or 19 as desired.

DMP-29 and DMP-4x plotters (hardware):

```
        TRS-80 Model II              Plotter
           DB - 25P                  DB - 25S
        male connector            female connector

              pin 2  ------------  pin 3
              pin 5  -----------   pin 4
              pin 7  -----------   pin 7
```

A cable with these specifications is available from Houston
Instrument under part number DMP-1400.

DMP-3,4,6,7,8 and 9 plotters (hardware):

DMP-3,4,6,7,8 and 9 plotters are not capable of mode 1 (hardware)
handshaking using the mode 1 select on the plotters because lines 4
and 20 (RTS, DTR) are held continually high and are not toggled.

5.1.1.2 Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The TRS 80 Model II will support mode 1 (xon/xoff) handshake with
all models of DMPL plotters. It will support mode 1 (hardware)
handshake on DMP-29 and DMP-4x plotters since lines 4 and 20
(RTS,DTR) are toggled and either of these lines may be used
to indicate buffer status.

Boot up the CP/M operating system. After the system prompt, issue
the SETUP command and the setup chart will appear. Select the
following:

      Select the desired serial port (A or B).

      Select a baud rate. The selected baud rate must match the baud
      rate setting on the plotter (DMP -29,-4x) or with the
      cable if it has been hardwired for a baud rate (DMP-3,4,6,7,8,9).

      Select 2 stop bits.

      Set DTR and RTS high.

      Set the word length at 8 bits.

      Set parity to off.

      Ignore the even and odd parity option.

      For Xon/Xoff: Set X-MIT ON to 17. Set X-MIT OFF to 19.
      For Hardware: Set X-MIT ON to 2.   X-MIT OFF can be ignored.

      Set CON: to CRT:

      Set LST: to SIOA (for Serial Port A) or SIOB (for Serial Port B).

Ignore the PUN: and RDR: options.

Exit the SETUP utility, and after receiving the system prompt, load MBASIC.

5.1.2   Mode 2 (Programmed) Handshake

5.1.2.1 Cable Specifications

DMP-29 and DMP-4x plotters:

```
            TRS-80 Model 2              Plotter
               DB - 25P                 DB - 25S
            male connector     .     female connector

                    pin 2  -----------  pin 3
                    pin 3  -----------  pin 2
                    pin 7  -----------  pin 7
```

A cable with these specifications is available from Houston Instrument under part number DMP 1397.

DMP-3,4,6,7,8 and 9 plotters

```
            TRS-80 Model 2              Plotter
               DB - 25P                 DB - 25S
            male connector           female connector

                    pin 2  -----------  pin 3
                    pin 3  -----------  pin 2
                    pin 7  -----------  pin 7 jumpered to pin 9
                                       (Select Mode 2 handshaking)
                                         pin 6 jumpered to pin 16
                                       (Selects baud rate -- 2400)
```

Note: Baud Rate is selected by jumpering Pin 6 to Pin 14, 15, 16,
      17, 18 or 19 as desired.

5.1.2.2 Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The TRS 80 Model II will support mode 1 (xon/xoff) handshake with all models of DMPL plotters. It will support mode 1 (hardware) handshake on DMP-29 and DMP-4x plotters since lines 4 and 20 (RTS,DTR) are toggled and either of these lines may be used to indicate buffer status.

Boot up the CP/M operating system. After the system prompt, issue the SETUP command and the setup chart will appear. Select the following:

    Select the desired serial port (A or B).

Select a baud rate. The selected baud rate must match the baud rate setting on the plotter (DMP -29,-4x) or with the cable if it has been hardwired for a baud rate (DMP-3,4,6,7,8,9).

Select 2 stop bits.

Set DTR and RTS high.

Set the word length at 8 bits.

Set parity to off.

Ignore the even and odd parity option.

Set CON: to CRT:

Set LST: to SIOA (for Serial Port A) or SIOB (for Serial Port B).

Ignore the PUN: and RDR: options.

Exit the SETUP utility, and after receiving the system prompt, load MBASIC.

5.2   COMMUNICATIONS

5.2.1   One Way Communications

The following Basic programs test one way (computer to plotter) communications. The first program specifies the mode 1 (xon/xoff,hardware) handshake select and the second program shows the mode 2 (programmed) handshake select. Using the cable specifications and card set-up specifications for the desired handshake mode, enter and run one of the following programs:

Mode 1 (xon/xoff,hardware) handshake select:

```
10 LPRINT ";: T "
20 END
```

Mode 2 (programmed) handshake select:

```
10 LPRINT ";:I ØD Ø T."
20 END
```

Either of these programs will select the plotter and have it perform a self-test. If the plotter does not run a self-test, then some aspect in the computer/plotter communications link is incorrect. Double check the baud rate setting for the computer and the plotter. The baud rates must agree. Also check to make sure that 8 bits per character are being sent from the computer to the plotter.

5.2.2   Two Way Communications

Listed below are some suggestions as to areas that need to be
checked when problems arise in two way communications (computer to
plotter and plotter to computer).

   For DMP-3,4,6,7,8 and 9 plotters:

      The baud rate selected on the interface card and the cabled
      baud rate for the plotter must agree

      The interface card should be able to accept no parity, 8 data
      bits and 2 stop bits to match plotter defaults

   For DMP-29 and DMP-4x plotters:

      Baud rate selected on the plotter and interface card must agree

      Parity selected on the plotter and interface card must agree

      Data bits selected on the plotter and interface card must agree

      Stop bits selected on the plotter and interface card must agree

For DMP-4x plotters the default for data sent from the plotter to
the computer is no parity, 8 data bits with bit 8 being set to Ø,
and 2 stop bits. The UART setup command allows the user to select
the type of parity and the number of data bits. The plotter setup
the type of parity and the number of data bits. The plotter setup
must match the interface card setup for these factors. See plotter
manual for instructions on using the UART setup command (EU).

For DMP-29 plotters data sent from the plotter to computer is switch
selectable for the parity and data bits, with the stop bits being
set at 2. Plotter switches need to agree with interface card
settings for these items. See plotter manual for details on switch
settings.

The self-test on DMP-29 and DMP-4x plotters prints parity, data
bits, and UART setup information as well as the baud rate of the
plotter. Running a self-test from Local Mode will help assure all of
these parameters are correctly set. See plotter manual for details

If buffering problems are encountered running Mode 1 (hardware
handshake), check the UART in the TRS 8Ø Model II. It should
be an INTEL 8251A, NEC D8251 AC or compatible chip for proper
data transmission.

This chip is available from Houston Instrument under part number
MW-56Ø.

6.0   VICTOR 9000

These Interface Notes are intended to give an example of a suggested
cable, a I/O port setup, and a program that verifies one way
communication between the Victor 9000 computer and any of Houston
Instrument's DMPL Intelligent Plotters.

Developmental system for these technical notes consists of the Victor
9000 (64k minimum), one single sided / double density disk drive,
one hard disk, MSDOS ver. 1.25a/2.61 operating system, and
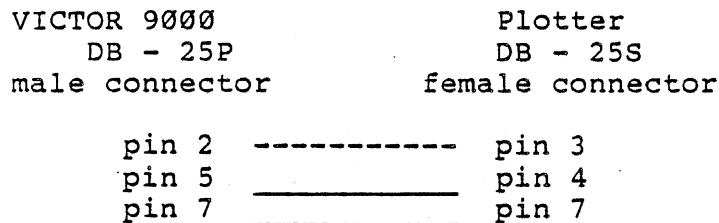MicroSoft Basic.

6.1   VICTOR 9000 SERIAL PORT

6.1.1   Mode 1 (xon/xoff, Hardware) Handshake

6.1.1.1 Cable Specifications

The Victor 9000 does not support xon/xoff handshaking.

DMP-29 and 4x plotters (hardware):

                VICTOR 9000   Plotter
                   DB - 25P   DB - 25S
                male connector   female connector

                    pin 2   ----------   pin 3
                    pin 5   _____   pin 4
                    pin 7   _____   pin 7

A cable with these specifications is available from Houston
Instrument under part number DMP-1400.

DMP-3,4,6,7,8 and 9 plotters (hardware):

DMP-3,4,6,7,8 and 9 plotters are not capable of mode 1 (hardware)
handshaking using the mode 1 select on the plotters because lines 4
and 20 (RTS, DTR) are held continually high and are not toggled.

6.1.1.2 Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The Victor 9000 will support mode 1 (hardware) handshake with
DMP-29 and DMP-4x plotters. Plotter lines 4 and 20 (RTS,DTR)
are toggled and either of these lines may be used to indicate
buffer status.

Boot up the MSDOS operating system. After the system prompt, issue one of the following SETIO commands:

```
SETIO LST=TTY(for Serial Port A) or
SETIO LST=UL1(for Serial Port B)
```

After the system prompt, issue the PORTSET command and a setup chart will appear. Select the serial port you want to configure and then select the baud rate for that port. Selected baud rate must match the baud rate setting on the plotter (DMP -29,-4x).

After receiving the system prompt, load MSBASIC.

6.1.2   Mode 2 (Programmed) Handshake

6.1.2.1 Cable Specifications

DMP-29 and DMP-4x plotters:

```
            VICTOR 9000                 Plotter
               DB - 25P                 DB - 25S
            male connector           female connector

                  pin 2  -----------  pin 3
                  pin 3  -----------  pin 2
                  pin 7  -----------  pin 7
     pin 4 jumpered to pin 5
     pin 8 jumpered to pin 20
```

A cable with these specifications is available from Houston Instrument under part number DMP 1397.

DMP-3,4,6,7,8 and 9 plotters:

```
            VICTOR 9000                 Plotter
               DB - 25P                 DB - 25S
            male connector           female connector

                  pin 2  -----------  pin 3
                  pin 3  -----------  pin 2
                  pin 7  -----------  pin 7 jumpered to pin 9
     pin 4 jumpered to pin 5        (Select Mode 2 handshaking)
     pin 8 jumpered to pin 20          pin 6 jumpered to pin 16
                                     (Selects baud rate -- 2400)
```

Note: Baud Rate is selected by jumpering Pin 6 to Pin 14, 15, 16, 17, 18 or 19 as desired.

6.1.2.2 Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The Victor 9000 will support mode 2 (programmed) handshake
with all models of DMPL plotters.

Boot up the MSDOS operating system. After the system prompt,
issue one of the following SETIO commands:

  SETIO LST=TTY(for Serial Port A) or
  SETIO LST=UL1(for Serial Port B)

After the system prompt, issue the PORTSET command and a
setup chart will appear. Select the serial port you want
to configure and then select the baud rate for that port.
Selected baud rate must match the baud rate setting on the
plotter (DMP -29,-4x) or with the cable if it has been
hardwired for a baud rate (DMP-3,4,6,7,8,9).

After receiving the system prompt, load MSBASIC.

6.2   COMMUNICATIONS

6.2.1   One Way Communications

The following Basic programs test one way (computer to plotter)
communications. The first program specifies the mode 1
(hardware) handshake select and the second program shows
the mode 2 (programmed) handshake select. Using the cable
specifications and card set-up specifications for the desired
handshake mode, enter and run one of the following programs:

Mode 1 (hardware) handshake select:

10 LPRINT ";: T "
20 END

Mode 2 (programmed) handshake select:

10 LPRINT ";:I 0D 0 T "
20 END

Either of these programs will select the plotter and have it perform
a self-test. If the plotter does not run a self-test, then some
aspect in the computer/plotter communications link is incorrect.
Double check the baud rate setting for the computer and the plotter.
The baud rates must agree. Also check to make sure that 8 bits per
character are being sent from the computer to the plotter.

6.2.2   Two Way Communications

Listed below are some suggestions as to areas that need to be checked when problems arise in two way communications (computer to plotter and plotter to computer).

For DMP-3,4,6,7,8 and 9 plotters:

The baud rate selected on the interface card and the cabled baud rate for the plotter must agree

The interface card should be able to accept no parity, 8 data bits and 2 stop bits to match plotter defaults

For DMP-29 and DMP-4x plotters:

Baud rate selected on the plotter and interface card must agree

Parity selected on the plotter and interface card must agree

Data bits selected on the plotter and interface card must agree

Stop bits selected on the plotter and interface card must agree

For DMP-4x plotters the default for data sent from the plotter to the computer is no parity, 8 data bits with bit 8 being set to 0, and 2 stop bits. The UART setup command allows the user to select the type of parity and the number of data bits. The plotter setup the type of parity and the number of data bits. The plotter setup must match the interface card setup for these factors. See plotter manual for instructions on using the UART setup command (EU).

For DMP-29 plotters data sent from the plotter to computer is switch selectable for the parity and data bits, with the stop bits being set at 2. Plotter switches need to agree with interface card settings for these items. See plotter manual for details on switch settings.

The self-test on DMP-29 and DMP-4x plotters prints parity, data bits, and UART setup information as well as the baud rate of the plotter. Running a self-test from Local Mode will help assure all of these parameters are correctly set. See plotter manual for details

7.0   ZENITH 89

These Interface Notes are intended to give an example of a suggested
cable, a I/O port setup, and a program that verifies one way
communication between the Zenith 89 computer and any of Houston
Instrument's DMPL Intelligent Plotters.

Developmental system for these technical notes consists of the
Zenith 89 (64k minimum), one single sided / double density disk
drive, CP/M 2.2 operating system, and MicroSoft Basic.
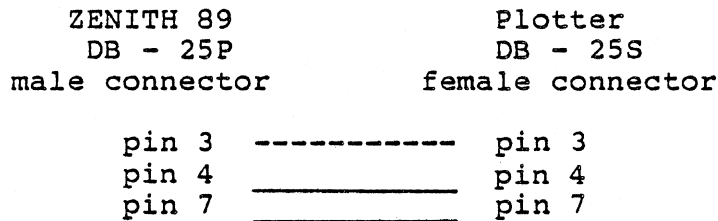

7.1   ZENITH 89 SERIAL PORT

7.1.1   Mode 1 (xon/xoff, Hardware) Handshake

7.1.1.1 Cable Specifications

The Zenith 89 does not support xon/xoff handshaking.

DMP-29 and 4x plotters (hardware):

                ZENITH 89   Plotter
                DB - 25P   DB - 25S
             male connector   female connector

                pin 3 ------------ pin 3
                pin 4 _____ pin 4
                pin 7 _____ pin 7

A cable with these specifications is available from Houston
Instrument under part number DMP-1398.

DMP-3,4,6,7,8 and 9 plotters (hardware):

DMP-3,4,6,7,8 and 9 plotters are not capable of mode 1 (hardware)
handshaking using the mode 1 select on the plotters because lines 4
and 20 (RTS, DTR) are held continually high and are not toggled.

7.1.1.2 Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The Zenith 89 will support mode 1 (hardware) handshake with
DMP-29 and DMP-4x plotters. Plotter lines 4 and 20 (RTS,DTR)
are toggled and either of these lines may be used to indicate
buffer status.

Boot up the CP/M operating system. After the system prompt,
issue CONFIGUR command. The CONFIGUR program will ask you
if you want the standard system setup. Answer "NO" and a

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menu will appear. Select "A" to "Set Terminal and Printer
Characteristics." When the set up chart appears on your
screen, select "C" and enter the baud rate and address
of the serial port. The serial ports are labeled with
their addresses (320,340) on the back of the computer.
The Print Ready Signal must be set to RTS and the Printer
Ready Signal Polarity must be HIGH. If it is LOW, select
"M" and the polarity will be toggled to HIGH. Save the
changes you have made and exit the CONFIGUR utility.

After receiving the system prompt, load MBASIC.

7.1.2   Mode 2 (Programmed) Handshake

7.1.2.1 Cable Specifications

DMP-29 and DMP-4x plotters:

```
          ZENITH 89              Plotter
          DB - 25P               DB - 25S
        male connector        female connector

             pin 2   ------------   pin 2
             pin 3   ------------   pin 3
             pin 7   ------------   pin 7
```

A cable with these specifications is available from Houston
Instrument under part number DMP 1401.

DMP-3,4,6,7,8 and 9 plotters:

```
          ZENITH 89                Plotter
          DB - 25P                 DB - 25S
        male connector          female connector

             pin 2   ------------   pin 2
             pin 3   ------------   pin 3
             pin 7   ------------   pin 7 jumpered to pin 9
                                    (Select Mode 2 handshaking)
                                    pin 6 jumpered to pin 16
                                    (Selects baud rate -- 2400)
```

Note: Baud Rate is selected by jumpering Pin 6 to Pin 14, 15, 16,
      17, 18 or 19 as desired.

7.1.2.2 Card/System Setup

We recommend powering up the plotter BEFORE powering up the computer.

The Zenith 89 will support mode 2 (programmed) handshake
with all models of DMPL plotters.

Boot up the CP/M operating system. After the system prompt,
issue CONFIGUR command. The CONFIGUR program will ask you
if you want the standard system setup. Answer "NO" and a
menu will appear. Select "A" to "Set Terminal and Printer
Characteristics." When the set up chart appears on your
screen, select "C" and enter the baud rate and address
of the serial port. The serial ports are labeled with
their addresses (320,340) on the back of the computer.
To do software handshaking the Print Ready Signal must
be LOW. If it is HIGH, select "M" and the polarity will
toggled to LOW. Save the changes you have made and exit
the CONFIGUR utility.

After receiving the system prompt, load MBASIC.

7.2   COMMUNICATIONS

7.2.1   One Way Communications

The following Basic programs test one way (computer to plotter)
communications. The first program specifies the mode 1
(hardware) handshake select and the second program shows
the mode 2 (programmed) handshake select. Using the cable
specifications and card set-up specifications for the desired
handshake mode, enter and run one of the following programs:

Mode 1 (hardware) handshake select:

```
10 LPRINT ";: T "
20 END
```

Mode 2 (programmed) handshake select:

```
10 LPRINT ";:I ØD Ø T "
20 END
```

Either of these programs will select the plotter and have it perform
a self-test. If the plotter does not run a self-test, then some
aspect in the computer/plotter communications link is incorrect.
Double check the baud rate setting for the computer and the plotter.
The baud rates must agree. Also check to make sure that 8 bits per
character are being sent from the computer to the plotter.

7.2.2   Two Way Communications

Listed below are some suggestions as to areas that need to be
checked when problems arise in two way communications (computer to
plotter and plotter to computer).

    For DMP-3,4,6,7,8 and 9 plotters:

        The baud rate selected on the interface card and the cabled
        baud rate for the plotter must agree

        The interface card should be able to accept no parity, 8 data
        bits and 2 stop bits to match plotter defaults

For DMP-29 and DMP-4x plotters:

       Baud rate selected on the plotter and interface card must agree

       Parity selected on the plotter and interface card must agree

       Data bits selected on the plotter and interface card must agree

       Stop bits selected on the plotter and interface card must agree

For DMP-4x plotters the default for data sent from the plotter to the computer is no parity, 8 data bits with bit 8 being set to 0, and 2 stop bits. The UART setup command allows the user to select the type of parity and the number of data bits. The plotter setup the type of parity and the number of data bits. The plotter setup must match the interface card setup for these factors. See plotter manual for instructions on using the UART setup command (EU).

For DMP-29 plotters data sent from the plotter to computer is switch selectable for the parity and data bits, with the stop bits being set at 2. Plotter switches need to agree with interface card settings for these items. See plotter manual for details on switch settings.

The self-test on DMP-29 and DMP-4x plotters prints parity, data bits, and UART setup information as well as the baud rate of the plotter. Running a self-test from Local Mode will help assure all of these parameters are correctly set. See plotter manual for details

APPENDIX A

The following listing summarizes cables that are available from
Houston Instrument and that are described in the Houston Instrument
Interface Notes. Each cable is listed by part number with a
description that gives cable configuration, Houston Instrument
product configuration and computer configuration.

The following cautions should apply to these cables:

1. The listed cables are for RS-232C serial communications only.
   To cable a plotter or digitizer using a centronics parallel or
   GPIB-IEEE interface refer to the plotter/digitizer Operation and
   Installation Manual and the computer's interface documentation.

2. These cables will not necessarily run the software packages
   listed in "The H. I. Connection" Software/Systems Directory or
   "The H. I. Connection" Software/Systems Abstract. Most software
   packages give cabling information in their manuals, and to
   assure proper operation, a user should always use the cable
   specifications defined by the software package.

3. The plotter cables listed below will work only with plotters
   that have DMP-4x or DMP-29 plotters. Cable configurations
   for DMP-3,4,5,7,8, and 9 plotters are described in the Houston
   Instrument Interface Notes but are not available from Houston
   Instrument.

4. XON/XOFF and hardware handshakes are selected with the Mode 1
   select sequence. Programmed handshake is selected with the Mode
   2 select sequence. Note that cable specifications are linked to
   the type of handshake mode.

CABLE PART #	CABLE CONFIGURATION	H. I. DIGITIZER OR PLOTTER	COMPUTER CONFIGURATION
DT11-320	4800 Baud Rate .01" Resolution	DT-11 or DT-114	Apple II, II+, IIe Super Serial Card
DT11-322	4800 Baud Rate .01" Resolution	DT-11 or DT-114	IBM PC Asynchronous Card
DMP-1396	Hardware Handshake	DMP-4X or DMP-29	Osborne 1 North Star Horizon
DMP-1397	XON/XOFF or Programmed Handshake	DMP-4x or DMP-29	Apple II, II+, IIe Communications Board TRS-80 Model II(CP/M) Victor 9000
DMP-1398	Hardware Handshake	DMP-4x or DMP-29	Apple II, II+, IIe CCS Card Zenith 89
DMP-1399	Programmed Handshake	DMP-4x or DMP-29	Apple II, II+, II CCS Card
DMP-1400	Hardware Handshake	DMP-4x or DMP-29	Apple II, II+, IIe Super Serial Card TRS 80 Model II(CP/M) Victor 9000
DMP-1401	XON/XOFF or Programmed Handshake	DMP-4x or DMP-29	Apple II, II+, IIe Serial Card Super Serial Card North Star Horizon Osborne I Zenith 89