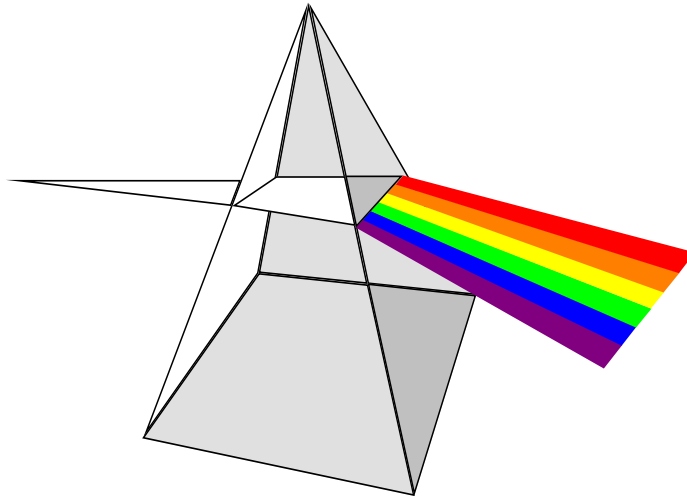


# **RS1000 INSTALLATION AND INSTRUCTION MANUAL**



**The Innovative Technology Group  
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## RS1000 Installation and Operation Manual

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## **ITG**

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### **Warranty, Exclusions and Limitations**

ITG warrants workmanship and materials to be free from defects for a period of one year from the date of shipment.

Excluded from the warranty coverage are products a) which have been subjected to mechanical, electrical or other misuse or abuse b) which have been disassembled or repaired or attempted to be, by other than ITG authorized servicing agents.

The foregoing warranty shall be in lieu of all other warranties, expressed or implied, and the Corporation expressly disclaims any warranty for merchant ability or fitness for a particular purpose.

Unless otherwise agreed in writing by the Corporation, repairs and replacement parts provided by the Corporation under its warranty shall be guaranteed only for the non expired portion of the original warranty on the repaired product.

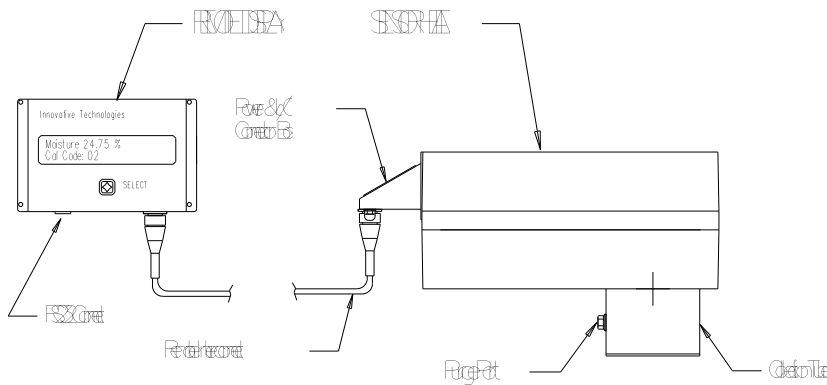
The liability of ITG to any purchaser or user of its products shall not in any case exceed the cost of correcting defects in a product as herein provided and, upon expiration of one year from the date of sale, all such liability shall terminate. In no event shall the Corporation be liable for interruption of operations, loss of profit, or special or consequential damages.

## **Introduction**

Congratulations on your purchase of the RS1000 constituent analyzer. This rugged instrument will provide you with years of accurate and reliable service.

## **Sensor Components**

The RS1000 is a Process ready constituent analyzer. It comes configured to measure constituents such as moisture, fat/oil and protein. A wall mountable remote interface display box complete with alphanumeric display and 4 way menu driven control can be provided in lieu or in addition to a computer interface.



## Setup/Installation

**General Instructions:** After unpacking, the user can implement the following progression:

1. Complete the review of this manual.
2. Find a suitable mounting location for the sensor head and the remote display box.
3. Site the sensor for proper light collection and sensor to sample distance. (*Refer to siting under the Installation section*)
4. Provide for power and any input/output wiring required. (*Refer to the Installation section and wiring diagrams*)
5. Decide on a plan for presentation of calibration samples to the sensor head via sample preparation or process variation. (*Refer to the Calibration section*)
6. Use the Calibration routine menu to acquire sample data, edit in the Lab values, run regression and save the generated calibration to a particular product code. (*Refer to the Calibration section*).
7. Return to the Home menu, change the PROD Code to the Code number you saved the calibration to.
8. If using the outputs, make sure they are wired correctly. Set the output mappings according to your expected process ranges. (*Refer to the Cal Parameters menu section and the output wiring diagram*)

**Restrictions:** The user should observe the following performance restrictions when installing the RS1000:

*Stray light:* The sample under observation should not be exposed to relatively strong infrared light or direct sunlight while in operation.

*Temperature:* The RS1000 is designed to operate between 35° and 122° F. Custom ranges available upon request.

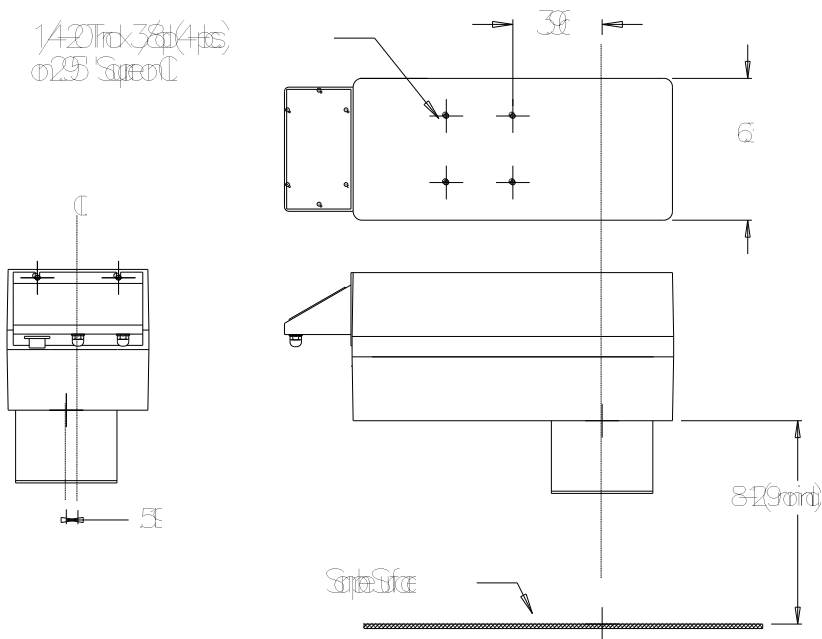
*Humidity:* The RS1000 must be kept free of moisture. Condensing conditions must be avoided for most applications. If the product under inspection is emitting or splashing matter into the optics, a purge accessory can be provided.

*Vibration:* Although the RS1000 is of solid state construction, as a general rule, the sensor head should be kept free from excessive vibration. Traverse systems are commonly used and do not pose any problems for the sensor. Anti Vibration mounts are available upon request.

### Siting the RS1000 sensor head

The sensor is designed to be placed at a specific distance from the sample/web to be monitored. Distances of from 8-12 inches from the bottom of the sensor head are sufficient.

In general, the sensor should be mounted parallel to the web and at a distance of roughly 8-12 inches from the bottom of the sensor head. If the sample of interest is of highly specular (reflective) nature, the sensor should be tilted 10-15 degrees off normal.



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### **AC Power Connection**

The Sensor head comes with a U.S. standard power cable designed for 85 to 250vac operation at less than 1 amp. The user may choose to use this cable or discard it in favor of a power connect into the terminal box via the compression gland located toward the bottom of the junction box.. ITG also recommends the use of a breaker switch or power interlock.

*Please refer to the junction box wiring diagram for customer provided power connect.*

*Remember to disconnect power to the sensor head any time the sensors utility box is accessed !*

### **Remote Display Interconnect**

The RS1000 comes with a wall mountable operator interface complete with display. This is a fully interactive interface which can be placed up to 250 feet from the sensor head. The RS1000 comes standard with 10 feet of interconnect cable unless otherwise specified. The user simply plugs one end of the cable to the circular connector located on the remote display box and the other end to the circular connector located on the sensor heads rear utility box.

### **Computer Interface**

In addition to or in lieu of the Remote display box (provided), the user may choose to communicate with the sensor head using a standard RS232 cable and a computer. The user can utilize ITG software running under windows control or any dumb terminal and the provided DB9 entry ports located on the side of the sensor and on the remote display box to achieve full communications capabilities.

*Refer to the junction box wiring diagram for optional RS232 connect site and communication configurations.*

### **Analog Output Connection**

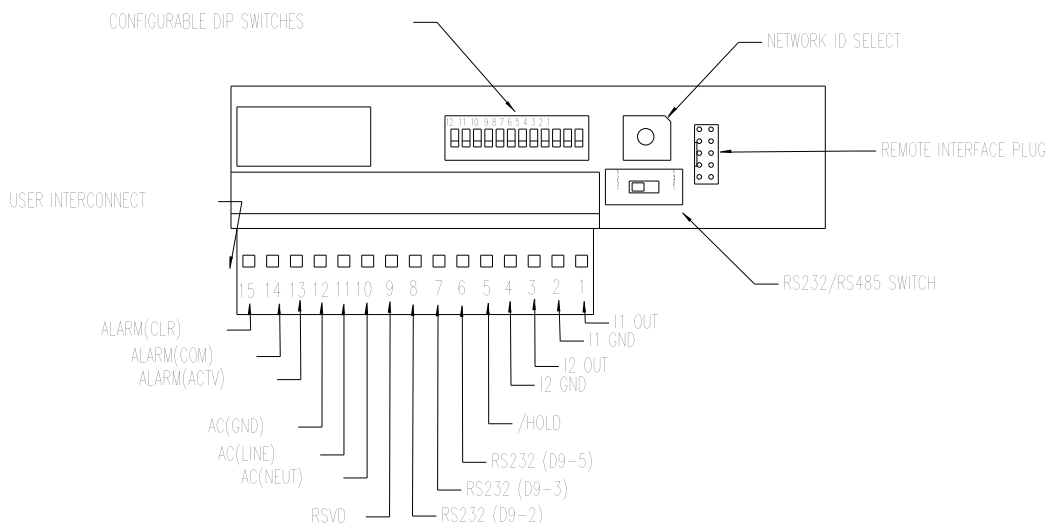
The RS1000 provides two analogue output channels one isolated and one non-isolated. The outputs can be configured individually via a jumper (JP4 & JP5) located on the mother-board to provide either a (0-10)volt or a (4-20)ma output format. These outputs can be easily mapped to the customers desired display range utilizing the menu selector panel mounted on the sensor head or via the optional software program.

*Refer to the junction box wiring diagram for analogue output connection and jumper config.*

**RS1000 Wiring Diagram**

The wiring block is located at the rear of the Sensor head within the junction box. The qualified Electrician may gain access by removing the 6 Phillips head screws that fasten the cover plate.

**Caution ! Please remove power from the instrument when servicing !!**



- Power Entry:** 85-250vac, 50/60 Hz. Use AC(GND), AC(LINE), AC(NEU)
- RS232 Communication:** RS232 Full Duplex, 9600 baud, 8 data, 2 stop, no parity  
 Use RS232 (2, 3, 5) and connect to D9 pins 2,3 and 5.
- Alarm Relay contact:** 250vac, 10 amp rated contacts. Supports normally open, normally closed with common. Use ALARM (CLR), ALARM(COM) and ALARM(ACTV)
- Analog output CH-0:** Isolated analog output can be jumper **JP4** configured to current mode (4-20)ma or voltage mode (0-10)vdc. Use I1 OUT and I1 RTN  
 Usually mapped to the top display constituent (e.g. Fat)
- Analog output CH-1:** Non-isolated analog output can be jumper **JP5** configured to current mode (4-20)ma or voltage mode (0-10)vdc. Use I2 OUT and I2 GND. Usually mapped to the bottom or successive displayed constituent (e.g. Moisture or Oil)
- Hold or Gate Input:** For hold or gated mode, the function is active when low (gnd)  
 Use /HOLD and pull to ground.
- Dip switch settings:** **Factory preset=** dip switch 1,2,3 and 6 to the “ON” position.



**User options=** Refer to the Appendix for further definition

## **Instrument Parameters**

**PROD Code (1-14):** Cal codes are numbers between 1 and 14 used to identify up to 14 calibration sets. For example, PROD Codes may identify different blend combinations and match them to the appropriate calibration (span and zero).

**PROD Code 15 :** PROD Code 15 is reserved for **ABSORBANCE**...This particular code is used for absorbance mode calibration of the instrument.

**Span and Zero:** The span determines the systems sensitivity, while the zero sets a baseline for system output. Mathematically,

$$\text{Display Output} = \text{Span} \times (\text{System Response}) + \text{Zero}$$

Where Display Output can be moisture (%), coat weight (g/m<sup>2</sup>), oil (%)  
*etc.*

The span and zero are set during calibration for each product code. However, they can be adjusted by the user through the use of the CAL Parameters menu function.

**Damp Time:** The Damp time setting applies either an exponential smoothing or a boxcar smoothing function to both the display reading and the output values. The lower the value, the more rapidly the instrument display and outputs change in response to process variation changes; however, process noise will also show more readily. Typical numbers are 5-15.

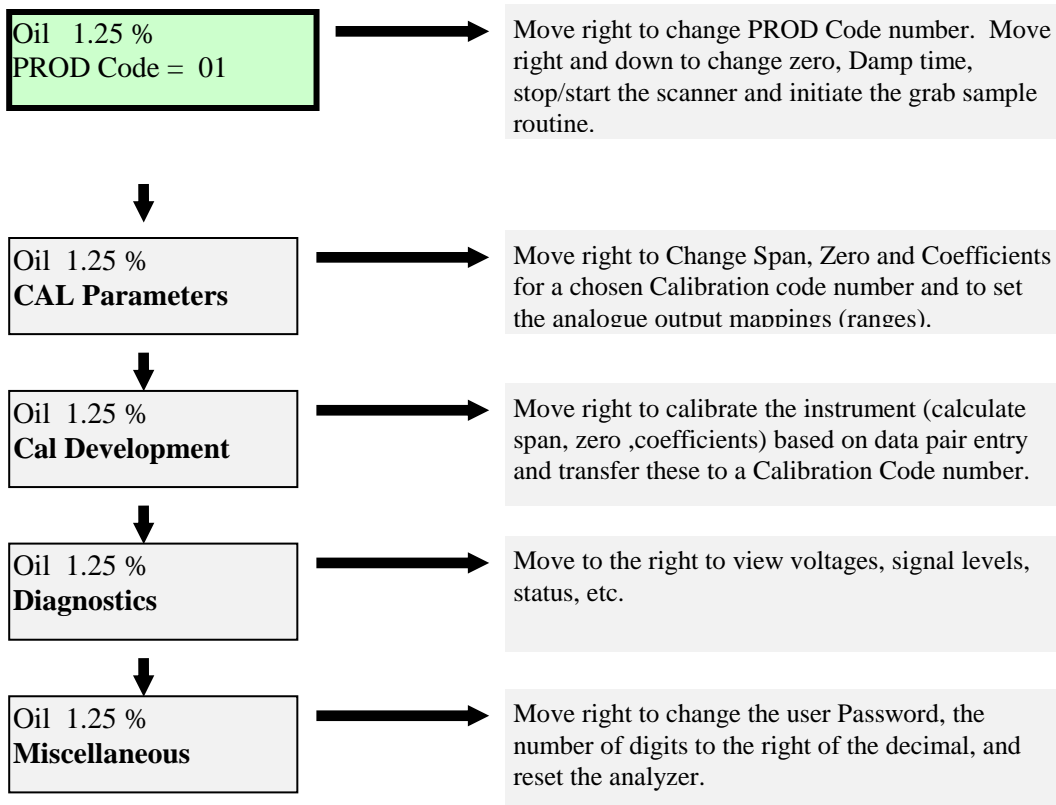
## Menu Overview:

For menu access, use the following convention:

Move joystick left	←	Move joystick right	→
Move joystick up	↑	Move joystick down	↓

More than one arrow in any direction indicates the number of moves in that direction

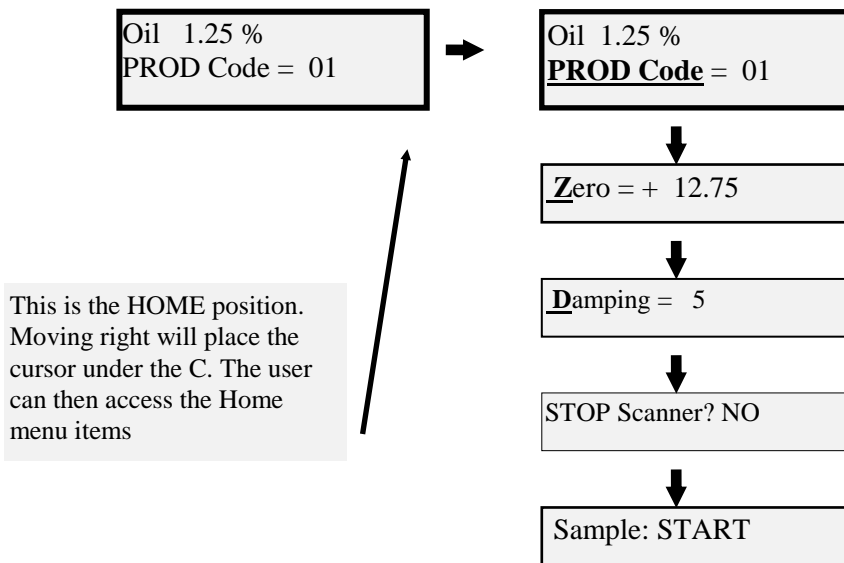
<b>Home Menu</b>	This is the top of the menu hierarchy. This menu contains its own items which can be accessed by moving right 1 then down or right.
<b>Cal Parameters</b>	Accessed from the Home menu by down 1
<b>Cal Development</b>	Accessed from the Home menu by down 2
<b>Diagnostics</b>	Accessed from the Home menu by down 3
<b>Miscellaneous</b>	Accessed from the Home menu by down 4



## Home menu:

The Home menu is the top of the menu hierarchy. From here, the user can:

- Choose the product or blend code (PROD Code)
- Perform a zero adjustment (Zero)
- Set the output smoothing value (Damping)
- Start or Stop the Scanner (YES/NO)
- Scan in and store samples that are to be used for calibration (START). If this option is utilized, during calibration (Cal Development menu), the user will toggle to the *Fit Lab Data & Scans option*. Many users prefer to change to PROD Code 15 (Absorbance mode) and write down the instrument readings.



**To change PROD Code #:** From Home, move right 1. Move up and/or down to change the number. Move right 1 to accept change and left 1 to return to Home.

**To change the Zero :** From Home, move right 1 then down 1. Move right under the number. Move up or down to change the number. Move right to accept the change and up to return.

**To change Damping:** From Home, move right 1 then down 2. Move right under the number, up and/or down to change current time. Move right 1 to accept change and up 2 return .

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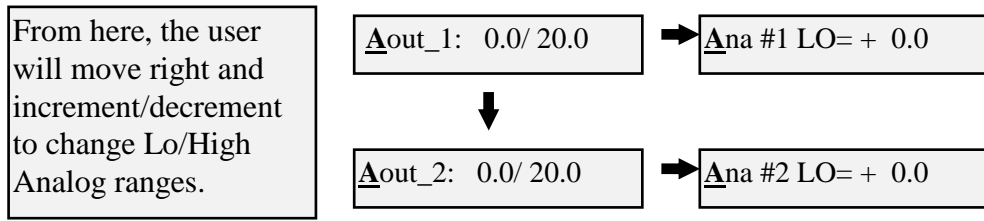
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**To Start/Stop Scanner:** From Home, move right 1 and down 3. Move right under NO/YES. Toggle and proceed right to accept. Move up 3 to return.

**To Scan a Cal Sample:** From Home move right 1 and down 4. Place your sample under the instrument. Move right 2 to start sampling (you will see STOP). When you have averaged for enough time, move right again to stop sampling (you will see START). You may now move down and right to store the sample. You will be asked to increment the sample number, do so and proceed right. Place the next sample under the instrument and repeat until all calibration samples are exhausted. Move left and up to return.

It is important to note that scanning in the sample data will allow the instrument to store your scanned data. The alternative to this is to toggle the instrument to PROD Code 15 which will display in Absorbance numbers. This is a factory default calibration which cannot be changed. It is the users choice which technique to use for calibration. Either technique is supported during Calibration. The user will be prompted to choose from one of three techniques; Fit Lab Data and Scans, Analyze Data Pairs and Fit Lab & Absorbance Data.





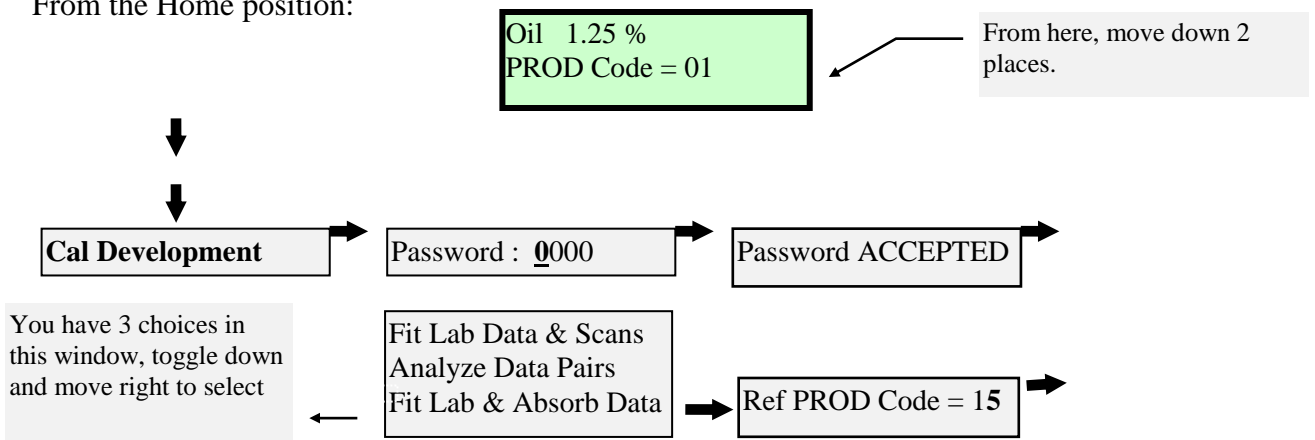
**Cal Development Menu:**

The Cal Development menu allows the user to :

- **Perform a calibration** for a given product based on data pairs (Lab, Estimator).

*Follow your way through the menu for Cal Development by moving to the right to accept messages and changes. You will be prompted to enter your password, the method of data collection (fit lab data & scans, analyze data pairs, fit Lab & Absorb Data), the type of fit you want to perform (linear,quadratic X^2 or Cubic X^3), the number of data pairs you have, and the data pair values. Once complete, the instrument will show the regression statistics and the calculated calibration coefficients. You may then choose to save this calibration (calculated coefficients) to a particular CAL channel (0-14)*

From the Home position:

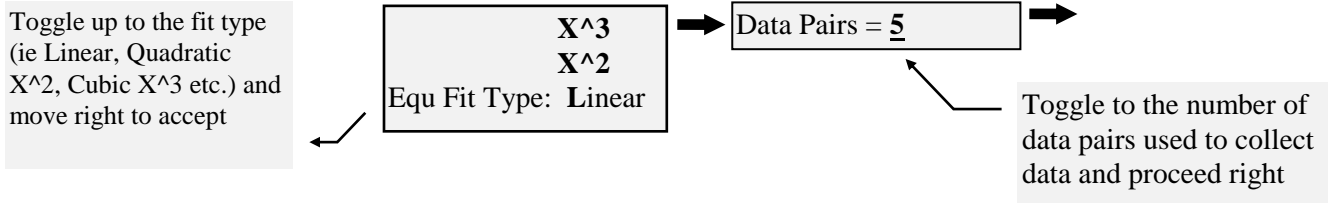


Analysis Methods:

**Fit Lab Data & Scans-** This method will use the scan data that was acquired and stored using the Home menu option of scanning in Cal Samples.

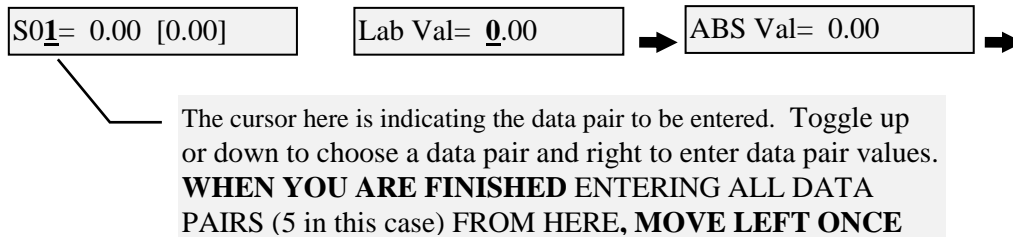
**Analyze Data Pairs-** For this method, the user would have used a PROD Code other than PROD Code 15 (Absorbance) to scan samples for written results.

**Fit Lab & Absorbance Data-** For this method, the user would have used PROD Code 15 (Absorbance) to scan samples for written results.

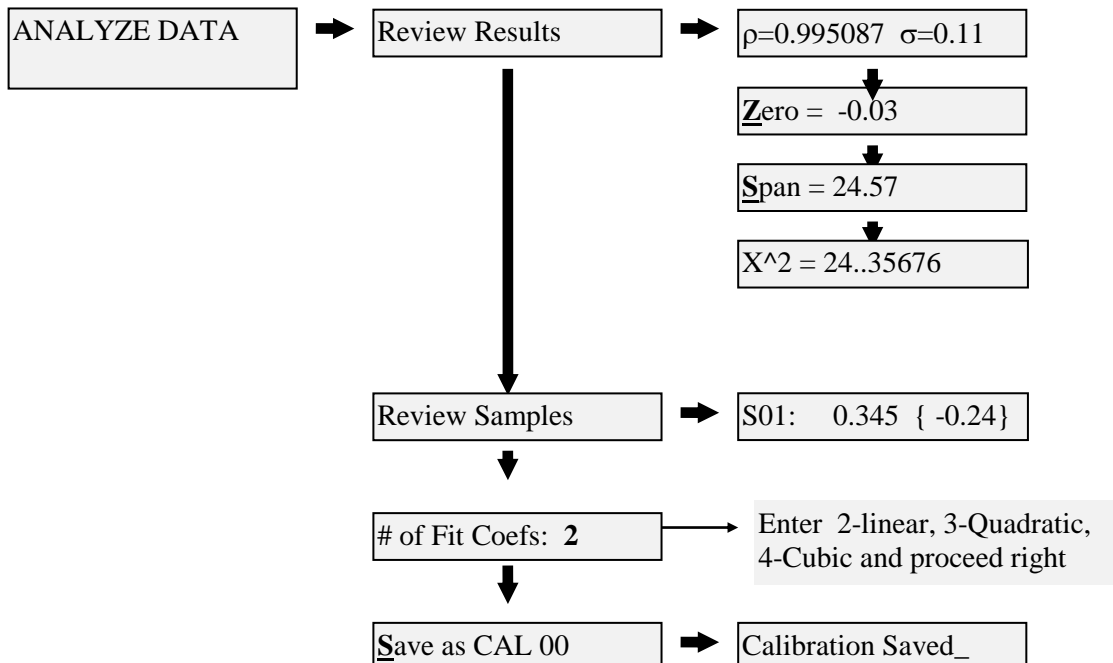


Analysis fit types:

The instrument supports many fit types including linear, quadratic  $X^2$  and Cubic  $X^3$ . The menu system will allow the user to try a fit type and use the statistics (correlation coefficient  $\rho$  and standard error  $\sigma$ ) to decide on the best fit type before saving to a PROD Code.



You are now ready to ANALYZE DATA . From here, the user can choose to Review the Results of the calibration (Correlation coefficient, Standard error and calibration coefficients) and Review the samples (test multiple fit types and finally save the calibration to a PROD Code [1-14]). It is important to note that once the user has entered the data pairs, they may test as many fit types as they want. Additionally, the user can remove data points and continue testing out the calibration! When the user is satisfied with the fit, they may save it to the PROD Code of their choosing.



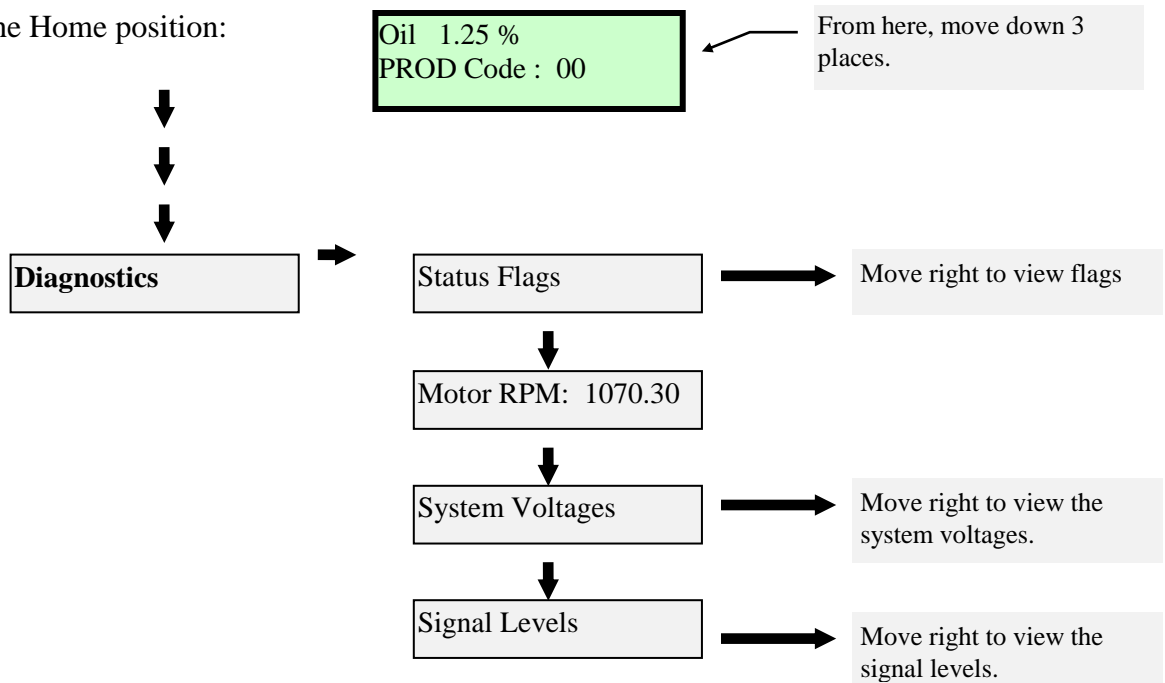
**Diagnostics Menu:**

The Diagnostics menu allows access to the following health parameters:

- Voltages
- Signal levels
- Status flags
- Motor speed

In general, there is no need to enter this menu unless the Start menu shows an alarm or the system is malfunctioning.

From the Home position:



The expected diagnostics are as follows:

Status Flags = Scanner INITIALIZED, Motor speed: Nominal, Manuf Ctrl data: OK, Signals: Nominal, Det Cooler: Nominal

If one of the Status Flags is in alarm, the user may proceed through the menu to view actual signal and voltage values. Please call the factory if an alarm condition is noted.

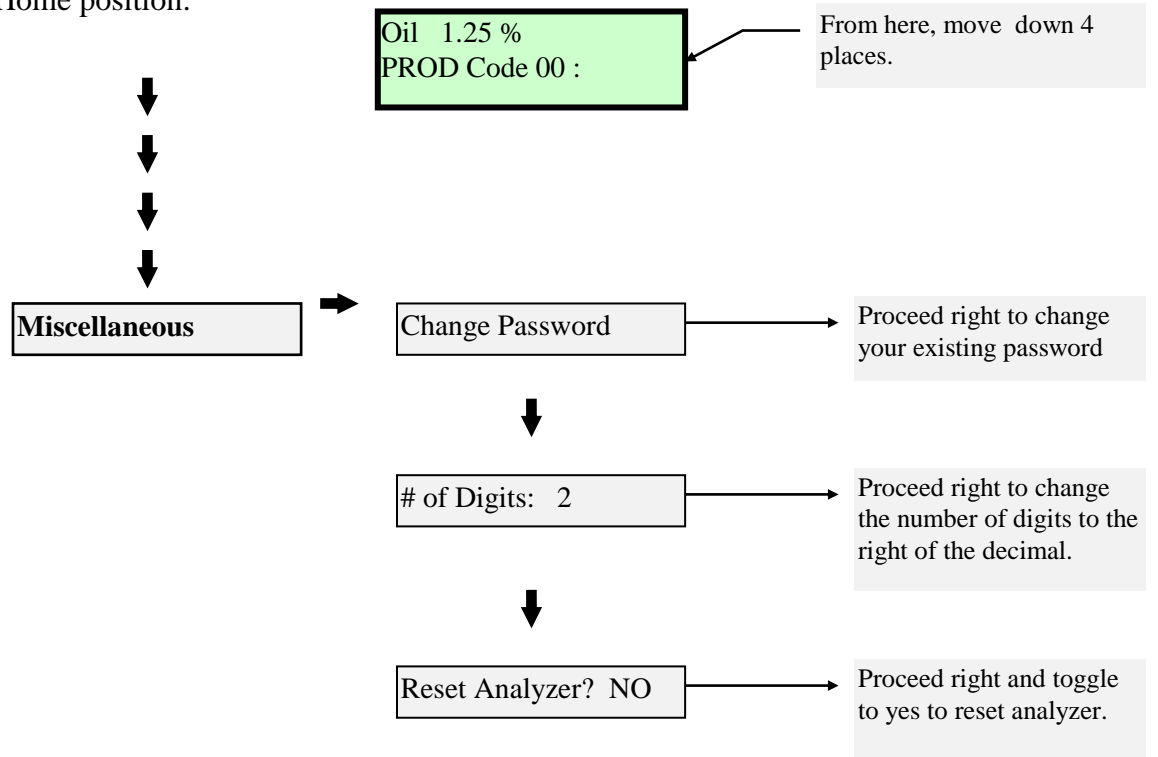


**Miscellaneous Menu:**

The Miscellaneous menu allows the user to :

- **Change password**
- **Change the number of significant digits** in the display
- **Reset the analyzer**

From the Home position:



## Calibration

Calibration is achieved by using a set of representative samples to develop a mathematical relationship between the instrument response and the concentration of some species to be measured. The RS1000 optimizes the mathematical correlation automatically, but the correlation can be no better than the “training set” of samples on which it is based.

**Sample Selection:** Training set samples are chosen to represent the full range of constituent concentrations expected in the “real” samples. Training set values should be equally distributed across the range of possible values. Generally, 9 samples should be used. Although the instrument will permit as few as 3 samples for a linear fit and 5 for a cubic fit, the user should use 9 if possible. If the unit is to be calibrated on line (in process), grab samples which are representative of the process variations should be acquired as close as possible to the sensor. Additionally, to prevent calibration errors, measures should be taken to ensure that the grab samples when transferred and measured in the lab are still representative of the original grab samples.

**Data Collection:** Having obtained a suitable training set or adjusted process parameters to force product variation, the user chooses a PROD Code (choose 15 ABSORBANCE) and monitors the resultant display number while associating the appropriate sample.

**Instrument Regression:** In order to perform a system calibration, the user enters matched pairs of laboratory and instrument values (LAB and ABSORBANCE respectively), and the RS1000 processor calculates a best-fit correlation for use with unknown samples. The instrument supports several fit models including linear, quadratic and cubic.

After obtaining a complete set of matched pairs of laboratory (LAB) and instrument (ABSORBANCE) values, the user may proceed with the **Calibration Development Routine** to calculate the calibration zero, span and other coefficients as follows:

### Enter the Calibration Routine menu:

From the Home screen, move down 2 places {CAL Development} . Move right while entering your password, acknowledging Password ACCEPTED until {Fit Lab Data & Scans}. You have 3 possible choices for data collection method. Move down 2 places to {Fit Lab & Absorb Data}. Move right 1 to {Ref PROD Code = 15} then right 1 to {Equ Fit Type: Linear}. You have 3 choices for fit type. Move up 2 places to {X^3} cubic fit. *Caution...use the quadratic and cubic fits with a full complement of data. Data representative of the full range of variations should be introduced.* Proceed right 1 to {Data Pairs = 3}. Increment/ Decrement to the number of data samples collected with the RS1000. Proceed right 1 to {S01: 0.00 [0.0000]}. Proceed right while entering the Lab Values and ABS Values for the first data pair until {S01:

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### [#####]. Increment the counter and repeat the previous two lines until all data pairs have been entered.

**Move Left** one place to {ANALYZE DATA}. Proceed right to {Review Results}. Proceed right to enter Review results and view the regression statistics and the calibration coefficients the sensor calculated.

Move left 1 back to {Review Results}. Move down 3 through {Review Samples}, {# of fit Coefs: 4} to {Save as CAL 00}. Move right 1 to {Save as CAL 00}. Increment/Decrement to the PROD Code # (choose 0-14) to which you wish to save the calibration. Move right 1 to {Calibration Saved}. You may now return home by moving left to stop and up to the home menu.

*What to do if you make an error:* Through most of the menu you may backup (move left) to fix mistakes or back out of the entire menu. The steps through the calibration menu are as follows:

1. Enter the Cal Development menu; proceed right to
2. Enter your password if necessary; proceed right
3. Choose Regression Method; {Fit Lab Data & Scans} or down 1 to {Analyze Data Pairs} or down 2 to {Fit Lab & Absorb Data}. Choose the later if PROD Code 15 Absorbance was used to collect data; proceed right to {Ref PROD Code = 15}. If OK proceed right
4. From {Equ Fit Type: Linear} Choose the Fit type; {Linear} or up 1 to {X<sup>2</sup> Quadratic} or up 2 to {X<sup>3</sup> Cubic} and proceed right to
5. Enter the number of Data Pairs collected; proceed right
6. Note and/or change the data pair number (S01 to S0#) and values for Lab and Absorbance. Once all the data pairs have been entered, proceed **LEFT** one place to
7. From {ANALYZE DATA}; proceed right 1 {Review Results}. If you would like to view the calibration statistics and coefficients proceed right and down. You may then proceed left 1 back to {Review Results}. From here, proceed down 3 past {Review Samples} and {# of Fit Coefs: #} to {Save as CAL 00}.
8. Move right 1 to place the cursor under the PROD Code number and increment/decrement to the number (0-14) to which you wish to save the calibration.
9. Proceed Left and up to return to the HOME menu.

**Verification:** The correlation coefficient should be between 0.9 and 1.0 for a good calibration. The standard deviation should be less than 1/6 of the total range of the data. Ideally, the new calibration should be verified with several test samples with known laboratory values that were not included in the calibration training set.

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### **Service**

**User Service:** The RS1000 is based on the ITG line of process analyzers for constituent analysis and as such, is a robust process analyzer based on a modular construction. Should the need arise, items such as the motherboard, power supply and light source could be replaced but only by a qualified user.

**Warranty Service:** The Innovative Technology Group warrants all parts and workmanship for one year from the date of purchase. Should the need arise, we will repair or replace your instrument at our option.

**Other Manufacturer Service:** After the warranty period has expired, we assure our customers of prompt, thorough service at a fair price whenever needed.

## **ITG**

## Appendix "A"

### Dip Switches

The instrument contains a 12 position dip switch bank with the following functions:

Convention: 0= dip switch on, 1= dip switch off, X= dip switch position don't care  
 Manufacture Defaults= Bolded

Switch	Baud
<u>3 2 1</u>	<u>Rate</u>
0 0 0	75
0 0 1	150
0 1 0	300
0 1 1	600
1 0 0	1200
1 0 1	2400
1 1 0	4800
<b>1 1 1</b>	<b>9600</b>

<u>5 4</u>	<u>Parity Control</u>
<b>0 0</b>	<b>No parity; MARK Parity</b>
0 1	SPACE Parity
1 0	EVEN Parity
1 1	ODD Parity

<u>Switch 6</u>	<u>Data Length</u>
0	7 data bits + 1 stop bit (unless MARK Parity when 2 Stop Bits)
<b>1</b>	<b>8 data bits + 1 stop bit</b>

Switch 7: Reserved

<u>Switch 8</u>	<u>Extended Network Address</u>
<b>0</b>	<b>Network Identification 00-FF</b>
1	Network Identification 10-1F

<u>10 9</u>	<u>Local Communications Protocol</u>
<b>0 0</b>	<b>Dumb Terminal / Diagnostic Mode</b>
0 1	Proprietary Slave
1 X	Reserved

<u>12 11</u>	<u>Local Communications Protocol</u>
<b>0 0</b>	<b>Dump Terminal / Diagnostic Mode</b>
0 1	Proprietary Slave
1 X	Reserved

## Appendix “B”

### Theory of operation & System overview

The RS series of Spectrophotometer provides a non-contact, non-destructive method for constituent and/or property analysis utilizing NIR absorption technology. In the NIR spectral region (900-2500nm) the second and third overtones of basic chemical bonds exist permitting compositional analysis of product much as the IR region may provide, but with a depth of penetration far greater. This spectral region remains void of electronic transitions which dominate the UV and visible light wavelengths. As a consequence, excellent product determination with limited sample preparation and control remains the hallmark of the NIR method.

Since the wavelength bands overlap and interfere, NIR analysis methods always rely on a reference method for calibration. The quality of the calibration set will reflect the quality of the NIR method. A calibration set should reflect the variance of all components and variables present in the process. Such a statement may frighten newcomers to NIR, as no one can guarantee that **ALL** variables are accommodated or even known especially if the product is a complex organic or natural product. Fortunately, the nature of the absorption bands, their width, and intensity are such as to render excellent measurement capabilities void of constant interference. For any given band, only a very few other chemical structures respond at the same wavelength. In many instances those structures may not even be present in the analyzed product. In almost all instances a single compensating wavelength is sufficient to correct for any interferences.

As NIR requires a reference technique, there is no direct measurement method. All NIR methods utilize a statistical correlation method of establishing the calibration. Once a product calibration is developed, the method or equation can easily be transferred from one instrument to another usually requiring no additional adjustment other than the offset, and in a few instances requiring a slope adjustment as well.

Two instrument families provide excellent analysis methods utilizing NIR technology. The first and more complex system involves scanning monochrometers. These systems are capable of scanning a portion of the NIR spectrum and utilize all of the wavelength information to determine the desired constituents. Intuitively this system provides the greatest ability to detect the constituents of interest; however, in reality this method also becomes strongly influenced by the regions of *no-information* or noise. As a result, the calibration sample sets for scanning spectrometers are generally larger in numbers and must exhibit even greater variances than its simpler cousin the Filter Photometer. In addition, as the more wavelength are used in calibration, they represent additional large numbers of degrees of variance in the sample, and require large sample sets to establish the proper correlative relationship.

The Filter Photometer uses fixed wavelength filters to select only the wavelengths which measure the constituent of interest, and may add an additional wavelength or two to correct for interacting components. The bandwidth of the filter is controlled to assist in maximizing the measurement success. Such a technique becomes simpler to calibrate as the number of variables

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is significantly less. Nonetheless, the teaching set must represent as much of the variance of the process as possible independent of the constituent of interest.

The RS SERIES Filter Photometer utilizes a dual beam construction: a Sample Beam and a Reference Beam. The Reference and Sample beams traverse the same temperature and time critical components: lamp, filters, and detector. By comparing the Sample Beam response continuously to the Reference Beam results, any variation in lamp, filter, or detector response is immediately corrected providing an exceptionally stable measurement method. Additionally, by maintaining a constant detector temperature, the response time of the detector also remains constant over very long periods of time helping to further stabilize the measurement results.

The RS SERIES Filter Photometer utilizes an internal microprocessor for continuous diagnostic monitoring to assure the integrity of each reported sample result. Motor speed, detector temperature, power voltages, and light energy levels are just a few of the monitored components.

The rugged NEMA-4 construction of the RS SERIES Filter Photometer provides unparalleled process compatibility. Air Purge of the optical surface as well as customized viewing ports assure maximum process reliability. Vortex or Water cooler panels extend the operating environment of the instrument for hostile environments. Fiberoptic probes provide remote process access when instrument size or temperature requirements prohibit proximity mounting.

The RS-232 interface permits connection to a single computer port, or the switchable RS-485 networking interface permits multiple units to co-exist on a single partyline, while the dual channel 4-20 mA outputs permit simple connection to existing PLC process hardware. Other network options are available.