RST INSTRUMENTS LTD.

C109
Pneumatic
Readout
Instruction Manual

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C109 Pneumatic Readout

Although all efforts have been made to ensure the accuracy and completeness of the information contained in this document, RST Instruments reserves the right to change the information at any time and assumes no liability for its accuracy.

Product: C109 Pneumatic Readout

Document number: PPM0031B C109 Pneumatic Readout Instruction Manual.doc
Revision: B
Date: April 4, 2017

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1 OVERVIEW

The RST C109 Pneumatic Readout Instrument retains all the functionality and features of the RST C108 Pneumatic readout with the added feature of USB connection.

The C109 Digital Pneumatic Readout monitors all pneumatic transducers. The standard FC-100 automatic flow controller ensures accurate, repeatable readings, independent of operator error. As the correct flow rate is critical, the FC-100 controls the flow regardless of back pressure or tubing length. The unit incorporates an internal pressure cylinder which can be refilled without needing to be removed. A filler hose is supplied with the unit and no additional regulators are required to fill the internal cylinder.

Complementing its high level of accuracy, the C109 is also designed for maximum efficiency with the user in mind. The C109 comes well-equipped with standard features such as a large graphics display with backlight.

The C109 is a precision instrument and should be treated as such. It should be protected against shock and heavy vibration. Its case is water resistant; however care should be taken to avoid getting the open unit wet, as damage to internal components could occur.

For any repair, the unit should be returned to the manufacturer as there are no user serviceable parts. In the event that the unit is disassembled by the user the warranty will be void.
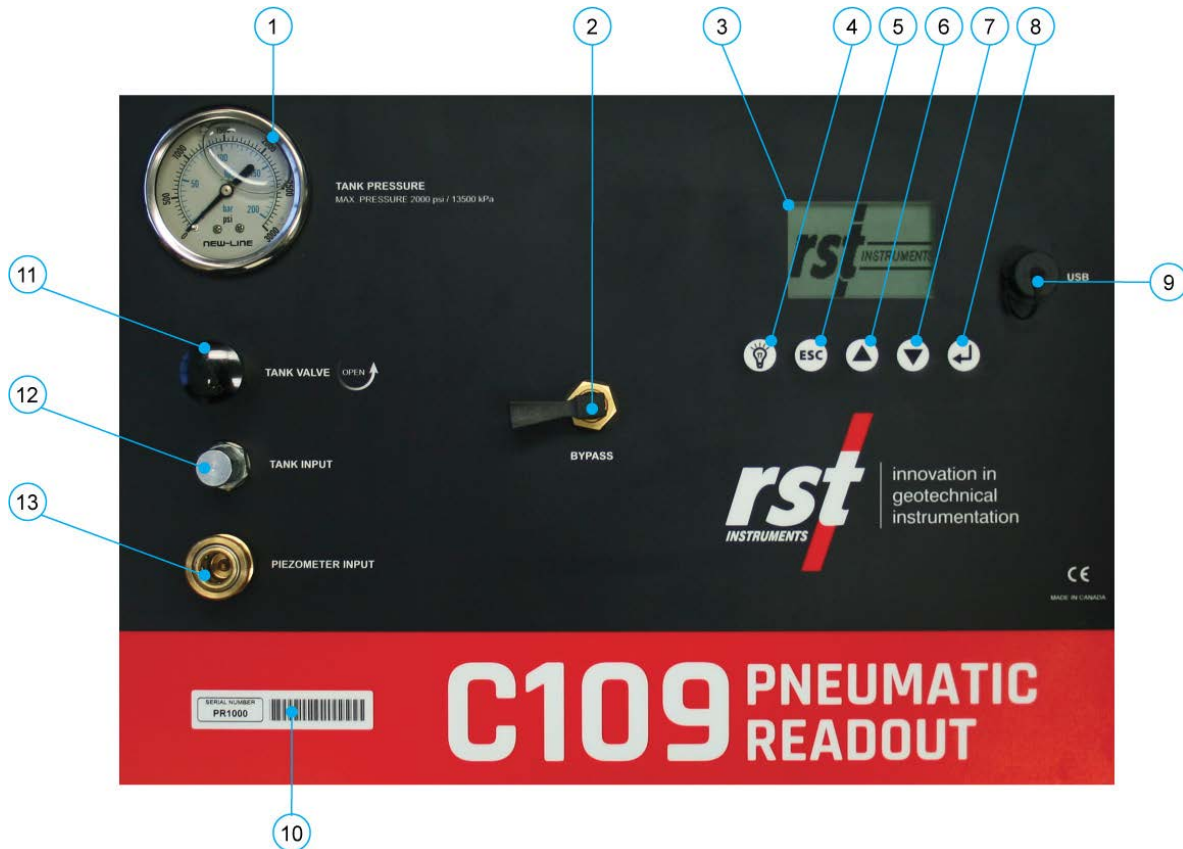
Figure 1 – C109 Readout

1. Internal Tank Pressure   2. Bypass Valve

3. Display Screen

4. Backlight

5. ESC (navigates back a menu)

6. Scroll Up

7. Scroll Down

8. Enter

9. Serial Connection (USB)

10. Serial Number Plate/Calibration Date

11. Tank Valve

12. Tank Input

13. Piezometer Input

2 QUICK START INSTRUCTIONS

The following instructions outline the basic steps needed to take and store readings with the C109 Pneumatic Readout with the appropriate references to sections in the manual:

- Install the Multireadout Host Software on a Desktop or Laptop PC (refer to Multireadout Host Software Instruction manual).

- Connect to the C109 via a USB port.

- Using the software, enter the list of locations (boreholes) as they appear on site (refer to Multireadout Host Software Instruction manual).

- Upload the information to the C109 Readout (refer to Multireadout Host Software Instruction manual)

- Fill the internal tank with CO2 or Nitrogen (section 3).

- Take the readout to the field and record readings in the locations that were setup with the software. Else, create generic locations in the field (section 8).

- When finished, return to the office, connect to the C109 Readout with the host software and download the data (refer to Multireadout Host Software Instruction manual).

- When finished downloading, make any changes (if needed) and **upload to the readout.** During the upload, the software will prompt if you would like to erase all data on the readout except previous readings. Erasing the historical data ensures that data will not be duplicated in the *.csv file the next time the readout is downloaded.

- Make any changes or additions to location information and save the configuration. If there are no changes, do not save to avoid duplicate data in the *.csv file. Close the program.

- Open the *.csv file automatically created by the software (in the default directory) with Microsoft Excel, sort and plot the data (refer to Multireadout Host Software Instruction manual).

3 PRESSURIZING THE INTERNAL SUPPLY TANK

The RST C109 Pneumatic Readout Instrument will operate with most compressed, dry gas (except oxygen and oil-pumped nitrogen). Water-pumped nitrogen and carbon dioxide are the two gases most generally available.

Nitrogen is obtainable through industrial gas or welding supply outlets, with CO_2 available at industrial gas or fire extinguisher suppliers. As we recommend the use of Grade K (certified dry) nitrogen, a filler hose with fittings for nitrogen tanks is provided with the instrument, unless otherwise requested.

Please note there is no industry standard for N_2 fittings. Both common types are provided with the RST C109 Pneumatic Readout, however, we recommend compatibility be verified.

3.1 Maximum Safe Working Pressure

The maximum safe working pressure for the instrument is 2000 PSI (13 500 kPa). This pressure is monitored on the TANK PRESSURE gauge.

Warning
Do not exceed 2000 PSI (13 500 kPa) or serious damage to the instrument or personal injury can result.

3.2 Pressurizing with Nitrogen

1. Connect the supplied filler hose to a (water-pumped) nitrogen cylinder, tightening the nut securely. Remove protective cap from TANK INPUT connector and attach the other end of filler hose.

2. Open the TANK VALVE.

3. Slowly OPEN nitrogen cylinder valve and observe the TANK PRESSURE gauge. Fill tank to 2000 PSI (13 500 kPa) maximum, and CLOSE nitrogen cylinder valve.

4. Close the TANK VALVE.

5. Loosen filler hose at cylinder and allow pressure in hose to bleed off. Disconnect hose and replace protective plug cap on TANK INPUT connector.

6. Replace protective cap on TANK INPUT.

3.3 Pressurizing with Carbon Dioxide

7. Connect the filler hose to a carbon dioxide cylinder, tightening the nut securely. Remove protective cap from TANK INPUT connector and attach the other end of the filler hose.

Note
If the recharge cylinder contains liquid CO_2, ensure the cylinder remains in an upright position so that no liquid CO_2 within the cylinder can rupture the gauges.

8. Open the TANK VALVE.

9. Slowly open carbon dioxide cylinder valve and observe the TANK PRESSURE gauge. Carbon dioxide usually remains at approximately 835 PSI (5757kPa) at room temperature, but can attain higher pressure with increasing temperature. Fill the tank and close carbon dioxide cylinder valve.

10. Close the TANK VALVE.

11. Loosen filler hose at cylinder and allow pressure hose to bleed off. Disconnect the hose and replace protective cap on TANK INPUT connector.

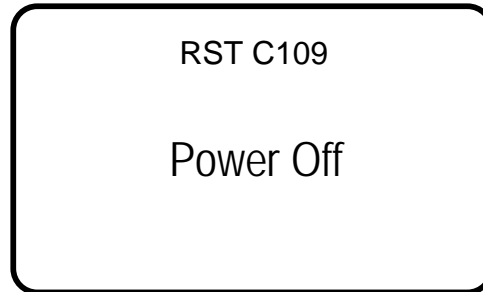## 3.4 Shipment of Pressurized Tanks

The shipment of pressurized tanks is controlled by government Restricted Articles Regulations. A shipper's certification for Restricted Articles may be required, especially for air shipment unless packaging and labeling complies with Transport Restricted Articles Tariff No. 6D, CAB No. 82. Information and necessary documentation can be obtained from individual carriers.
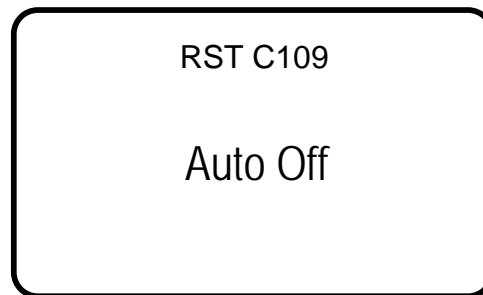
4 POWERING ON/OFF

The C109 readout can be powered on anytime by pressing any key. The unit can be powered off manually or automatically. To power off manually, use the up/down arrows to scroll to the following screen:

```
┌─────────────────────────────┐
│                             │
│          RST C109           │
│                             │
│         Power Off           │
│                             │
│                             │
└─────────────────────────────┘
```
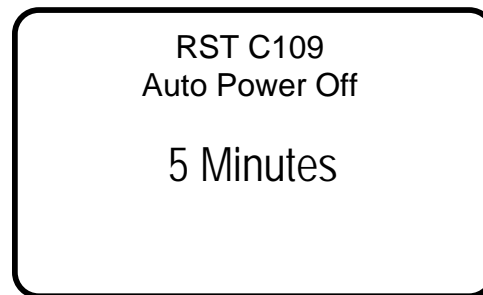
Figure 2 – Manual Power Off

- Press *Enter* and the unit will turn off.

- To adjust the automatic power off settings, navigate to the *Auto Off* screen as shown below:

```
┌─────────────────────────────┐
│                             │
│          RST C109           │
│                             │
│          Auto Off           │
│                             │
│                             │
└─────────────────────────────┘
```

Figure 3 – Auto Off Screen

- Press *Enter* and the following screen will appear:

```
┌─────────────────────────────┐
│          RST C109           │
│        Auto Power Off       │
│                             │
│         5 Minutes           │
│                             │
│                             │
└─────────────────────────────┘
```

Figure 4 – Auto Power Off Time

Use the arrow keys to scroll to the desired auto power off time. Please note that the auto power off feature is always active and cannot be disabled. This is to conserve battery life. The default is 5 minutes. The next screen prompts to set the Auto Backlight Off:
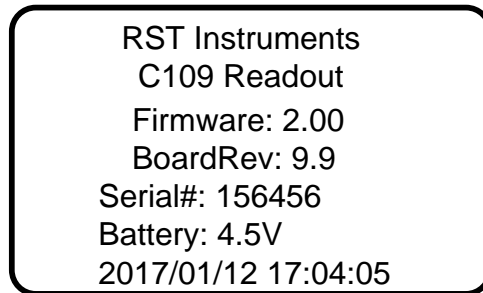
```
RST C109
Auto Backlight Off

10 Seconds
```
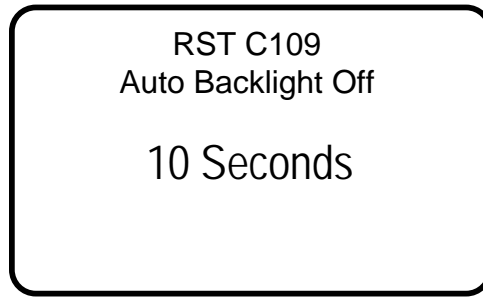
Figure 5 – Auto Backlight Off

Use the up/down scroll buttons to adjust.

5 C109 FRONT PANEL CONTROLS

5.1 Startup

Upon powering on the unit (by pressing any key), an opening screen will appear showing the RST Instruments logo. If the user wishes to view the details of the readout *press any key* immediately and the following will appear:

```
RST Instruments
C109 Readout
Firmware: 2.00
BoardRev: 9.9
Serial#: 156456
Battery: 4.5V
2017/01/12 17:04:05
```

Figure 6 – C109 Readout Details

This displays the model, version number, serial number and the current date/time settings. It is always a good idea to ensure that the date and time are correct, as this may affect any readings being stored in memory on the unit. Refer to section 5.2 for setting the date and time.

Upon connecting of the pneumatic sensor, readings will display as shown below.

```
RST C109     22.6 ºC

4.46   psi

2017/01/17  10:43:02
```
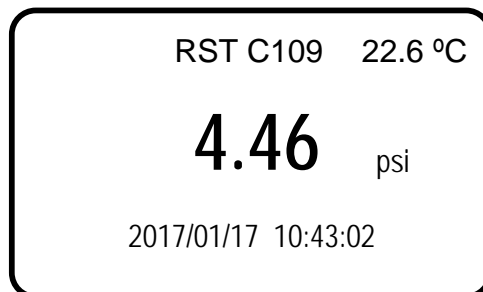
Figure 7 – Readings Screen

The readings screen displays the current pressure reading (assuming an instrument is connected).
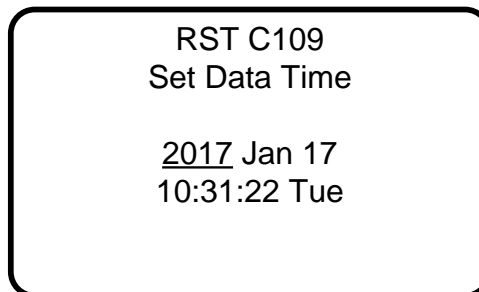
5.2 Setting the Date & Time

Keeping the date and time current ensures that you have accurate historical records of your data. Whenever a reading is taken and stored in the units' memory, an associated date/time stamp is always included.

- Turn on the readout by pressing any key.

- Using the arrow keys, scroll down to the *Set Time* screen and press *Enter:*

```
RST C109


Set Time
```
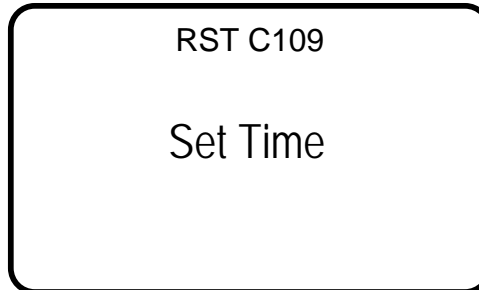
Figure 8 – Set Time

- The current editable data field will have an underline, use the arrow keys to modify the field and press enter when complete (pressing enter cycles through each field).
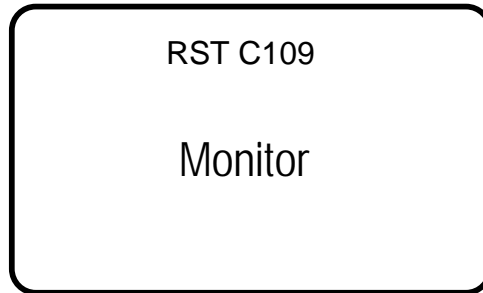
```
RST C109
Set Data Time

2017 Jan 17
10:31:22 Tue
```

Figure 9 – Date/Time Set

- When complete the program will exit to the main menu screen.

6 MONITOR SETTINGS

Various parameters of the C109 readout can be adjusted by selecting the *Monitor Settings* menu as shown below:

```
RST C109


Monitor
```

Figure 10 – Monitor Settings

Press *Enter* to choose whether a custom or predefined setting is required.

```
RST C109
Monitor Settings

> 1) Import From Site
  2) Default Settings
  3) Exit
```
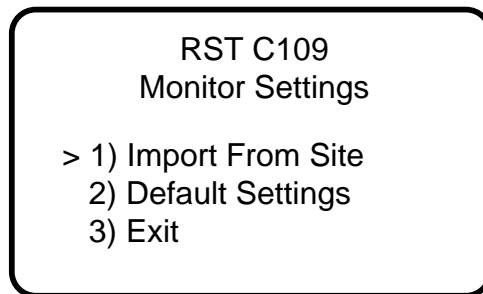
Figure 11 – Monitor Settings Options

- Select *Import From Site* to copy settings from existing location.

- To reset settings to default, select *Default Settings*. Monitor readings will have no zero reading and Psi units.
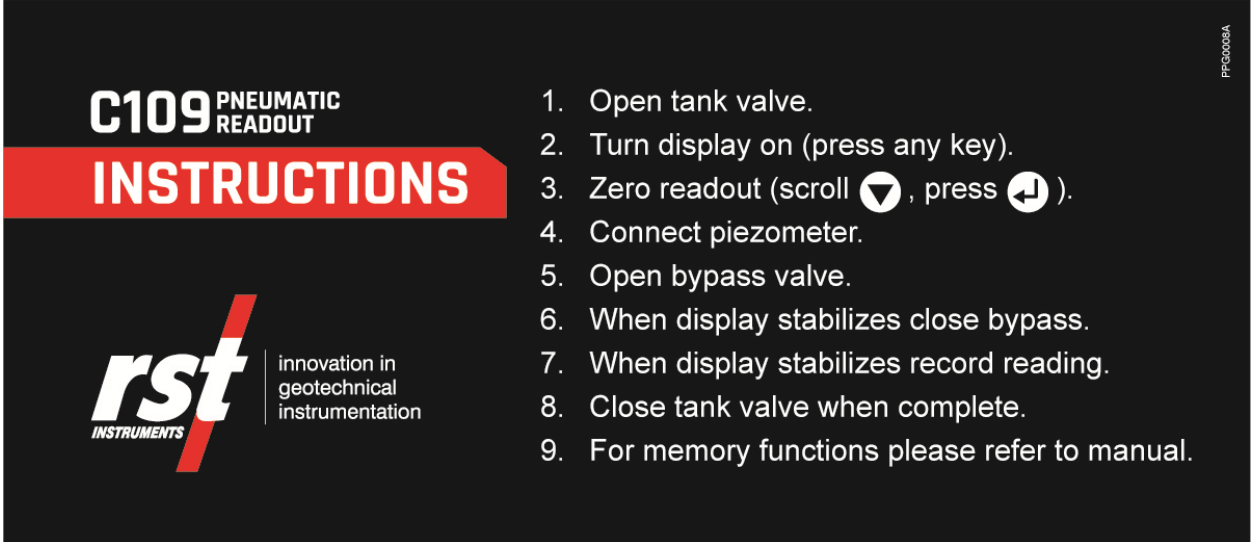
- Select *Exit* to go back to previous menu.

The sample monitor screen is shown below.

```
RST C109      22.6 ºC

4.46    psi

2017/01/17  10:43:02
```
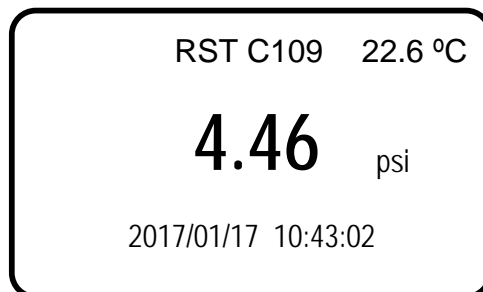
Figure 12 – Monitor Display

7 MANUAL READINGS

The instructions for performing a manual reading (i.e. not storing to memory) are found on a decal placed on the inside of the lid of the instrument as repeated here:

Figure 13 – C109 Quick Start Instructions

1. Open tank valve
2. Turn display on (press any key)
3. Zero readout (scroll *Down*, press *Enter*)
4. Connect piezometer
5. Open bypass valve
6. When display stabilizes close bypass
7. When display stabilizes record reading
8. Close tank valve when complete

Record the reading in your field notebook when complete.

For memory functions, please refer to section 8.

8 STORING READINGS IN MEMORY

The C109 has 128k of internal memory allowing it to store over 11 000 time-stamped, readings. The current memory usage is displayed on *Memory* screen, as shown in Figure 16. Data can be reviewed either on-board or downloaded to a host computer via the USB connector. Individual locations can be preconfigured in the office via the Multireadout Host Software or by creating locations on the unit itself (section 10).

9 ZERO READOUT

Connect to appropriate sensor, and then use the arrow keys to scroll to *Zero Readout.*

```
RST C109


    Zero
  Readout
```
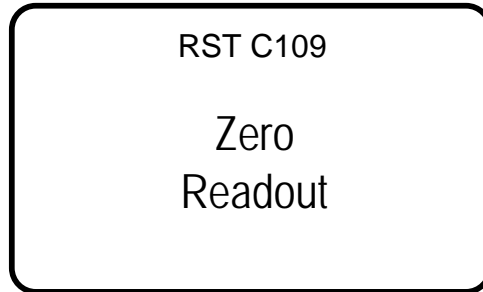
Figure 14 – Zero Readout

- Press *Enter.* The following screen will appear:

```
Zero Readout        43

             13.05
  0.865      psi


 Press enter to zero
```
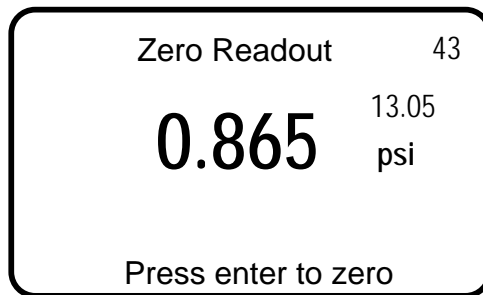
Figure 15 – Zero Readout – select location

- Press *Enter* to store the reading.
- After storing the reading, the C109 will return the user to the Monitor screen.

10 CREATING MEMORY LOCATIONS IN THE FIELD

The C109 Readout has the ability to be either pre-configured in the office (through Host Software), or taken directly to the field. If taken directly to the field, each location will be assigned a generic name which is editable once back in the office and connected to a host computer. In most cases it is recommended that the C109 be pre-configured in the office prior to taking readings in the field. In this manner, site location names can be setup ahead of time allowing the field personnel to be able to arrive at instrument locations, and store readings without needing to create a location in the units' memory.

If the C109 has not been pre-configured in the office, the following instructions explain how to create new locations. Please refer to Figure 33 (flow chart) for a graphical representation of the steps outlined below:
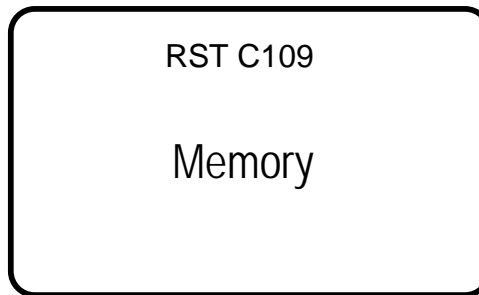
- Turn on the readout by pressing any key.

- Using the arrow keys, scroll to *Memory* and press *Enter*.

RST C109

Memory

Figure 16 – Memory Screen

- Press *Enter* to advance to the next screen.

- Using the arrow keys, scroll to *Create Location* and press *Enter*.

Note
The maximum number of predefined locations is 254.

RST C109
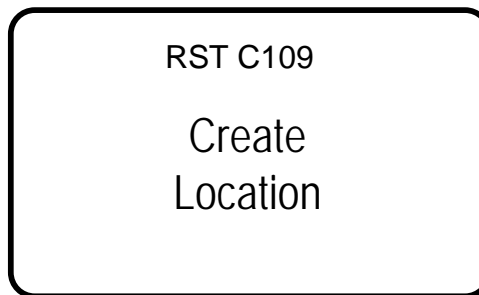
Create
Location

Figure 17 – Create Location

- The readout unit will automatically create a site called *Location X* where '*X*' is the next storage location available in the units' memory. Please note that when creating new sites in the field, you can only name them *Location X*. Make note of the real location name in your field notebook and its relation to the *Location* number. When connecting to the Host Software back in the office, a custom name can be entered at that time. This replaces the site name assigned by the readout.

```
RST C109
Location 1

Output Units:  psi
```
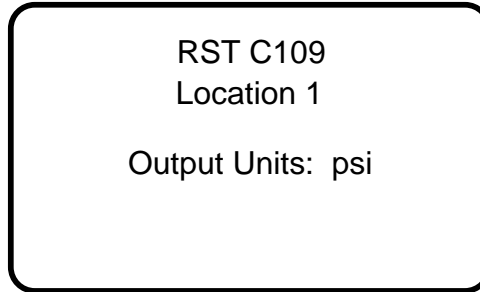
Figure 18 – New Location units

- The C109 automatically increments the new location to the next number available.

- Select desired units using arrow up and down keys, then press Enter

```
RST C109
Location 1

Precision:        2
```
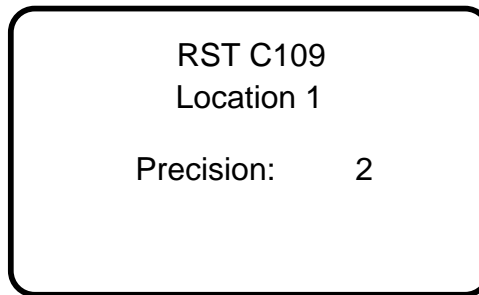
Figure 19 – New Location precision

- Select precision using arrow up and down keys, then press Enter

- Press *Enter* and the unit will return to the previous menu.

Note

Sensor label and sensor serial number can only be set using the Multireadout Host Software, please refer to the Host Software manual for further information.

10.1 Store Readings

- Use the arrow keys to scroll to *Store Data* and press *Enter.* The following screen will appear:

```
RST C109
Location 1
Units :        psi
Prev :         3.3
Date:          2017/01/17
SN  : ...
Label : ...
```
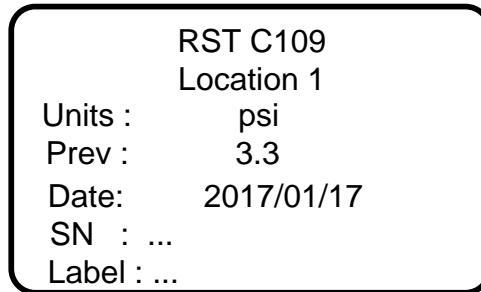
Figure 20 – Select Location

- Use the arrow keys to select location. When the desired location is found, press *Enter* to select it. The following will appear:

```
Press ENTER to accept

                        13.05
    0.865              psi


2017/01/12 17:04:05
```

Figure 21 – Storing a Reading

- Reading time and zero value are displayed for a reference.

- The C109 will prompt you with the question: *Press Enter to accept*, press *Enter* to store the reading.

- After storing the reading, the C109 will return the user to the previous screen.

10.2 Reviewing Data

To review any reading on the C109 unit itself, please follow these instructions:

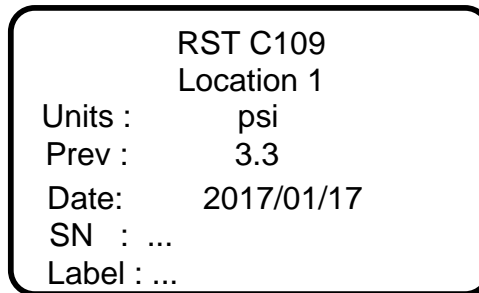- Power on the readout by pressing any key.

- Using the arrow keys, scroll down to *Memory*, press *Enter.*

- Scroll to *Review Data* and press *Enter.*

- Scroll to the desired location (using arrow keys). If the previous reading session was downloaded using Host Software, the *Prev* value shows last reading in previous session. Refer to Multireadout Host Software manual for instructions.
  If present, zero reading is displayed along with recording date.

- Press *Enter* to display recorded data.

```
          RST C109
          Location 1
Units :        psi
Prev :         3.3
Date:      2017/01/17
SN  : ...
Label : ...
```

Figure 22 – Select a Location

- If the location contains more than one reading, these readings can be scrolled through using the arrow keys. The date and time of each reading will appear to differentiate each reading.

```
      Review Data        6
      Location 1
                    21.1°C
     0.865    psi


   2017/01/12 17:04:05
```
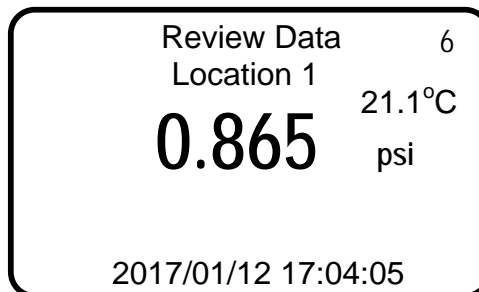
Figure 23 – Reviewing Data
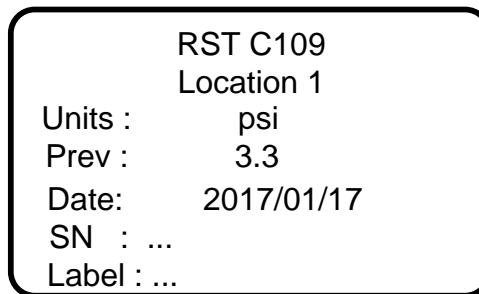
10.3 Datalogging

The C109 has a basic datalogging function where the user is able to set the datalogging interval and the number of iterations.

- From the C109 main reading screen scroll to *Memory* and press *Enter*.

- Use the arrows to scroll to the Auto Store Data screen as shown below and press *Enter*.

RST C109

Auto
Store Data
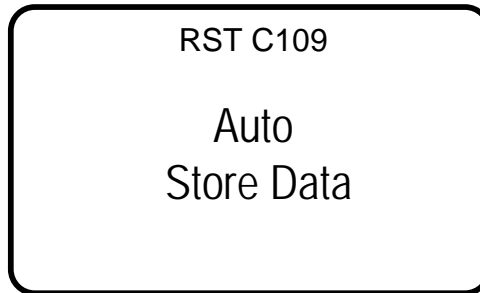
Figure 24 – Datalogging Screen

- Choose a location you wish to record data to by using the arrow keys. If no locations are currently set-up, the readout will respond with "No Locations". Proceed to setup a location as described in section 10.

RST C109
Location 1
Units :   psi
Prev :   3.3
Date: 2017/01/17
SN   : ...
Label : ...

Figure 25 – Datalogging Screen Location selection

- First set the *Interval* but using the arrow keys. Holding down the arrow keys make the digits scroll faster. Press *Enter* when complete.

RST C109
Auto Store Data
Interval

00:00:04

2017/01/12 17:04:05
Max Interval = 1 hour
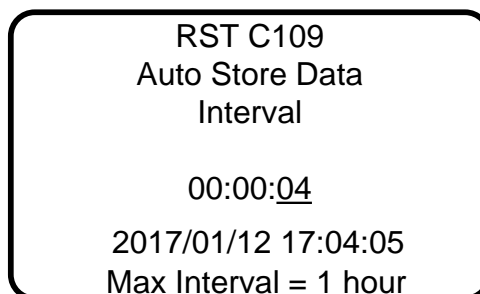
Figure 26 – Datalogging Interval

- Once the interval is set, press *Enter* and the following screen will appear:

```
RST C109
Auto Store Data
Number To Store

50
Stop On Memory Full=0
2017/01/17 17:04:05
```

Figure 27 – DataLogging Number

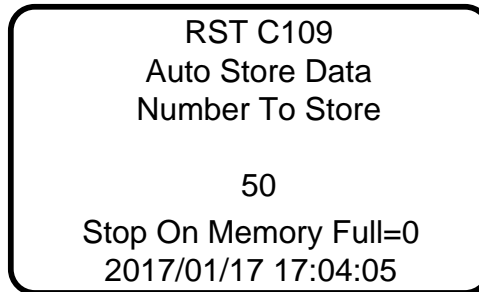- Use the arrow keys to select the number of iterations you wish the readout to datalog (in the above case, it will take 50 readings at a 4 second interval). To continuously datalog until the memory is full, select 0. After pressing *enter* the readout will start the datalogging process and will end with "logging completed". ESC can be pressed at any time to abort the datalogging process.

- Datalogging can also be accessed through the *Store Data* screen (once the intervals have been created as described above). Scroll to *Store Data* and select the location were you would like to datalog. Press *Enter.*

- Press and HOLD the enter button to commence datalogging. The screen will appear as follows:

```
Logging 2               14:18:17

         4.46      psi
```
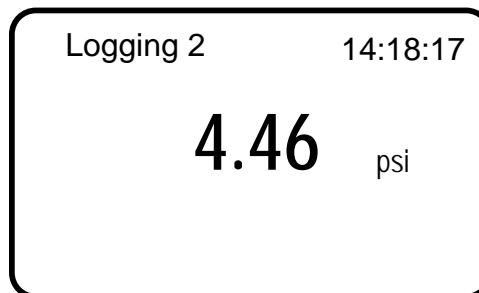
Figure 28 – Logging Screen

- During datalogging, the logging number will increase with the corresponding time stamp being updated in the upper right-hand corner of the screen.

- Once logging has finished, the following will appear:
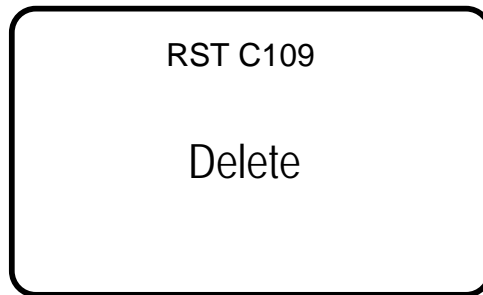
```
Logging
Completed
```
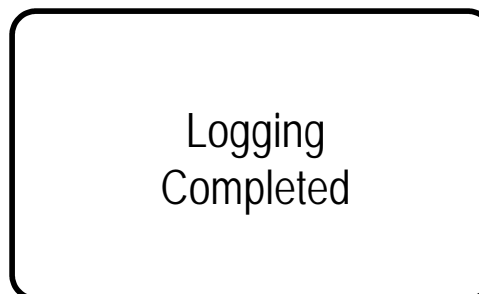
Figure 29 – Logging Completed

- Once datalogging is complete, the readout will automatically turn off according to the *Auto Off* setting (section 0).

10.4 Deleting

All location information can be deleted from the C109 readout or via the host Software. This is done by the following:

- Power on the display by pressing any key.

- Using the arrow keys, scroll down to *Memory*, press *Enter*.

- Using the arrow keys, scroll to *Delete* and press *Enter*.

RST C109

Delete

Figure 30 – Delete

RST C109
Delete Memory

1) Exit
2) Delete all data.
3) Delete all data
   and locations.
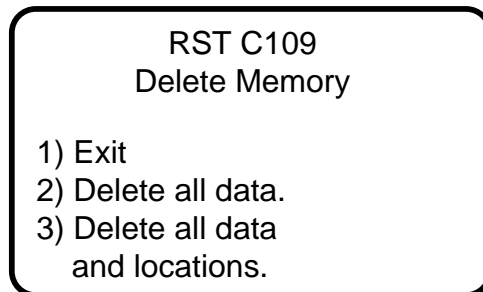
Figure 31 – Delete Options

- Using the *arrow keys*, scroll to the desired delete option and press the *Enter* key to select. Press *Enter* to confirm, press *ESC* to exit back to the main menu.

11 C109 INTERNAL BATTERY

The battery is contained inside the readout case. The inside of the case is inaccessible to the user and the battery is not removable. **Do not attempt to remove the battery.**

```
┌─────────────────────────────────┐
│   RST C109          99%          │
│                                  │
│     3.60   Volts                 │
│                                  │
│              0  14:18:17         │
└─────────────────────────────────┘
```
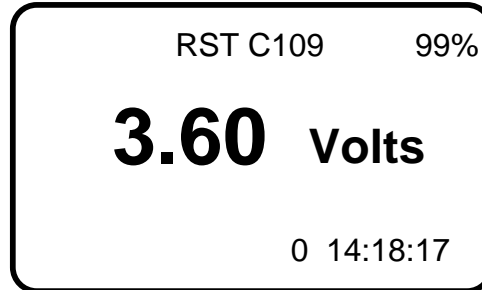
Figure 32 – Battery Voltage

Note
If the battery voltage drops below 3.5 volts a low battery warning will be displayed in the form of "BATT" in the upper right of each screen. Send the readout to RST Instruments for battery replacement.

12 SOFTWARE & FIRMWARE UPDATES

The C109 readout is designed such that the unit's software and firmware can be easily updated by the customer through the USB port. Please regularly visit: http://www.rstinstruments.com for product updates.

13 WARRANTY

RST Instruments Ltd. reserves the right to change the price or modify the specifications of its equipment without notice.

RST Instruments Ltd. agrees, for a period of 12 (twelve) months from the date of purchase, as evidenced by the date of the invoice, to replace any equipment which fails or malfunctions as a result of defects in materials or workmanship when that equipment has been serviced or installed by the servants or agents of RST Instruments Ltd. The agreement to replace herein contained does not apply to the compensation or any portion of installation or site preparation

There is no warranty, representation, or condition of any kind, expressed or implied with respect to the equipment or the accuracy or longevity thereof, except that of replacement as stated above. RST Instruments and its servants or agents will not be liable for any special, indirect or consequential damages arising from the servicing or installation of the equipment, nor shall recovery of any kind against the said company be greater in amount than the purchase price of the specific equipment purchased which allegedly caused the damage. The purchasers assumes all risks and liabilities for any loss, damage or injury to persons or property of the purchasers or others, however caused, arising out of the use or possession of any equipment supplied by RST Instruments Ltd. save and except the agreement to replace contained herein.

14 CONTACT US

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15 APPENDIX A – C109 MENU FLOW CHART

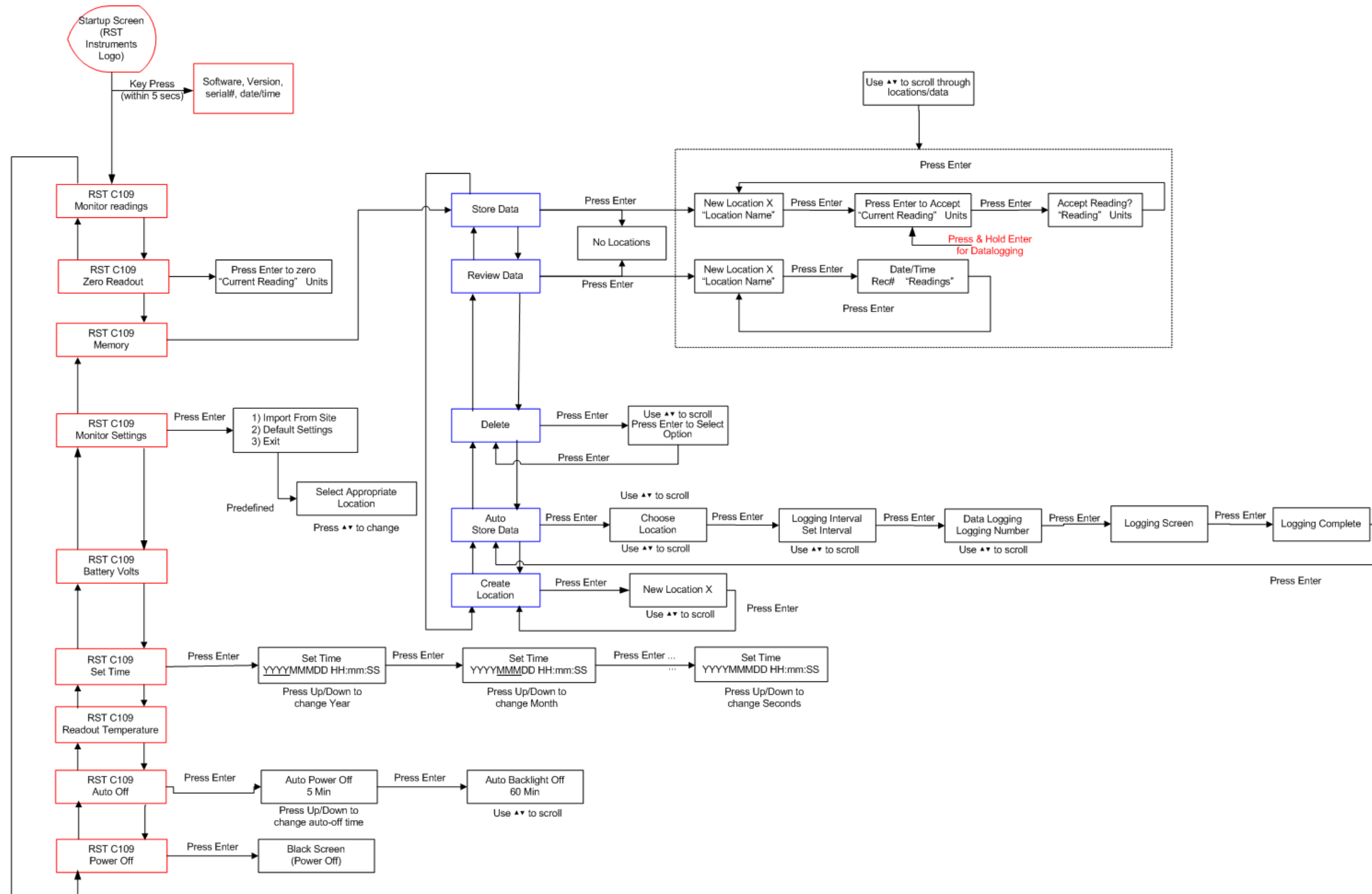The following flow chart outlines all functions of the C109 front panel controls:

Figure 33 – C109 Menu Flow-Chart

16 APPENDIX C – SPECIFICATIONS

Description	Specification
Display	Graphic 128 x 64 pixels large character display
Display Backlight	High efficiency LCD with auto off
Memory	128 kB
Max Instrument Locations	254
Memory Capacity	6500 custom labeled points
Location Identification String	Up to 20 characters
Download Speed	15 seconds (full memory)
Battery	3.6 lithium internal battery pack
Battery Indicator	On-screen low battery indicator
Operating Temperature	-20 ºC to 60 ºC
Dimensions	W 43cm x D 35.5cm x H9.5cm (17.0 x 14.0 x 3.75in.)
Weight	9.1 kg (20.2 lbs)