SmartCET

from InterCorr International, Inc.

Smart Products for
Field Corrosion Monitoring,
MIC and Scale Detection

Oil & Gas Production
Refining
Chemical Process
Water Systems

InterCorr
INTERNATIONAL

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System Start-Up Guide

This System Start-Up Guide contains set-up instructions for the SmartCET™ instrumentation and associated FieldCET™ software to enable field or laboratory corrosion testing. Further information can be obtained by contacting:

InterCorr International, Inc.
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Houston, Texas 77014
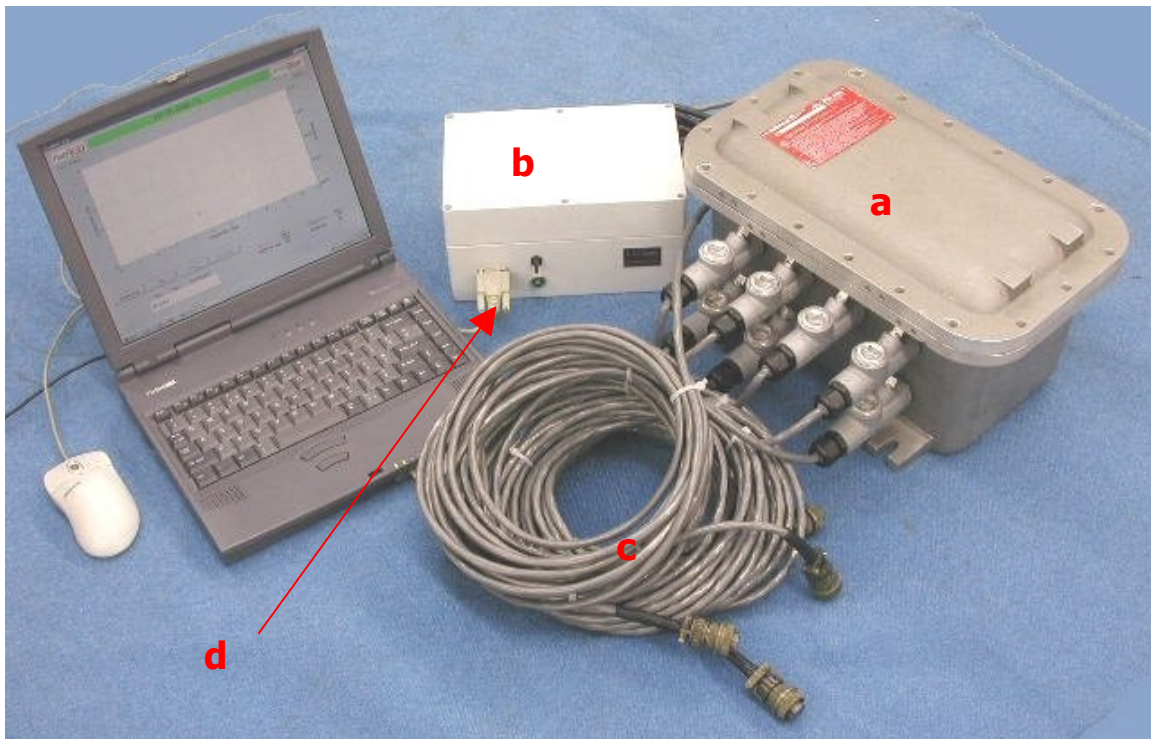Tel: (281) 444 2282
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Contents:
1. Instrumentation Arrangement
2. Probe Requirements
3. SmartCET Set-Up
4. Recommended PC Specifications
5. FieldCET Software Set-Up and Execution
6. Data Management

1. Hazardous Area System Instrumentation Arrangement
Unpack instrument and check that you have the following components:
   a) SmartCET corrosion monitoring unit (configuration may vary from unit shown)
   b) Power / communications unit (not included if using radio communications)
   c) Probe cable(s) - Note: probe(s) not included
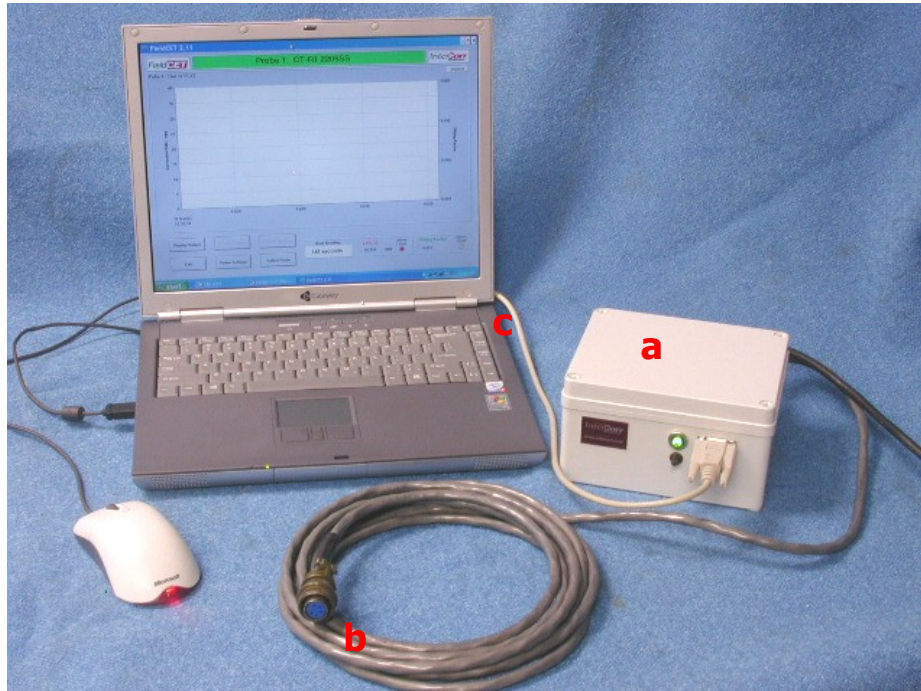   d) Communications cable to PC (Note: PC not included)

Non-Hazardous Instrumentation Arrangement (NEMA 4X Systems)
Unpack instrument and check that you have the following components:
a) SmartCET corrosion monitoring unit (configuration may vary from unit shown)
b) Probe cable(s) - Note: probe(s) not included
c) Communications cable to PC (Note: PC not included)

2. **Probe Specification**
To complete the set-up you will also need to provide the required number of three-identical-electrode corrosion probes, suitable field location or flow loop, cell or vessel, and computer for installation of the software. The probe(s) are connected using ring terminals for flow through electrodes, alligator clips for some lab systems, and either a standard 6-pin or 5-pin Amphenol connector for standard three-electrode probes. The SmartCET must be wired as follows for correct operation:

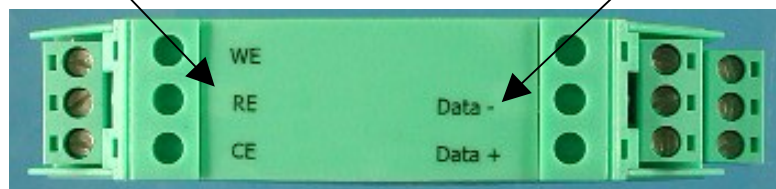Working Electrode (WE): Terminal Marked "WE"
Reference Electrode(RE): Terminal Marked "RE"
Counter Electrode(CE): Terminal Marked "CE"

Data Hook-Up

Electrode Hook-Up

The RS 485 data are wired to the respective "Data +" and "Data – " terminals opposite the electrode hook-up discussed above.

The SmartCET units operates at 24 V DC with hook-up to the respective "V+" and "V-" terminals shown in the picture below.
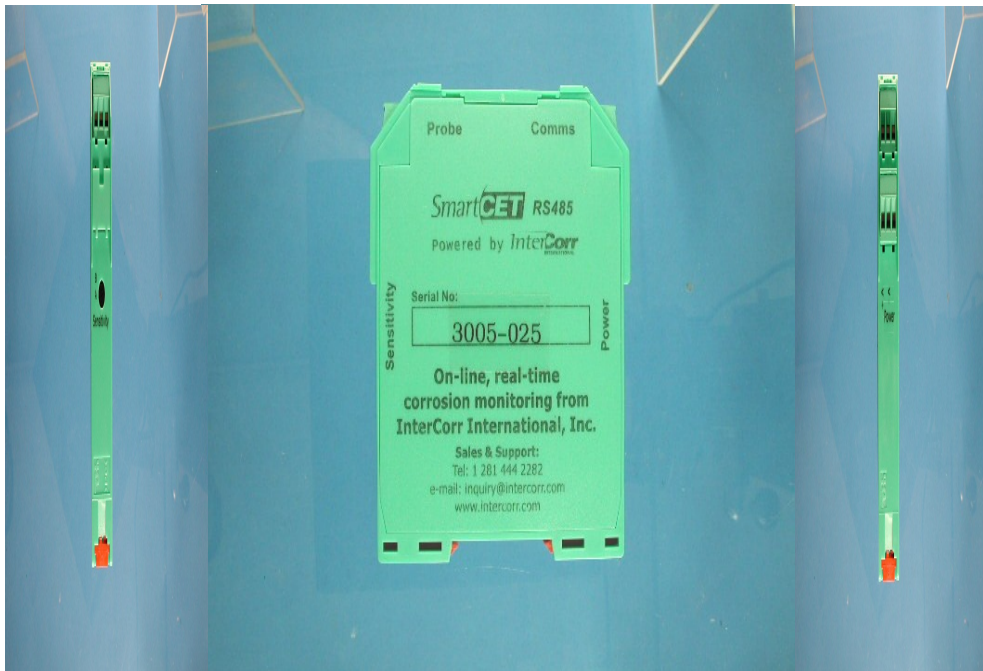
The SmartCET instrument can handle a wide range of corrosion rates. A sensitivity switch is included to expand the use of the instrument measurement range before the signal becomes saturated. Under nearly all applications, the sensitivity switch position should be set to Position B (factory default). Switch Position A should only be used in high impedance (very low corrosion rate) applications, and only after consultation with *InterCorr*.

In the settings panel (described later), enter 0 ohms for Sensitivity Switch Position A, and enter 100 ohms for Sensitivity switch position B (factory default position).

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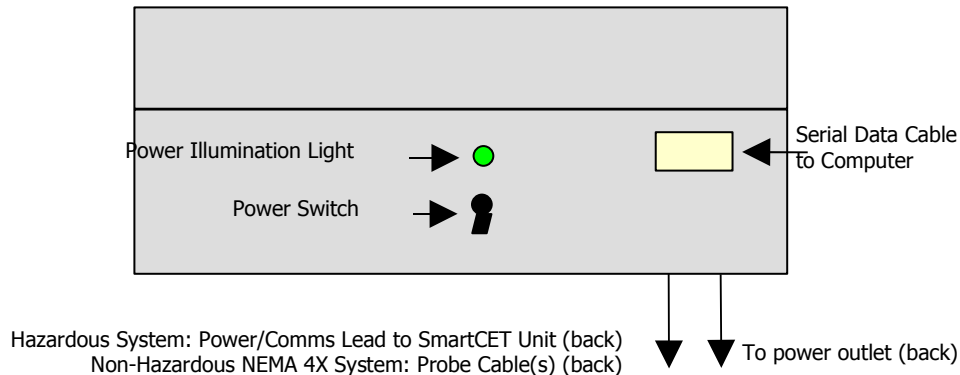**e-mail:** inquiry@intercorr.com **Website:** www.intercorr.com

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3. **SmartCET Set-Up**

    Connect the cables as indicated in the photograph and the following diagram:

    Power Illumination Light → ●
    Power Switch →
    Serial Data Cable to Computer

    Hazardous System: Power/Comms Lead to SmartCET Unit (back)
    Non-Hazardous NEMA 4X System: Probe Cable(s) (back)
    To power outlet (back)

    Power up the instrument using the switch mounted on the front of the unit. Check that the power light is illuminated. You are now ready to load the system software.

4. **Recommended PC Specifications**
    Operating System: Windows 98-NT4-2000-XP
    Processor: Pentium 200 or above CPU
    Memory: 32Mb RAM
    Disk Space: 20Mb
    Screen Resolution: 1024 x 768 pixels or higher

5. **FieldCET Software Set-Up and Execution**
    The FieldCET™ software is provided on a CD. Load the CD and the setup should start automatically. If it does not start automatically, run the file "setup.exe" from the Run application or from Windows Explorer. This program guide you through the installation process to load the FieldCET application onto the PC. When you have loaded the application, you are ready to set-up the software.
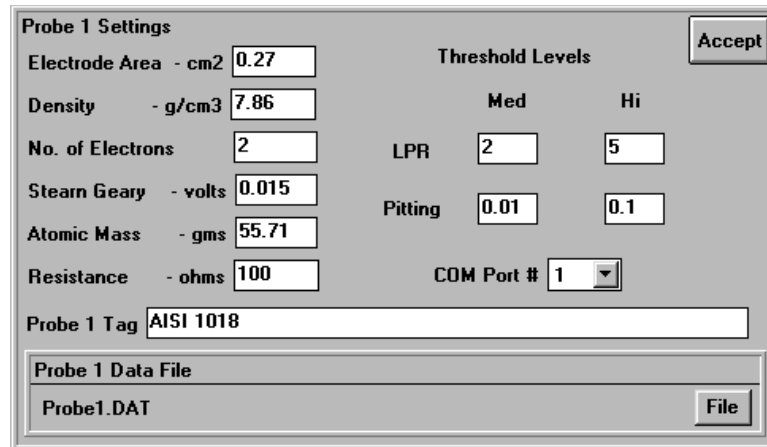
    Select the FieldCET application by choosing from the Programs Menu, Windows Explorer or selecting the associated icon. The screen view will be as follows:
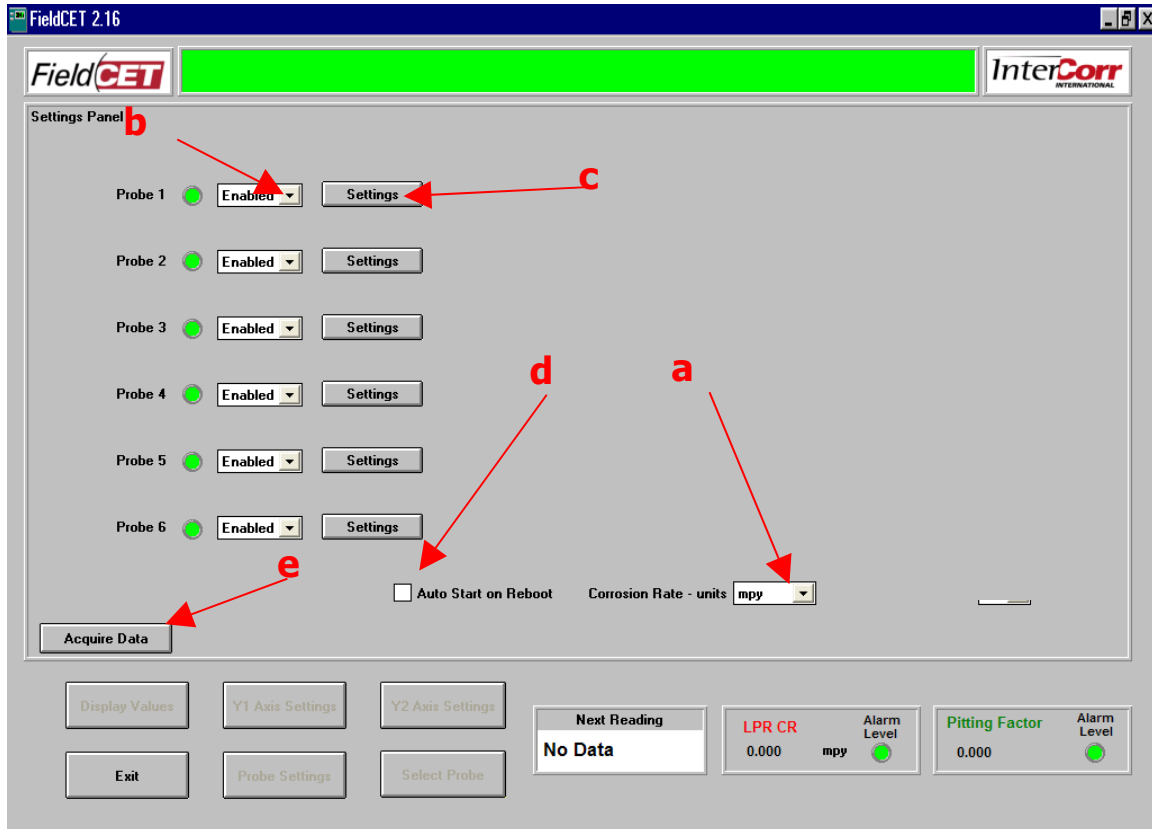
This screen enables you to:
a)   Choose corrosion rate units
b)   Enable or disable each of the probes
c)   Click to a settings screen to verify / input probe settings
d)   Click box to enable automatic restart and data acquisition on computer reboot after power loss (requires program shortcut to be manually copied into Windows Startup folder).
e)   Click to begin acquiring data

Clicking on the Settings button next to a probe will pop up a window on the screen as follows:

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This window allows input of the probe and material parameters:

- Electrode Area: Enter area in cm^2 for one electrode
- Density: Enter the density in g/cm^3 for the electrode material
- No. of Electrons: Enter the number of electrons transferred in the metal oxidation process
- Stern Geary: Enter the Stern Geary constant in volts
- Atomic Mass: Enter the atomic mass of the electrode material
- Resistance: Enter 0 ohms for Sensitivity Switch Position A. Enter 100 ohms for Sensitivity Switch Position B (factory default position).
- Enter a suitable probe tag to be displayed on the graphic displays
- Select the filename(s) for data storage
- Set the communications port (COM1, COM2, COM3 or COM4)
- Set alarm levels (InterCorr's factory setting for Pitting Factor is recommended for most applications)

A listing of typical material constants are provided in Table 1.

After completing the above sections, click the accept button to return to the previous screen. Once the settings have been input for each of the enabled probes, ensure:

- the instrument has power
- the corrosion probes are connected to the instrument
- the communications cable is connected to the PC

Click the acquire data button to display the main FieldCET screen and automatically initiate data acquisition.

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Table 1
Selected Material Constants

UNS Number	Material	Atomic Mass	Density (g/cm^3)	Electrons (typical)
A91100	Aluminum 1100	27.20	2.71	3
A92024	Aluminum 2024	28.97	2.77	3
A95083	5083 Al	27.38	2.66	3
C11000	CDA 110ETP 99.9 Cu	63.54	8.89	2
C12200	DHP Cu	63.53	8.89	2
C27000	Yellow Brass	64.32	8.47	2
C44300	CDA443 (ARS AD. Brass)	64.22	8.52	2
C68700	CDA687 (Al Brass)	63.23	8.33	2
C70600	90-10 Cu-Ni	62.95	8.94	2
C71500	CDA 715 (Cu/Ni 70/30)	61.99	8.94	2
G10100	1010 Carbon Steel	55.77	7.87	2
G10180	1018 Carbon Steel	55.75	7.86	2
G10200	1020 Carbon Steel	55.74	7.86	2
G10800	1080 Carbon Steel	55.46	7.84	2
G41400	4140	55.62	7.85	2
K01200	A179	55.77	7.87	2
K01201	A192	55.70	7.86	2
K02598	ASTM A36	55.71	7.86	2
K02700	A516-70	55.62	7.86	2
K03005	ASTM A53	55.68	7.86	2
K03006	A106, Grade B	55.66	7.86	2
K03006	API 5L-X52	55.71	7.86	2
K03006	API 5L-X70	55.71	7.86	2
L13601	60 Sn / 40 Pb	153.97	8.42	3
N04400	Monel 400	59.62	8.80	2
N08020	Carpenter 20 Cb3	57.30	8.08	2
N10276	C-276	63.43	8.89	2
R50400	Titanium GR2	47.79	4.52	4
R60702	Zr 702	95.08	6.10	4
S30400	AISI 304	55.04	7.94	2
S30403	AISI 304L	55.08	7.94	2
S31600	AISI 316	56.19	7.98	2
S31603	AISI 316L	56.22	7.98	2
S41003	Duracorr	55.12	7.70	2
S41425	Mod. 13Cr	56.13	7.70	2

Data acquisition will commence immediately. The FieldCET measurement cycle is 7 minutes 10 seconds. Time to the next reading is displayed at the bottom center portion of the screen. Data will be updated on the main screen at the above time interval. The time axis will continue to compress or rescale as required to display data from the start of the data acquisition.

After the next reading indicator has counted down to 0 seconds, the next data will be acquired and the Y1 and Y2 axis settings buttons will be enabled. To change the plot settings, single click on the respective axis settings button. Then set the desired limits. After making the changes click "OK" to return to the main screen. The screen below provides an example of this process. Any changes to the Y1 and Y2 axis affect only respective probe. Changes in the Y1 / Y2 axes settings need to be carried out for each of the probes independently.

Input variable choices include LPR corrosion rate, HDA corrosion rate, ECN corrosion rate, pitting factor, Stern Geary (B), anodic and cathodic Tafel slopes, potential kurtosis, potential skew, current kurtosis, current skew and solution resistance. Any combination of these variables can be chosen for the Y1 / Y2 axes using the drop down selectors in the Y1 / Y2 Axis Settings Panels.

To examine current values of each of the above variables, single click the "Display Values" button. After review, simply single click "Close" to return to the main screen.

To view the data for another probe, simply click the Select Probe button to cycle through the available probe data.

6. Data Management

The data accessible from the FieldCET main screen comprises:

1. General Corrosion Rate (LPR)
2. Pitting Factor (to indicate whether corrosion is uniform or localized)

The factory default alarm settings for pitting factor (PF) are as follows:

PF < 0.01 $\equiv$ Green zone – pitting unlikely

0.01 < PF < 0.1 $\equiv$ Yellow zone – pitting transition, probability for pitting increases through this range

PF > 0.1 $\equiv$ Red zone – strong possibility for pitting

The data files are stored in the following formats:

<name>.dat: This ASCII text file contains date, time, LPR corrosion rate, HDA corrosion rate, ECN corrosion rate, pitting factor, Stern Geary (B), anodic and cathodic Tafel slopes, potential kurtosis, potential skew, current kurtosis, current skew and solution resistance. These data can be easily imported into MS Excel or similar spreadsheet packages.
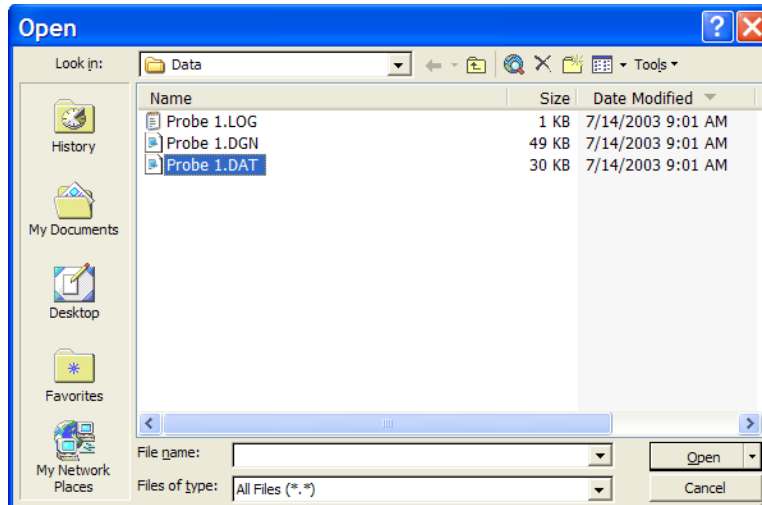
<name>.dgn: This file contains probe set-up information (probe & materials constants, etc.) plus additional raw data to enable more in-depth data analysis by *InterCorr*. Should more in-depth information be desired, email the request and the associated <name>.dgn data file to *InterCorr*.

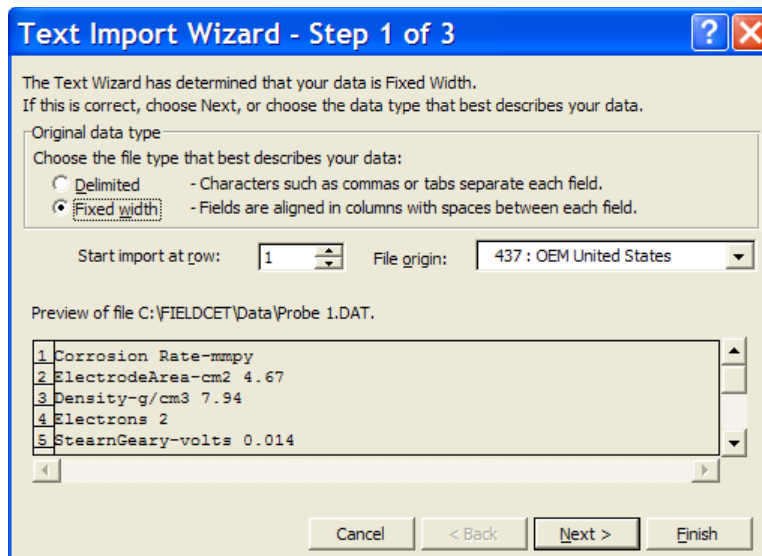**<name>.log:** This file contains a record of alarm conditions throughout the data file period.

Data management should be performed by the user to ensure that data are stored to a new file once every two to four weeks.

7. **Microsoft Excel™ Data Importing**

a) Launch Microsoft Excel.
b) Select File - Open.
c) Browse to the folder containing the data to be imported. Default settings will be in C:\FieldCET\Data
d) Select All Files (*.*) in the "Files of type:" drop down box.
e) Select the desired filename.dat file to import as shown in the example window below.

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f)   Click the Open button.
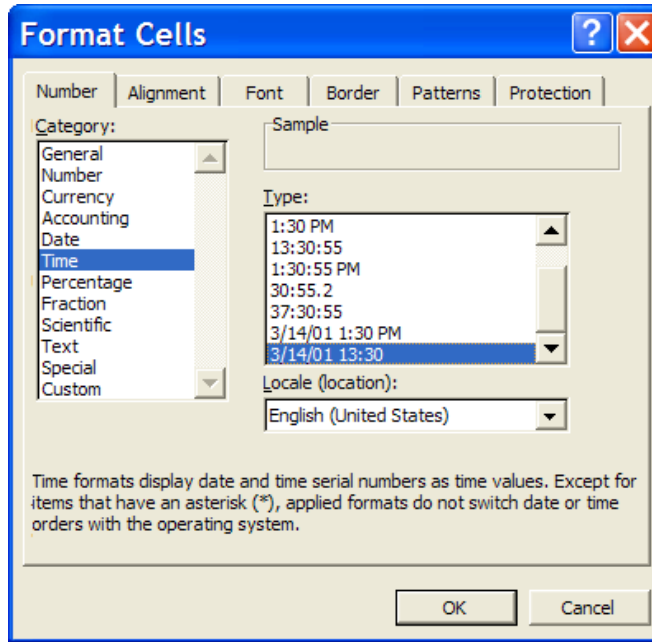g)   This will open the Text Import Wizard window shown below.

h)   Select Delimited and press Next >.
i)   The following window will be displayed.
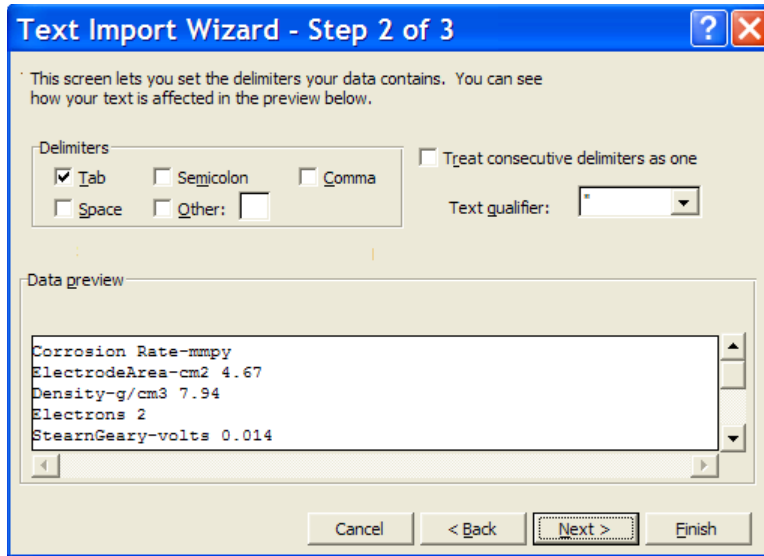
j)   Check Comma and Space delimiters in addition to the Tab delimiter already checked.
k)   Click Finish.
l)   The following window will be displayed in Excel.
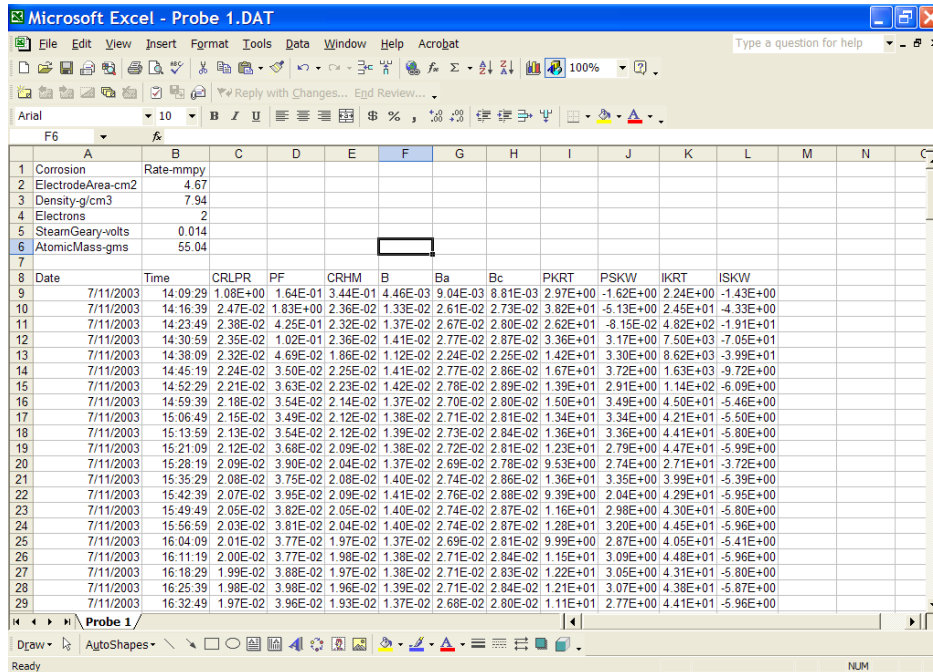
m)   This data can now be saved as a standard Excel spreadsheet with extension *.xls.
n)   The data and time (Columns A & B) can be added to provide a single time stamp by inserting an additional column and inserting a formula i.e. =+A9 + B9.
o)   Format this new column using a suitable time format under Format – Cells – Number Tab – Time Category with the format Type as shown in the window below.

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p)   This will produce the following result.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Corrosion	Rate-mmpy												
2	ElectrodeArea-cm2	4.67												
3	Density-g/cm3	7.94												
4	Electrons	2												
5	StearnGeary-volts	0.014												
6	AtomicMass-gms	55.04												
7														
8	Date	Time	Date/Time	CRLPR	PF	CRHM	B	Ba	Bc	PKRT	PSKW	IKRT	ISKW	
9	7/11/2003	14:09:29	7/11/03 14:09	1.08E+00	1.64E-01	3.44E-01	4.46E-03	9.04E-03	8.81E-03	2.97E+00	-1.62E+00	2.24E+00	-1.43E+00	
10	7/11/2003	14:16:39	7/11/03 14:16	2.47E-02	1.83E+00	2.36E-02	1.33E-02	2.61E-02	2.73E-02	3.82E+01	-5.13E+00	2.45E+01	-4.33E+00	
11	7/11/2003	14:23:49	7/11/03 14:23	2.38E-02	4.25E-01	2.32E-02	1.37E-02	2.67E-02	2.80E-02	2.62E+01	-8.15E-02	4.82E+02	-1.91E+01	
12	7/11/2003	14:30:59	7/11/03 14:30	2.35E-02	1.02E-01	2.36E-02	1.41E-02	2.77E-02	2.87E-02	3.36E+01	3.17E+00	7.50E+03	-7.05E+01	
13	7/11/2003	14:38:09	7/11/03 14:38	2.32E-02	4.69E-02	1.86E-02	1.12E-02	2.24E-02	2.25E-02	1.42E+01	3.30E+00	8.62E+03	-3.99E+01	
14	7/11/2003	14:45:19	7/11/03 14:45	2.24E-02	3.50E-02	2.25E-02	1.41E-02	2.77E-02	2.86E-02	1.67E+01	3.72E+00	1.63E+03	-9.72E+00	
15	7/11/2003	14:52:29	7/11/03 14:52	2.21E-02	3.63E-02	2.23E-02	1.42E-02	2.78E-02	2.89E-02	1.39E+01	2.91E+00	1.14E+02	-6.09E+00	
16	7/11/2003	14:59:39	7/11/03 14:59	2.18E-02	3.54E-02	2.14E-02	1.37E-02	2.70E-02	2.80E-02	1.50E+01	3.49E+00	4.50E+01	-5.46E+00	
17	7/11/2003	15:06:49	7/11/03 15:06	2.15E-02	3.49E-02	2.12E-02	1.38E-02	2.71E-02	2.81E-02	1.34E+01	3.34E+00	4.21E+01	-5.50E+00	
18	7/11/2003	15:13:59	7/11/03 15:13	2.13E-02	3.54E-02	2.12E-02	1.39E-02	2.73E-02	2.84E-02	1.36E+01	3.36E+00	4.41E+01	-5.80E+00	
19	7/11/2003	15:21:09	7/11/03 15:21	2.12E-02	3.68E-02	2.09E-02	1.38E-02	2.72E-02	2.81E-02	1.23E+01	2.79E+00	4.47E+01	-5.99E+00	
20	7/11/2003	15:28:19	7/11/03 15:28	2.09E-02	3.90E-02	2.04E-02	1.37E-02	2.69E-02	2.78E-02	9.53E+00	2.74E+00	2.71E+01	-3.72E+00	
21	7/11/2003	15:35:29	7/11/03 15:35	2.08E-02	3.75E-02	2.08E-02	1.40E-02	2.74E-02	2.86E-02	1.36E+01	3.35E+00	3.99E+01	-5.39E+00	
22	7/11/2003	15:42:39	7/11/03 15:42	2.07E-02	3.95E-02	2.09E-02	1.41E-02	2.76E-02	2.88E-02	9.39E+00	2.04E+00	4.29E+01	-5.95E+00	
23	7/11/2003	15:49:49	7/11/03 15:49	2.05E-02	3.82E-02	2.05E-02	1.40E-02	2.74E-02	2.87E-02	1.16E+01	2.98E+00	4.30E+01	-5.80E+00	
24	7/11/2003	15:56:59	7/11/03 15:56	2.03E-02	3.81E-02	2.04E-02	1.40E-02	2.74E-02	2.87E-02	1.28E+01	3.20E+00	4.45E+01	-5.96E+00	
25	7/11/2003	16:04:09	7/11/03 16:04	2.01E-02	3.77E-02	1.97E-02	1.37E-02	2.69E-02	2.81E-02	9.99E+00	2.87E+00	4.05E+01	-5.41E+00	
26	7/11/2003	16:11:19	7/11/03 16:11	2.00E-02	3.77E-02	1.98E-02	1.38E-02	2.71E-02	2.84E-02	1.15E+01	3.09E+00	4.48E+01	-5.96E+00	
27	7/11/2003	16:18:29	7/11/03 16:18	1.99E-02	3.88E-02	1.97E-02	1.38E-02	2.71E-02	2.83E-02	1.22E+01	3.05E+00	4.31E+01	-5.80E+00	
28	7/11/2003	16:25:39	7/11/03 16:25	1.98E-02	3.98E-02	1.96E-02	1.39E-02	2.71E-02	2.84E-02	1.21E+01	3.07E+00	4.38E+01	-5.87E+00	
29	7/11/2003	16:32:49	7/11/03 16:32	1.97E-02	3.96E-02	1.93E-02	1.37E-02	2.68E-02	2.80E-02	1.11E+01	2.77E+00	4.41E+01	-5.96E+00	

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This addendum to the SmartCET® System Start-Up Guide contains set-up instructions for local data storage via PC card and 4-20 ma output capability included as part of the SmartCET® corrosion monitoring system.

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Instructions to Connect to PC Card via Local Lap-top Connection:
1. Please switch on the Smartcet unit (this unit will be called SMARTCET throughout the remainder of this section).
2. Login to your laptop computer (it is assumed that Windows / XP is installed on the laptop; we will call this LAPTOP).
3. Connect LAPTOP to SMARTCET using a cross over cable.
4. Open Windows Explorer. On the left hand pane, you will see the Icon labeled '**My Computer'**
5. Right click with the mouse on '**My Computer'** and select '**Properties'**
6. You will see a dialog box called '**System Properties'**
7. Click the tab labelled **Computer Name**
8. Click on the Change button and set the computer name as **LAPTOP**, and workgroup as **INTERCORR**. Click OK, and you will return to the Windows Explorer View.
9. Right click with the mouse on '**My Network Places'** and select **Properties**.
10. You will see an Icon with the description '**Local Area Connection'**. Right click on this icon, and select '**Properties'**. You will see a dialog box labelled '**Local Area Connection Properties'**
11. Select and highlight the item called '**Internet Protocol (TCP/IP)**'
12. Click on **Properties**.
13. You will see a dialog box labelled '**Internet Protocol (TCP/IP) properties'**
14. Select the option for '**Use the following IP address'**, and input the information:
a. IP address: <input LAPTOP's Ipaddress>
b. Subnet mask: 255.255.255.0
c. Default gateway: 192.168.0.1

Click OK twice (once on the TCP/IP properties dialog and once more on the Local area connection properties dialog).

Now, restart your computer (**LAPTOP**) and login to the system. Open Windows Explorer, expand My Network Places, and you will see the name **SMARTCET**. Double click on **SMARTCET** to see a **C:** and **D:** drive. All the data will be available for copying from the D: drive.

This is the boot screen, identical to the standard FieldCET screen with the addition of a 4-20 ma Output button as illustrated below

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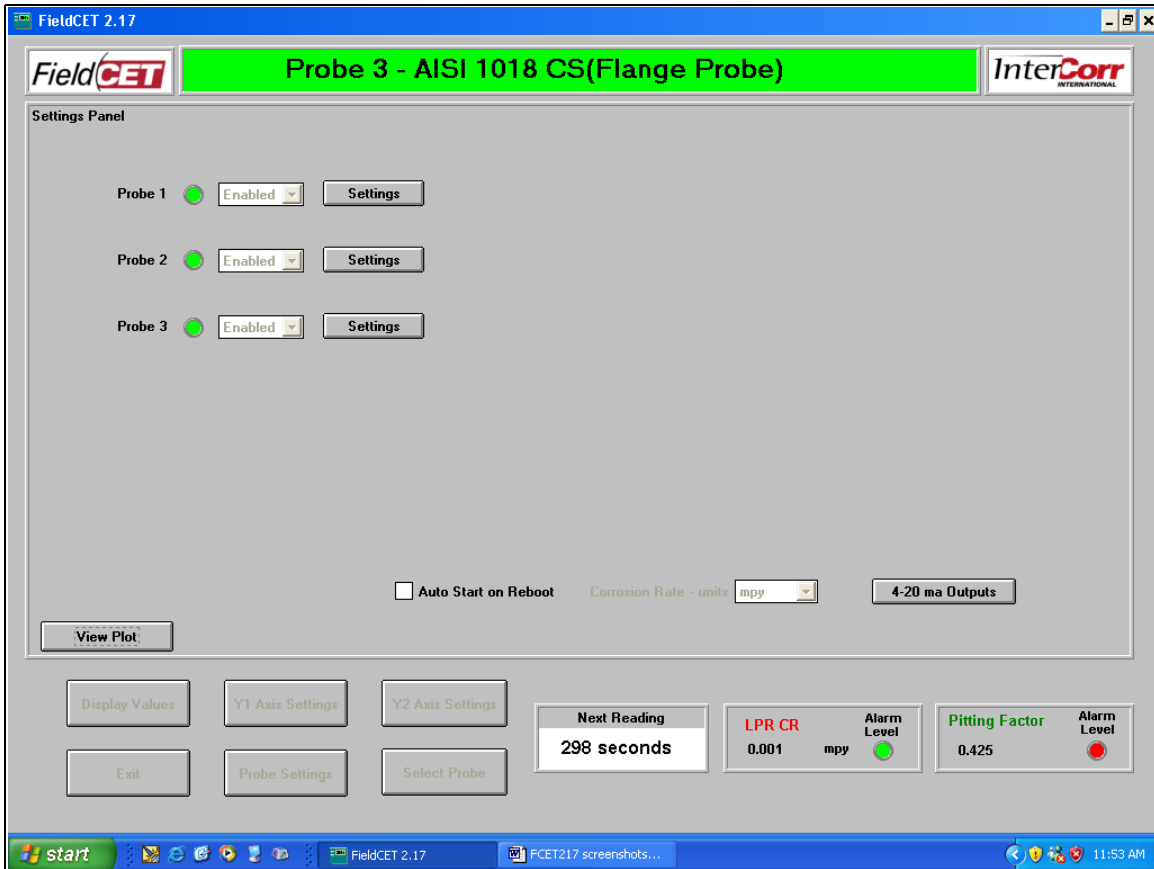
Clicking on "4-20 ma Outputs" brings up this series of panels for configuration and setup of the outputs. The "Input" control allows for selection of the LPR and ECN corrosion rates, online calculated B value, Anodic and Cathodic Tafel slopes, and Pitting Factor. The "4ma=", and 20ma=" controls provide for scaling of the LPR and ECN corrosion rate outputs. Scaling is fixed for B value, Tafel slopes, and Pitting Factor as indicated. The ma output for the three decades of Pitting Factor indication is as follows:

.001 to .01 is 4ma to 9.333ma
.01 to .1 is 9.333ma to 14.666ma
.1 to 1 is 14.666ma to 20ma

Notes: - All outputs initialise to 4ma on program startup.
 - Scaling and input selection are accessible at all times.
 - Outputs associated with calculated values are updated every 430 seconds, corresponding to the measurement cycle of the device.
 - All outputs are reset to 4ma at program termination.

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Selecting "Setpoint" on an input selector will disable scaling for that output as shown below. Entering a value from 4 to 20 will result in immediate update of the ma output. The "Setpoint" control is provided as an aid in the setup of associated instrumentation.

The outputs are powered and do not require an auxiliary power supply. Output impedance on an individual loop is limited to 500 ohms maximum.