SAMPLER INTERFACE SYSTEM
Version 03.03

1.0 INTRODUCTION

The new IMPROVE particulate sampler is controlled by a TERN 16-bit controller. A program written in C/C++ is downloaded into the controller. The programmed controller is responsible for the following aspects of the particulate sampler.

1. Provide the site operator a status of current sampler operations.
2. Provide the site operator an interface for taking initial and final measurements of the filter pack.
3. Provide options for sampling protocols and filter types.
4. Switch on and off the filter solenoids and pump relays.
5. Take and record differential pressure and vacuum transducer for each of the modules.
6. Take and record ambient temperature and relative humidity,
7. Download the measurements to a removable media (Serial Flash Module).

2.0 TERMINAL

The sampler's program is accessed through the Two Technologies terminal located in the controller module (See Figure 1). The terminal consists of a LCD and a twenty-button keypad. See Figure 2 for the layout of the Terminal. The LCD is a 4 line, 20 character long display. When the sampler is in the "normal" mode, the LCD will display the current status of the sampler modules. All functions of the sampler are setup using menus and sub menus.

The rest of this manual will discuss the sampler's menu system. The manual is sections are as follows:
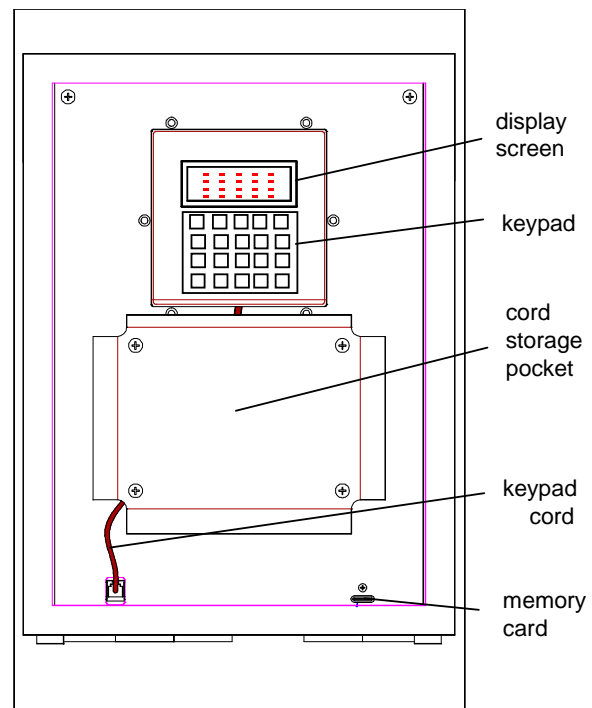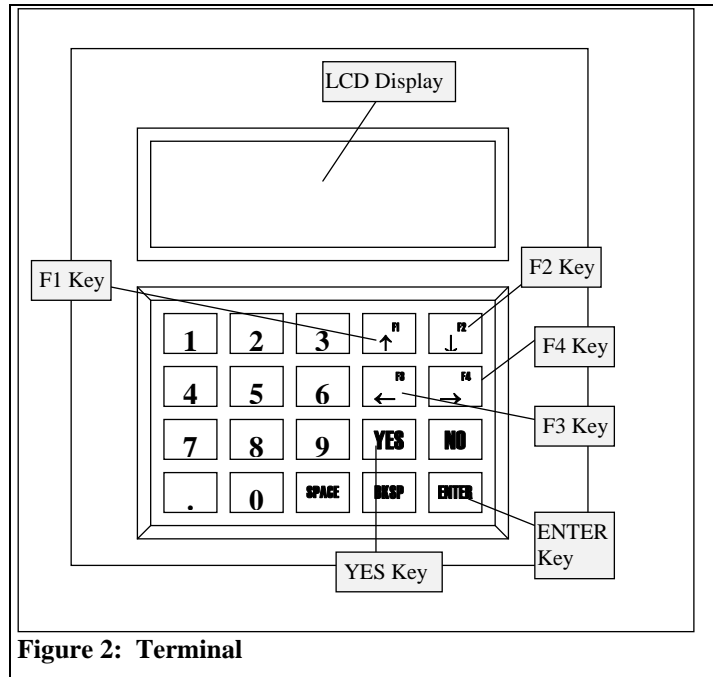

Figure 1

Figure 2: Terminal

3.0 CURRENT STATUS MODE

When the sampler is in AUTO MODE, the current status of the sampler is displayed. The display shows whether sampler is collecting, idling or waiting for samples. In the figures below, several example displays are shown.

In the first example, the first line displays the current date and time. For this example, the date is January 2nd, 2000. The time is 4pm or 16:00. The star after the time shows that local time is in daylight saving. The first line shows finally the day of the week, in this case Saturday. The second line indicates that the 2nd

```
01/02/00 04:00p* SAT
Fil 2 ON, Temp= 95V
Fil 1 |Fil 2 |Fil 3
24hrs |  16hrs|  0hrs
```

filter in each module is sampling and the reference temperature is reading 95 volts. The voltage reference is converted to temperature at the lab. The third line is the header for the elapse time that is displayed in the fourth line in hours. In this example, Filter 1 sampled for 24 hours, Filter 2 for 16hrs and Filter 3 have not sampled.

The display to the right is the same as the above display, except that it is displaying that the sampler is currently recording sensors. At this time, the sampler is reading the flow, time and other parameters and will not accept any keystrokes from the keypad.

```
01/02/00 04:00p  SAT
Fil 2 ON, Temp= 95V
Fil 1 |Fil 2 |Fil 3
Recording sensors
```

The next display shows that the sampler is idling. It is not a sampling day. The date displayed is June 4th, 2003. It is 8am and the site is observing daylight saving. The day of the week is Tuesday.

```
06/04/03 08:00 * TUE

 A   B   C   D
OFF OFF OFF OFF
```

In this display, the sampler has collected all the samples for the week and will remain idle until the operator changes the cassettes and the exposed and clean filter readings. The date is November 1st, 2000 at 10am, standard time.

```
11/01/00 10:00   SAT
     SAMPLING
     COMPLETED
```

4.0 MAIN MENU

The main menu can be accessed by the operator by hitting the **ENTER** key while the sampler is displaying the current status. When the **ENTER** button is pushed the display on the right will appear. You have four options.

```
F1=Filter Readings
F2=Change Date&Time
F3=Advanced Menu
ENTER=AUTO MODE
```

F1 - Pressing the ↑**F1** key will bring up the Filter readings menu. Press ↑**F1** when you need to take the readings of the exposed and clean cassettes. This will be described in depth in section 4.1 Filter Readings.

F2 - Pressing the ↓**F2** key will bring up the menu to change the current date and time. This will be described in depth in section 4.2 Change Date&Time.

F3 - Pressing the ←**F3** key will bring up the advanced menu. The menu will allow the user to change the sampler protocols. This menu should not be accessed unless authorized by UC Davis personnel. This menu will be described in depth in section 4.3 Advanced Menu.

ENTER - Pressing the **ENTER** key will return the sampler to current status mode.

Easter Eggs

1 - Pressing the **1** key will display the Current temperature in mV, °C and °F. Press **ENTER** to return to the main menu.

```
Realtime TEMP
Volt     C       F
 95     25.0    76.0
ENTER= Main Menu
```

2 - Pressing the **2** key displays The Maximum vacuum of each pump. This closes all the solenoids and starts the pumps. Press **ENTER** to return to the main menu.

```
Max Vac realtime
  A    B    C    D
 40   40   40   40
ENTER= Main Menu
```

3 - Pressing the **3** key display the Elapse time of the three filters in minutes. The display will revert to the main menu after 3 seconds.

```
Current Ets(min)
  FIL1   FIL2   FIL3
  1440   1440   1440
```

4 - Pressing the **4** key will display the captured "zero", the differential transducer or Magnehelic. The number is used in a diagnostic routine to determine low flow. The screen will revert to the main menu after 3 seconds.

```
Current MAG Zero(mV)
  A    B    C    D
  5    5    5    5
```

5 - Pressing the **5** key will display the primary and backup operator's initials. The display will show for only about 3 seconds and then reverts to the main menu options.

```
Operator INFO
Primary: 1-PHW
Backups: 2-ABC 3-XYZ
```

6 - Pressing the **6** key will display the change parameters for the sampler. They include the change day, whether the site observes daylight saving and the blue box cartridge sequence. The display will show for only about 3 seconds and then reverts to the main menu options.

```
Change Parameters
DAY: TUE
DST:YES
SEQ:322
```

7 -   Pressing the **7** key will display the controller parameters. They include the site ID, length of time data average and firmware version number. The display will show for only about 3 seconds and then reverts to the main menu options

```
CNTRLR Parameters
INV:1138
AVG  15 min
Firmware: V03.03.01
```

8 -   Pressing the **8** key will display the module parameters. They include the active module designation, and whether the sampler is operating under normal or urban protocols. The display will show for only about 3 seconds and then reverts to the main menu options

```
MODULE Parameters
Active: A B C D E
Protocol: Normal
```

```
Checking Memory Card
Please Standby
```

9-   Pressing the **9** key will check the memory card slot. It will check whether or not the serial flash module is functioning. If the module is malfunctioning it will give a possible reason. The display will show for only about 3 seconds and then reverts to the main menu options

4.1 Filter Readings

When you press the ↑**F1** key, you will be recording the readings of the exposed cassette, replace them with clean cassettes and record the readings of the clean cassettes. You have the option of pressing the **YES** key to continue or the **NO** key return to AUTO MODE.

```
   Filter Reading
        PRESS
YES to Continue
NO to Cancel
```

4.1.1 Exposed filter readings

The screens below appear in the exposed filter reading phase. The first three displays show the sampler preparing to take the exposed filter readings. The second screen will display once the controller takes its own set of exposed filter readings. At this point select your initials. If they do not appear press the **4** key to add your initials into the controller. Once your initials are entered the third screen will appear. Write down on the information the on the logsheets and press the **ENTER** key to proceed.

```
One moment please,
Storing EXPOSED
filter readings
  0% complete
```
```
Select a number
Primary: 1-PHW
Backups: 2-ABC 3-XYZ
Press 4 to add/edit
```
```
USED WEEK:02/04/2003
Logsheet Entry T=95V
02/11/03 10:17am TUE
Hit ENTER when ready
```

The display on the right shows cassette number (**FIL 1**), the pressure readings (**Vac** & **Mag**) and elapsed time (**ET**). You will cycle through the filters by pressing the ←**F3** key to go backwards or →**F4** key to go forwards.

```
Mod(A)
 Cass   Vac Mag  ET
(FIL 1)  13  25 1440
   F3-Bkwd F4-Fwd
```
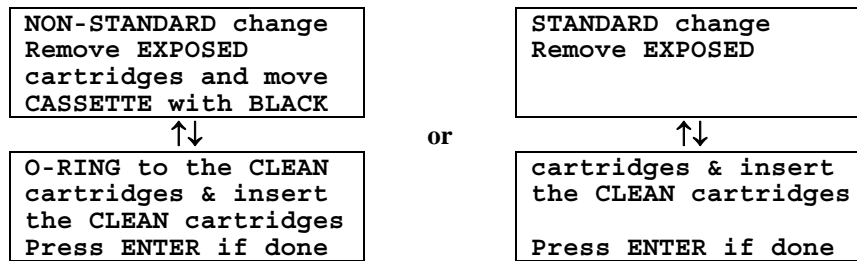
After you press the →**F4** key on the last filter of the last module, the program will offer you the ability to repeat the exposed filter readings or proceed to the next step.

```
F3-GO BACK to take
   EXPOSED readings
F4-Continue with
   CLEAN readings
```

4.1.2 Exchanging cassettes

The next display will show you which bag of cartridges the operator will be inserting into the sampler. After the logsheet information has been taken, the operator will press enter to continue. One of the two boxes shown in figure below will appear. Which box appears depends upon the protocol. After you exchange

```
USE WEEK:02/11/2003
Logsheet Entry T=95V
02/11/03 10:17am TUE
Hit ENTER when ready
```

the cassettes and the flash module (if necessary), press **ENTER** to continue to the initial readings of the fresh cassettes.

```
NON-STANDARD change
Remove EXPOSED
cartridges and move
CASSETTE with BLACK
       ↑↓
O-RING to the CLEAN
cartridges & insert
the CLEAN cartridges
Press ENTER if done
```
or
```
STANDARD change
Remove EXPOSED


       ↑↓
cartridges & insert
the CLEAN cartridges

Press ENTER if done
```

If the operator is starting a fresh Blue Box, the controller will prompt the user to change the flash card with this display.

```
Replace controller's
flash card with the
one in the blue box.
Hit ENTER when done.
```

During the cartridge replacement, the sampler will also detect if a flash module is installed prior to taking the readings for the clean filters. If the sampler does not detect the flash module, the display on the right will appear. If this occurs, reinsert the card and press the **YES** key. If the warning display reappears, press the **NO** key to continue.

```
Warning: No mem card
Insert card then hit
YES to continue.
Press NO if no card.
```

4.1.3 Clean filter readings

Press the **ENTER** key once again, and you will then take the readings on the clean filters. The display on the right shows the displays for the initial readings. You will cycle through each of the filters similar to the exposed filter readings.

```
Continuing with
initial readings
One moment please.
```

```
Mod(A)
 Cass  MxVac Vac Mag
(FIL 1)  40   13  25
    F3-Bkwd F4-Fwd
```
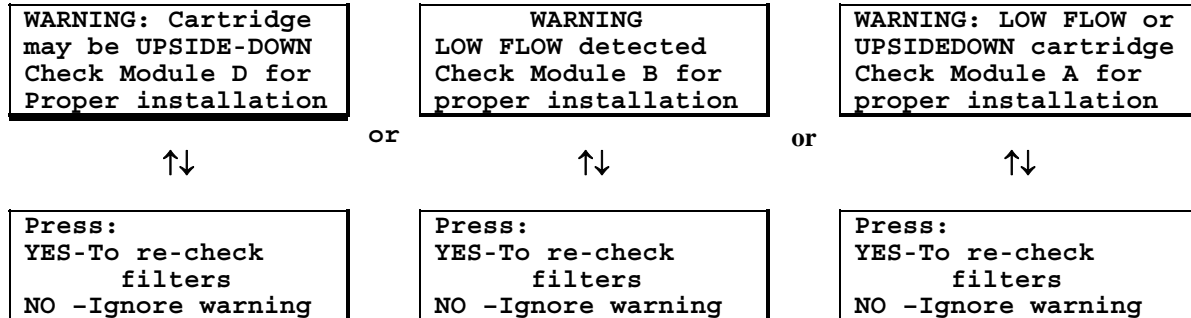
After you press the →**F4** key on the last filter of the last module, the program will offer you the ability to repeat the clean filter readings or finish.

```
F3-GO BACK to take
   CLEAN filter
   Readings.
F4-FINISH
```

4.1.4 WARNINGS

During the clean filter readings, warning messages may appear if the controller detects anything unusual.

```
WARNING: Cartridge
may be UPSIDE-DOWN
Check Module D for
Proper installation
```
or
```
      WARNING
LOW FLOW detected
Check Module B for
proper installation
```
or
```
WARNING: LOW FLOW or
UPSIDEDOWN cartridge
Check Module A for
proper installation
```

↑↓   ↑↓   ↑↓

```
Press:
YES-To re-check
     filters
NO –Ignore warning
```
```
Press:
YES-To re-check
      filters
NO –Ignore warning
```
```
Press:
YES-To re-check
      filters
NO –Ignore warning
```

4.2 Change Date&Time

To change the Date and/or the Time, press the ↓F2 key in the main menu. The top display shows the menu for changing the time. By pressing the ←F3 and →F4 keys, the operator can move the cursor to change the month, day, year, hour or minute. The day of the week will automatic change base of the month, day and year. If you enter an invalid date, the bottom display in figure 8 will be shown.

```
12/01/00 08:00 SAT 3
F1&F2 adjusts values
F3&F4 to move cursor
Press ENTER to write
```

```


INVALID DATE
PUSH ENTER TO CHANGE
```

An invalid date would be to enter a day that does not exist in the month (i.e. 2/30 or 9/31).

4.3 Advanced Menu

Pressing the ←F3 key in the main menu accesses the Advanced Menu. The advanced menu should not be accessed unless authorized by UC Davis. Depending upon the code, you can take a manual or auto calibration, reset elapse timers or set the site configuration parameters. There are two separate Advanced Menus that are accessed by two different access codes.

```
Authorized use only
 Please enter code:
       ****
```

Access Codes:

1123 – Complete a manual calibration, set site configuration parameters and get zero flows.
9051 – Reset or adjust elapse timers, Operator initials, E-Mag Audit

4.3.1 **Site configuration, manual calibration/audit and get zero flows (Code: 1123)**

Once accessed, the operator will be able perform calibrations on the sampler by
pressing the ↑**F1** key. Section 4.3.2.1 Calib will describe this in depth. Pressing
the ↓**F2** key will allow the operator to change the sampler program based on the
sampler's configuration. Section 4.3.2.2 Site Config will describe this in depth.
Pressing the ←**F3** key will allow the operator to set the zero flow readings for each
module. Section 4.3.2.3 Get Zero flows will describe this in depth.

```
F1=Calib
F2=Site Config.
F3=Get Zero flows
ENTER=Main Menu
```

4.3.1.1 **Manual audit/calibration (Code: 1123)**

The sampler should be loaded with a set of calibration cassettes before beginning.
Pressing the ↑**F1** key in the advanced menu will activate the calibration mode of
the sampler. Pressing the **YES** key will move you from filter to filter. It will
cycle through all the modules. If the operator misses a reading in one of the
modules, they must cycle through the other modules in order to return to the

```
Mod(A) ENTER to exit
Cass        Vac  Mag
(FIL 1)     15.3 25.7
   F3-Bkwd F4-Fwd
```

missed reading. Future versions of the software will fix this to make it easier to jump from module to module.
After the calibration readings are taken, press **ENTER** to return to the site configuration/calibration menu.

4.3.1.2 **Site Config (Code: 1123)**

This menu will allow you to change the Serial Number, time average, sample change day, module type and daylight
saving settings.

Serial number: Enter the 4-digit site code assigned by UCD.

```
  Enter SERIAL NO.
  Then press ENTER
SITE CODE: 1138
```

Protocol: Select "Normal" or "Urban" sample collection protocol.
Selecting Normal sets the sampler to collect an uninterrupted
sample for 24 hours. Selecting Urban will sets the sampler to
collect a sample 15 minutes out of every hour for 24 hours.
This is to reduce the chance of clogging.

```
Select protocol
*Normal   Urban
F3&F4 to change
Press ENTER to save
```

Time average: Enter the time interval, which the data will be reported to the
serial flash module. Typically the value will be 15 minutes.

```
Enter time avg(mins)
  Then pres enter
  Max: 1440 min
 15 minutes
```

Change day: This is day that you would change the sampler. This will be set
to Tuesday unless otherwise specified by UCD.

```
Change Day ON:  TUE
F1&F2 Select Weekday
For Change Day
Press ENTER to save
```

Module type: This screen will allow you to assign letters to the samplers.
Press ENTER to save.

```
Select Module Types
MOD 1 2 3 4 5
    A B C D
```

Daylight Saving: If the site observes daylight saving time, select yes. If the site does not (AZ, HI, parts of Indiana), select no.

```
 Daylight saving?
Press YES or NO
YES
Hit ENTER to accept
```

```
BLUE BOX Sequence
Select from one:
1-322 2-232 3-None
Current order:322
```

Box sequence: This screen allows the user to set up the cartridge sequence of the blue box. You have only two main choices here. If the user presses ENTER, no cartridge sequence is selected.

Firmware: The final screen shows the firmware version plus the sampler serial number, time average and module type.

```
CNTRLER Parameters
INV:1138
AVG  15 min
Firmware: V03.02.01
```

4.3.1.3 Resetting or adjusting elapse timer (Code: 1123)

This option allows you to set the zero flow potentiometers values. This is used to determine the low flow setting in the clean filter diagnostic routine. Press enter to accept each of the modules available.

```
Readings for Mod(A)
            Vac  Mag
ZERO FLOW:  5.0 10.0
ENTER – Record zero
```

4.3.2.1 Resetting or adjusting elapse timer (Code: 9051)

This option allows you to reset or change the elapse times of the three filters. A display will show for each of the three individual filters. A final screen will show the times of all three timers. The final screen will appear for about 3 seconds and then returns to the main menu.

```
OLD ET[1]=   0 min
Enter NEW ET below

NEW ET[1]=   0 min
```

4.3.2.2 Operator intials (Code: 9051)

This menu allows you to add or edit the operators initials. You are allowed to make as many edits as necessary.

```
Press # edit/add
Primary: 1-PHW
Backups: 2-AAA 3-BBB
ENTER-Return to Menu
```

```
Operator 1: PHW
F1&F2 adjusts values
F3&F4 to move cursor
Hit ENTER to accept
```

4.3.2.3 **Electronic calibration/audit (Code: 9051)**

The electronic requires an electronic calibration device, serial flash module reader and a DOS PC with a free parallel port. The PC should be loaded with correct software to read and interpret the flash module. Once you enter the code in the advanced menu, the sampler will initialize and then prompt you to insert the audit probe into a sampler and connect the cable to a port on the controller.

```
Auto calib mode
Initializing...
```

```
Please remove data
card and replace w/
the audit card.
Hit Enter when done.
```

Repeat the steps below as necessary to audit each module

```
Insert Probe into
Mod(A) & plug calib
into Mod(E). Press
any key when done.
```
$\rightarrow$
```
Equalizing pressure
```

```
Set Nom for Mod(A)
CASS CalMag Vac  Mag
(F1)  25.2 13.6 26.9
F3-Bk F4-Fw ENT-Exit
```
$\rightarrow$
```
One moment please
Taking 4 point audit
```

Once the points are collected, the sampler will prompt you to replace the serial flash module and then return to Auto Mode.

```
Remove the audit
flash card and
replace w/ data card
Hit a key when done.
```