BC2000 / DSR2000 / P100 / D40
Upgrade Kit

Technical Manual

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October 1993
Revised: March 2001

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1 Preface

?? This document describes the installation and troubleshooting of the BC2000, DSR2000, and P100 upgrade kits. It also outlines the basic principles of the operation.

?? The information in this document is subject to change without notice.

2 Introduction

The BC2000/DSR2000/P100 upgrade kits by SoftMap offer the ability to upgrade Aviolyt (AC1, BC1, BC2, BC2S and BC3), Kern DSRx and Zeiss (C100, C110, C120 and C130) analytical plotters to current technology with minimal changes and costs. The analytical plotters remain unchanged except for the Nova 4/X or DG 30 or LSI-11 or HP 1000 minicomputers. These obsolete and expensive to maintain computers are replaced by the plate processor which connects to the electronic cabinet by a new cable. The minimal changes allow for easy installation by the customer.

The BC2000/DSR2000/P100 upgrade kits do not only replace the minicomputers, but also provide the BCx/DSRx/C1xx systems with a modern computing environment where application-oriented tasks are separated from system tasks. The BC2000/DSR2000/P100 upgrade kits function as real-time processors, which handle the user input, control the stage movements, and communicate with the host computer through a serial line. A distinct advantage is the choice of the SD2000 LMT communication protocol for the BCx/DSRx systems and the Zeiss P-protocol for the C1xx systems. These solutions provide great flexibility in the selection of host computers and software. In fact, from the point of view of the host application programs, the BC2000/DSR2000 upgrade transforms a BCx/DSRx analytical plotter into an SD2000 compatible instrument while the P100 upgrade transforms a C1xx instrument into a Zeiss P-series compatible (such as P1, P33). What is available as a host application for an SD2000 or Zeiss P-series system works without any changes on BC2000/DSR2000/P100 upgraded BCx/DSRx/C1xx instruments. There are only very minor differences due to the different sets of input keys, wheels, buttons, etc. Since the new generation of the host application programs offers a high level of user customization, these differences can be virtually eliminated.

There is no preference concerning what kind of host system should be used on BC2000/DSR2000/P100 upgraded BCx, DSRx and C1xx systems. Definitely, the most economical solution is to use a PC as a host computer with a plethora of application software, including orientation and map compilation software. Certainly, SoftMap, Inc., highly recommends AP32 for the Windows 95/NT systems. The serial connection offers also the possibility of using a UNIX workstation for a host. Regardless of what kind of host is selected, the communication with the real-time processor remains unchanged. The compatibility of the BC2000/DSR2000/P100 upgraded systems with the SD2000/Zeiss P-series analytical plotters is also evident from the fact that the same host can be switched from one system to another without any modifications in the software.

Three versions for the BC2000 upgrade exist: Type A for AC1 and (optionally) BC1 analytical plotters, Type B for BC2 and (optionally) for BC1, and Type C for BC3. Thus, BC1 can be upgraded either by Type A or Type B. Type A and C upgrades differ only

slightly (see Sections 3 and 4). Type C, BC3 version is based on different hardware and software.

3 Components

Included in the BC2000/DSR2000/P100 upgrade packages are:

?? **PCx86 desktop computer**

The Intel 486/33MHz (minimum) or Pentium-based PC configuration comes with a hard-drive and a 3.5" Floppy drive in a mini tower case without any other peripherals (keyboard, monitor, etc.). The power supply of the computer is switch-able. A power cord of North-American type is included which needs to be replaced in other areas of the world.

User may provide PCx86 in which case only the upgrade-specific interface boards are shipped, and the user carries out installation including the software setup of the real-time program.

?? **Instrument cable**

The cable connects the electronics box of the BCx/DSRx/C1xx analytical plotter to the PCx86 real-time control computer.

The 6 foot long cable of the Type A BC2000 upgrade kit is built from two loosely attached flat ribbon cables with two standard 37 pin D type female connectors at one end, and the so-called P13 interface connector at the other one. For Type B upgrade, two standard 37-pin D type connectors replace the P13 connector. Type C upgrade comes with a standard serial cable (straight) adapter that connects to serial line cable #4 (the thinner gray cable coming out of the instrument).

The 6 foot long flat ribbon cable of the DSR2000 upgrade kit comes with two standard 37 pin D type female connectors. One side connects to the Kern bus interface board while the other is connected to the interface board in the PCx86 computer.

The 12 foot long Y-cable of the P100 upgrade kit is built from three loosely attached flat ribbon cables with three standard 37 pin D type female connectors at one end, and the so-called St10 and St11 interface connectors at the other one.

?? **System disk**

The 3.5" disk contains the latest version of the real-time processor program. There are also some additional program and data files on this boot-able disk.

?? **Technical manual**

The most recent version of this manual.

?? **Microsoft compatible mouse**

An option for P100 system connects the mouse to COM1. The mouse can control the instrument movement and pressing the mouse buttons generates measurement codes. Mouse X, Y motion provides increments such as the X, Y handwheels while holding down CTRL and/or ALT key will translate mouse motion into Z increments. The mouse L/R buttons act such as the footswitches.

?? **BC2 SM interface board for BC2000**

This board replaces the interface board (#435 664) in the BC2 electronics cabinet or the interface board #407 034 in the BC1 electronics cabinet if Type B installation is selected for upgrading a BC1. The interface circuitry contains two D37 type connectors, which connect the instrument ribbon cables to the real-time processor. With Type B installation, the P13 connector is no longer used (see Section 4).

?? **DSR SM interface board for DSR2000**

This board replaces the Kern bus / LSI-11 interface board in the DSRx electronics cabinet. The upgrade interface circuitry contains a single D37 type connector, which connects the instrument ribbon cable to the real-time processor.

?? **Hardlock for the real-time software**

For certain upgrade configurations such as P100 (Zeiss C1xx) and BC2000/C (Wild BC3), a hardlock is required that should be plugged into the parallel interface connector (the hardlock is usually labeled as Upgrade/AP32).

4 Installation

The installation of the BC2000/DSR2000/P100 upgrade kits is very simple, and does not require special expertise or skills. A minimum experience with PCs is perfectly adequate to carry out the whole procedure. Three versions for the BC2000 upgrade kits exist Type A for AC1 and (optionally) for BC1 analytical plotters, Type B for BC2 and (optionally) for BC1, and Type C for BC3. Thus, both Type A and B can upgrade BC1. The three upgrade versions differ really only in the cable and the way it is connected from the real-time processor to the electronics cabinet (see step 7 below) and by the replacement of the interface boards (see step 4 below). There is only one version of the DSR2000 and P100 upgrade kits.

1. Unpacking and inspecting the system

Check the shipping cartons for wrinkled or damaged corners, holes through the cardboard or other signs of rough handling or abuse. If you detect any signs of damage, notify the shipping carrier at once. After unpacking, check the items. For your protection, report any damage to the carrier immediately. Save the packing materials so that you can repack the system safely in case you ever need to move or ship it.

2. Room temperature

If your system arrives in cold weather, allow the system and cables to warm up to room temperature before removing from their boxes. Exposing a cold computer to a warm room causes condensation that could damage the system. Also, a cold cable can easily be broken.

3. Checking the operation of the PCx86

Even though the computers shipped in the upgrade kits are carefully tested during manufacturing, still something might have happened during shipment. To check the proper operation, a keyboard and a VGA display must be temporarily connected to the PCx86. If everything is all right, then a short message shows up after booting. The displayed message informs you about the version number of the real-time processor software. If for some reason the program does not start, then stop the installation process and continue only if the malfunctioning of the PCx86 is corrected.

4. Disconnecting the plotter from the old computer

Make sure that both the Aviolyt/Kern//Zeiss analytical plotter and the microcomputer (Nova4/X or DG30 / LSI-11 / HP1000) are powered down.

Open the plastic/metal cover at the back of the electronics cabinet (front or side panel for DSRx).

For AC1, BC1 and BC2 instruments, unplug the cable connecting the computer to the electronics cabinet. The connector P13 is in the upper left corner and can be removed by untying the knob. For BC3, unplug the serial cable #4 coming out the instrument.

For C1xx instruments, unplug the cable connecting the computer to the electronics cabinet. The connector St10 is in the middle of the backplane and can be removed by untying the knob. Similarly, unplug the St11 connector, which seats behind the left handwheel.

Now the mini computer with its accessories can be safely removed from the plotter. Of course, it can be done later too, especially if for a limited time the user wants to preserve the capability of switching between the two systems.

5. Installing the new interface board into the plotter electronics rack

For upgrading a BC2 (Type B installations), replace the DG interface board (#435 664) by the new BC2 SM interface board. For upgrading a BC1 (Type B installations), replace the Nova4/X interface board (#407 034) by the new BC2 SM interface board. Open the front of the electronics cabinet to get access to the boards. The interface board is usually the first board on the right side.

For DSRx instruments, replace the Kern bus LSI-11 interface board with the new DSR SM board. The two flat ribbon cables connecting it to the LSI-11 microcomputer can easily identify the board.

6. Placing the PCx86 computer box

There is a certain degree of freedom concerning the placement of the computer case. Since access to the computer is only required when a new real-time version should be downloaded, the PCx86 can be placed anywhere you like, as long as the system cable can connect the plotter to the PCx86. If there is no traffic behind the instrument then the PCx86 box can be placed on the ground at the rear of the plotter.

7. Power connection

First make sure the line voltage selector on the rear panel is set correctly. Check the power switch and make sure that it is in the OFF position. We recommend connecting the power cord of the PCx86 to a main power distributor (preferably with surge protection) which serves the plotter, the PCx86, the host, and any other system peripherals. This is very important if high-power instruments such as elevators are used on the same power network. Since the plotter operation exclusively depends on the PCx86, it is practical and convenient to use the same power switch to connect them to the main power outlet. Of course, any other arrangement, say powering them up independently, works fine. In this case the sequence of powering should be first the plotter and then the PCx86. Use only a three-wire grounded power for the PCx86.

8. System cable

?? **BC2000 Type A installation (AC1 and BC1)**

Make sure that both, the Aviolyt analytical plotter and the upgrade PC computer are powered down. Connect the P13 plug of the system cable into the connector from where you earlier disconnected the old computer cable. It is quite similar to point 4, only the steps are in reverse sequence. Be careful when tying the connector with the knob, make sure that the male and female connectors are properly aligned.

?? **BC2000 Type B installation (BC1 and BC2)**

Connect the D37 pin connectors to the BC2 SM interface board, which you used in step 5 to replace the mini computer interface board.

?? **BC2000 Type C installation (BC3)**

Connect the serial line cable #4 (the thinner gray cable coming out of the instrument electronics box) to COM2 on PCx86. Use the included D25/Female to D25/Female adapter.

?? **DSR2000 installation**

Connect the instrument cable D37 connector to the DSR SM interface board, which you used in step 5 to replace the mini computer interface board. The other end of the cable connects to the interface board labeled #1 in the PCx86 computer. Connect the serial line coming out of the switch box to

COM2 on PCx86 (make sure that the switchbox is set to the "RUN" position).

?? **P100 installation**

Make sure that both, the C1xx analytical plotter and the upgrade PC computer are powered down. Connect the St10 plug of the system cable into the connector from where you earlier disconnected the old computer cable in the electronics cabinet. It is quite similar to point 4, only the steps are in reverse sequence. Similarly, connect the St11 plug of the system cable into the connector, which is behind the left handwheel. Be careful when tying the connectors with the knob, make sure that the male and female connectors are properly aligned.

Connect the three D-SUB 37-pin connectors to the backplane of the PCx86. Numbers (1, 2 and 3) mark both the female connectors on the cable and male connectors in the computer. Make sure that they are matching.

9. Install real-time software and hardlock

If the PCx86 is not provided, then load the real-time software from the installation diskette (create the appropriate directory, then copy all the files from the Floppy, and finally replace the AUTOEXEC.BAT with the one provided on the installation diskette).

Install the hardlock if necessary.

10. Test run

BC2000 system

Once the system cable connects the plotter to the PCx86, the whole system can be powered up for a test run. If everything goes well, the typical startup procedure will be executed. First, the stages move to the left front position, then back to locate the zero point, and finally a default model is loaded. The AC1, BC1 and BC2 display panel shows a

HELLO

message, and once the model is established, displays a selected coordinate. The movement keys, as well as the handwheels and Z-wheel, are active. If the plotter operation differs from the aforementioned, stop the installation process.

After powering on, the BC3 upgrade computer starts to download the firmware to the BC3 motion control microcomputer. This process may take a few minutes. The

progress of the downloading is indicated by beeps and also by a counter, which can be seen on a VGA monitor if connected. The original BC3 startup procedure is unchanged.

DSR2000 system

Once the system cable connects the plotter to the PCx86, the whole system can be powered up for a test run. If everything goes well, the typical startup procedure will be executed. First, the stages move to the left front position, then back to locate the zero point, and finally a default model is loaded.

P100 system

Once the system cable connects the plotter to the PCx86, the whole system can be powered up for a test run. First, the stages move to the lower left front position to locate the zero point. Make sure that the real-time program starts only after the plotter stopped moving. If the plotter and the instrument are powered up at the same time, the time it takes to boot and start the real-time program on the upgrade PCx86 is usually sufficient for the instrument hardware to finish its move. The plotter is in stereo comparator mode, the panel displays are initialized and the movement keys, as well as the handwheels are active. If the plotter operation differs from the aforementioned, stop the installation process.

11. Connecting the host

Once the BC2000/DSR2000/P100 upgraded plotter passed the test, it is ready to connect to the host. The host communication is realized through a serial line. The serial line cable must be connected to the port COM1 on the PCx86 for BC2000/DSR2000 systems and to COM2 on P100 instruments. The serial cable is not included in the upgrade kits. Make sure that the connection was setup properly. Every communication device acts as either DTE (Data Terminal Equipment) or DCE (Data Communication Equipment). If it is possible to switch between DTE and DCE modes on the host, then any serial cable can be used. If this is not the case, then either a crossed (null modem) cable should be used or use a null modem adapter with a straight (normal) cable. If the host is PC-based, then use the second type (receive and transmit lines swapped). Since neither the SD2000 LMT nor the Zeiss P-protocol serial line protocol uses any hardware handshaking (such as DTR, DSR, RTS, CTS, DCD, RI; Zeiss P-protocol uses software flow control by XON/XOFF protocol), thus only the TXD, RXD and GND signals are used. In other words, virtually any serial cable including the so-called four line cables works fine. With establishing the host serial communication, the installation process is complete and the system is ready to run the host application and test the system operation.

5 Hardware operation

The heart of the BC2000/DSR2000/P100 upgrade kit hardware is an IBM compatible PC (PCx86) equipped with one/two/three special interface cards.

To achieve high performance and to preserve some computer power for future additions, the PCx86 computer is based on an Intel i486 or Pentium microprocessor running at 66 MHz (or faster). The operative memory is at least 1 Mbyte. Besides the motherboard, the PC system comes with a low capacity harddisk, a 3.5" Floppy drive, a VGA graphics adapter card and a 2S/1P-interface card. The harddisk stores the DOS system and the real-time processor software. The Floppy drive is used to install software and later to upgrade the real-time processor program. It is also useful for troubleshooting. Only the serial ports are used from the interface card. COM1 serial port is used for host communication on BC2000/DSR2000 systems and COM2 is used for P100 systems. The sole purpose of the graphics adapter is troubleshooting. A configuration label is attached to the back of the computer.

The high-speed digital I/O boards provide the interface to the electronics system of the BCx/DSRx/C1xx analytical plotter. The CIO-DIO24H type boards are manufactured by several card-makers. The boards are modified in order to meet the special requirements of the plotter interface. Basically each can handle three 8-bit fields and interrupt signals. Appendix 8.8 lists both the configuration on the PC side and the assignment of the plotter interface signals to data fields of the interface boards. The boards combined handle all the interface signals of the plotter. Bi-directional data and control fields connect to the data bus of the plotter, and the remaining signals are used to address the plotter's registers as well as to generate the read and write control signals. The real-time clock and key interrupts from the plotter are channeled to the interrupt logic on board #1, which uses IRQ5 on the PC-bus (BC2000 systems).

6 Software operation

The BC2000 real-time software (BC1.EXE) supports most Aviolyt plotters (AC1, BC1, BC2, and BC2S). It automatically senses the type so there is no need to specify it explicitly. To bypass the automatic plotter identification, you may enter the plotter type into the PLOTTER.DEF file such as AC1, BC1, BC2 or BCS. Also, the same software is used for the Type A and B upgrades. Type C, BC3 instrument upgrade, comes with a different executable (BC3.EXE).

The DSR2000 real-time software (DSR.EXE) supports all Kern DSRx plotters.

The P100 real-time software (C100.EXE) supports all Zeiss C1xx plotters.

The real-time processor (plate processor) software (RPS) is an interrupt-driven DOS program compiled in Borland C/C++ language environment. The analytical plotter interface uses IRQ5 of the PCx86 and similarly, the serial communication is directly handled through IRQ4/IRQ3. The plotter interface generates an interrupt request for every tick of the real-time clock of the instrument and for all footswitch and panel-key actions. The serial communication port causes an interrupt for each incoming or outgoing character transfer.

Running RPS is very simple and doesn't require special setup. The AUTOEXEC.BAT and the CONFIG.SYS files of the PCx86 are in Appendix 8.1. The RPS executable code (BC1.EXE/BC3.EXE/DSR.EXE/C100.EXE) is stored in the BC2000/DSR2000/P100 upgrade product directory, called BC, DSR or C100. For BC2000 systems an optional file, ZEROPNT.DAT is used to translate the plate coordinate system of the plotter relative to the zero point locations. This ASCII format file contains the four offset values: left x, left y, right x and right y. If the file is missing, then the zero point has the (131072, 131072) default plate location coordinates for both stages. The reason to use this file is that there are a few host applications where a certain operating range of the plate coordinates is assumed. There are a few other plotter specific configuration files too. Typical files are included in 8.1.

If a new version of the RPS should be downloaded, then simply insert the 3.5" distribution diskette into the Floppy drive and boot the system. A small batch is executed during the booting process. The new release will overwrite the previous code and the ZEROPNT.DAT and INPUTKEY.DEF files are also transferred. See BCLOAD.BAT in Appendix 8.1. Another way for upgrade is to boot from Floppy or stop the execution of the real-time software and then manually replace the executable file. It is highly recommended to save the previous version, in case there is some problem with the new version.

During power up or booting, the RPS is automatically invoked. The program first checks the CIO-PIO24H boards. For BC2000/DSR2000 systems, it executes a full plotter

initialization, including zero point capture. If a zero point offset data file exists then it will also be read and considered during the computations. If the initialization phase has been successfully passed, then a default model is downloaded and the interrupt operation for both the instrument and the serial line is enabled. Appendix 8.2 outlines the firmware.

The frequency of the real-time clock of the BC1 electronics is about 150 Hz, and the generated interrupt is directly forwarded to IRQ5. The real-time clock of the C1xx systems is 50Hz while the DSRx systems work with 60Hz. Thus, through the interrupt line the real-time loop of the program is activated in every 6.7/16.7/20 ms. This high frequency of processing plate coordinates results in very smooth stage movements. First, the new location coordinates are issued, then the encoder values, user control input, and instrument status are read, and the coordinates of the next movements are computed. Then come the record processing and sending, the panel display update, etc. Appendix 8.3 shows an overview workflow.

The user control input devices: the footswitches, the panel-keys, and the turtle select switch cause an interrupt on the interface. This interrupt event is also channeled to IRQ5 where the interrupt routine of RPS identifies the cause of the interrupt then handles the real-time clock and the user input processes independently. For BC2000/DSR2000 systems, the panel-keys deliver record codes according to the definitions of the INPUTKEY.DEF file. The INPUTKEY.DEF file is a user edited ASCII file in the product directory. Out of the nine possible entries there are eight keywords to define the record code for the three/four footswitch events (left down, right up and right down, right up) and five panel buttons. The ninth entry provides diagnostic control by allowing the user to stop the RPS when the PROFILE display line is selected and the EXIT button is activated. The codes must be in hexadecimal format, eight digits representing the four characters. See Appendix 8.1. The use of the INPUTKEY.DEF file gives a great flexibility to accommodate any kind of host record formats. The C1xx systems use only the three main buttons on the panel and their codes are assigned according to the three main button of the P-cursor on the Zeiss P-series plotters.

The host communicates to the PCx86 (to the plotter system) through a duplex serial line. The Leica LMT and the Zeiss P-protocols define both the hardware and the software protocols. The physical parameters of the communication are: 9600 baud rate, no parity, 8 data bits and 1 stop bit (9600,N,8,1) for the BC2000/DSR2000 and 19200 baud rate, no parity, 8 data bits and 1 stop bit (19200,N,8,1) for the P100 systems. This setup is hardwired into the RPS except the baud rate can be configured for P100 systems. The SD2000 protocol is binary (see Leica LMT binary protocol definition from Leica, Inc.) while the Zeiss P-protocol is ASCII (see Zeiss P-protocol definition from Carl Zeiss, Inc.). The RPS has its own interrupt routine to handle the serial communication on COM1/COM2 and IRQ4/IRQ3.

The major blocks of the photogrammetric computations are shown in Appendix 8.5 and 8.4 depict the encoder controls.

7 Troubleshooting

Assuming error-free host operation, there are three different groups for potential breakdowns:

?? Communication problems on the instrument or serial cable.
?? Malfunctioning of the PCx86, including the special interface boards.
?? Plotter electronics and mechanical failures.

In general, the sequence on the above list actually corresponds to the frequency of the mishaps, also the difference between the last two items is negligible compared to the first one.

Cable/Communication problems

The communication-related cable problems can be checked by substitution. Serial cables are commonly used thus they are easily available. Use serial line test boxes to monitor the traffic on the serial line. The included PCTEXT.EXE program with the BC3 and DSR2000 upgrades can be used to test the proper operation of the serial lines as well as the IRQ5 interrupt (you must use a null-modem cable to connect the two serial lines on the PCx86 computer).

The instrument cable in most cases is proprietary. However, the signals as well as the connector pin-outs are listed in Appendix 8.6 and 8.8. It is suggested to always restart the upgrade system after any test or modification was carried out. On BC2000/DSR2000 systems, simply reboot the upgrade PCx86 computer. On P100 systems, first reset also the instrument by pressing off and on the computer switch, then start again the real-time software by rebooting it. The host system should be also initialized which is normally accomplished by software reset.

PCx86 failure

Connect a keyboard and a VGA monitor, then follow standard PC diagnostics procedures to identify the problem.

Instrument failure

For any diagnostic testing, it is suggested that the LASTDATA.SMD file be removed from the upgrade PC directory (thus, the system can enter into the default mode).

Call maintenance service from Leica/Zeiss or from qualified third-party instrument service providers. Typical problem if the zero-mark is lost for one of the encoders (BCx systems).

8 Appendix

8.1 PCx86 software setup

****
* PCx86 directories *
****

Installed files on PCx86 hard disk:
(Actual size, date, etc. may vary)

Volume in drive C is CMS
Volume Serial Number is 337D-07CB
Directory of C:\

AUTOEXEC	BAT	181	10-21-92	8:38a
COMMAND	COM	47845	05-08-91	12:00p
CONFIG	SYS	122	10-20-92	2:05a
MOUSE	SYS	55169	03-10-92	8:20a
BC	<DIR>		10-20-92	12:54a
C100	<DIR>		10-20-92	12:54a
DOS	<DIR>		09-26-92	12:04a
DSR	<DIR>		09-26-92	12:04a
MSMOUSE	<DIR>		09-26-92	12:03a

Volume in drive C is CMS
Volume Serial Number is 337D-07CB
Directory of C:\BC

ZEROPNT	DAT	31	1-27-93	23:11p
INPUTKEY	DEF	147	7-10-93	3:11p
PLOTTER	DEF	6	4-10-96	9:11p
STAGESYS	DAT	4	8-23-94	10:05p
BC1	EXE	173886	2-4-96	10:23p
BC3	EXE	190261	9-28-97	12:07p
BC3	FMW	174323	2-1-97	12:34p
BC3	CFG	51	2-2-97	12:55p

Volume in drive C is CMS
Volume Serial Number is 337D-07CB
Directory of C:\C100

```
C100        EXE    166878      4-11-96  10:17p
CFG         DAT       175      7-22-97   11:04p
```

****
* PCx86 files *
****

AUTOEXEC.BAT file:

```
@ECHO OFF
PROMPT $p$g
PATH C:\DOS;
SET TEMP=C:\DOS
C:
CD\BC or CD\C100 or CD\DSR
BC1 or BC3 or C100 or DSR
```

CONFIG.SYS file:

```
FILES=20
```

BC2000 systems

BCLOAD.BAT file:

```
COPY A:ZEROPNT.DAT C:\BC\ZEROPNT.DAT COPY A:INPUTKEY.DEF
C:\BC\INPUTKEY.DEF COPY A:BC1.EXE C:\BC\BC1.EXE
C:
CD\BC
BC1
```

ZEROPNT.DAT file:

Typical values in ZEROPNT.DAT:

```
122000 122000 122000 122000
```

PLOTTER.DEF

Typical values in PLOTTER.DEF:

```
BC2
```

STAGESYS.DAT

Typical values in STAGESYS.DAT:

0

BC3.CFG

Typical values in BC3.CFG:

```
RATE    150
DEMO    OFF
DISP    ON
TIMER   ON
```

INPUTKEY.DEF file:

Record codes for MAPCE extensions:

```
RUP           21592121
RDOWN         22212321
LDOWN         24212221
HEIGHT        6b202021
RECORD        6a202021
RELEASE       69202021
EXIT          68202021
NEXT          67202021
P/EXIT        OFF
```

Codes if panel buttons are not used:

```
RUP           21592121
RDOWN         22212321
LDOWN         24212221
HEIGHT        20202020
RECORD        20202020
RELEASE       20202020
EXIT          20202020
NEXT          20202020
P/EXIT        OFF
```

DSR2000 systems

INPUTKEY.DEF file:

Record codes for typical system configuration (freehand device installed, manual serial line switch – such as DSR11 and DSR14)

```
RUP     21592121
RDOWN   22212321
LDOWN   24212221
LUP     23592221
KEY7    24212221
KEY8    22212321
KEY9    26252221
KEYDEL  28212021
GILTB   OFF
FREEH   ON
```

Record codes for typical system configuration (no freehand device installed, automatic serial line switch – such as DSR1)

```
RUP     21592121
RDOWN   22212321
LDOWN   24212221
LUP     23592221
KEY7    24212221
KEY8    22212321
KEY9    26252221
KEYDEL  28212021
GILTB   ON
FREEH   OFF
```

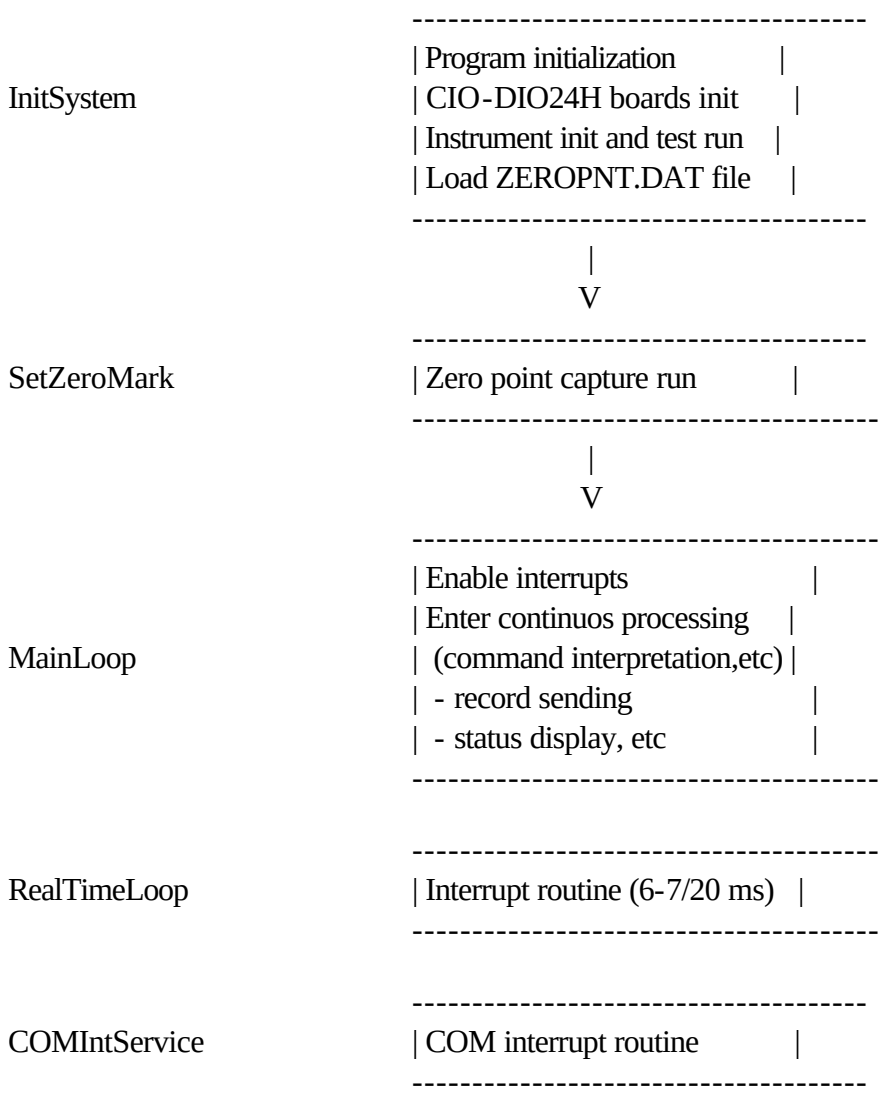
P100 systems

CFG.DAT

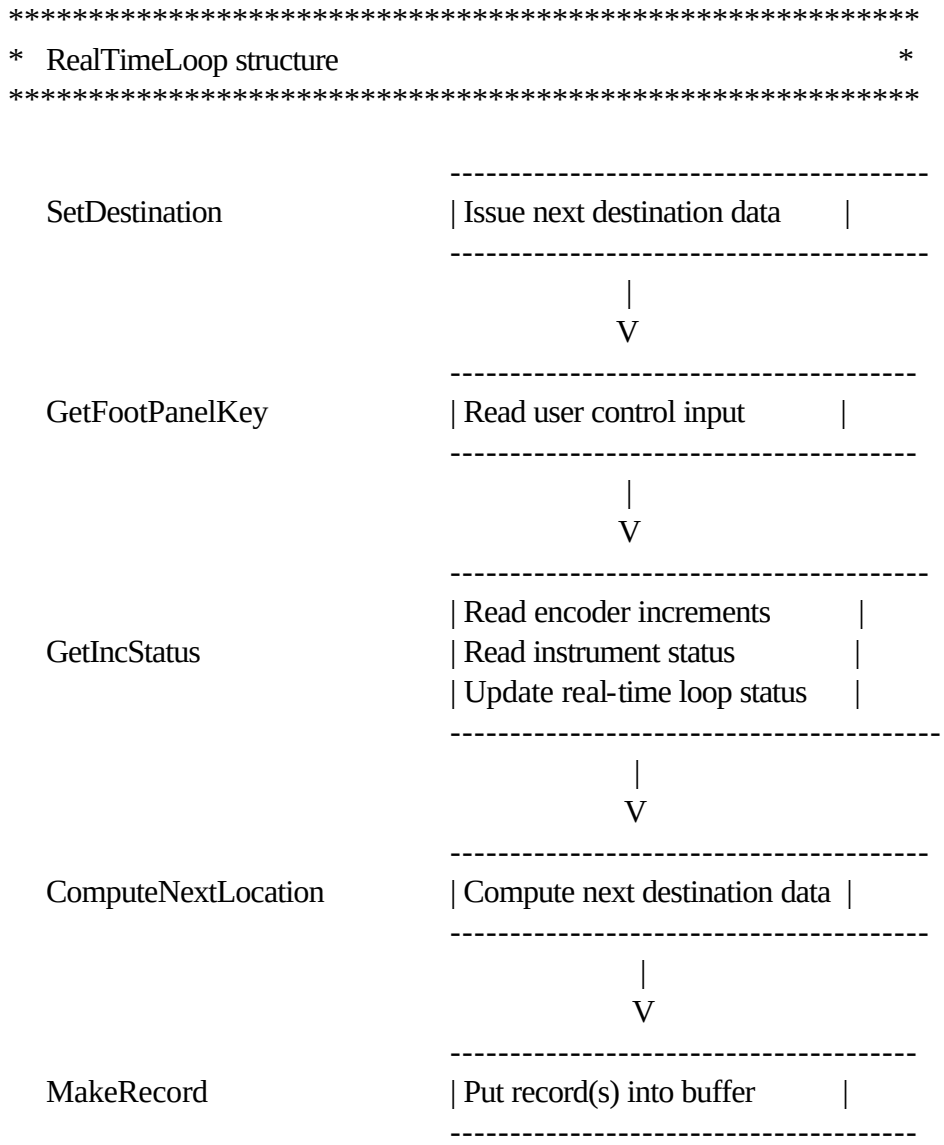
Typical values in CFG.DAT:

```
19200          700            0              1
// Baud Rate   Max Motor      Term Char      Test Mode
// for COM2    Increment      0: CR; 1: LF   0: AP; 1: Test
```

8.2 RPS firmware

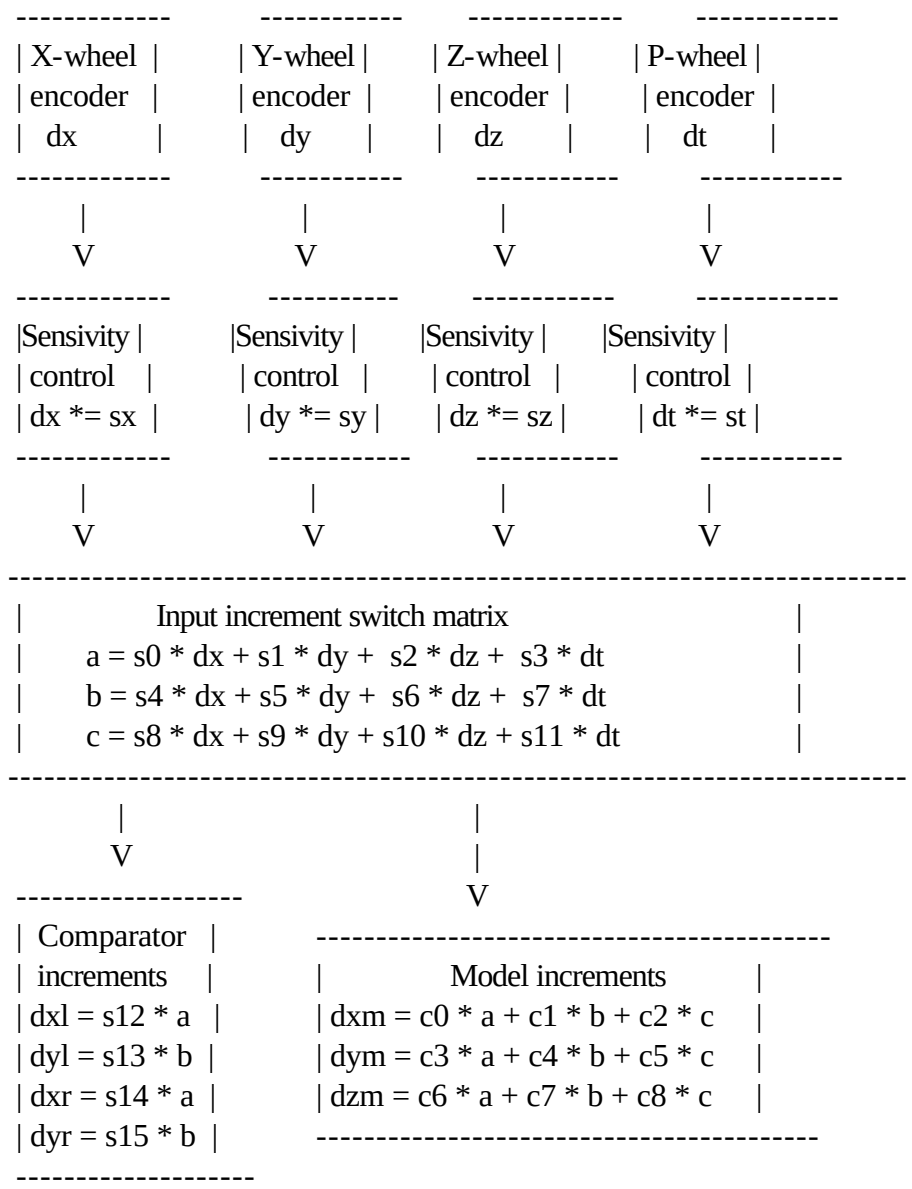


8.3 RPS real-time loop



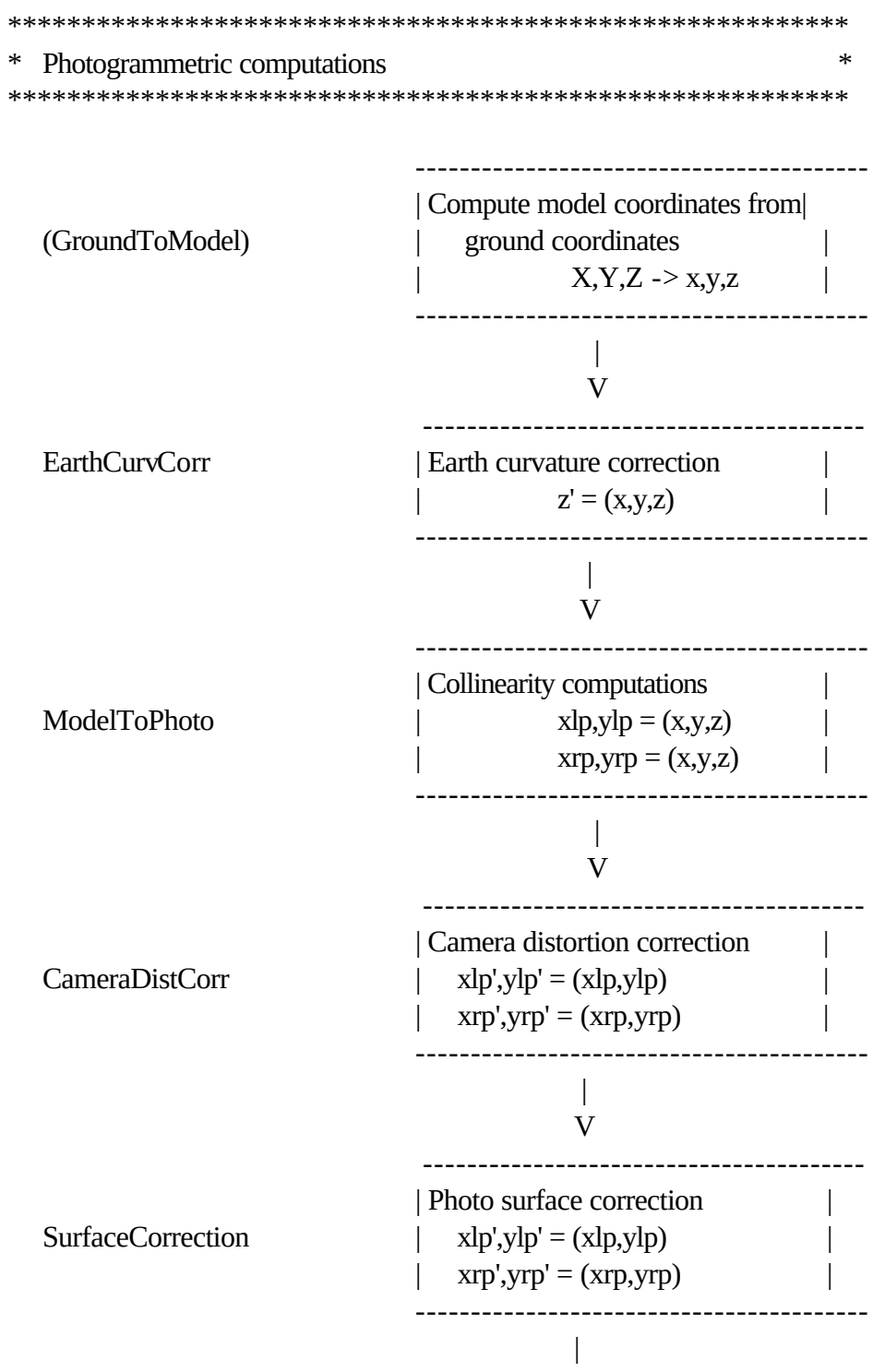
8.4 RPS input device control

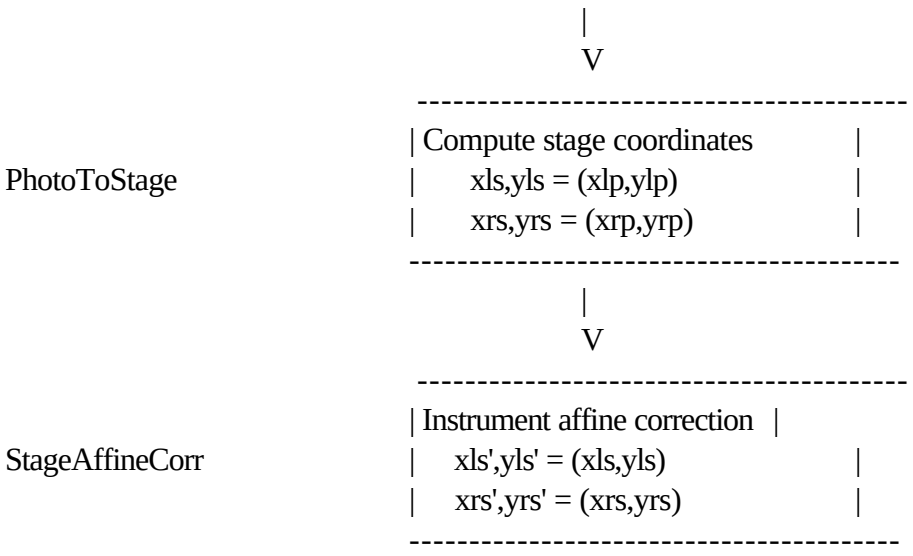
BC2000/DSR2000 system



P100 System

8.5 RPS computations




PhotoToStage
Compute stage coordinates
xls,yls = (xlp,ylp)
xrs,yrs = (xrp,yrp)
StageAffineCorr
Instrument affine correction
xls',yls' = (xls,yls)
xrs',yrs' = (xrs,yrs)

8.6 About serial interface port

****
* Serial interface port signals and connector pinouts *
****

RS-232C signals:

Signal name	DB9	DB25
DXD Data Carrier Detect	1	8
RXD Receive Data	2	3
TXD Transmit Data	3	2
DTR Data Terminal Ready	4	20
GND Signal Ground	5	7
DSR Data Set Ready	6	6
RTS Request to Send	7	4
CTS Clear to Send	8	5
RI Ring Indicator	9	22

Serial cable wiring:

Normal (straight)			Crossed (null modem)		
DTR	<--->	DTR	DTR	<--->	DSR
DSR	<--->	DSR	DSR	<--->	DTR
RTS	<--->	RTS	RTS,CTS	<--->	DCD
CTS	<--->	CTS	DCD	<--->	RTS,CTS
DCD	<--->	DCD			
RXD	<--->	RXD	TXD	<--->	RXD
TXD	<--->	TXD	RXD	<--->	TXD
GND	<--->	GND	GND	<--->	GND

8.7 CIO-DIO24H PC interface configurations

```
**********************************************************
*              CIO-DIO24H PC setup                       *
**********************************************************
```

BC2000 system (Type A and B)

Board #1:
Revision: REV 4
Configuration:

I/O address:	x380	[___^ ^^^^]
IT request:	5	[---X---]
Wait request:	ON	[X-]

Board #2:
Revision: REV 4
Configuration:

I/O address:	x390	[___^ ^_^^]
IT request:	-	[------X]
Wait request:	ON	[X-]

BC2000 system (Type C)

Board #1:
Revision: REV 4
Configuration:

I/O address:	x300	[__^^ ^^^^]
IT request:	5	[---X---]
Wait request:	ON	[X-]

DSR2000 system

Board #1:
Revision: REV 4
Configuration:

I/O address: x390 [___^ ^_^^]
IT request: - [------X]
Wait request: OFF [-X]

Board #2:
Revision: REV 4
Configuration:

I/O address: x300 [__^^ ^^^^]
IT request: - [---X---]
Wait request: OFF [-X]

P100 system

Board #1:
Revision: REV 4
Configuration:

I/O address: x380 [___^ ^^^^]
IT request: - [---X---]
Wait request: OFF [-X]

Board #2:
Revision: REV 4
Configuration:

I/O address: x300 [__^^ ^^^^]
IT request: - [------X]
Wait request: OFF [-X]

Board #3:
Revision: REV 4
Configuration:

I/O address: x390 [___^ ^_^^]

IT request: - [------X]
Wait request: OFF [-X]

8.8 CIO-DIO24H interface signal configurations

****
* BC2000/PC system cable documentation I. *
****

Interface signals: board #1 cable #1

Signal name DATAn data bus (I/O)	P13 interface connector	CIO-DIO24H board name/37 pin D	number	Cable number
DATA0 (MSB)	AX	C7	22	6
DATA1	BC	C6	23	8
DATA2	BH	C5	24	10
DATA3	BA	C4	25	12
DATA4	AY	C3	26	14
DATA5	AR	C2	27	16
DATA6	BF	C1	28	18
DATA7	AT	C0	29	20
DATA8	AM	B7	3	5
DATA9	AW	B6	4	7
DATA10	AZ	B5	5	9
DATA11	AP	B4	6	11
DATA12	AN	B3	7	13
DATA13	AV	B2	8	15
DATA14	AS	B1	9	17
DATA15	BB	B0	10	19

Interrupt signal (I)

INTR	AK	IR	1	1
***IREN	(from board #2)	IREN	2	3

Status signals (I)

SELD	AB	A0	37	36
SELB	AA	A1	36	34

Ground signals

GND	(F, BD-CW)	21	4
	(Except BF,BH)	11	21
		13	25
		15	29
		17	33
		19	37

****

* BC2000/PC system cable documentation II. *

****

Interface signals:	board #2	cable #2		
Signal name	P13 interface connector	CIO-DIO24H board name/37 pin D		Cable number
DATIn input control signals (O)				
DATIA	A	C0	29	20
DATIB	B	C1	28	18
DATIC	K	C2	27	16
DATOn output control signals (O)				
DATOA	H	C4	25	12
DATOB	J	C5	24	10
DATOC	N	C6	23	8
DSn device select signals (O)				
DS0 (MSB)	AD	B5	5	9
DS1	S	B4	6	11
DS2	T	B3	7	13
DS3	P	B2	8	15
DS4	V	B1	9	17
DS5	U	B0	10	19
Control signals (O)				
INTA	C	A0	37	36
***IREN	(to board #1)	A1	36	34
INTPIN	Y	A2	35	32
RQENB	AU	A3	34	30
MSKO	D	A4	33	28
IORST	R	A5	32	26
STRT	L	A6	31	24
CLR	M	A7	30	22
Ground signals				
GND	(F, BD-CW) (except BF,BH)			21 4 11 21 11 21 13 25 15 29 17 33 19 37

```
**********************************************************
* C1xx/PC system cable manufacturing documentation      *
**********************************************************

          cable #1:           St-10 Loop connector:
         ---------             ---------------------

            1
            2
            3
            4                 K         PC Buc GND          (GND)
            5                 EE        B7                  LFG

            6                 FF        C7                  LFC
            7
            8
            9                 MM (NN) B5                    MM bit1
           10

           11                 KK (LL) B4                    MM bit0 (LDO-1) (Read back)
           12
           13
           14
           15                 AA        B2                  LDJ-15

           16
           17                 z         B1                  LDJ-14
           18
           19                 v         B0                  LDJ-13
           20

           21                 E         GND-11              GND
           22                 p         A7                  LDJ-12
           23
           24                 l         A6                  LDJ-11
           25                 DD        GND-13              GND

           26                 h         A5                  LDJ-10
           27
           28                 e         A4                  LDJ-9
           29                 JJ        GND-15              GND
           30                 b         A3                  LDJ-8

           31
           32                 X         A2                  LDJ-7
           33
           34                 W         A1                  LDJ-6
           35

           36                 S         A0                  LDJ-5
           37
```

****
* C1xx/PC system cable manufacturing documentation *
****

cable #2:	St-10 Loop connector:		
1			
2			
3			
4	K	PC Buc GND	(GND)
5			
6			
7			
8			
9			
10			
11			
12	P	C4	LDO-4
13			
14	N	C3	LDO-3
15	CC	B2	LDO-15
16	J	C2	LDO-2
17	x	B1	LDO-14
18	D	C1	LDO-1
19	t	B0	LDO-13
20	C	C0	LDO-0
21	E	GND-11	GND
22	s	A7	LDO-12
23			
24	m	A6	LDO-11
25	DD	GND-13	GND
26	j	A5	LDO-10
27			
28	f	A4	LDO-9
29	JJ	GND-15	GND
30	c	A3	LDO-8
31			
32	Z	A2	LDO-7
33			
34	Y	A1	LDO-6
35			
36	U	A0	LDO-5
37			

```
*********************************************************
* C1xx/PC system cable manufacturing documentation      *
*********************************************************

       cable #3:            St-11 Panel connector:
       ---------            ----------------------

          1
          2
          3
          4                 L         PC Buc GND          (GND)
          5                 T         B7                  PFG

          6                 R         C7                  PDC
          7
          8
          9
         10

         11
         12
         13                 t         B3                  PDJ-15
         14                 W         C3                  PDO-3
         15                 CC        B2                  PDJ-14

         16                 Y         C2                  PDO-2
         17                 HH        B1                  PDJ-13
         18                 a         C1                  PDO-1
         19                 h         B0                  PDJ-12
         20                 c         C0                  PDO-0

         21                 L         GND-11              GND
         22                 LL        A7                  PDJ-11
         23
         24                 x         A6                  PDJ-10
         25                 L         GND-13              GND

         26                 k         A5                  PDJ-9
         27
         28                 v         A4                  PDJ-8
         29                 JJ        GND-15              GND
         30                 AA        A3                  PDJ-7

         31
         32                 EE        A2                  PDJ-6
         33
         34                 m         A1                  PDJ-5
         35

         36                 r         A0                  PDJ-4
         37
                            L M S U X Z                   GND connected
                            b e f j l p s u w z           GND connected
                            BB DD FF KK                   GND connected
```

Digicart Installation Notes

Version 1.0 December 2000

1) Prepare control PC for installation

Requirements: i486 @ 66 MHz or better (may run @ 33 MHz)
2 ISA slots, COM1 serial line
IRQ5 available (sometime conflicts with audio)
(old Digicart PC may be considered)

2) Install boards

Install timer board provided in the upgrade kit

Install original Digicart interface board

3) Control PC hardware test

For hardware conflicts, there is a very limited chance under normal circumstances. For diagnostics, there are a few tests:

1) run PCTEXT.EXE program to check that the timer works; the program shows a seconds counter in the upper left corner and there is a fast running number (ASCII codes) a few lines down toward the center, indicating that
   card I/O address is available (0x300)
   interrupt works (IRQ5) - seconds counter
   serial line (COM1) is available - fast counter

2) run DIT40.EXE to check that the original Digicart memory address doesn't conflict with the VGA display address; in which case move up the Digicart memory window (SW2)

4) Make sure that there is a clean DOS system installed on the control PC

DOS versions 5.0, 6.0 and 6.22 are fine

Have clean AUTOEXEC.BAT and CONFIG.SYS files on the system

for the DIT40.EXE testing, install ANSI.SYS driver in the CONFIG.SYS file, but make sure that it's removed/commented out otherwise

5) Create the D40 directory and copy all the files there from the Installation Floppy diskettes (cd\, md d40, copy a:*.*)

6) Edit the AUTOEXEC.BAT file to automatically start the real-time program (there is a sample file in the D40 directory).

7) A VGA monitor may be connected to the control PC but it's not required. For testing, however, it should be connected since it displays a Variety of information (basically, all the coordinates, motion increments, user keys, status flags, etc.).

Normal Operation

1) Power-on sequence is that first the Digicart should be powered on and then can come the control PC boot. Practically having both on the same power strip, the switch of the power strip can serve as a main power switch to the whole plotter system.

2) Once the real-time program started, the user should measure the reference mark. After positioning the mark on both stages, any user keys will record the positions and the system either drives to the center of a default model or it restores the model of the last accepted AO orientation.

3) User keys as well as other control parameters can be configured in the INPUTKEY.DEF file.

Left footswitch	LDOWN	24212221
	LUP	23592221
Center footswitch	RDOWN	22212321
	RUP	21592121
Right footswitch	MDOWN	26252221
	MUP	25292121
	KEY7	24212221
	KEY8	22212321
	KEY9	26252221
	KEYDEL	28212021
	KEY4	21303921
	KEY5	21313921
	KEY6	21323921
	KEYA	21333921
	KEY1	21343921
	KEY2	21353921
	KEY3	21363921
	KEYB	21373921
	KEY0	21383921
	KEYDOT	21393921
	KEYMIN	213a3921
	KEYENT	213b3921

	GILTB	OFF
Acceleration control	FREEH	ON
	REVZEN	OFF
Instrument speed	MAXINC	77 44 77 44
Interface speed	TIMEOUT	25
Stage physical limits	LIMITS	-20020 230030

These parameters should be edited with extreme care.