ÅirIQ Airborne Corrosion Monitoring System

Operations Manual

COSASCO®

A Haïma company

Table of Contents

Figures and Drawings

CHAPTER 1

Chapter 1 - Introduction

General

ÅirIQ™ provides real-time, continuous air monitoring to indicate a corrosive environment well before damage to critical assets can occur. The electrical resistance (ER) technology provides a direct measurement of corrosive contaminants in the air by measuring changes in electrical resistance of two metal sensors.

The electrical resistance of the two coupons (copper and silver) is measured as they corrode in response to the environment. This provides a direct calculation of the corrosion rate due to airborne contaminants.

Built in LEDs provides an immediate alert of increasing corrosion levels corresponding with the Instrument Society of America's (ISA) 71.04-2013 classification for environmental corrosion (G1 through GX) for copper and silver.

Airborne corrosion is becoming more of an issue because lead-free electronic components are now more susceptible to damage. Monitoring of these assets is becoming more prevalent due to the Restrictions on Hazardous Substances (RoHS).

The ÅirIQ is designed for use in monitoring controlled environments in industries such as refineries, chemical plants, pulp and paper plants, control rooms, computer rooms, museums, and clean rooms.

Early detection of humidity, temperature, and/or corrosive conditions will permit corrective action to be taken before substantial damage can occur to sensitive electronic systems and electrical equipment.

The ÅirIQ system measures and monitors:

a. Relative humidity (RH)
b. Temperature (˚C or ˚F)
c. Differential pressure (dP)
d. Corrosion Rate of Copper (Cu)
e. Corrosion Rate of Silver (Ag)
f. Metal loss of Cu
g. Metal loss of Ag

The ÅirIQ consists of the display plus the corrosion sensors, which allow for real-time monitoring of the atmospheric parameters. Both the display and the sensors contain an

LED indicator to show corrosion severity and an interactive touchscreen for immediate data visualization (See Figure 1-1 ÅirIQ Unit).

Figure 1-1: ÅirIQ Unit

Data Output Options

Analog

There are seven (7) 4-20mA output channels with current-sourcing (power supplied from the ÅirIQ) or current-sinking (power supplied from an external power source) provided through the 4-20 mA junction box

Information from any of the measurable parameters can be accessed by remote mounted systems via 4-20mA loop outputs. These outputs are user selectable to be either current-sourcing (power supplied from the ÅirIQ) or current-sinking (power supplied from an external power source).

The 4-20 mA output parameters are not assignable. They are preset within the software and cannot be changed.

Digital

The ÅirIQ is designed to communicate through an internal web interface, via the Ethernet and Modbus TCP/IP.

Chapter 2 - ÅirIQ Unit

Instrument Display

The ÅirIQ incorporates a 7” color touch screen display with digital and analog outputs (Reference Figure 2-1).

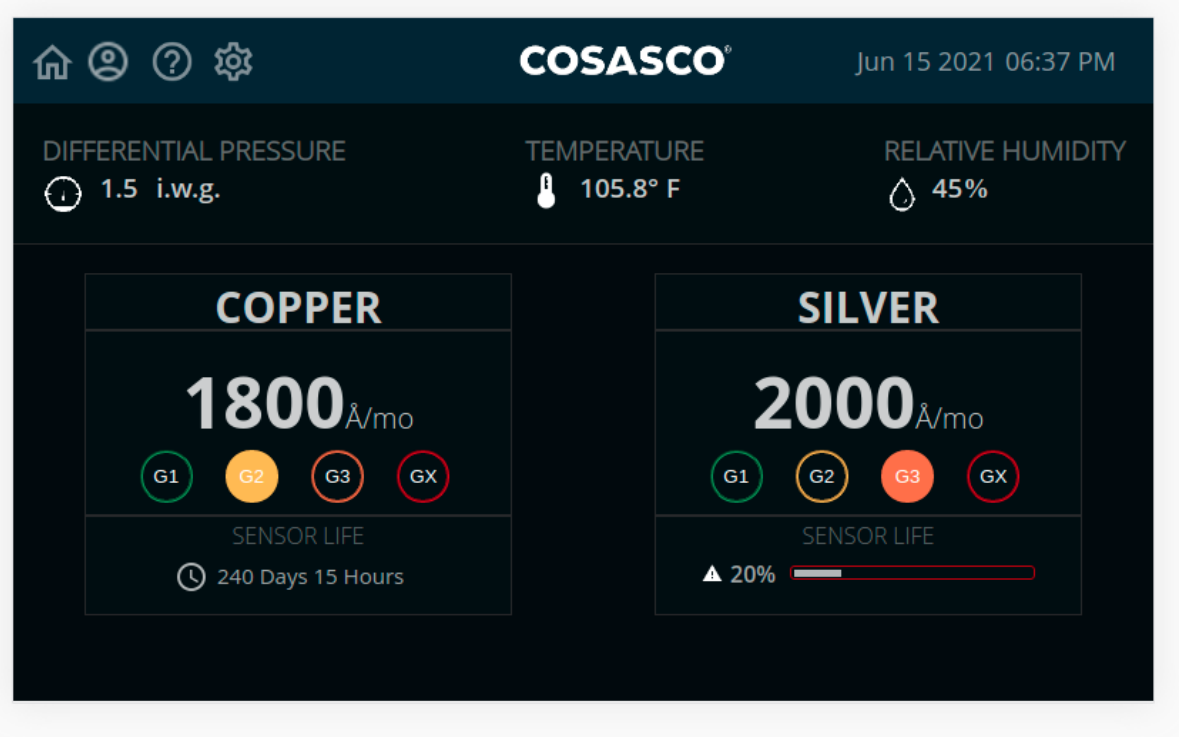


Figure 2-1: ÅirIQ Dashboard

The ÅirIQ reads the temperature, relative humidity, differential pressure, Cu/Ag corrosion rate, and Cu/Ag sensor life once every one (1) minute. Parameter values are updated on the dashboard.

Corrosion

Two corrosion sensors, one copper (Cu) and one silver (Ag), are used. The corrosion severity level is shown by indicators on the display that correspond to ISA-71.04-2013 (levels G1 through GX). This standard relates the corrosion rate of the thin film of copper or silver over a normalized 30-day period to the aggressiveness of the surrounding environment. The color-coded lights allow for quick and easy determination of the severity level.

This provides an immediate alert of increasing corrosion levels corresponding with ISA 71.04-2013 classification for environmental corrosion (Reference Table 2-1).

Copper

Corrosion Rate Monthly		
Severity	LED	Rate: Angstroms/Month
G1 - Mild	Green	0-299
G2 - Moderate	Yellow	300-999
G3 - Harsh	Orange	1000-2000
GX - Severe	Red	≥2000

Silver

Corrosion Rate Monthly		
Severity	LED	Rate: Angstroms/Month
G1 - Mild	Green	0-199
G2 - Moderate	Yellow	200-999
G3 - Harsh	Orange	1000-2000
GX - Severe	Red	≥2000

Table 2.1: Corrosion Rate (angstroms/month)

A numerical display shows the corrosion rate in angstroms per month. The metal loss of each sensor is displayed (in angstroms) from the time the sensor is set. The reference element of each sensor is displayed above the numeric display.

Sensor Life

The sensor life can be displayed as a percentage (%) or angstroms of metal loss on the front panel. The sensor life icon turns red when it hits 20% (4,000 angstroms of metal loss). When the metal loss value is 1,000 or less, the border of the sensor loss display will turn red.

Relative Humidity

The relative humidity is displayed as a percentage (%) on the front panel.

Temperature

The temperature is displayed on the front panel. The temperature can be configured to show the reading in either degrees Celsius or Fahrenheit on the settings page.

Differential Pressure

The differential pressure is displayed in units of inches of water gauge. When there is a new value on the differential pressure sensor, the value is updated on the dashboard.

Settings Screen

To get to the settings screen, touch the gear symbol on the dashboard. From the settings page the user can change the temperature units, select the sensor life display readings, and set the date, time, and the time zone (refer to Figure 2.2 Settings Screen).

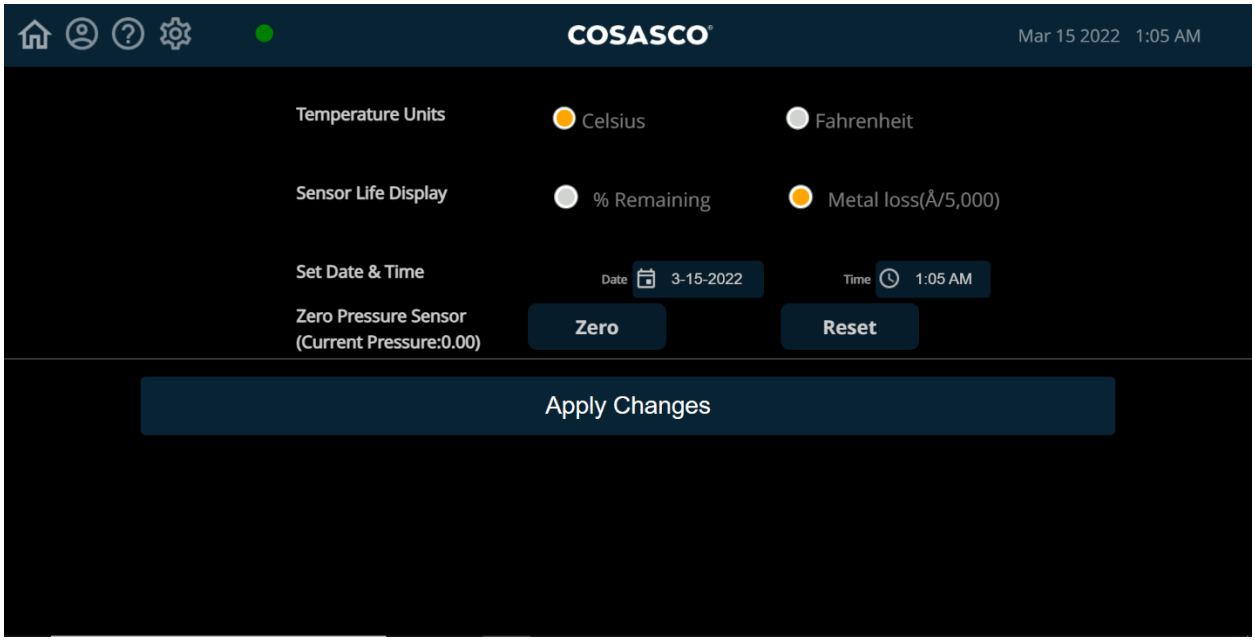


Figure 2-2: Settings Screen

Communications

The ÅirIQ has two options of communication for the customer to choose from:

1. Modbus TCP/IP over Ethernet Connection (reference Figure 2-5)
2. 4-20 mA Analog Output

Modbus

The ÅirIQ communicates environmental data via Modbus TCP/IP over Ethernet. The Ethernet port is located at the bottom of the equipment (reference Figure 2-3). The Modbus communicates the data through holding registers on slave unit id 0 or 1.

Figure 2-3: Modbus port

4-20 mA Junction Box

In addition to Modbus TCP/IP, the ÅirIQ can communicate real-time data through 7-channel Analog 4-20 mA. This can be done through an add-on junction box The junction box is connected to the ÅirIQ display unit using the provided cable (reference Figure 2-4). To finalize configuring the 4-20 mA communication, user can remove the cover of the junction box and connect each wire to the corresponding port.

Figure 2-4: System connected via junction box

CHAPTER 3

Chapter 3 - Specifications

Measured Parameters

The ÅirIQ relies on configuration settings and program values, both stored in the system software, to establish operational parameters (reference Table 3-1).

Measured Parameters			
Parameter Number	Operational Parameter	Unit of Measure	Range/Levels
1	Corrosion Rate, Copper (Cu)	Å/Month	0 to 5000Å per month
2	Corrosion Rate, Silver (Ag)	Å/Month	0 to 5000Å per month
3	Metal Loss for Cu	Å	
4	Metal Loss for Ag	Å	
5	Ambient Temperature	°C or °F	0°C to +50°C or +32°F to +122°F
6	Ambient Relative Humidity	% RH	0 to 100%
7	Differential Pressure	i.w.g.	0-0.5 range with 0.01 resolution

Table 3-1: Measured Parameters

Corrosion Sensors

The corrosion sensors have a lifespan of 5,000 angstroms. How long this lasts depends on the corrosivity of the environment.

One sensor unit with copper and silver corrosion coupons is provided with the instrument (reference Figure 3-1).

A ventilated shield is used to protect the sensors from physical damage while allowing airflow.

Contact COSASCO if you are interested in coupons made of other materials.

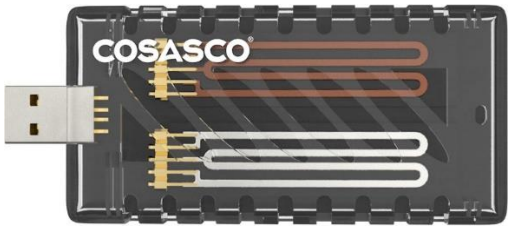


Figure 3-1: Corrosion Sensors

Displays

The LCD displays the metal loss (in angstroms) and corrosion rate (in angstroms per month) for each sensor, relative humidity (%), temperature (˚F or ˚C), and differential pressure (i.w.g.). Indicators are set to correspond to the G levels outlined by ISA 71.04-2013.

Outputs

Analog

The ÅirIQ incorporates seven 4-20mA outputs (current-sinking or current-sourcing) that are not assignable (reference Table 3-2). They are preset to specific parameters within the software and cannot be changed.

Outputs Menu	
Channel	Output
1	Copper Metal Loss
2	Silver Metal Loss
3	Temperature
4	Relative Humidity
5	Differential Pressure
6	Copper Corrosion Rate
7	Silver Corrosion Rate

Table 3-2: Outputs Menu

Digital

The ÅirIQ is designed to communicate through an internal web interface, via the Ethernet, Modbus TCP/IP.

Power Requirements

DC wall adapter (barrel connector) with a rating of: 24VDC, 1.5A. Universal input (90-264 Vac)

Operating Temperature Range

+32 °F to +122 °F (0 °C to +50 °C)

Weight

3.25 lbs. (1.5 kg)

Specifications

Reference Table 3-3 below for the ÅirIQ Specifications

Specifications	
Parameter	Value
Sensor Life Span	5000Å
Sensitivity	1Å
Repeatability	± 1 Ångstrom
Displays	0 to 100% RH (non-condensing)
Output Options	Seven 4-20 mA outputs assigned to specific parameters
	Modbus over TCP/IP
Voltage	24VDC, 1.5A. Universal input (90-264 Vac)
4-20mA External Loop Voltage	30V Max
4-20mA Loop Load	2 Ohms Min, 650 Ohm Max
Operating Temperature	+32° to +122°F or 0°C to +50°C

Table 3-3: Specifications

CHAPTER 4

Chapter 4 - Installation

NOTE: Your ÅirIQ instrument was carefully tested, inspected, and packaged prior to shipment. Before unpacking the instruments, please inspect the packaged materials for shipping damage and retain the damaged packaged materials to support any claim against your freight carrier, should this become necessary.

Mounting

The ÅirIQ is designed to be mounted on a wall or any flat vertical surface. There are 4 holes that can be used to be mounted on the wall. Figure 4-1 provides the location of the holes for mounting. Dimensional information is provided in Figure 4.2 below for mounting the ÅirIQ unit.

The unit may also be mounted using a DIN rail method. User must arrange all the necessary mounting kit to install the unit using DIN rail mount.

Figure 4-1: Mounting Holes

Figure 4-2: Dimensional Information for Unit Installation

For optimal performance, it is recommended that the ÅirIQ be positioned where the concentration of airborne contaminants is expected to be at a maximum. Likely mounting locations would be near vents, ducts, or any other potential source of contaminant gas.

Power

The power supply port is located at the bottom of the unit (reference Figure 4-3). The ÅirIQ ships with a power adapter with a rating of 24 VDC.

Figure 4-3: Power Supply

Atmospheric Sensors

Corrosion Sensors

The ÅirIQ corrosion sensors (the silver and copper coupons) come pre-installed within the sensor unit (reference Figure 4-4). The sensor unit is installed on the right-hand side of the main unit via USB (reference Figure 4-5).

CAUTION: **Great care should be taken so that the sensor element remains uncontaminated.**

When a corrosion sensor reaches its end of life, which happens when it reaches 5,000 angstroms of corrosion accumulation, it will cease to function and must be replaced. When a replacement sensor is obtained, remove the old sensor from the USB port and install the new sensor. The ÅirIQ will recognize that a new sensor has been installed and will begin the initialization procedure. This process takes approximately 24 hours, and during this time the information received from the ÅirIQ is not valid.

NOTE: **Corrosion rates are always high on newly exposed metal surfaces, therefore, it is more difficult for the ÅirIQ to distinguish between the different severity levels in the first 24 hours of operation after installation of a new sensor. Consequently, a 24-hour period of stabilization is recommended before taking actions as a result of an indicated severity level.**

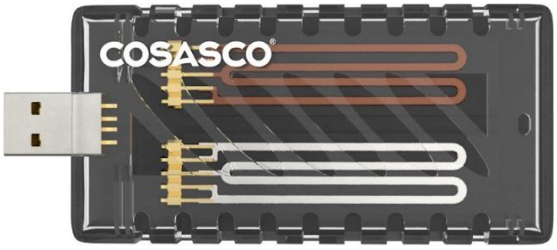


Figure 4-4: Corrosion Sensors

Figure 4-5: Corrosion Sensor USB

Relative Humidity

The ÅirIQ's relative humidity sensor is located inside the corrosion sensor enclosure.

Temperature

The ÅirIQ temperature sensor is located inside the corrosion sensor enclosure.

Differential Pressure

A 4-20mA differential pressure transmitter is located at the bottom of the unit. Tubing should be connected to at least one, if not both, of the air ports (reference Figure 4-6) and run to the areas to be monitored for differential pressure.

Figure 4-6: Differential Pressure Ports

Analog Output

The analog output for the ÅirIQ unit is provided via the 4-20mA junction box.

Table 4-1 identifies channel outputs for the 4-20mA output bridge

Outputs Menu	
Channel	Output
1	Copper Metal Loss
2	Silver Metal Loss
3	Temperature
4	Relative Humidity
5	Differential Pressure
6	Copper Corrosion Rate
7	Silver Corrosion Rate

Table 4-1: Outputs Menu

The G level is provided by stair-step loop outputs for the severity level of the silver and copper sensors. The corresponding G levels for the current outputs are as follows (reference Table 4.2):

Copper	
ISA G Level	**Range**
G1	4mA
G2	5.92mA
G3	10.4mA
GX	16.8mA

Silver	
ISA G Level	**Range**
G1	4mA
G2	5.28mA
G3	10.4mA
GX	16.8mA

Table 4.2: G Level Current Outputs

The ÅirIQ Modbus and Current Loops value ranges can be found in Appendix of this manual.

CHAPTER 5

Chapter 5 - Operation

General

The ÅirIQ provides continuous monitoring of the corrosive severity of gaseous environments. The metal loss on thin films of copper and silver is measured every one (1) minute and stored in short-term memory. This rate is then normalized to yield a theoretical corrosion rate in angstroms per month in accordance with the characteristics specified in ISA 71.04-2013. The G levels corresponding to each sensor's corrosion rate are displayed on the dashboard.

Startup

1. **INSERT** the power supply plug into an electrical socket.
2. **INSERT** the power supply barrel connector into power supply port (located at the bottom of the unit).
3. **OBSERVE** the ÅirIQ going through a self-test and display of the Splash Screen (reference Figure 5-1).

Figure 5-1: Splash Screen

4. The Log-In Screen appears (reference 5-2). **INPUT** the default username and password. To add additional user, refer to the user screen.
   Username: admin
   Password: admin
5. Upon completion, **VERIFY** the ÅirIQ displays the dashboard screen (reference Figure 5-2).

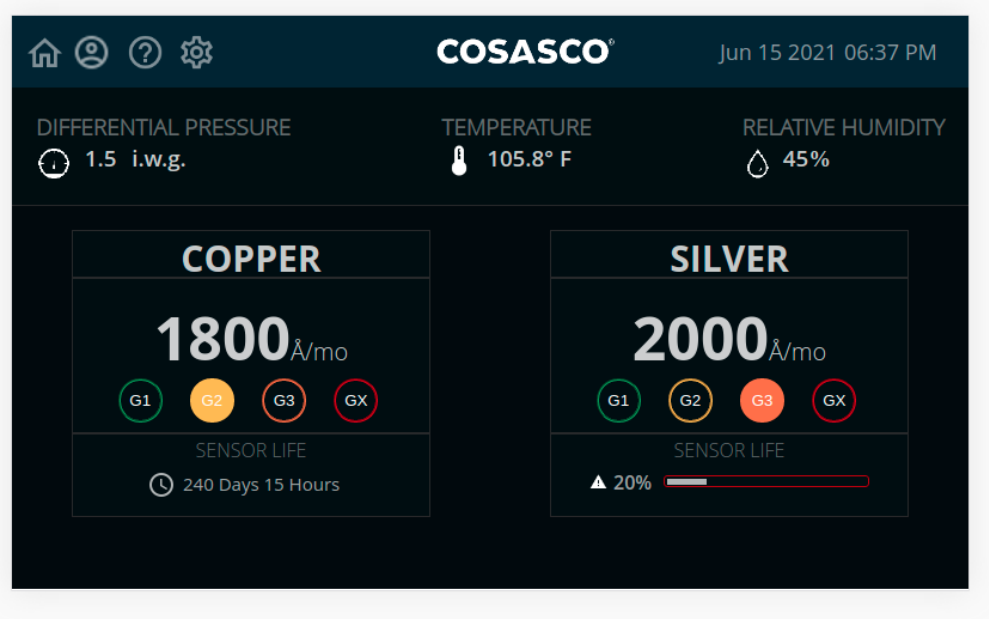


Figure 5-2: Dashboard Screen

Note: **If the USB corrosion sensor is not plugged into the USB port, or the ÅirIQ cannot read the data from the USB corrosion sensor, the user will get a USB Communications Error (reference Figure 5-4).**

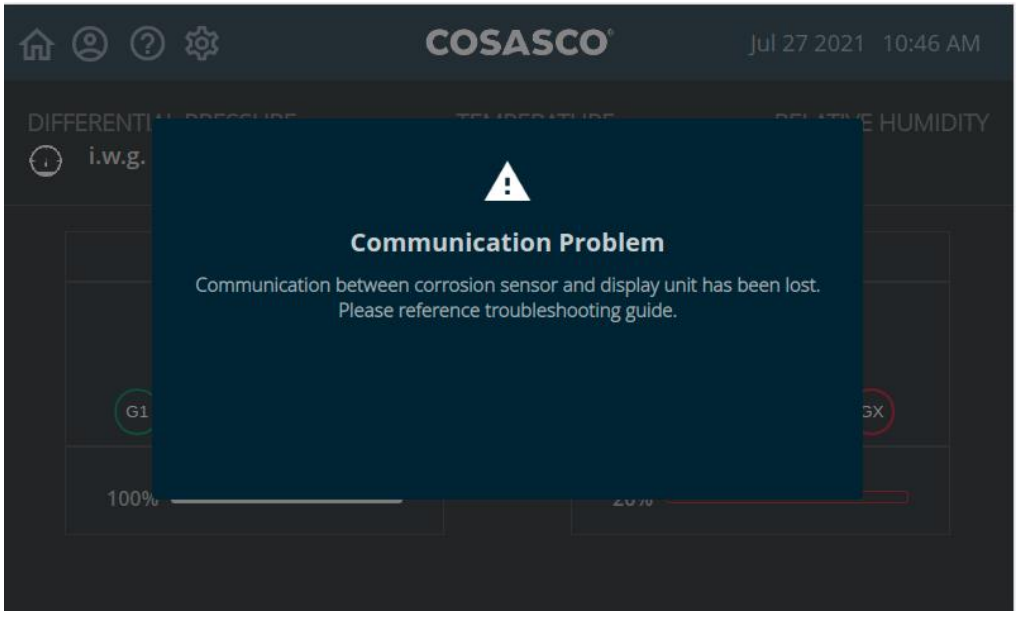


Figure 5-3: Communication Error

6. **OBSERVE** the LED indicators flashing on the sensors.

7. **OBSERVE** the dashboard screen displaying corrosion rates, temperature, and relative humidity data.
8. If the ÅirIQ is unsuccessful at start up, **CONTACT** COSASCO immediately for troubleshooting.

NOTE: **Corrosion rates will always read high on newly exposed metal surfaces, therefore, it is more difficult for the ÅirIQ to distinguish between the different severity levels in the first 24 hours of operation after installation of a new sensor. Consequently, a 24-hour period of stabilization is recommended before taking actions as a result of an indicated severity level.**

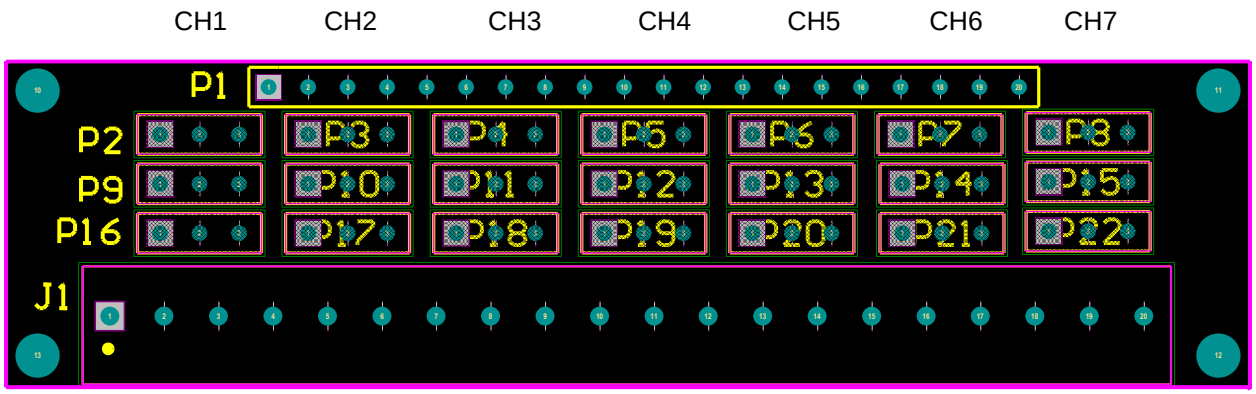
Configure the 4-20mA Junction Box

The add-on junction box can be configured with the loop being powered either by an external power supply or by the ÅirIQ internal 24V power supply. The power source of each of the seven channels can be set individually.

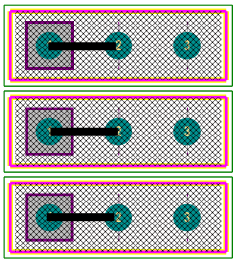
The ÅirIQ junction box comes preconfigured for ÅirIQ internal power supply for all the channels.

To modify the power selection and to connect the loops, remove the top cover of the junction box.

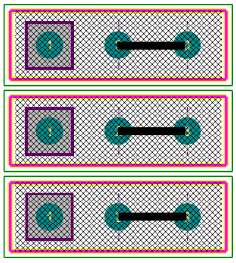
The ÅirIQ junction box power selection and the loop connections are shown below



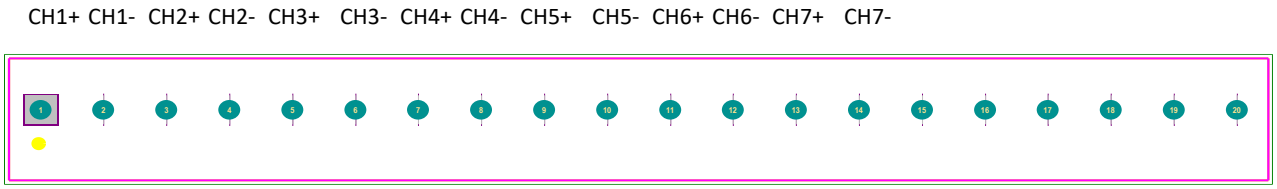
To select the external power option for each loop, connect jumper pins 1 and 2 as shown below:



To select the internal, ÅirIQ powered option for each loop, connect jumper pins 2 and 3 as shown below:



The loop connections are found on the terminal block connector J1 as shown below:



The last 6 pins are non-functional.

Configure Modbus

When the AirIQ unit comes from the factory, it is configured to work with a DHCP server to automatically get assigned an IP address. To assign a static IP address to the AirIQ, follow the procedure below:

1. **CLICK** on the connectivity screen.
2. Enter the static IP address and the default gateway addresses in the Ethernet portion of the screen. You can change the value of each box by tapping on the box.
3. Once all the values are entered correctly, tap the **Update** button.

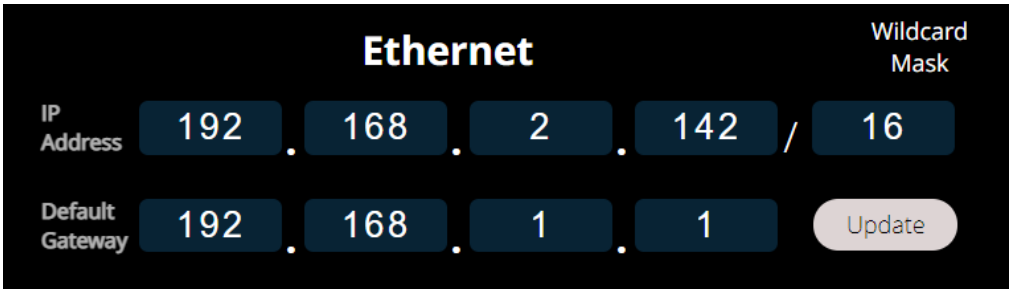


Figure 5-4: Ethernet IP Address Configuration

4. You will need to cycle power to the AirIQ for the new values to take effect.

- The Default Gateway is usually the IP address of the router that the device is connected to.

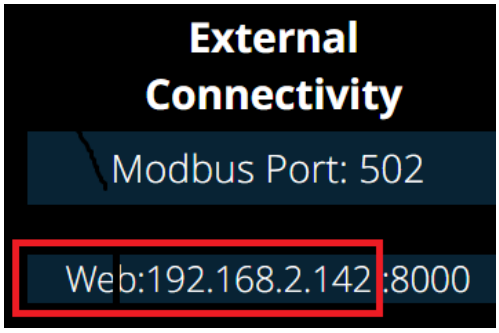
- The Wildcard Mask represents a shorthand notation for the Netmask and is summarized in the table below.

NOTE: For security reasons, once the static IP is set, the system cannot be switched back to a DHCP setup.

Slash	Netmask	Wildcard mask
/32	255.255.255.255	0.0.0.0
/31	255.255.255.254	0.0.0.1
/30	255.255.255.252	0.0.0.3
/29	255.255.255.248	0.0.0.7
/28	255.255.255.240	0.0.0.15
/27	255.255.255.224	0.0.0.31
/26	255.255.255.192	0.0.0.63
/25	255.255.255.128	0.0.0.127
/24	255.255.255.0	0.0.0.255
/23	255.255.254.0	0.0.1.255
/22	255.255.252.0	0.0.3.255
/21	255.255.248.0	0.0.7.255
/20	255.255.240.0	0.0.15.255
/19	255.255.224.0	0.0.31.255
/18	255.255.192.0	0.0.63.255
/17	255.255.128.0	0.0.127.255
/16	255.255.0.0	0.0.255.255
/15	255.254.0.0	0.1.255.255
/14	255.252.0.0	0.3.255.255
/13	255.248.0.0	0.7.255.255
/12	255.240.0.0	0.15.255.255
/11	255.224.0.0	0.31.255.255
/10	255.192.0.0	0.63.255.255
/9	255.128.0.0	0.127.255.255
/8	255.0.0.0	0.255.255.255
/7	254.0.0.0	1.255.255.255
/6	252.0.0.0	3.255.255.255
/5	248.0.0.0	7.255.255.255
/4	240.0.0.0	15.255.255.255
/3	224.0.0.0	31.255.255.255
/2	192.0.0.0	63.255.255.255
/1	128.0.0.0	127.255.255.255
/0	0.0.0.0	255.255.255.255

Wildcard and Netmask Values

When the AirIQ is connected to the Ethernet, the connection IP address is displayed in the External Connectivity portion of the screen:



When there is no TCP/IP connection, the Web portion of the field will not show an IP address.

Change Time and Date

1. On the setting screen, **CLICK** on Date (reference Figure 5-5).

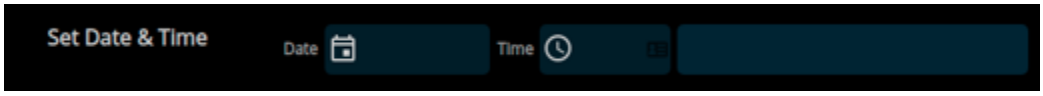


Figure 5-5: Date and Time (Settings Page)

2. **OBSERVE** the date input pop-up (reference Figure 5-6).

Figure 5-6: Date Input Pop-Up

3. **CLICK** on the current date.
4. **OBSERVE** the current date in the date field on the setting screen.
5. On the setting screen, **CLICK** on Time.

6. **OBSERVE** the time input pop-up (reference Figure 5-7).

Figure 5-7: Time Input Pop-Up

7. **PLACE** the cursor on the current time.
8. **CLICK** and **HOLD** the mouse button while rotating it to the desired time.
9. **RELEASE** the mouse button
10. **CLICK** on OK.
11. **OBSERVE** the desired time setting on the settings page

Change Temperature Units of Measure

1. **GO** to the settings page.
2. **SELECT** the desired units (Fahrenheit or Celsius) (reference Figure 5-8).

Figure 5-8: Temperature Units of Measure (Settings Page)

3. **RETURN** to the dashboard.
4. **OBSERVE** the temperature in the desired units.

Change Sensor Life Display

Note: Sensor life can be displayed as a percentage of life remaining or the amount of metal loss in angstroms out of 5,000.

1. **GO** to the settings page.
2. **SELECT** the desired units; Percentage of Life Remaining or the Amount of Metal Loss (reference Figure 5-9).

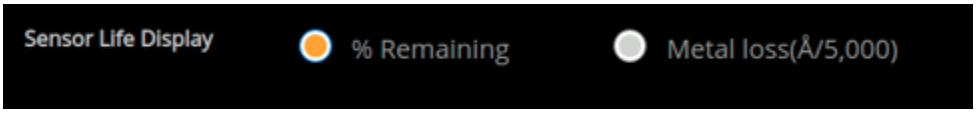


Figure 5-9: Sensor Life Display (on settings page)

3. **RETURN** to the dashboard.
4. **OBSERVE** the sensor life in the desired units.
5. **CLICK** apply button to finish setting

Access Help

At any time, the user can access the help menu.

1. At the top right side of the settings page, **CLICK** on the question mark.
2. **OBSERVE** the help message pop-up (reference Figure 5-10).

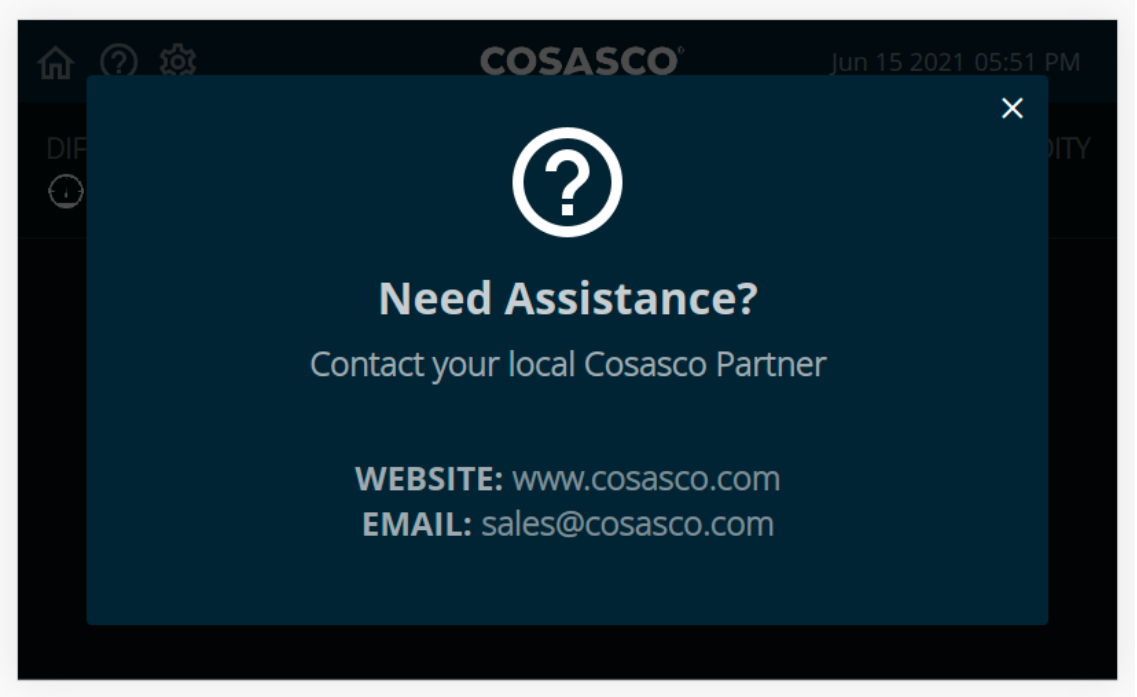


Figure 5-10: Help Message Pop-Up

Users

The User screen provides the ability to add new users and configure existing user credentials (Reference Figure 5-11)

1. From the settings screen, **CLICK** on user.
2. To add new user, **CLICK** Add User
3. The followings can be done to manage existing users:
    a. Edit User: **CLICK** on Edit to change the Username.
    b. Change Password: **CLICK** on Change.
    c. Delete User: **CLICK** on Delete.

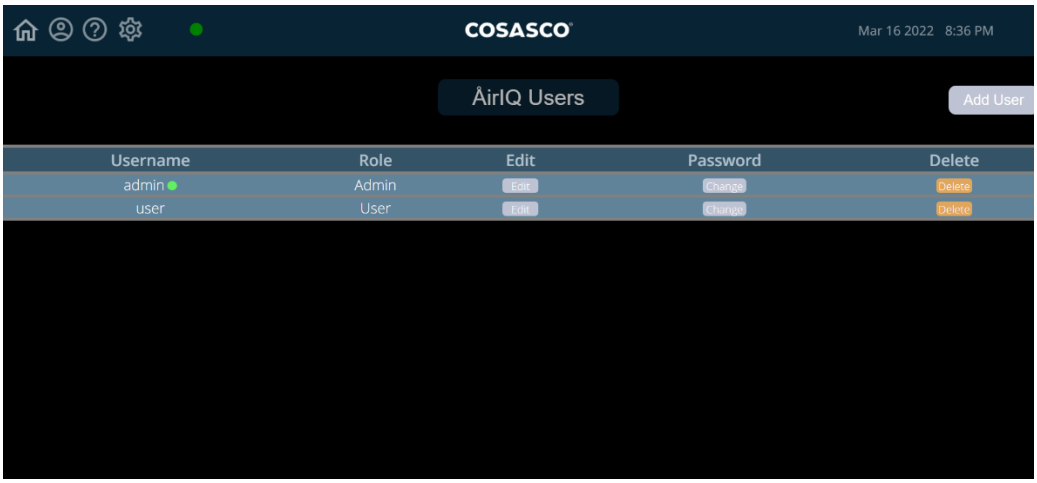


Figure 5-11: Users Screen

CAUTION: **Admin user cannot be deleted. Please make note of the Admin username and password for recovery purposes. Failure to do so may result in inaccessibility of the unit.**

Sensor Configuration

The User can change the interval for data logging in seconds in the configuration screen (Reference Figure 5-12). To do so:

1. **INPUT** the logging interval in seconds
2. **CLICK** configure to confirm the change

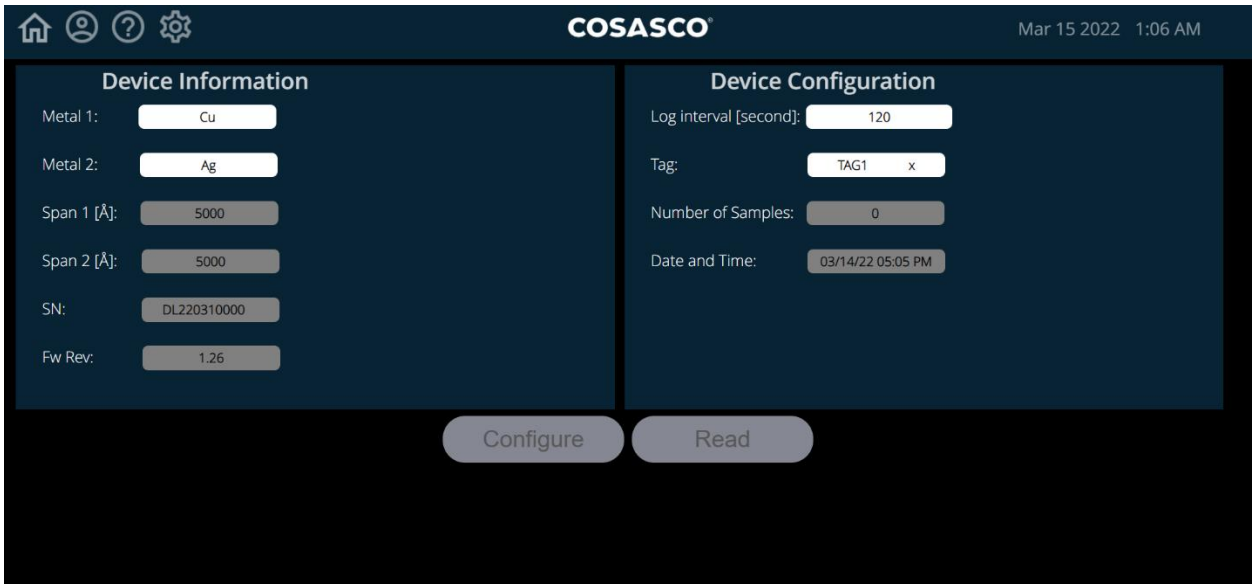


Figure 5-12: Device Configuration

The Read button pulls the latest configuration set on the equipment.

Parameter Output

The Parameter Output screen provides the summary on output parameters, current values, and outputs in mA. User can utilize this to configure the 4-20 mA communication and confirm the output readings (Reference Figure 5-13).

PV	Units	Min	Max	value	Out mA	Loop
Metal Loss 1	Å	0	5000	799	6.56	1
Metal Loss 2	Å	0	5000	85	4.27	2
Temperature	C	0	60	27°	11.08	3
RH	%	0	100	42	10.70	4
Pressure	i.w.g.	0	0.5	0.00	4.00	5
CR1	Å/month	0	2500	0	4.00	6
CR2	Å/month	0	2500	0	4.00	7

Figure 5-13: Parameter Outputs

CHAPTER 6

Chapter 6 - Maintenance

General

Routine maintenance on the ÅirIQ is not required. There is no initial calibration or periodic calibration required by the user.

Calibration

If a calibration check is requested, the unit must be returned to the factory for proper calibration and resetting. The suggested calibration interval (upon customer request) is 2 years. Prior to returning the unit(s) for calibration, contact the factory for a quote and a returned goods number.

Sensor Replacement

The sensors used on the ÅirIQ will require periodic replacement. When the sensor has reached its end-of-life (5,000 Å of metal loss) or cannot be read by the measurement electronics, the display will notify the user. Refer to Chapter 4 for sensor replacement.

NOTE: Factory recommends that a spare sensor unit of copper and silver sensors be kept on hand in the event of an unexpected sensor failure.

Appendix A

Appendix A - ÅirIQ Modbus and Current Loops

Current Loops						
PV	**Units**	**Min**	**Max**	**Loop#**	**mA Min**	**mA Max**
Metal Loss 1	Å	0	5000	1	4	20
Metal Loss 2	Å	0	5000	2	4	20
Temperature	˚C or ˚F	0	60	3	4	20
Relative Humidity	%	0	100	4	4	20
Pressure	i.w.g.	0	0.5	5	4	20
CR1	Å/Month	0	2500	6	4	20
CR2	Å/Month	0	2500	7	4	20

Modbus					
PV	**Units**	**Min**	**Max**	**Holding Register Floating Point**	**Holding Register Swapped Floating Point**
Metal Loss 1	Å	0	5000	40021 (address 20)	40001 (address 0)
Metal Loss 2	Å	0	5000	40023 (address 22)	40003 (address 2)
Temperature	˚C or ˚F	0	60	40025 (address 24)	40005 (address 4)
Relative Humidity	%	0	100	40027 (address 26)	40007 (address 6)
Pressure	i.w.g.	0	0.5	40029 (address 28)	40009 (address 8)
CR1	Å/Month	0	2500	40031 (address 30)	40011 (address 10)
CR2	Å/Month	0	2500	40033 (address 32)	40013 (address 12)
G Level Sensor 1				40035 (address 34)	40015 (address 14)
G Level Sensor 2				40037 (address 36)	40017 (address 16)

Table A-1: Modbus and Current Loops