Element-U User Manual

Model EU2

Take Control & Track the Actual Usage of Your Lab Equipment

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Introduction

This manual provides instructions on safety and installation of the Element-U, including information regarding security, specifications and certifications. Element-U is a battery-powered, wireless sensor that continuously monitors the real-time availability and usage of any powered instruments. The Element-U comes with a custom clamp and two thumbscrews that secures to most power cables. Installation does not interrupt the electrical chain and can even be done safely while the machine is on. Usage data is securely transmitted to the Elemental Machines Insights Dashboard™ where it is analyzed as the software digitally records and visually shows the usage timeline and percentage. The Usage Platform empowers agile lab operations to help guide the service, movement, efficiency, and purchase of lab equipment to optimize operating resources.

Safety Information

Batteries

WARNING: the Element-U, Model EU2 is powered by 2 non-rechargeable AA lithium batteries. These batteries can explode or leak and cause burns if installed backwards, disassembled, charged, or exposed to water, fire, high temperature or rapid warming from extremely cold temperature.

For this reason it is important that this Element-U does not exceed its operating limits in temperature of 5 to 45°C and in humidity of 0 to 95%RH (non-condensing).

Non-ionizing Radiation exposure

Element-U sends measurements to a Gateway using a low-power 2.4GHz wireless network. When transmitting, the radio module inside the Element-U works at a maximum power of 8 dBm (6.3 mW). This level is not recognized as hazardous but several nations (e.g. Canada, Australia) advise not to use such a device within 20cm of your body i.e. as a personal electronic device without further precautionary testing.

This equipment has been tested and found to comply with the USA’s (FCC) limits for a Class B digital device, which are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential installation. If not installed and used in accordance with this User Manual, the Element-U may possibly cause harmful interference to other radio communications. Possible remedies for any such interference include reorienting the receiving antennae, increasing the separation between affected equipment and Element-U, or connecting the affected equipment into an outlet on a circuit different from that to which the Element-U is connected.

Protecting the Environment

Element-U is designed with consideration for the environment and complies with relevant regulations such as the EU’s RoHS regulations and Batteries Directive, as well as the USA’s EPA initiative to ‘Reduce, Reuse, Recycle’. Element-U are provided to customers to support the service Elemental Machines provides, but they remain the property of Elemental Machines and should be returned to EM at the end of their life for reuse, recycling or disposal as appropriate. Elemental Machines relies on customers to play their role in the process of disposing of Element-U’s correctly, to help Elemental Machines in protecting the environment.

The Element-U is marked with this symbol, the EU’s ‘wheeled bin’ symbol, to identify it as Electrical or Electronic Equipment that the EU requires not to be added to unsorted municipal waste when it has reached the end of its life. The correct disposal is:

AA lithium batteries that have reached the end of their life should be removed from the Element-U, kept separate from unsorted municipal waste and disposed of according to local regulations (EU Non-hazardous Waste code: 16 06 04)

Element-U’s that have reached the end of their life should have their batteries removed for disposal as above and then returned to Elemental Machines (EU Non-hazardous Waste code 16 02 14)

When batteries need to be removed or replaced, remove the battery cover on the back of the device and remove the two AA batteries; these can be replaced with new AA lithium batteries.
Installation Guide

Below are the instructions for installing the Element-U. If you have any questions please contact help@elementalmachines.com.

Prior to Receiving the Element-U

If this is your first time setting up the Elemental Machines system, you will receive an email for your dashboard account verification. Save this email for when the devices arrive.

When devices are shipped they will be added to your Elemental Machines Insights Dashboard™ with default names. When you first log in you will see all of your devices with a 'disconnected' status.

Positioning Element-U

This Element-U needs to be within range of an Elemental Gateway. The range is usually up to 30 meters, but can depend on the layout and concentration of equipment in your lab. Signal strength for an individual Element can be acquired via the Elemental Machines Insights Dashboard™. Navigate to the device in question and the signal icon will have 1-4 bars of strength. More bars indicate a better signal using a low power 2.4GHz wireless communication protocol. The connection should be sufficient as long as there are at least 2 bars.

Install Element-U

Be sure to read and comply with the safety information at the beginning of this manual concerning operating environment.

Element-U can be placed at any location on a mains power cord, but should be installed as close to the front/side of the equipment as possible to ensure optimal communication with a Gateway.

The Element-U provides two methods of attaching the device to a mains cord:

Clamp Method - For Most Power Cords (5-12mm)

The provided clamp and thumbscrews can be used to easily attach the Element-U to a mains power cord.

1: Unscrew the thumbscrews ensuring the cable clamp is still attached, but has enough room to slide the cable in place. Some larger cables may require removing the clamp completely and then screwing the clamp back on.
2: Lay the cord flat in the groove with the sensors.
3: Gently holding the clamp in place, rotate the thumbscrews from the opposite face of the Element-U.
4: Tighten the thumbscrews until they are finger-tight only. The Element-U should not move or slide on the cord with the clamp in place. Do not use tools to tighten the screws further.

Gateway Setup

This Element-U communicates wirelessly to an Elemental Gateway, which should be set up prior to connecting Element-U. Depending on your location and application, your Gateway type may vary. If you have a tablet Gateway, brief setup instructions are given in the appendix below. If you have a Gateway Model GW2, please follow the setup instructions in your Gateway, GW2 User Manual.

Cable Tie Method – For Larger Power Cords (>12mm)

For power cords larger than 12mm in diameter, cable ties should be used instead of the provided clamp.

1: Completely unscrew the two thumbscrews and set the cable clamp & thumbscrews aside. They are not required for this installation.
2: Use the 3 provided cable ties through the Element-U. Do not close the cable ties yet.
3: Lay the cord flat in the groove with the sensors, sitting between the ends of the cable ties.
4: With the power cord is place, cinch down all 3 cable ties starting with the inner tie and moving outward. After all 3 are cinched, ensure the power cord can not move or slide by pulling or pushing it through the ties. The remaining cable-tie length can be clipped as necessary, but take care not to damage the mains cable.
Powering on the Element-U and Dashboard Setup

Remove the battery door on the rear of the Element-U and install the two provided Lithium AA batteries as shown. For optimal performance, use only the provided Energizer L92 AA batteries.

Use the Elemental Machines Insights Dashboard™, to confirm your Element-U is connected. You can also change the name/location and add tags for the device.

For further assistance, e.g. to complete the dashboard setup, click on “Support” at the bottom left of the dashboard.

Specifications

<table>
<thead>
<tr>
<th>ELEMENT-U SPECIFICATIONS</th>
<th>MODEL NUMBER</th>
<th>EU2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>3.6in x 3.1in x 1.1in (92mm x 78mm x 28mm)</td>
<td></td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>41ºF-113ºF (5º-45º C)</td>
<td></td>
</tr>
<tr>
<td>Operating Humidity Range</td>
<td>0-95% RH, Non-condensing</td>
<td></td>
</tr>
<tr>
<td>Battery Requirements</td>
<td>2 AA replaceable lithium batteries (supplied)</td>
<td></td>
</tr>
<tr>
<td>Battery Life</td>
<td>~2 Years at the default sample rate of 5 seconds</td>
<td></td>
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<table>
<thead>
<tr>
<th>UTILIZATION SPECIFICATIONS</th>
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</thead>
<tbody>
<tr>
<td>Maximum Cable Diameter (Clamp)</td>
<td>.47in (12mm)</td>
</tr>
<tr>
<td>Maximum Cable Diameter (Cable Tie)</td>
<td>0.63in (16mm)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMMUNICATION</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Default Data Sample Rate</td>
<td>5 seconds</td>
</tr>
<tr>
<td>Protocol (Element)</td>
<td>Proprietary</td>
</tr>
<tr>
<td>Range</td>
<td>98ft (30m)</td>
</tr>
<tr>
<td>Frequency band (power)</td>
<td>2.4 GHz (8 dBm ≡ 6.3 mW)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>COMMUNICATION</th>
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</thead>
<tbody>
<tr>
<td>Contains FCC ID</td>
<td>QOQ-GM220P, FCC Part 15.247</td>
</tr>
<tr>
<td>Contains IC ID</td>
<td>5123A-GM220P, RSS 247</td>
</tr>
</tbody>
</table>
Certifications

United States FCC:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

• Reorient or relocate the receiving antenna.
• Increase the separation between the equipment and receiver.
• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
• Consult the dealer or an experienced radio/TV technician for help.

WARNING: Changes or modifications not expressly approved by Elemental Machines, Inc. could void the user’s authority to operate the equipment.

Canada IC:

This equipment complies with Canada radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

This device complies with Industry Canada license exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Cet équipement est conforme Canada limites d’exposition aux radiations dans un environnement non contrôlé. Cet équipement doit être installé et utilisé à distance minimum de 20cm entre le radiateur et votre corps.

Le présent appareil est conforme aux CNR d’Industrie Canada applicables aux appareils radio exempts de licence. L’exploitation est autorisée aux deux conditions suivantes: (1) l’appareil ne doit pas produire de brouillage, et (2) l’appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d’en compromettre le fonctionnement.
Appendix 1: Gateway Setup

Elemental Machines provides multiple styles of Gateways. If you have a Tablet Gateway (Model GW1), please follow the setup instructions below. For Gateway-2, please follow the setup instructions in 771-00021 Gateway (Model GW2) User Manual.

**Tablet Gateway (Model GW1) Software Setup**

To power on the Gateway, press and hold the upper right-hand button on the device,

- Wait for the main screen to come up
- Press the ‘home’ button when you see the Elemental Machines Logo

Click on the blue circle in the upper right corner (if the circle is not visible, press the hardware home button on the bottom of the tablet to make it appear, or swipe up if you do not have a hardware button)

Click on the settings icon

Select WiFi from the list
Positioning the Tablet Gateway

Tablet Gateways collect data from the Elements, collating it and transmitting it across the internet to Elemental Machines’ Cloud. The tablet Gateways’ default is to transmit by Wi-Fi; for added reliability they fall back to Cellular connection when Wi-Fi connection drops out. There is a danger of data delay or even loss if all connection is lost, so tablet Gateways should be positioned where they are getting good Wi-Fi and Cellular connection.

The strength of the Wi-Fi and Cellular connection are displayed by the Wi-Fi icon using Cellular bar icons. These icons are displayed on the tablet Gateway to the left of the battery percentage.

- 4 or more bars for both Wi-Fi and cell indicate good connectivity
- 2 bars for both Wi-Fi and cell runs an increased risk of some data delay or loss
- <2 bars for cell or Wi-Fi carry a danger of significant data delay or loss

Elemental Machines Sensory Network Security Overview

The Elemental Machines Sensory Network is designed to operate securely on our customers’ networks. The system includes Elements, wireless devices that monitor critical equipment and/or the ambient environment, Elemental Gateways, which gather data from Elements, and the Elemental Machines Insights Dashboard™.

Local Communication

Individual Elements communicate to a local Gateway via a low power 2.4GHz wireless communication protocol, typically 8 dBm or lower power. Only whitelisted devices can connect with the Gateway; the whitelist is populated prior to shipping and adjusted with any subsequent additions to the network.

Communication through Customer Wi-Fi:

The system uses established communication and security standards to protect data transmitted between Gateways and the Elemental Machines Insights Dashboard™.

- TLS, the web standard for protecting sensitive data including usernames, passwords, credit card, and banking information.
- Asymmetric Cryptography is used to encrypt the data transmitted. The keys for this symmetric encryption are generated uniquely for each connection and are based on a shared secret negotiated at the start of the session.

The Elemental Machines’ Sensory Network external communication is designed to work even in the strictest environments. The communication uses an adaptive transport mechanism that is designed to work well when confronted with proxy authorities, firewalls, and antivirus software.

No inbound ports need to be opened. Security vulnerability using the above configuration is prevented as follows:

1: Internet Communication over port 80, 123, and 443
2: Device must be able to transmit outward to the Internet on 443
3: Clients do not open inbound ports
4: There is no need to open the firewall to receive on port 80, 123, or 443
5: There is no way for outside users to get into the user’s network
6: We do not listen to any ports; this is the case even if the user opens ports 80, 123, or 443 for receipt

Tablet Gateways opens connections through port 80, 123, and 443 of a customer’s firewall, opening only outbound connections. Elemental Gateways require the following outbound TCP connections to be open on your firewall for the system to work:

- *.elementalmachines.io:443, TCP – for sending data to the dashboard
- s3.amazonaws.com:[80|443], TCP – various files
- *.awmdm.com:443, TCP – device management
- play.google.com:443, TCP – provisioning
- android.googleapis.com:443, TCP – provisioning
- android.clients.google.com:80, TCP – app management
- time.windows.com:123, UDP – time synchronization
- *.pubnub.com:443, TCP – secure IoT device messaging
- *.pubnub.net:443, TCP – secure IoT device messaging
- *.pndsn.com:443, TCP – secure IoT device messaging
- *.papertrailapp.com:443, TCP – log management

Gateway-2’s open connections through ports 80, 123, and 443 of a customer’s firewall, opening only outbound connections. Gateway-2’s require the following outbound TCP and/or UDP connections to be open on your firewall for the system to work:

1. *.elementalmachines.io:443, TCP – for sending data to the Elemental Machines Insights Dashboard™
2. s3.amazonaws.com:[80|443], TCP – various files
3. *.balena-cloud.com:443, TCP – for device management
4. *.docker.com:443, TCP – for verified operating system images
5. *.docker.io:443, TCP – for verified operating system images
6. time.elementalmachines.io:123, UDP – for time synchronization
7. 8.8.8.8:443, TCP – for DNS resolution
Tablet Gateway Supplemental

Tablet Gateways are based on the Android technology and therefore enjoy the security benefits of the Android Development Network and Google. Sourced from the Security whitepaper from Google, Android:

- Strives to prevent security issues from occurring through design reviews, penetration testing and code audits
- Performs security reviews prior to releasing new versions of Android and Google Play
- Publishes the source code for Android, thus allowing the broader community to uncover flaws and contribute to making Android the most secure mobile platform
- Works hard to minimize the impact of security issues with features like the application sandbox Detects vulnerabilities and security issues by regularly scanning Google Play applications for malware, and removing them from devices if there's a potential for serious harm to the user devices or data
- Has a rapid response program in place to handle vulnerabilities found in Android by working with hardware and carrier partners to quickly resolve security issues and push security patches

Elemental Machines Network Information

Wireless Requirements:
- SSID: Not hidden
- Security: WEP, WPA, or WPA2
- IP Assignment: Dynamic Preferred
- Number of Unique Devices: Sum of all Gateways and other Element-D/C/U devices¹
- Captive Portal: Not Supported

Local Wireless Network Information:
SSID:
Password:

(1) Refers to Model EU1 only.