



MS3500L / MS3510L

High Resolution LPR Data Logger

Operator's Manual



Metal Samples

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I. Introduction

A. General Description

The MS3500L/MS3510L High Resolution LPR Data Logger is designed to measure general corrosion, localized corrosion and conductance in a wide range of industries. The instrument measures the corrosion rate and pitting factor, giving the output in mil/year or a 0-1 pitting factor respectively. It also provides conductance measurement. The corrosion (corrosion rate) data from a Linear Polarization Resistance (LPR) probe can be transmitted to a plant control system or other recording device.

After taking a reading, the instrument displays the corrosion rate in mpy, conductance in Siemens, and the pitting factor. All stored readings are automatically time and date stamped. Readings are stored to non-volatile Flash memory which retains data without the need for a battery backup.

The MS3500L/MS3510L data logger can store more than 100,000 readings. Stored data can be downloaded directly to a USB Flash (“jump”) drive or Bluetooth compatible devices via Bluetooth. Data can be opened and charted using the provided CDMS software, or it can be imported into any standard data analysis (spreadsheet) program such as Microsoft Excel. Data can also be reviewed and charted on the instrument’s LCD display for quick reference. The MS3500L/MS3510L data logger is compatible with 3-electrode and 2-electrode elements of Metal Samples LPR probes.

The remote-mount option allows the MS3500L/MS3510L data logger to be mounted independently from (but in close proximity to) the LPR probe. It is then connected to the probe via a short probe cable.

B. Principles of Operation

The MS3500L/MS3510L data logger operates on the Linear Polarization Resistance (LPR) technique and is used in conjunction with an LPR probe. The instrument measures the current required to polarize the electrodes of a probe to a known potential. From the polarization potential and the measured current, polarization resistance can be calculated. Then, using Faraday’s law, the instantaneous corrosion rate can be calculated from polarization resistance.

The MS3500L/MS3510L utilizes state-of-the-art algorithms and data analysis techniques to accurately measure general corrosion rate and pitting. Harmonic distortion analysis (HDA) is applied to improve the performance of the industry-accepted linear polarization resistance (LPR) technique used to measure corrosion rate.

To further enhance the performance, an application-specific Stern-Geary variable (B value) is calculated and updated every measuring cycle. There is no need to manually update the B value because of process changes. During the measurement cycle, the instrument also performs an automated electrochemical noise (ECN) measurement, which in combination with the corrosion rate data can provide a measurement of localized corrosion (pitting).

Probes are available in a variety of mounting types and materials to suit almost any type of installation.

C. Measuring Principal

General Corrosion

Linear Polarization Resistance (LPR) is based on the fact that in a corroding electrode the relationship between i_{corr} and the polarization resistance is given by the following equation

$$i_{\text{corr}} = \frac{B}{R_p} \quad \text{where} \quad R_p = \frac{\Delta E}{\Delta I} \quad \text{with } \Delta E \text{ being the applied voltage and } \Delta I \text{ the resulting current.}$$

Harmonic Distortion Analysis (HDA) allows data logger to determine i_{corr} without using the Tafel slopes (ba, bc). This is typically done by applying a low frequency sinusoidal voltage and determining the distance of the resulting current.

The data logger accurately measures the general corrosion rate by implementing Harmonic Distortion Analysis (HDA) to improve the performance of Linear Polarization Resistance (LPR). A process-specific Stern-Geary voltage (Bharm) is calculated with every measurement cycle through HDA. This value is then implemented in the LPR corrosion rate calculation resulting in a highly accurate self-adjusting, process specific corrosion rate calculation. The MS3500L/MS3510L can measure the general corrosion rate from 0 ... 1000 mpy (0 ...25 mmpy).

Localized Corrosion (Pitting)

Electrochemical Noise (ECN) is the method of monitoring spontaneous fluctuations generated at the interface of the corroding metal and process solution. As localized corrosion occurs, these fluctuations increase.

The MS3500L/MS3510L monitors for these fluctuations on the electrode surfaces for 17 minutes. It then performs a statistical analysis resulting in a unitless pitting factor value between 0 and 1. A pitting factor of nearly 0 represents no localized corrosion activity and a pitting factor of 1 represents high localized corrosion activity. Independent studies have revealed that a sustained pitting factor of greater than 0.3 is cause for concern and you should investigate the source of the elevated Localized Corrosion rate.

Conductance

Solution resistance is a measure of how easily electricity flows along a certain path through an electrical element. The reciprocal of the solution resistance is solution conductance. The data logger measures solution resistance in order to more accurately calculate the general corrosion rates. As an added feature, the data logger provides you with the solution conductance in units of Siemens as the tertiary variable that is not scalable. The data logger requires a minimum solution conductance of 4 μS in order to provide reliable corrosion data.

The solution conductance value that data logger provides can be used to approximate solution conductivity by this relationship:

$$\text{Conductivity} \left(\frac{S}{cm} \right) = \frac{\text{Conductance}(S)}{19}$$

Solution conductivity is a function of distance. As the electrodes corrode, their sizes and geometry change causing this correlation to deteriorate. The data logger should not be considered as a replacement for standard conductivity meters.

D. Disclaimer

Metal Samples has no power, nor does it undertake to police or enforce compliance with the contents of this manual or observance of the safety precautions set forth herein. Metal Samples does not certify, test, or inspect the installations of MS3500L/MS3510L for safety or other purposes. Metal Samples disclaims liability for any personal injury, property, or other damages of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, or reliance upon this manual. Metal Samples makes no guaranty or warranty, express or implied, as to the accuracy or completeness of any information published in this manual and disclaims and makes no warranty that the information in this manual will fulfill any particular purposes or needs. Metal Samples' only warranty is set forth in the written Limited Warranty specifically provided by Metal Samples in connection with the purchase of the MS3500L/MS3510L data logger.

E. Device Identification

Name Plates

 Metal Samples <i>Corrosion Monitoring Systems</i>	
MS3500L REMOTE LPR DATA LOGGER	
<p>Intrinsically Safe For Use In The Following Areas:</p> <p>Ex ia [ia] IIC T4 Ga -40°C ≤ Ta ≤ +70°C - With Battery Pack ET1664 / ET2250 -40°C ≤ Ta ≤ +50°C - With Battery Pack ET1857 / ET2257</p> <p>ATEX Cert. No: ITS17ATEX201833X IECEX Cert No: IECEX ETL 17.0020X</p> <p> 2903  II 1(1) G</p> <p>Refer user manual for maximum electrical input and output entity parameters.</p>	<p>Warning! Only certified USB storage device Part # ET1650 allowed in hazardous locations.</p> <p>Warning! Use only with battery pack part # ET1664 or ET1857.</p> <p>Warning! Equipment is intended for use only with Xeno Energy model XL-205F and Tadiran model TL-5930 cells. Use of any other battery in this device may impair intrinsic safety.</p> <p>Warning! Do not replace cells in the pack unless area is known to be Non-Hazardous.</p> <p>Made in the USA by Metal Samples Company A Division of Alabama Specialty Products, Inc. 152 Metal Samples Road Munford, AL 36268 Phone: 256-368-4202 Fax: 256-368-4515 e-mail: mso@alspi.com www.metalsamples.com</p>

C. Technical Specifications

Model

MS3500L - Basic Model

MS3510L - Basic Model + 4-20mA Current Loop Output

Physical Data

Instrument Weight:	11.94 lbs. (5.42 kg)
Total Weight w/ Accessories:	13.64 lbs. (6.19 kg)
Instrument Dimensions:	11.50" H x 8.94" W x 4.00" D (29.21cm x 22.71cm x 10.16cm)
Case Specifications:	NEMA 4X / IP66 - stainless steel
Mounting Specifications:	10.75" H x 6" W (27.31cm x 15.24cm) Bolt Pattern 0.3" (0.76cm) Diameter Bolt Holes
Operating Temperature:	-40° to 158°F (-40° to 70°C)
Storage Temperature:	-40° to 158°F (-40° to 70°C)

Performance Data

Probe Type:	3-Electrode LPR		
Measurement Type:	General corrosion	Local Corrosion	Conductance
Measurement Unit:	mpy or mmpy	unitless	microSiemens
Measurement Range:			
Default Range:	0-40 mpy (0-1 mmpy)	0.0 - 1.0	5 - 333,333
Low:		0.0 - 0.3	
Maximum:	1000 mpy (25 mmpy)	0.3 - 1.0	
Max. Error:	Excitation voltage <0.05% of full span		
Data Storage:	> 100,000 readings		
Factory Settings:	B value (Stern Geary value): 25.6 mV K value (corrosion constant): 11800		
Measurement time:	4 to 21 minutes (depends on configuration)		

Electrical Data

Power Requirements:	7.2V lithium battery pack
Nominal Probe Cable Distance:	12 ft. (3.6 m)
Download Method:	Directly to USB Flash drive (Certified Data Transfer Unit required for use in hazardous areas)

Hazardous Location Certifications – Intrinsic Safety

See Appendix B

Included Accessory Items

12' Probe Cable, Meter Prover, Current Loop Connector**, Operation Manual, Corrosion Data Management Software

**MS3510L model

Optional Accessory Items (Ordered Separately)

Certified Data Transfer Unit (required for transferring data in a hazardous area)

II. Start-up and Operation

A. Receiving the MS3500L/MS3510L High Resolution LPR Data Logger

Check the MS3500L/MS3510L High Resolution Data Logger for any shipping damage when it is first received. When the unit is unpacked, verify that the following items are included:

- Data Logger
- Battery Pack (shipped separately)
- Meter Prover
- User's Manual
- Current Loop Cable (MS3510L model only)

In the event of shipping damage, quantity shortage, or missing items, it is recommended that the event is documented immediately and that digital photographs are taken. Any shortages or missing items should be reported to Metal Samples immediately. In the event of shipping damage, a claim should be opened with the responsible carrier.

B. Start-Up

CAUTION: *Using this product in any way other than that specified within this manual may impair the intrinsic safety protection.*

Start-up of the MS3500L/MS3510L Data Logger involves the following steps:

1. Port Details and Probe Connection
2. Current Loop Connection (MS3510L Model Only)
3. Power-Up
4. Setup and Operation

1. Probe Connection

CAUTION: *Using this product in any way other than that specified within this manual may impair the intrinsic safety protection.*

When selecting a location to mount the data logger it is important to consider the surrounding environment. To ensure proper operation:

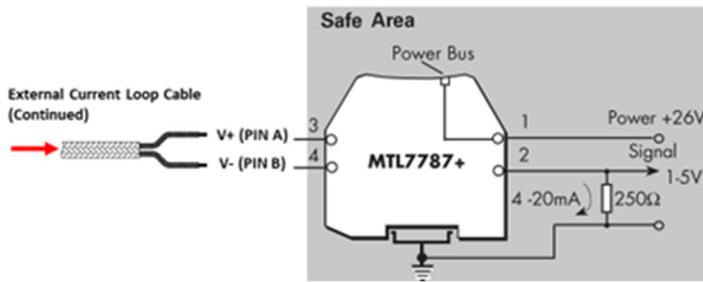
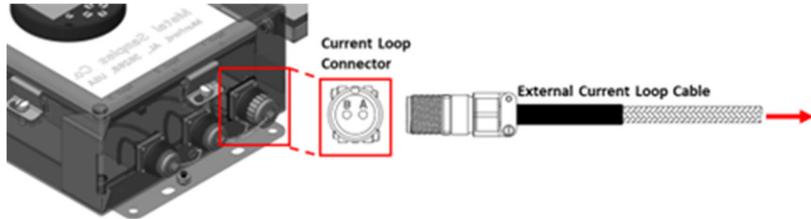
- Do not mount the data logger in a location that exceeds its operating temperature.
- Avoid mounting the data logger near sources of strong electrical noise.
- Ensure that there is sufficient clearance for installation and to open the data logger cover afterwards.

a. Remote Mounting

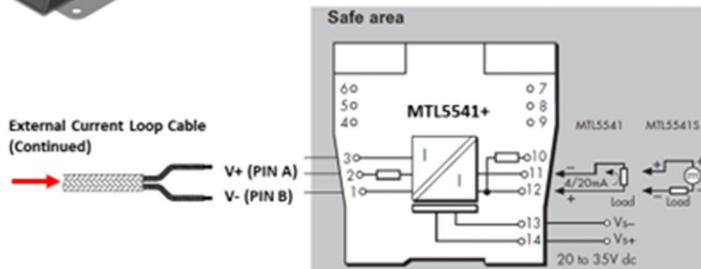
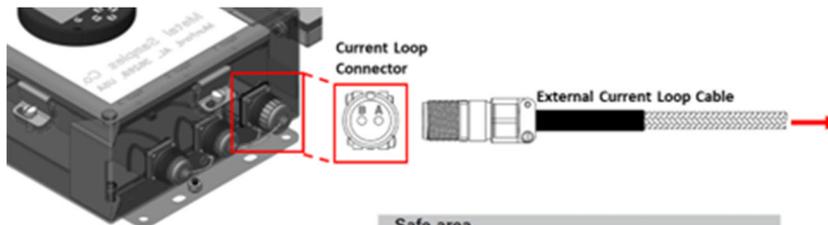
The unit is designed to mount remotely. The data logger is connected to the LPR probe via the probe extension cable. When possible, the data logger should be mounted within 10' (3m) of the probe to keep the probe cabling short and minimize signal degradation.

2. Current Loop Connection (for the MS3510L model)

To setup current loop communication, refer to the Control Drawing (Hazardous Area Wiring Diagram), found in Appendix C.



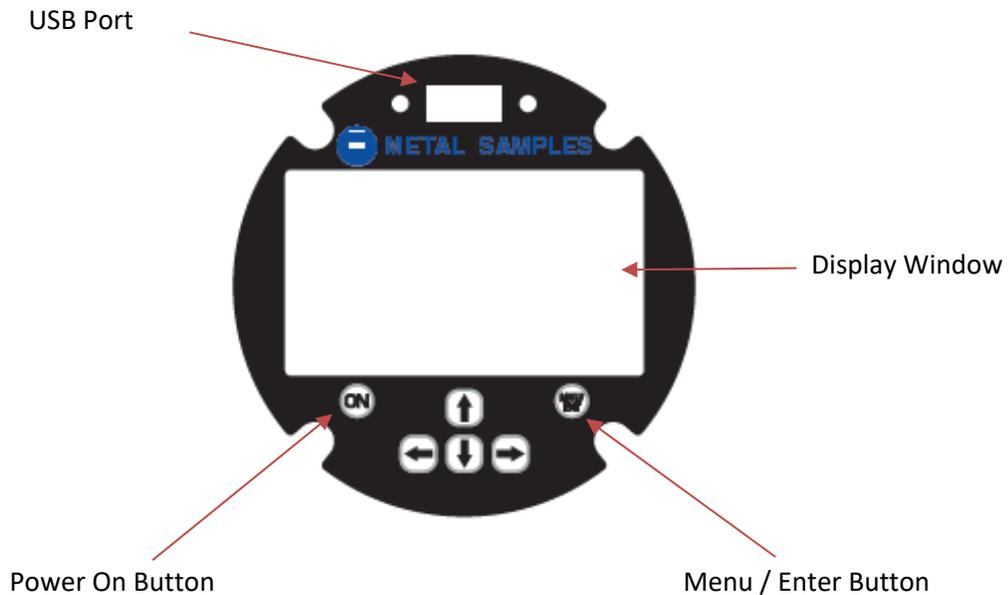
OR



- a. **In a Safe Area only**, connect the external current loop cable (shipped with the instrument) to either:
 - Certified Safety Barrier (EEx ia) IIC Typical of MTL 7787+
 - Certified 4-20mA Repeater Power Supply (EEx ia) IIC Typical of MTL 5541+
- b. Connect the 2-pin connector from the external current loop cable to the instrument's 4-20mA current loop port.
- c. Current measurements will be explained in the "Comm./Loop" section.

3. Power-Up

The unit is supplied with a battery pack in a separate package. Install the battery pack before starting the product. The instrument can be powered up by pressing the 'ON' button on the keypad. The start-up screen with the Metal Samples logo will appear on the screen; the start-up screen confirms the software version currently running and the SD card status. The keypad switch layout is shown below.



a. Safe Area Usage

The MS3500L/MS3510L High Resolution Data Logger is approved for use in hazardous areas but can be used in non-hazardous areas as well.

The cells in the battery pack must be replaced only in a safe area and it should be replaced with batteries of the same make and model.

b. Hazardous Area Usage

Refer to Appendix B for details.

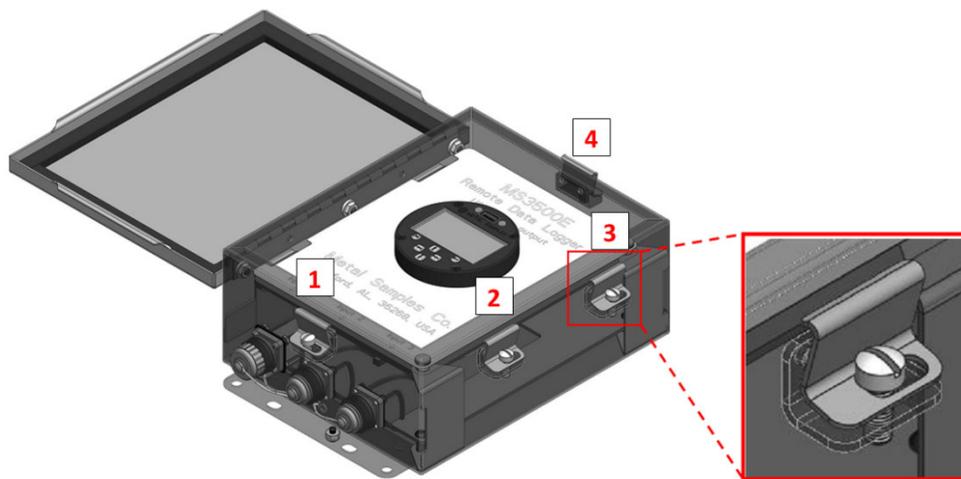
c. Battery Replacement

WARNING:

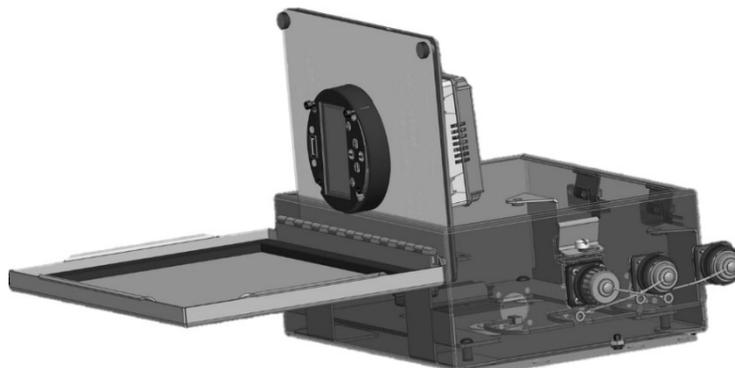
- Do not mix old and new batteries. Equipment is intended for use only with Xeno Energy model XL-205F and Tadiran model TL-5930 cells. Use of any other battery in this device may impair intrinsic safety.
- Do not mix batteries of different types (such as alkaline and lithium.)
- The cover screw is used to prevent unauthorized tampering of the batteries and is required to ensure intrinsic safety.
- Do not over-tighten the cover screw, as this may damage the instrument case.

To remove the battery pack from the Instrument:

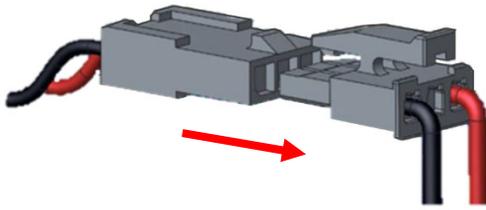
1. Open the front door of the enclosure by unscrewing and unlatching the four latches securing the front door.



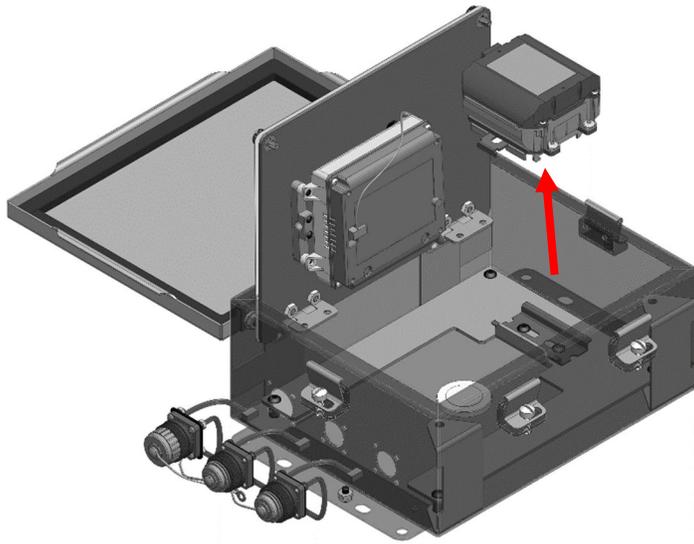
2. Unscrew the two thumb screws securing the front panel. Open the front panel.



3. Disconnect the battery cable connection, by pressing down on the locking tab and pulling.



4. Unlatch and remove the battery holder assembly from the mounting plate DIN rail.

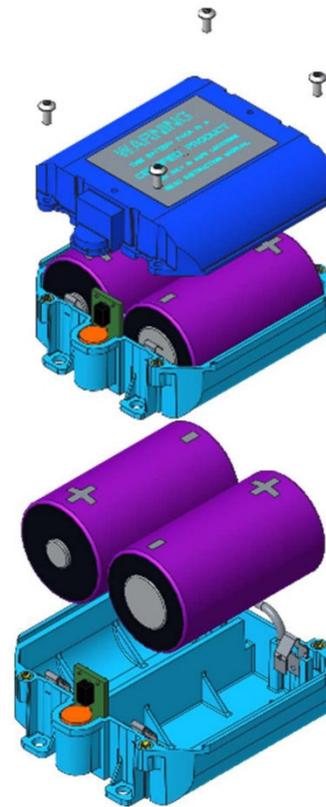


Replace battery cells:

Follow the previous instructions 'To remove the battery pack from the Instrument' and move the battery pack to a safe location.

**WARNING: ENSURE BATTERY PACK IS MOVED TO SAFE LOCATION BEFORE CONTINUING.
FAILING TO DO SO MAY IMPAIR INTRINSIC SAFETY.**

1. With the battery pack in a SAFE location, remove the 4 Tamper Resistant Torx Screws from the battery pack. Remove the battery pack cover.
2. Remove the battery cells from the pack. Check that new batteries are of the same type as those removed.
3. Insert the new batteries into the pack, ensuring that the direction matches the battery pack.
4. Replace the battery pack cover and screw in the 4 Tamper Resistant Torx Screws until snug.
DO NOT OVERTIGHTEN.



Replace battery Pack:

Follow the instructions to return the battery pack

To return the battery pack with replacement:

1. Reinstall the battery pack within the instrument enclosure by latching the battery pack assembly to the mounting plate DIN rail.
2. Reconnect the battery pack cable by pushing the battery cable and the power cable connectors together until they lock.
3. Close the front panel and tighten the 2 thumb screws.
4. Close the enclosure door, latch all 4 of the latches to the door, then tighten the 4 screws to secure the latches.

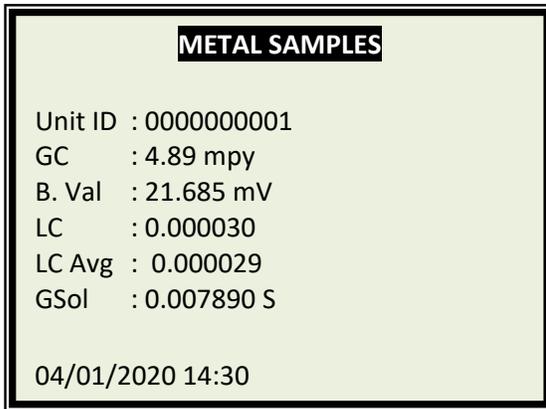
C. Setup and Operation

Abbreviations

GC – General Corrosion
Con – Conductance
B.Val – Calculated B Value
GSol - Conductance
RSol – Solution Resistance
LC – Localized corrosion
LC AVG. – Local Corrosion Average
mpy – mils per year
PID – Probe Id.
S - Siemens

MAIN SCREEN

The MS3500L/MS3510L allows you to measure general corrosion rate, localized corrosion and Conductance. This section describes the functions that display on the Main Menu:



The Start-Up display shows the data logger's unit ID at the top of the screen.

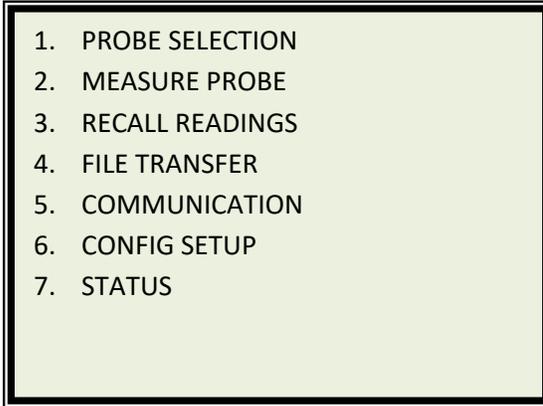
It also shows the recent probe data Conductance in siemens, General Corrosion rate in mils per year, Calculated B value, Local Corrosion with a range of 0 to 1, and Local Corrosion average value. Current date and time are displayed in the last line.

Press 'MNU/ENT' key on the keypad to display the menu screen.

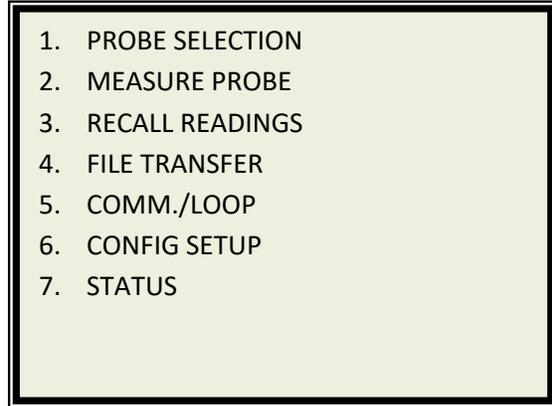
MENU DISPLAY

Review this section which describes the functions that are displayed on the Main Menu with respect to the model.

MS3500L

- 
- A screenshot of the MS3500L main menu, showing a list of seven options: 1. PROBE SELECTION, 2. MEASURE PROBE, 3. RECALL READINGS, 4. FILE TRANSFER, 5. COMMUNICATION, 6. CONFIG SETUP, and 7. STATUS.
1. PROBE SELECTION
 2. MEASURE PROBE
 3. RECALL READINGS
 4. FILE TRANSFER
 5. COMMUNICATION
 6. CONFIG SETUP
 7. STATUS

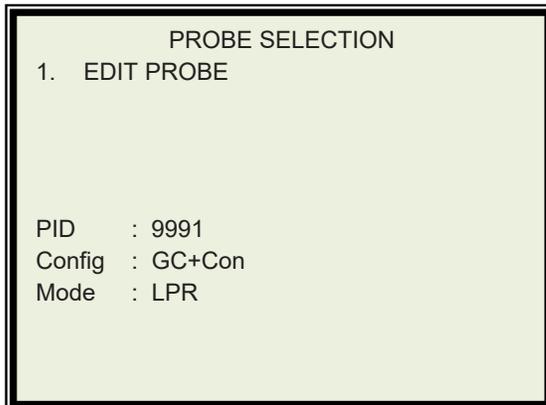
MS3510L

- 
- A screenshot of the MS3510L main menu, showing a list of seven options: 1. PROBE SELECTION, 2. MEASURE PROBE, 3. RECALL READINGS, 4. FILE TRANSFER, 5. COMM./LOOP, 6. CONFIG SETUP, and 7. STATUS.
1. PROBE SELECTION
 2. MEASURE PROBE
 3. RECALL READINGS
 4. FILE TRANSFER
 5. COMM./LOOP
 6. CONFIG SETUP
 7. STATUS

Select the functions by using the UP/DOWN arrow keys to navigate and pressing 'MNU/ENT' key to select an option. Pressing '<-' will return the selection to the previous screen.

1. PROBE SELECTION

Select the 'PROBE SELECTION' option from the main menu to access the probe selection menu. You can edit the current probe or enter a new probe.



a. EDIT PROBE

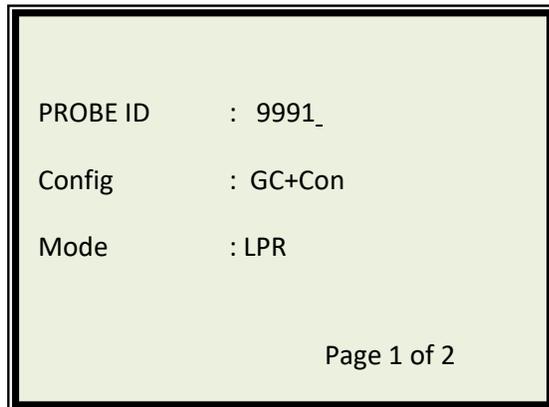
To edit the ID of the probe, navigate to the 'EDIT PROBE' menu by using the UP/DOWN arrow keys, and press MNU/ENT key to select the option; the next screen allows you to edit the probe ID number and the probe type.

1. Enter the Probe ID using the Up/Down arrow Keys. (Use the Up/Down arrows to scroll between alphanumeric characters. Use the Right/Left arrows to advance to the next character or go back to the previous character.) When a 7-digit Probe ID is entered the cursor automatically advances to the 'Config' field.
2. Use the Up/Down arrows to select the 'Config'. Use the Right arrow to advance to the Configuration.
3. Select the measurement Configuration using the up/Down arrow keys and Press 'Mnu/Ent' button.
 - a. GC+Con = General Corrosion + Conductance.
 - b. LC+Con = Local Corrosion + Conductance.
 - c. GC+LC+Con = General Corrosion + Local Corrosion+ Conductance.
4. Select the measurement mode using up/down arrow keys and press 'Mnu/Ent' button.

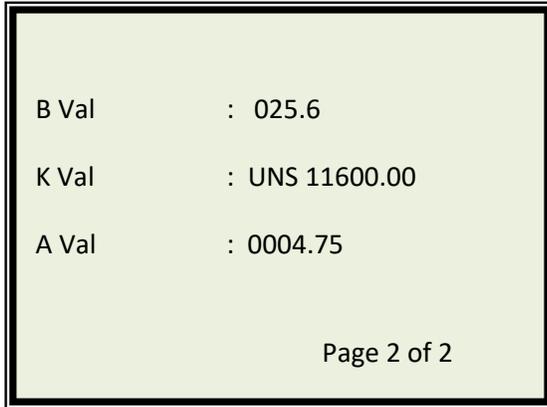
LPR - A user defined Stern-Geary voltage (B user) is used for all LPR corrosion rate calculations. This is the default setting on MS3500L/MS3510L.

DYNAMIC – A process specific Stern-Geary voltage (B Value) is calculated with every measurement cycle through Harmonic Distortion analysis. The B Value is dynamically implemented in the LPR corrosion rate calculation resulting in a highly accurate self-adjusting, process specific corrosion rate calculation.

Page :1



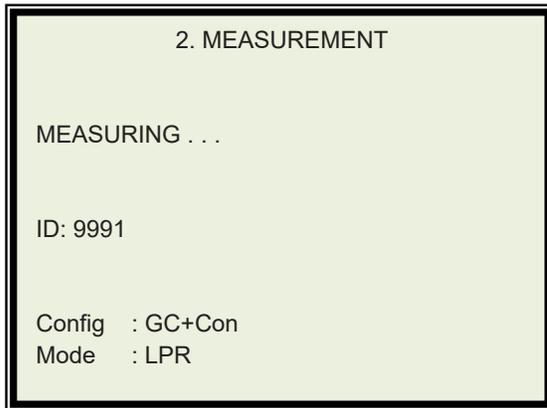
5. Next page 2 of 2 appears on the screen.



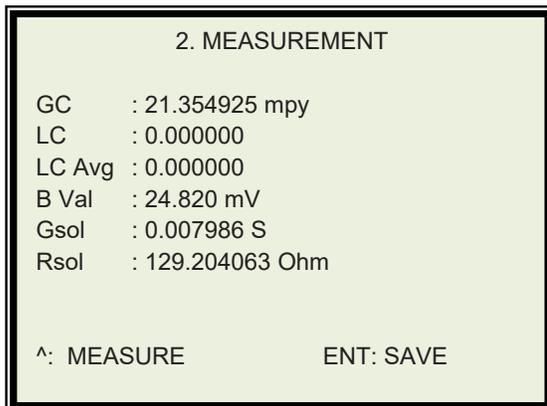
6. B Val - B User Value. Enter B User Value. The default setting is 25.6 B Value of Stern-Geary voltage. This is relevant in LPR mode only.
7. K Val – K Probe Constant. Use Up/Down arrow keys to select the different UNS number and respective K Value.
8. A Val - A Electrode area, Enter electrode are in cm². Default value is 4.75 cm²(EL400 Electrodes)

2. MEASURE PROBE

To make a measurement manually, select 'MEASURE PROBE' in the Main Menu. Ensure that the probe is connected to the data logger before using this function. The display changes as below and the data logger measures the probe. The configuration and mode of the current measuring probe is displayed at the bottom of the screen.



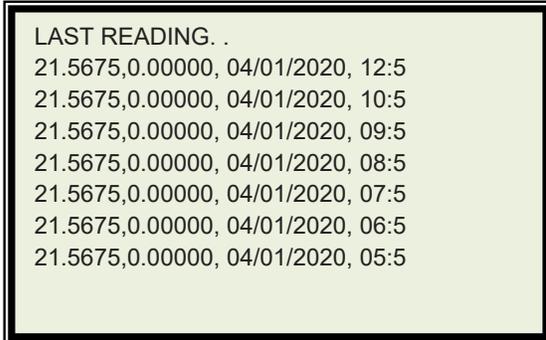
The measured values will be displayed as shown below.



The measured value can be saved by pressing the 'MNU/ENT' key.
Take another measurement by pressing the 'up' arrow key.

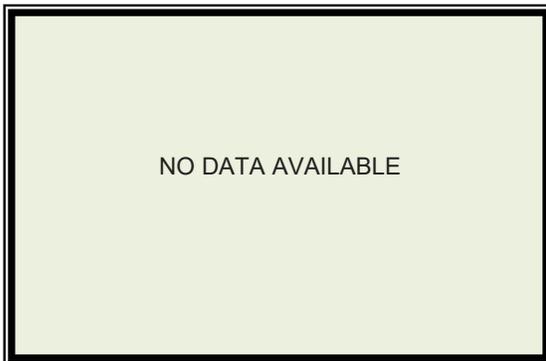
3. RECALL READINGS

Selecting 'RECALL READINGS' in the main menu will allow you to display the last 7 readings of the probe selected. The readings will be displayed as shown below. To exit the menu, press the left arrow key.



LAST READING .
21.5675,0.00000, 04/01/2020, 12:5
21.5675,0.00000, 04/01/2020, 10:5
21.5675,0.00000, 04/01/2020, 09:5
21.5675,0.00000, 04/01/2020, 08:5
21.5675,0.00000, 04/01/2020, 07:5
21.5675,0.00000, 04/01/2020, 06:5
21.5675,0.00000, 04/01/2020, 05:5

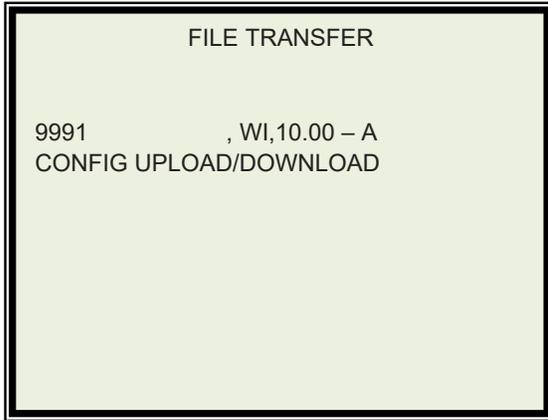
If there are no readings saved for the selected probe this screen will appear. Press the left arrow key to exit.



NO DATA AVAILABLE

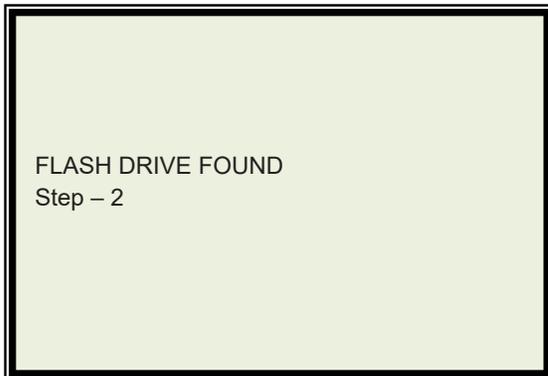
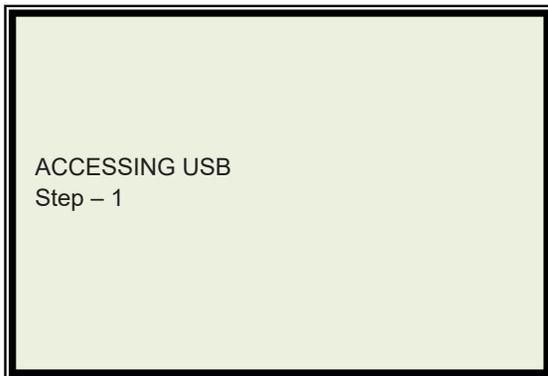
4. FILE TRANSFER

Selecting 'FILE TRANSFER' from main menu screen will display the file transfer screen as below.



a. MEASUREMENT DATA FILE TRANSFER

To transfer probe readings, insert the USB storage device into the USB port of the data logger. Use the UP/DOWN arrow keys to navigate to the probe and press 'MNU/ENT' to select it. The data will be transferred to the USB storage device. The following screens show the process of a successful file transfer. For information on potential errors see the Error Messages section on page 25.



Checking DIR . . .

Copying Files

Remaining 0%

Closing File

b. UPLOAD/DOWNLOAD CONFIG

This function uploads a copy of the unit's current settings to a flash drive in a .txt file. This file may be edited on a computer and then downloaded back onto the unit. Any settings altered in the file will be altered on the unit.

Note: Config Download will delete the data stored on the device. Before using the Config Download feature, upload any data stored on the instrument.

Enter the File Transfer menu and insert the data logger's flash drive into the data logger's USB port. Use the Up/Down arrow keys to highlight the CONFIG UPLOAD option and select it with the 'MNU/ENT' key. The file transfer for Config Upload will have the same sequence as the one for measurement data with an extra step to enter a password for confirmation before the file transfer begins. Use the Up/Down and Left/Right arrows to enter '3333' and press 'MNU/ENT' to confirm.



After completing the file transfer, save the configuration file, named 'CONFIG' to a computer and open it. The information stored in the file will have this format.

```
Pass Word,3333
Interval,0,0000
Display Power Down,02
Active PID,1
Pid1,9991 ,2,1
Unit_ID,000000001
|
```

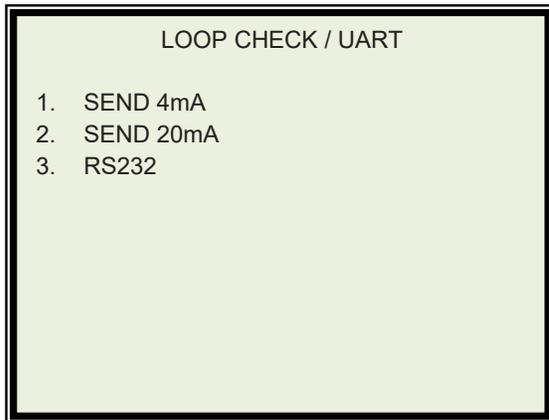
After saving changes to the configuration file, save the file to a flash drive. Ensure that there are no other files on the flash drive and that the configuration file is not stored in any folders. Power on the data logger, enter the File Transfer menu and insert the data logger's flash drive into the data logger's USB port. Use the Up/Down arrow keys to highlight the CONFIG DOWNLOAD option and select it with the 'MNU/ENT' key. The file transfer for Config Download will have the same sequence as the one for measurement data with an extra step to enter a password for confirmation before the file transfer begins. Use the Up/Down and Left/Right arrows to enter '3333' and press 'MNU/ENT' to confirm. After completing the file transfer, the data logger's settings will match those of the configuration file and all data stored on the data logger will be erased.

5. COMM./LOOP

4-20mA Current Loop Output (Model MS3510L)

Prior to using the 'Comm/Loop' function, connect the external current loop cable according to the instructions on Page 5.

Select 'Comm./Loop' from the Main Menu to enter the Loop Check menu.

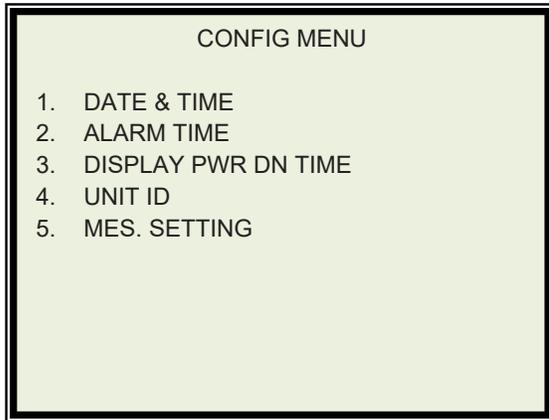


To ensure the current loop measurement is okay:

1. Use the Up/Down arrow keys to highlight the "Send 4mA" option and press the 'MNU/ENT' key. Ensure the loop current measurement is approximately 4mA.
2. Use the Up/Down arrow keys to highlight the "Send 20mA" option and press the 'MNU/ENT' key. Ensure the loop current measurement is approximately 20mA.
3. Ensure the loop current measurement is the correct value when measuring the meter prover:
 - a. Connect the meter prover to the probe connector or probe cable.
 - b. Measure the connected meter prover using the steps described on pages 13-14, after the reading, the current should be:

6. CONFIG SETUP

Select 'CONFIG SETUP' from Main Menu to set Date & Time, Alarm Time, and other settings. The screen below shows the available settings.

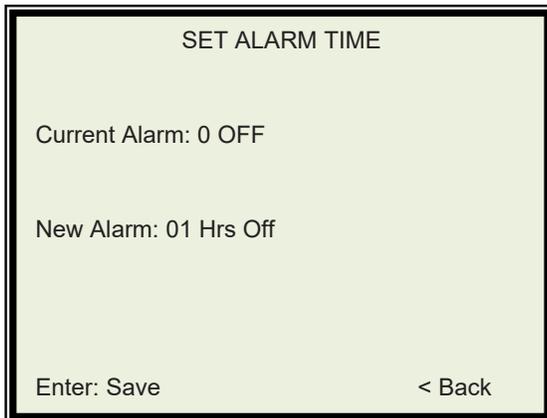


a. DATE & TIME

Selecting 'DATE & TIME' in the config menu will display the date and time setup screen. Enter the current date and time using Up/Down arrows and Left/Right arrows.

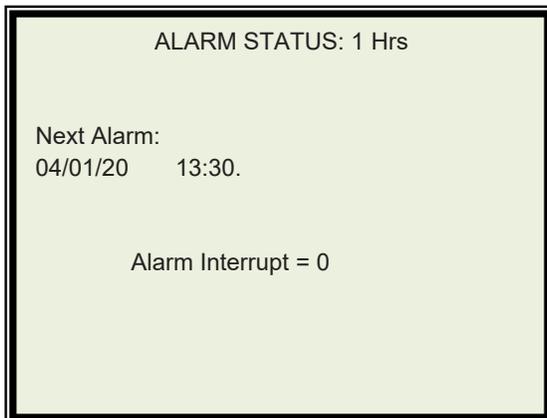


b. ALARM TIME



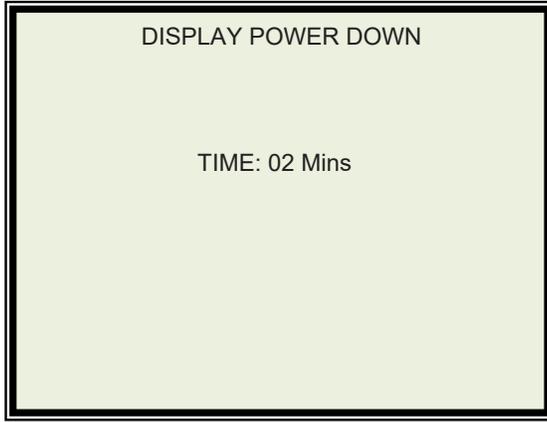
Selecting ALARM TIME will display the set alarm time screen. The current alarm is displayed at the top. Enter the desired alarm interval with the UP/DOWN and LEFT/RIGHT keys. The maximum interval is 99 days and the default minimum interval is 1 hour. The minimum interval can be changed to one minute by enabling “Alarm Mins.” in the Unit ID menu (page 23), then setting the alarm interval to “01 Min”. The unit takes one reading per the interval.

While on the main menu, press the right arrow key to access the Alarm Status screen that shows alarm interval, the time of the next alarm measurement and the number of times the current alarm interval has been interrupted.



c. DISPLAY POWER DOWN TIME

Select the DISPLAY PWR DWN TIME option to display the screen below. Use the UP/DOWN and LEFT/RIGHT arrow keys to set the amount of time the display will remain on without any input.

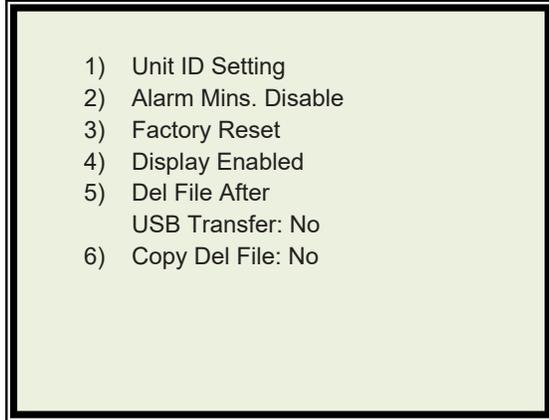


d. UNIT ID

Select the Unit ID option to display the screen below. To access a menu with additional options, use the UP/DOWN and LEFT/RIGHT arrow keys to enter the code '3333' and press the 'MNU/ENT' key.

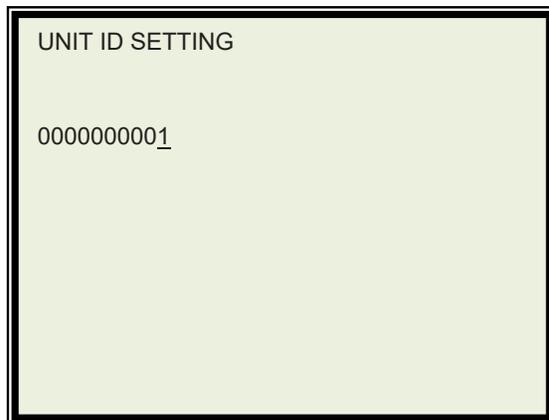


The following screen appears.



Use the Up/Down arrow keys to navigate the menu

1. Select 'Unit ID Setting' to change the data logger's unit ID. Use the UP/DOWN and LEFT/RIGHT to enter the new unit ID and press 'MNU/ENT' to save the new unit ID. The Unit ID Setting screen is shown below.



2. Use the Left/Right arrow keys to toggle the Alarm Mins. Disable option between Enable/Disable. This will allow alarm intervals of less than an hour to be used.
3. Select the Factory Reset option to erase all probe IDs and readings.
4. Use the Left/Right arrow keys to toggle the Display Enabled option between Enabled/Disabled. This will cause the display to turn off while still allowing the data logger to make alarm measurements and transfer files.
5. Use the Left/Right arrow keys to toggle the Del File After USB Transfer option between Yes/No. This will cause transferred measurement data to be deleted from the data logger after file transfer.
6. Use the Left/Right arrow keys to toggle the Copy Del File option between Yes/No. This will copy deleted probe IDs onto the USB device during USB transfer.

7. Display Disabled

The display can be disabled in the settings menu described above. This function is for use in temperatures under -20°C. It allows the unit to take alarm measurements and transfer data and configuration files with the display off.

After selecting the option to disable the display, the display will automatically turn off while the green LED remains on. Before using any of the unit's functions, power the unit off and on again.

To transfer files the unit must be in file transfer mode. To turn on file transfer mode, hold 'MNU/ENT' for 3 seconds. When the unit is in file transfer mode the red LED will flash 2 times a second. To exit file transfer mode, hold 'MNU/ENT' for 3 seconds again. The red LED will stop flashing.

When the unit is not in file transfer mode, hold the LEFT arrow key for 5 seconds. The green LED will turn off when the unit is powered off.

To temporarily turn the display on hold the UP key for 3 seconds while the unit is not in file transfer mode. To enable the display, enter the settings menu and change the Display Disabled setting to Enabled.

To download the data of the active probe ID, enter file transfer mode, insert a flash drive, then hold the DOWN key for 3 seconds. The green LED will flash once per second during the file transfer. When the green LED stops flashing, the flash drive may be removed.

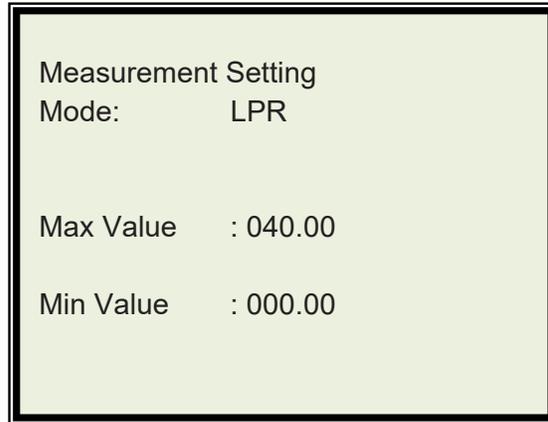
To download the data of all probe IDs, enter file transfer mode, insert a flash drive, then hold the UP and DOWN keys for 3 seconds. The green LED will flash once per second during the file transfer. When the green LED stops flashing, the flash drive may be removed.

To download the configuration file of the unit onto a flash drive, enter file transfer mode, insert a flash drive, then hold the RIGHT key for 3 seconds. The green LED will flash once per second during the file transfer. When the green LED stops flashing, the flash drive may be removed.

To download a configuration file stored on a flash drive onto the unit, enter file transfer mode, insert the flash drive, then hold the LEFT key for 3 seconds. The green LED will flash once per second during the file transfer. When the green LED stops flashing, the flash drive may be removed.

e. **MEASUREMENT SETTING**

Select the 'MES.SETTING' menu to set the instrument setting configuration. The below screen appears.

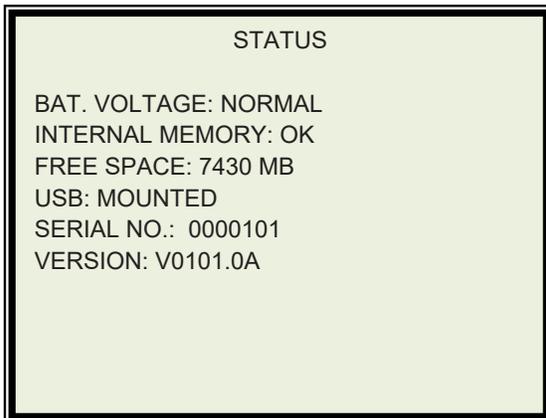


LPR Mode: A user defined Stern-Geary voltage (B user) is used for all LPR corrosion rate calculations. This is the Default setting on MS3500L/MS3600L.

Dynamic mode. A process specific Stern-Geary Voltage (B Value) is calculated with every measurement cycle through Harmonic Distortion Analysis. This B value is dynamically implemented in the LPR corrosion rate calculation resulting in a highly accurate self-adjusting, process specific corrosion rate calculation Set the mode to Dynamic for dynamically

Select the Max. Value for the corrosion rate.
Select the Min Value for the corrosion rate.

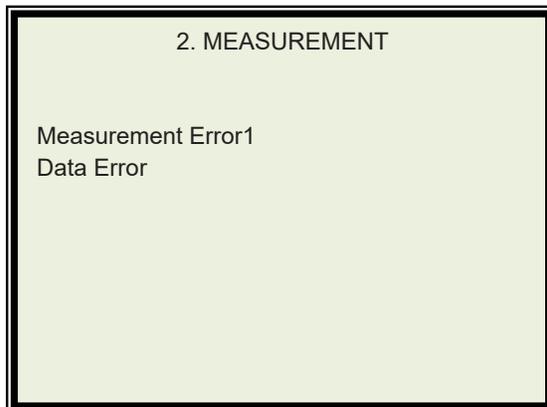
7. STATUS



Current battery status is displayed on the first line.
Internal memory status is displayed on the second line.
Free memory space is displayed on the third line in MB.
USB status is displayed on the fourth line.
Serial number is displayed on the fifth line.
Firmware revision is displayed on the last line.

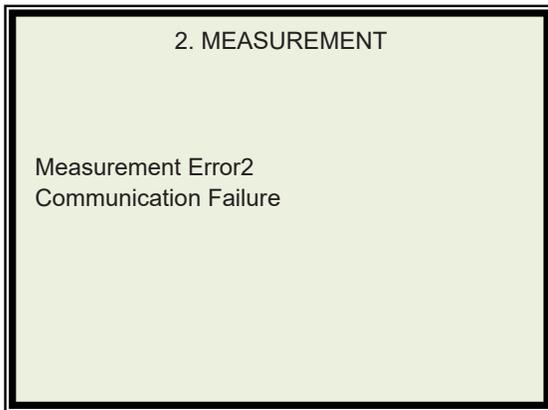
8. ERROR MESSAGES

This error message may appear after taking a measurement.



If this message appears, first ensure that the probe elements are tightened properly and ensure no damages on the probe cable. If it is not, select the correct probe type before taking another measurement. If the error repeats even if the correct probe is selected, connect the probe to the data logger directly to the data logger, ensure that the connection between the probe and the data logger is secure and take another measurement. If the error repeats take a measurement with the meter prover. If the error repeats, there may be an issue with the data logger, and you will need to contact Metal Samples' customer support.

Communication Failure → Measurement Board not communicating to the Host Board. Please contact Metal Samples this error appears frequently.

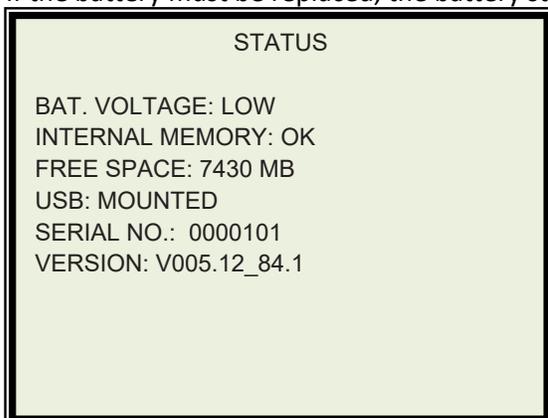


The below error message may appear when attempting to take a measurement.

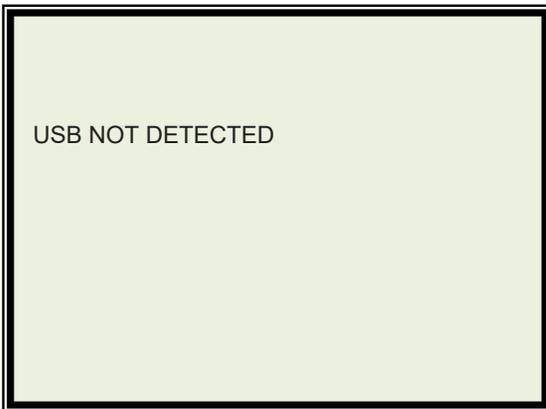
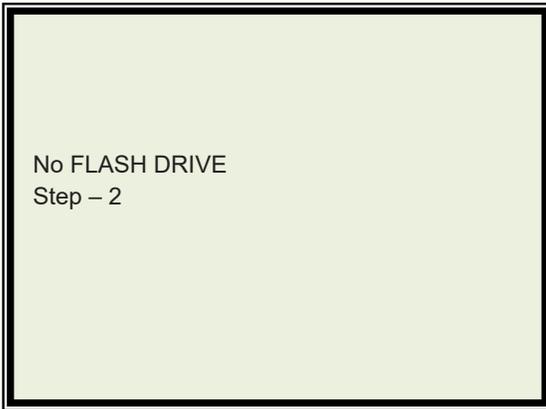


You will need to replace the batteries before attempting another measurement. Instructions for replacing the battery are on page 7 of this instruction manual.

If the battery must be replaced, the battery status is listed as “LOW” in the status menu.



The below error messages may appear while attempting a USB transfer.



If these errors occur ensure that you are using the approved Metal Samples flash drive that was shipped with the data logger. Remove the flash drive from the USB port of the data logger and inspect both the flash drive and the USB port for damage. If both appear undamaged reinsert the flash drive and attempt another USB transfer. If the USB Transfer still fails, you will need to contact Metal Samples' customer support.

This error message may appear while attempting current loop communication:



If this error occurs, ensure that all of the current loop cable is connected. Ensure that you are using the Metal Samples current loop cable that was shipped with the data logger.

D. Maintenance

Once installed, the MS3500L/MS3510L High Resolution LPR Data Logger requires no maintenance. However, it is important to verify the following items periodically to ensure continued safe operation.

CAUTION: Before performing any tests or maintenance on the MS3500L/MS3510L High Resolution ER Data Logger, ensure that all hazardous area requirements are met.

Inspection Item	Frequency
Inspect the enclosure for any signs of damage. Return if necessary.	Annually
Inspect the probe cable / connector for any signs of damage. Replace as necessary.	Annually
Replace the Battery pack	As needed

Contact Metal Samples for replacement parts or if instrument repair is necessary.

1. Testing the MS3500L/MS3510L High Resolution LPR Data Logger with the Meter Prover

A Meter Prover is provided to allow routine checks of the MS3500L/MS3510L High Resolution LPR Data Logger. The Meter Prover simulates a LPR probe at a fixed value. To test the unit with the Meter Prover:

- 1) Connect the Meter Prover to the probe connector.
- 2) Turn on the MS3500L data logger by pressing the 'ON' button
- 3) Ensure Device Mode = LPR Mode and B Value = 25.6 mV.
- 4) Select MAKE MEASUREMENT in the main menu.
- 5) Press 'ENT' button to start measuring the probe value. During measurement, the 'MEASURING' message is displayed on the screen. On completion of the measurement, the display shows the Meter Prover reading. The output should closely match the value printed on the Meter Prover label.

If the Data Logger output matches the Meter Prover value, the instrument can be used for probe measurement by selecting the appropriate probe ID and connecting to the respective probe. If the Data Logger output shows a significant difference compared to the Meter Prover value, further troubleshooting may be required. Refer to Troubleshooting section or contact Metal Samples for further assistance.

E. Troubleshooting

If the MS3500L/MS3510L High Resolution LPR Data Logger does not seem to perform as expected, check the following items:

CAUTION: Before performing any tests or maintenance on the MS3500L/MS3510L High Resolution LPR Data Logger, ensure that all hazardous area requirements are met.

CAUTION: If the Data logger shows any signs of damage, remove it from service immediately and consult the factory.

If the MS3500L/MS3510L data logger does not seem to perform as expected, check the following items:

1. Basic Troubleshooting guide.

SYMPTOM	CAUSE / PROCEDURE	SOLUTION
No Response	<ul style="list-style-type: none"> a. Check Battery voltage. Nominal voltage: 7.0 V DC. b. Ensure that all electrical cables and wiring are in good condition. c. Ensure that all electrical contacts are secure and free of corrosion. 	Replace the battery if necessary.
No communication to the computer/PLC/DCS	<ul style="list-style-type: none"> a. Check communication cable between the instrument and DCS/PLC. b. Check the baud rate setting switch on the instrument and set the same rate on communication unit. c. Ensure Number of bits, parity and stop bits. 8 bits Even parity one stop bit 	Replace the communication cable and try. Set RS485 communication parameters as below and try. Baud Rate: 19200 Data bits: 8 Parity: Even Stop Bit = One
No Data	Check and ensure the probe connections and electrode condition.	Replace probe cable and check. Replace electrodes and check.

2. If there is insufficient supply voltage on the power connector, check the battery.
3. Test Data logger using the supplied Meter Prover (see page 40.)

These basic checks should indicate the source of any problem (probe, battery supply, wiring, etc.). If it is determined that the data logger is malfunctioning, or if you need further assistance in troubleshooting, contact Metal Samples Technical Support.

III. Service and Warranty Information

A. Warranty

Metal Samples warrants that any part of the model **MS3500L/MS3510L High Resolution LPR Data Logger** and accessories which proves to be defective in material or workmanship within one year of the date of original shipment to Purchaser will be repaired or replaced, at Metal Samples option, free of charge. This warranty does not cover (1) probe assemblies, (2) items expendable in nature, or (3) items subject to damage from normal wear, misuse or abuse, or failure to follow use and care instructions.

All damaged items are to be shipped at Purchaser's expense to and from Metal Samples which shall have the right to final determination as to the existence and cause of a defect.

The foregoing shall constitute the sole and exclusive remedy of any purchaser of Metal Samples products for breach of warranty and IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, INCLUDING THE IMPLIED WARRANTIES OR MERCHANTABILITY AND FITNESS. IN NO EVENT SHALL METAL SAMPLES BE LIABLE FOR SPECIAL OR CONSEQUENTIAL DAMAGES, OR FOR ANY DELAY IN THE PERFORMANCE OF THIS WARRANTY DUE TO CAUSES BEYOND ITS CONTROL.

The technical information and suggestions contained herein are believed to be reliable, but they are not to be construed as warranties since conditions of use are beyond our control.

B. Obtaining Service and Returning the Instrument for Repair

If you experience problems with your instrument, please contact the factory at 256-358-4202 and ask for customer support for instrumentation. Our customer support department will assist you in troubleshooting your instrument.

Most issues can be resolved over the phone, but in some cases, it may be necessary to return your instrument for further evaluation and repair. In this case, please obtain a Return Materials Authorization (RMA) number from the salesperson or support technician. This RMA number will ensure that your instrument is routed to the correct department when it is received at the factory.

After receipt of an RMA number you may pack your instrument for return. Be sure to pack your instrument in a sturdy box and to pad it sufficiently to avoid damage during transit. Also be sure to complete the "Instrument Repair Form" on the next page and include a copy with your repair. This will ensure that the repair department has sufficient information regarding the problems you are experiencing with your instrument, as well as the billing, contact, and return shipping details for the repair.

Once you have obtained an RMA number, completed the "Instrument Repair Form", and packed your instrument securely, please ship it prepaid to the following address:

Metal Samples
152 Metal Samples Road
Munford, AL 36268
ATTN: RMA# _ _ _ _ _

NOTE: Be sure to list your RMA number in the attention line (shown as blanks in the example above.)

C. Instrument Repair Form

This form may be photocopied for use when returning an instrument to Metal Samples for repair. Please fill in all known information and enclose a copy of the completed form with the instrument.

General Information

Model Number		Serial Number	
RMA Number		Date of Purchase*	

**If known.*

Contact Information for Repair

Contact Name		Company	
Phone Number		E-mail Address	

Return Shipping Information

Recipient Name*		Company*	
Return Address			

**If different than above.*

Reason for Return. (Provide as much detail as possible. Attach additional pages if required.)

Invoice Instructions (For non-warranty repairs)

<input type="checkbox"/>	Invoice me for the repair <i>(Requires an open account with Metal samples.)</i>	→	Reference PO#
<input type="checkbox"/>	Contact me for credit card information <i>(For security purposes, do not list credit card information on this form.)</i>		

Appendix B: Hazardous Certification Details

	MS35XXL & MS36XXL Hazardous Area Certification Details	Doc.Number	EXDOC-000017
		Revision	0
		Date	05/23/2019
		Page	1 of 2
<p>Worldwide and Europe</p>		<p>Ex ia [ia] IIC T4 Ga $-40^{\circ}\text{C} \leq \text{Ta} \leq +70^{\circ}\text{C}$ (When used with Tadiran TL-5930 Cells) $-40^{\circ}\text{C} \leq \text{Ta} \leq +50^{\circ}\text{C}$ When used with Xeno Energy XL-205F Cells</p> <p>ATEX Cert. No: ITS17ATEX201833X IECEx Cert. No: IECEx ETL 17.0020X X – See special Conditions below</p>	
<p>Special Conditions</p> <ol style="list-style-type: none"> Potential Electro charging Hazard. Only Battery packs allowed to replace in Hazardous areas. 			
<p><u>Hazardous Area Installation</u></p> <p>CAUTION: This section provides general guidelines for hazardous area wiring. However, regardless of anything stated here, the MS35XXL / MS36XXL Data Logger must be installed in full compliance with the control drawing provided Annexure-C and all of the local area requirements.</p>			
<p><u>Entity Parameters</u></p> <p><u>at Probe (common for all models Except MS3502L and MS3504L)</u></p> <p>Uo: 8.61V Io: 0.305A Po: 0.377W Co: 0.1μF Lo: 60μH</p> <p><u>at each Probe connector (For models MS3502L and MS3504L)</u></p> <p>Uo: 8.61V Io: 0.848A Po: 1.047W Co: 0.1μF Lo: 20μH</p>			



MS35XXL & MS36XXL Hazardous Area
Certification Details

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Revision	0
Date	05/23/2019
Page	2 of 2

at J2 Connector (Serial output to Certified handheld equipment)

This is applicable to Model number MS3530L,MS3630L,MS3540L and MS3640L

Uo: 4.94V
Io: 2mA
Po: 24.7mW
Ci: 0 μ F
Li: 0 μ H
Co: 100 μ F
Lo: 880.0 μ H

at J3 Connector (4-20 current loop input thru' barrier)

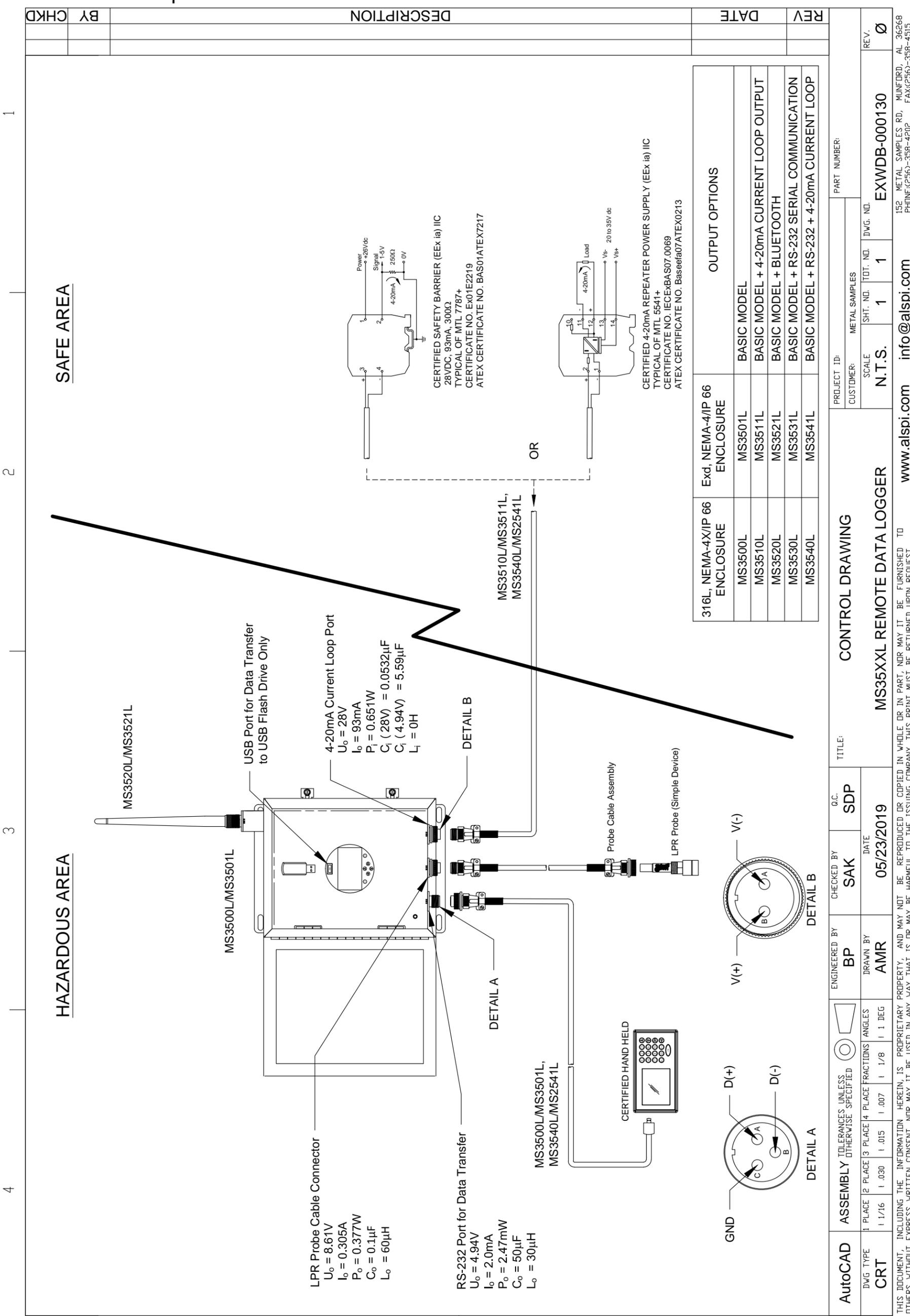
This is applicable to Model number MS3510L,MS3610L,MS3540L and MS3640L

Ui 28V
Ii 93mA
Pi 0.75W
Ci (@28V) 0.054 μ F
Ci: (@4.94V) 5.59 μ F
Li: 0H

CAUTION:

1. When replacing the battery packs in Hazardous area, discharge the static charge from the body using ground strips or other methods.
2. Use gas analyzers or other type of equipment to ensure the area is non-hazardous before changing the batteries. Cells in the batteries not allowed to replace in hazardous areas.
3. Use only with battery pack part # ET1664 / ET2250 / ET1857 / ET2257.
4. Equipment is intended for use only with Xeno Energy model XL-205F and Tadiran model TL-5930 cells. Use of any other battery in this device may impair intrinsic safety.
5. Do not replace cells in the pack unless area is known to be Non-Hazardous.

Appendix C: Control Drawing (Hazardous Area Wiring Diagram)



AutoCAD		ASSEMBLY TOLERANCES UNLESS OTHERWISE SPECIFIED		ENGINEERED BY		CHECKED BY		Q.C.		CONTROL DRAWING		PROJECT ID:		PART NUMBER:						
DWG TYPE	1	PLACE	2	PLACE	3	PLACE	4	PLACE	FRACTIONS	ANGLES	BP	SAK	SDP	METAL SAMPLES	SCALE					
CRT	1/16	1/30	1/015	1/007	1/8	1 DEG	AMR	DATE	05/23/2019	05/23/2019	AMR	SAK	SDP	METAL SAMPLES	N.T.S.					
TITLE: MS35XXL REMOTE DATA LOGGER													SHT. NO.	1	TOT. NO.	1	DWG. NO.	EXWDB-000130	REV.	Ø
THIS DOCUMENT, INCLUDING THE INFORMATION HEREIN, IS PROPRIETARY PROPERTY, AND MAY NOT BE REPRODUCED OR COPIED IN WHOLE OR IN PART, NOR MAY IT BE FURNISHED TO OTHERS WITHOUT EXPRESS WRITTEN CONSENT, NOR MAY IT BE USED IN ANY WAY THAT IS OR MAY BE HARMFUL TO THE ISSUING COMPANY. THIS PRINT MUST BE RETURNED UPON REQUEST.													www.alspi.com		info@alspi.com		152 METAL SAMPLES, RD., MINIFORD, AL 36268 PHONE:(256)-358-4202 FAX:(256)-358-4515			

B

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