# Universal Gateway
## Protocol Converter

### Installation & Service Manual - V1.0

We Believe Technology Improves Navigation.™

| Version No. | Description | Date | Author | Reviewed | Approved | Design |
|---|---|---|---|---|---|---|
| 1.0 | Manual Launch | December 2020 | P. Naidu | J. Ohle | W. Evans | M. Sugars |

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# 1.0 Introduction

The Universal Gateway is a protocol converter that connects products of various communication protocols and allows them to talk to each other, as well as higher level systems. As a result, devices and systems are able to work together to access, exchange, integrate and cooperatively use data in a coordinated manner.

Fully configurable interface mapping is included for implementation by an integrator or end-user. As a result, the Universal Gateway is able to interface to a variety of existing and potential future third party products, thereby allowing alternative OEM product to be integrated, monitored and controlled via Avlite and Sealite monitoring systems.

The Universal Gateway is available in two input power configurations, a Universal Mains or DC input and can be installed as either a complete mechanical assembly or as a board only (PCA) option for Sealite/Avlite or third-party control enclosures.

The following sections of this user guide will allow you to become familiar with the versatility of the Universal Gateway and enable you to maximize its operating function.

Particular care has been taken to ensure your system gives years of trouble-free service and our commitment to producing the highest quality products is highlighted by our independently certified compliance with the requirements of the ISO 9001:2015 quality management system.

# 2.0 Glossary of Terms

**Alarm Data** - Line item entries in the Data Mapping Table (registers/addresses/tags/identifiers/IO) flagged as 'Alarms'

**Command Data** - Line item entries in the Data Mapping Table (registers/addresses/tags/identifiers/IO)

**Communication Interface** - Connection through which product Configuration Data can be uploaded from a 3rd party device to the product, or downloaded from the product to a Third Party Device. Diagnostic product status and interface states can also be read from the product using this interface.

**Configuration Access Password** - Password required to access information on the device once a USB or BT connection is established.

**Configuration Data** - Payload containing data to transfer user-selected settings generated by the UGW Configuration Application to the product.

**Configuration Interface** - Hardwired connection to directly configure and query the product configuration and status

**Data Mapping** - The configuration of the product to the specific registers, coils, output states, addresses to or from which data is to be processed. This includes the look-up values used to translate inputs from one interface to the corresponding expected output of the other interface.

**Data Mapping Table** - Reference stored in memory on Primary PCB containing Data Mapping of each Interface.

**Destination Interface** - A physical data communication connection to the product configured to:

- Read Alarm and Status data from the device connected to it
- Write Command data to the device connected to it

This connection can be any one of the following: Modbus (RTU or TCP/IP), Sealite/Avlite ALS (Gen 3) RF, GPIO, Dry Contacts or SATCOM.

**GPIO** - General Purpose Input/Output. A Port configurable to perform as a voltage-sensitive Input, or as a voltage inducing Output. The Universal Gateway has dedicated Input and Output pins, which cannot be configured to change between the two options.

**Inactive Interface** - A physical data communication connection to the product configured to not read, transmit or respond to any network traffic.

**Interface State** - The configuration of a given interface which governs the allowed direction of flow of data. The three Interface States in the Universal Gateway are:

- Source Interface
- Destination Interface
- Inactive

**Irrecoverable Error** - Used for gateway diagnostics only. A problem in hardware, configuration or otherwise, which cannot be resolved without operator intervention. NB: These are problems which are local to the gateway only. This does not include if a node on the network returns a valid exception code or if an alarm is triggered on an output, as per the Alarm flag configuration.

**OEM** - Original Equipment Manufacturer. An organization that creates products using components or parts bought from other organizations.

**Periodic Status Reporting** - Automatic periodic querying of the Destination Interface (if supported) and transmitting of response, as interpreted by Data Mapping configuration, to the Source Interface.

**Pin** - Connection within a port within which a single signal is transmitted

**Port** - Physical connection at which a device is located for a given Interface.

**Primary PCB** - The circuit board which hosts the DC power supply, microcontroller and all non-optional Interfaces. All add-on circuit boards plug into this circuit board.

**Response Delay Period** - A configurable elapsed period, measured between the completion of a Transaction and the beginning of the responding Transaction, during which no data is sent. Used for communicating with slow devices without message queues. A period of 0 disables this feature.

**Response Latency** - The time elapsed between a signal sent from a Source Interface to a Destination Interface.

**Source Interface** - A physical data communication connection to the product configured to:

- Read Command data from the device connected to it
- Write Alarm and Status data to the device connected to it

This connection can be any one of the following: Modbus (RTU or TCP/IP), Sealite/Avlite ALS (Gen 3) RF, GPIO or SATCOM

**Status Data** - Line item entries in the Data Mapping Table (registers/addresses/tags/identifiers/IO) flagged as 'Status'.

**Translated Data Mapping** - Mapping configuration where the Source Interface data value is evaluated by the product and compared to the Data Mapping Table of pre-defined data inputs. If a matching data value is found, the corresponding response data from that row is transmitted to the Destination Interface.

**Transmission Delimiter Period** - A configurable elapsed period, measured between the end of a message and the beginning of the next message, during which no messages are sent. Used for communicating with slow devices without message queues. Also applicable to GPIO and Dry-contact interfaces, where the Transmission Delimiter Period determines the maximum frequency at which IO can switch. A period of 0 disables this feature.

**Verbose Data Mapping** - Mapping configuration where the Source Interface data value is directly transmitted to the Destination Interface without any data conversion or interpretation.

**Watchdog Timer** - Timer, if reaches user configurable elapsed period, initiates a product reboot. Intended to return product from an Irrecoverable Error or locked-up state. Timer is reset to zero on each completed Transaction.

# 3.0 Background

The Internet of Things, more commonly known as IoT, refers to the immense range of physical devices around the world that are connected to the internet and are all collecting and sharing data. Thanks to modern technology such as micro processors and the omnipresence of wireless networks, it is now possible to connect any physical object to the internet and transform it into part of the IoT to be controlled and/or communicate information.

One of the most important building blocks of the IoT is Protocol Conversion which enables real-time data to be collected from different devices and systems, and then translated and shared with other devices and systems to form one, complete, unified system. This data can then be turned into usable, trend-related information to help systems become more responsive, as well as allow asset owners to make informed decisions and affectively plan resources.

Asset managers utilize a range of different products, and getting them all to talk to each other is not easy due to the varying communication protocols used by each product. The Universal Gateway is a protocol converter which transforms the protocol of a particular device into a suitable protocol of another device or system, thereby allowing them to communicate with each other.

The Universal Gateway is bi-directional, meaning the system can then communicate and command back to the asset for control or monitoring purposes. It includes fully configurable interface mapping. This can be implemented by an integrator or end-user to align with their products.

The sections in this guide cover the necessary fundamentals of Protocol Converters and applicable systems to provide an understanding of how the Universal Gateway operates.

# 4.0 Fundamentals

## 4.1 Bits and Bytes

Computers and electronic devices store all their information and communicate with each other using bits and Bytes.

The 'bit' is the smallest measurable form of data and is given a value of either 0 or 1, similar to an on/off switch. A bit is generated by fluctuations of electric current that run through the components of the computer or electronic device. These fluctuations are converted into the ones and zeros used to relay information across a network.

Before a data message is sent across a network, it must first be encoded. In this process, each bit of the message is encoded into a format suitable for transmission. The methods used for network message encoding depend on the network media over which the bits are transmitted. These are shown below:

- **Ethernet connections:** carries bits using electrical signals of varying voltages
- **Fiber connections:** carries bits using pulses of light
- **Wi-Fi:** carries bits using radio signals

A Byte is a sequence of bits and is used to improve speed and efficiency of data processing. Every Byte consists of eight bits and can be visualized as eight on/off switches that can be configured in any number of combinations of either on/off (in this case 0 or 1) to represent different values, often a letter of the alphabet, or a character. As the number of Bytes increases, so do the number of possible combinations, thereby allowing more complex information to be stored and transmitted.

Number of combinations=**2^(The number of bits placed together)**

Referring to the above equation, the number of combinations provided by a single bit is given by 2^1 , which is 2. However, the number of combinations provided by one Byte (which is made up of 8 bits) is 2^8 , which is 256.

Because a Byte is eight times larger than a bit, it is used as the base measure for data.

### 4.1.1 Bit Rate and Baud Rate

The bit rate and baud rate are generally used in data communication as measures of transmitting speed and signal speed respectively.

The bit rate is the rate at which data bits are sent from one point to another. Measured in 'bits per second' (bps), the bit rate is also a measurement of speed.

The baud rate is defined as the number of **signal units** per second. The unit of measurement is the 'baud' (Bd) and is also a measurement of speed. The baud rate is used to determine the bandwidth requirement for signal transmission. For example, a baud rate of 1 Bd means that there is 1 signal pulse per second, whereas a baud rate of 3 Bd indicates that there are 3 signal pulses per second.

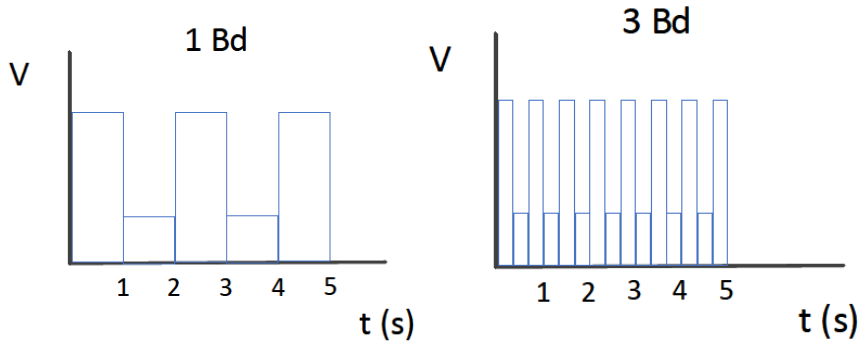



***Figure 1:*** *Baud Rate*

For clarity, the above diagrams have been drawn to show the different pulses at different voltage levels to emphasis that these are separate pulses. However, they could all be at the same voltage level as well.

The bit rate and baud rate are related using the following formula:

*bit rate=baud rate X  Number of bits per baud*

Usually, simple devices will have the same bit rate and baud rate. However, more complicated devices will usually have a higher bit rate. Transmitting more bits per signal means that more data can be transmitted per second.

### 4.1.2 Bandwidth

Bandwidth is defined as the maximum rate of data transfer and is another measure of how quickly data can be sent.

Like the bit rate mentioned above, the bandwidth is also measured in bits per second (bps) and describes the maximum theoretical capacity of the network. Bandwidth is shared, so if many devices are using a particular network, their individual bit rates will be less than the bandwidth. For example, the bandwidth of a particular network could be 100Mbps, however, an individuals bit rate could be much less at 37 Mbps.

### 4.1.3 Latency

With regard to networks, latency refers to the time taken from the point of data transmission to reception. The unit of Latency is seconds, however, milliseconds (ms), microseconds (µs) or nanoseconds (ns) are used more frequently since the measured time is so small.

The total time taken for data to travel from the source to destination, then back again, is referred to 'Round Trip' latency since data often travels back and forth between senders and receivers in a network.

For example, the approximate round trip latency for data travelling from London to New York, then back again using a fiber optic cable would be about 55 milliseconds.

## 4.2 Data Communication

In general terms, data communication is the transmission of information (in the form of bits or bytes) between devices or systems via a transmission medium.

A typical Data Communication System consists of the following main components:

- **Message** - The data or information that needs to be communicated. The message can take a variety of forms, including text, numbers, images, audio and video.
- **Sender (Transmitter)** - The device that generates and sends the data message
- **Receiver/End Point** - The device at the end of a communication channel that receives the message or data from the sender. The receiver can be a device, tool, service, application or node accessed over a connected network.
- **Transmission Medium (Communication channel)** - The physical path over which the message travels between the sender and receiver. Examples of transmission media include twisted-pair cable, coaxial cable, fibre optic cable or over the air.
- **Protocol** - A set of hardware/software rules that the sender and receiver must follow in order to exchange information.

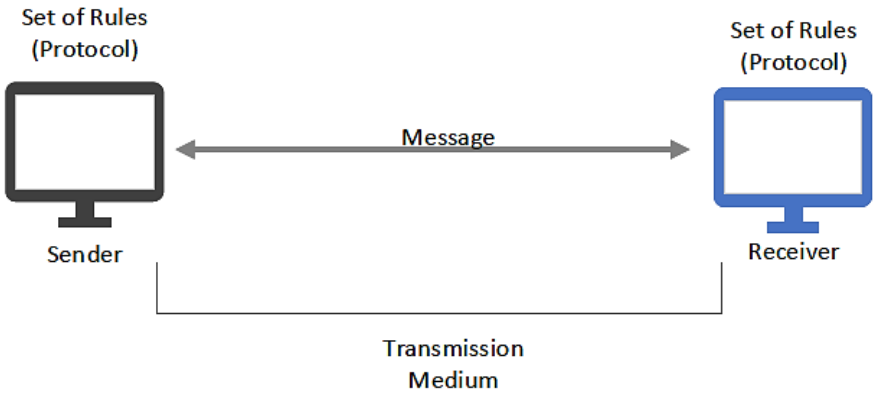



***Figure 2:*** *Components of a Data Communication System*

A collection of data communications systems that are interconnected with each other make up a **data communications network.**

## 4.3 Protocols

Unlike spoken language where there are numerous ways of saying the same thing, computers or devices need rigid, structured rules about how they should communicate with each other. This is why protocols are such an integral part of a data communications system as they specify exactly how the sender and receiver should format, transmit and process information.

The devices within a data communications system or network may use vastly different software and hardware, however, the use of protocols enables them to communicate with each other regardless.

### 4.3.1 Key Elements of a Protocol

The main three elements of a protocol are shown below:

- Syntax - The structure and format of data. This also includes the order in which the data is presented. For example, a protocol used by a particular receiver might expect the first eight bits of the message to be the address of the sender, the second eight bits to be the address of the receiver, and the remaining bits to be the message itself.
- Semantics - Defines how the data will be interpreted and what action needs to be taken based on that interpretation. It also includes control. For example, does the address in the message identify the route to be taken or the final destination of the message?
- Timing - The agreement between the sender and receiver regarding transmission rates and duration i.e. when the data should be sent and how fast the data should be sent. For example, if a sender produces data at 100 Mbps, but the receiver can only process data at 1Mbps, the receiver will be overloaded which will result in data loss.

### 4.3.2 Types of Protocols

- Standard Protocols - Standard protocols are published open standards, which are agreed upon and accepted by the whole computing industry. These protocols are often developed through the collaborative efforts of experts from different organisations and are therefore not vendor specific. Common examples of standard protocols include IP (Internet Protocol), TCP (Transmission Control Protocol) and UDP (User Datagram Protocol).
- Proprietary Protocols - Proprietary protocols are developed and owned by a single company specifically for the devices that they manufacture, and are therefore vendor specific. Devices can communicate with one another without a problem when they are from the same vendor because they will most likely support the same proprietary protocol. This makes it difficult for asset owners who may utilize products from a range of different vendors, all of which will be using different proprietary protocols. So if the devices in a system use different protocols, how can they talk to each other? This is when protocol converters become very useful.

### 4.3.3 Protocols and Network Models

A protocol hierarchy is used in a network to divide the communication task into multiple layers. A protocol is used for communication within a layer and a service is what a particular layer provides to the layer above it through an interface. Protocols used within one layer are unaware of issues at another layer.

The concept of the network layer framework is used to help illustrate and understand complex network interactions. The network layers are not strictly linear where one layer needs to complete its own process before the next one begins. Rather, they all work in conjunction with each other.

There are two models that are widely referenced today; The OSI Model and the TCP/IP Model. The concepts are similar, but the layers themselves differ between the two models.

#### *The OSI Model*

The Open Systems Interconnection (OSI) Model breaks down the functions involved in sending data over the internet into seven layers. Each layer serves a function to the layer above it, and is served by the layer below it. Each layer within a network uses a protocol to communicate with its equivalent layer in another network.

#### *The TCP/IP Model*

The TCP/IP model breaks down the functions involved in sending data over the internet into four concise layers instead of seven. However, these four layers correspond to the layers in the OSI model.

Each layer is described briefly in the table below:

| Layer Number TCP/IP | Layer Number OSI | Layer Name | Function | Example Protocols |
|---|---|---|---|---|
| 4 | 7 | Application | At this layer, both the end user and the application slayer interact directly with the software application. Most of what the user actually interacts with is at this layer. | HTTP, FTP, Telnet |
| | 6 | Presentation | Converts data to and from the Application layer by translating application formatting to network formatting and vice versa. | SSL, TLS |
| | 5 | Session | Establishes and terminates connections between devices. | NFS, SQL, PAP, PPTP |

| | | | | |
|---|---|---|---|---|
| 3 | 4 | Transport | Coordinates data transfer from a source to destination host. This includes keeping track of the data that has been transmitted successfully and retransmitting those that have failed delivery. | TCP, UDP |
| 2 | 3 | Network | Receives data segments from the data link layer and delivers them, in the form of packets, to their intended destinations (i.e. different networks) based on the addresses specified in each frame. | IP, ICMP, ARP |
| 1 | 2 | Data Link | Packages data into frames to be used in node-to-node data transfer. The data link layer also corrects errors that may have occurred at the Physical Layer. | CDP, STP, ATM |
| | 1 | Physical | Transmits and receives unstructured, raw data in the form of digital bits and converts them into electrical, radio or optical signals. | Ethernet, Wi-Fi, Bluetooth, USB, Fiber |

### 4.3.4 Modbus

Modbus is an application layer communication protocol used for transmitting information between electronic devices over serial lines (RTU) or via Ethernet (TCP/IP). Data transmission is based on a client/server architecture, where the device requesting the information is called the Modbus Client and the device/s supplying the information is called the Modbus Server.

#### *Modbus RTU*

Modbus RTU (Remote Terminal Unit) is an open serial protocol that uses one of three serial interfaces; RS 232, RS 485 and RS 422. This type of Modbus is supported by almost every commercial SCADA, HMI, OPC Server and data acquisition software program in the market.

A Modbus RTU network has one client and one or more servers that use serial transmission lines to communicate with each other.

The information is stored in the server devices in four different tables. Two tables store on/off discrete values, also known as ‘coils’ and the other two tables store numerical values, also known as ‘registers’. The coils and registers each have a read only table and read-write table, and each table has 9999 values. Each coil or contact is 1 bit , whereas each register is 16 bits. Both coils and registers can be assigned a data address between 0000 and 270E.

| Coil/Register Numbers | Data Address | Type | Table Name |
|---|---|---|---|
| 1-9999 | 0000 to 270E | Read-Write | Discrete Output Coils |
| 10001-19999 | 0000 to 270E | Read Only | Discrete Input Contacts |
| 30001-39999 | 0000 to 270E | Read-Write | Analog Input Registers |
| 40001-49999 | 0000 to 270E | Read Only | Analog Output Holding Registers |

Some devices are built with a fixed table, like the above, that is defined by the manufacturer. However, the Universal Gateway allows the user to configure or program a custom table to fit their needs.

During data transmission, the client will write data to a server device's registers, and read data from a server device's registers. A register address or register reference is always in the context of the server registers.

Each transmitted message begins with the server address, followed by a function code, followed by specifications defining what is being asked for or provided. Each server in a Modbus network is assigned a unique address from 1 to 247. When the client requests data, the first byte it sends is the server address. This way, each server will know whether or not the message is intended for them after reading the first byte. The server will simply ignore the message if it does not recognize the server address. The second byte sent from the client is the function code, which tells the server which table to access and whether to read from or write to the table.

Two additional bytes called the Cyclic Redundancy Check (CRC) are added to the end of every Modbus message for error detection. Every byte in the message is used to calculate the CRC. The receiving device calculates the CRC and compares it to the CRC from the sending device. If the CRC's are different, an error will result.

***Modbus TCP/IP***

Modbus TCP/IP is simply the Modbus RTU protocol with a TCP interface that runs on Ethernet. TCP/IP refers to the Transmission Control Protocol and Internet Protocol which provides the transmission medium for Modbus TCP/IP messaging. The primary function of TCP is to ensure that all messages are received correctly, while IP ensures that messages are correctly addressed and routed. Essentially, Modbus TCP/IP combines a physical network (Ethernet) with a networking standard (TCP/IP) and a standard method of representing data (Modbus as the application protocol).

## 4.4 Protocol Converters

As the name suggests, a protocol converter is a program or device that converts standard or proprietary protocols of one device to the protocol suitable for another device to achieve interoperability. In this way, devices are able to communicate with one another even if they have been sourced from different vendors.

The protocols are software installed on routers. These routers are then used to transfer commands from one device to another. This protocol transformation involves the conversion of commands, data, their encoding, representation and framing.

### 4.4.1 General Architecture

The general architecture of a Protocol Converter consists of an internal protocol slave, an internal protocol master and an internal database. The internal protocol master communicates to the external slave device and the internal protocol slave communicates to the external protocol master device.

This is shown in the image below:

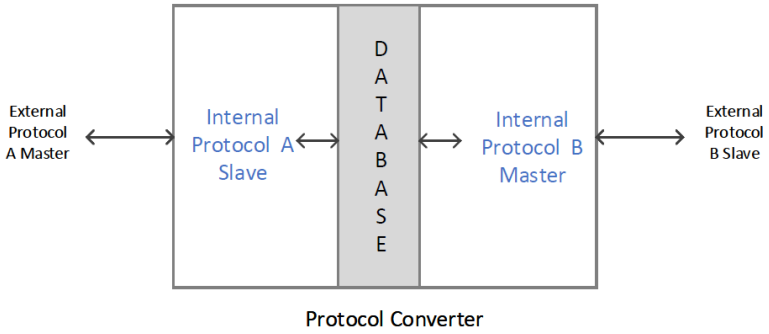



***Figure 3:*** *Components of a Protocol Converter*

The **internal** Protocol-B Master receives data from the external Protocol B Slave and stores it in the internal database. When the **external** Protocol-A Master (e.g. a PLC) requests this data, the protocol-A slave will obtain the data from the internal database and send it to the protocol-A Master.

Another scenario is if the **external** Protocol-A Master sends data or commands to the **internal** Protocol-A Slave. When this happens, the **internal** Protocol-A Slave will pass the data or commands to the internal database and trigger the **internal** Protocol-B Master to send this data or command to the **external** Protocol-B Slave.

Most Protocol Converters are programmed to understand a small number of different protocols which are tracked in its internal database. This database stores all factors associated with these known protocols and is tasked to help the protocol converter understand what needs to be changed to transform one protocol to another. This database is typically locked from end-users.

# 5.0 The Universal Gateway

The Universal Gateway (UGW) is a protocol converter and connector that allows products with different communication protocols to talk to each other, bringing all connected devices into a single, unified system. As a result, assets can work together to access, exchange, integrate and cooperatively use data in a coordinated manner.

The UGW is bi-directional, allowing communication and commands back to the asset for control or monitoring purposes.

The UGW is available in two input power configurations; a Universal Mains or DC input. As standard, the UGW comes with Modbus TCP/IP or RTU, 14 discrete IOs via General Purpose Inputs (8) and Outputs (6), as well as a serial configuration interface via USB and Bluetooth.

As options, the UGW can also come with Satellite or GSM communication, dry contact relays via electromechanical or high current variants or RF capability.

Available as either a complete mechanical assembly or as a PCA only variant, the UGW is designed to perfectly integrate and supplement Sealite/Avlite products as well as an existing lighting control system. It is also optimized for integration into third party equipment and also allows third party products to be monitored via SATCOM.

The UGW is completely configurable via the UGW Configuration Application that is provided with the unit itself. Details on how to use this software is described in *section 7.0 Universal Gateway Configuration Application*.

Using our Star2M Asset Management software, all connected assets are controlled, monitored and maintained. In all applications, the UGW can be integrated using a standard methodology, but is configured by the application and specific interface requirements for the installation.

## 5.1 Interfaces

The Universal Gateway offers a variety of physical interfaces. These are shown below:

| Interface | Description |
|---|---|
| RF via proprietary protocol | Allows the Universal Gateway to interface to a single RF network used by Sealite/Avlite OEM RF systems. |
| Serial Configuration Interface via USB | Allows end point configuration by the factory or by the user via the UGW Configurator Software |
| Satellite Communication Interface | Provides remote monitoring and control functionality for standalone applications of the Universal Gateway |
| GSM Communication Interface | Provides remote monitoring and control functionality for standalone applications of the Universal Gateway |
| MODBUS TCP/IP | An industry standard protocol for achieving integration of products into existing monitoring and control systems (e.g. SCADA, BMS etc.) as well as third-party equipment. Ethernet is an industry standard interface for implementing Modbus TCP/IP. |
| MODBUS RTU via RS-485 | Modbus RTU (Remote Terminal Unit) is an industry standard protocol for achieving integration of products into existing monitoring and control systems (e.g. SCADA, BMS etc.) as well as third-party equipment. RS-485 is an industry standard interface for implementing Modbus RTU. |
| Dry Contact Relay Interface via electromechanical or high current variants (Solid State Relay) | Allows Universal Gateway to interface to third party equipment that does not support GPIO inputs |
| Discrete IO via General Purpose Inputs (8) and Outputs (6) | Allows the Universal Gateway to interface to any discrete signal based product |

In any particular installation, one or multiple interfaces can be used in a combination of multiple 'reporting' interfaces and a single primary 'command' interface.

## 5.2 Interface Data Mapping

The UGW includes fully configurable interface mapping to be implemented by an integrator or end-user to align with their products. An input trigger on one interface is mappable to an equivalent output on the second interface, e.g. a 'Set Op Mode' trigger on the SATCOM interface shall be mappable to a 'Set GPIO' output on the GPIO interface.

Interface mapping is configured via the UGW Configurator Software. Please see section *7.0 Universal Gateway Configuration Application*.

## 5.3 Available Options

- Universal Mains (AC) input
- RF mesh network communication
- Satellite communication interface
- GSM communication interface
- Dry contact  relay interface via electromechanical or high current variants
- Cable Kits
- Mounting Accessories
- Star2M

## 5.4 Mechanical Arrangement

### 5.4.1 Product Design

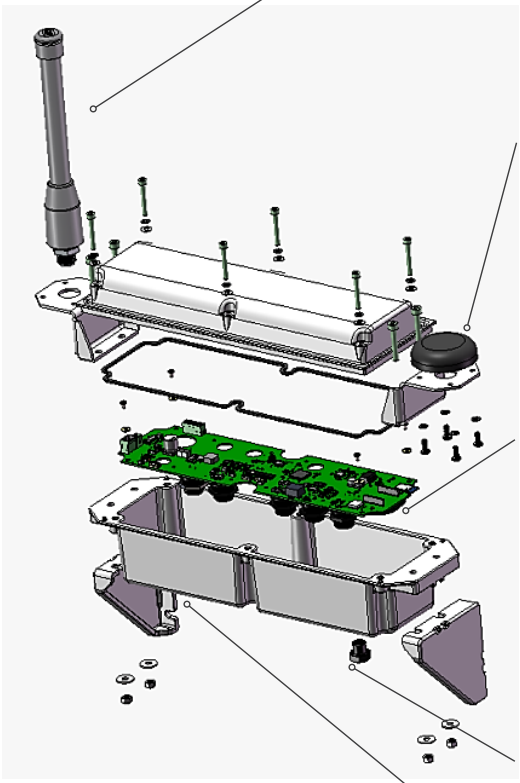


***Figure 4:*** *Product Design. A single PCB has been shown for clarity.*

Product comes with appropriate antennas and antenna mounts (GSM, SATCOM and RF variants only). Antenna mounts for SATCOM and RF are external and GPS/GSM antenna is mounted internally. Enclosure will come with applicable antenna mounts pre-attached to the enclosure, but can be separated upon request, however, mandatory standardized and approved integration design and cabling guidelines must be adhered to. Please contact your Star2M representative for more information.

**Standalone Assembly:** Primary board (shown) is connectorized by default. Options are provided by daughter boards stacked and interfaced to the primary board.
**Board Only Variant:** The board arrangement itself can be integrated into Sealite/Avlite products and controllers utilizing mandatory standardized and approved integration designs.
Please contact your Star2M representative for more information

Side brackets are included with the base product and come attached to the enclosure for wall mounting.

Product includes boot-loader capabilities allowing for field updates to firmware via USB connection.

Product is user configurable via Bluetooth or USB connection. The UGW Configuration Application is provided to the user to download onto a PC or Laptop.

### 5.4.2 Connectors

**Standalone mechanical assembly shown only*

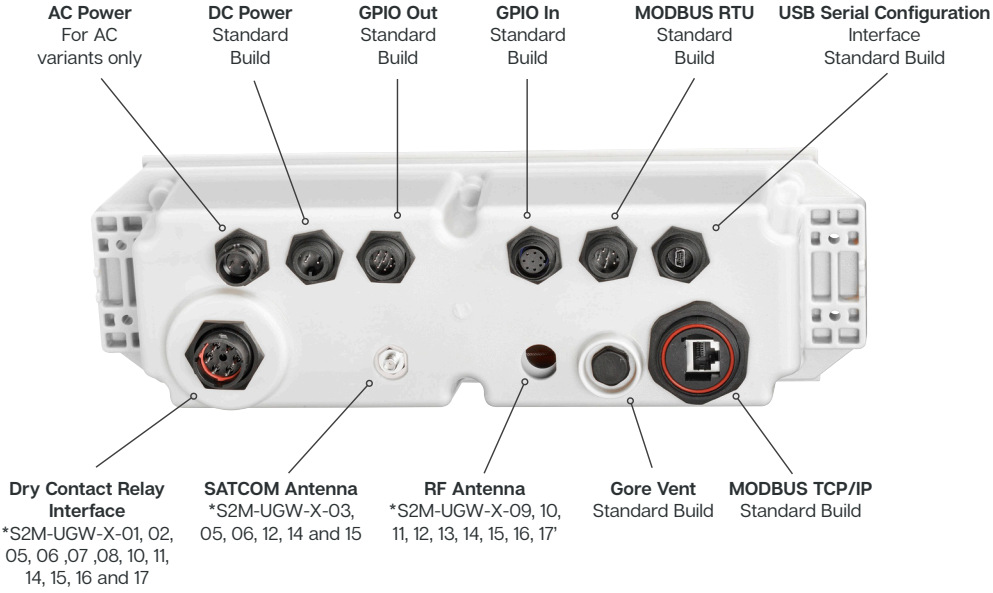
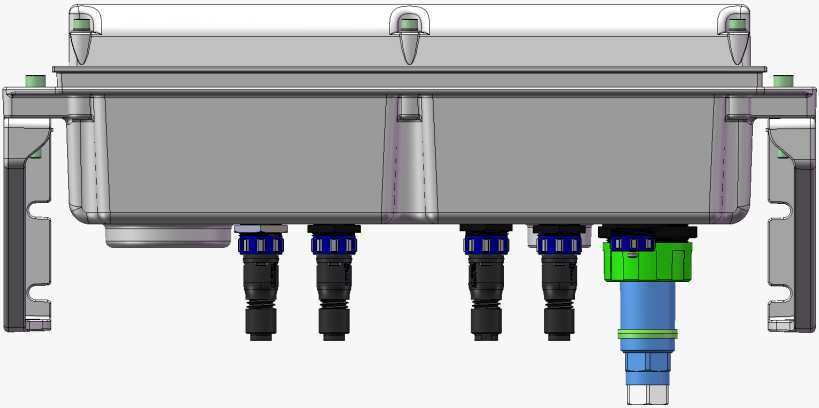
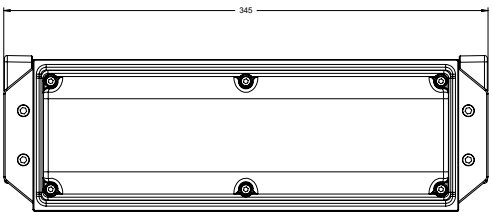


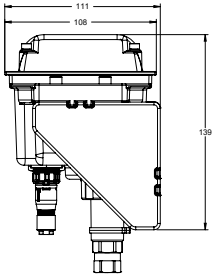

***Figure 5:*** *Connector layout*

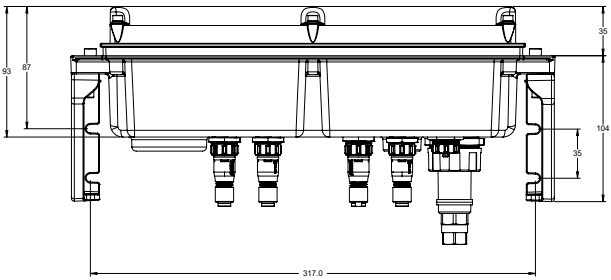
## 5.5 UGW Diagrams and Data

### Base Build

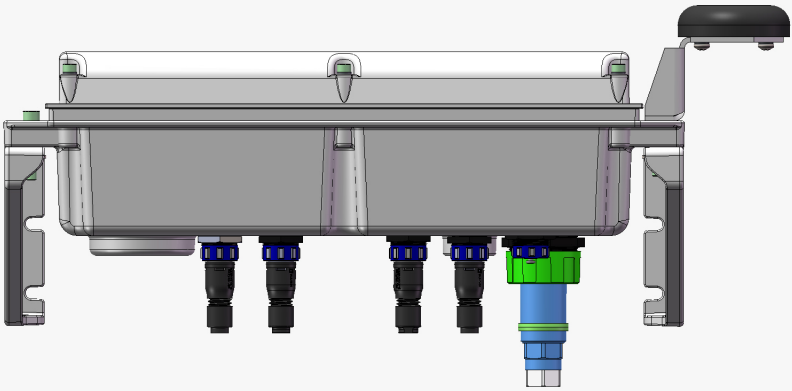


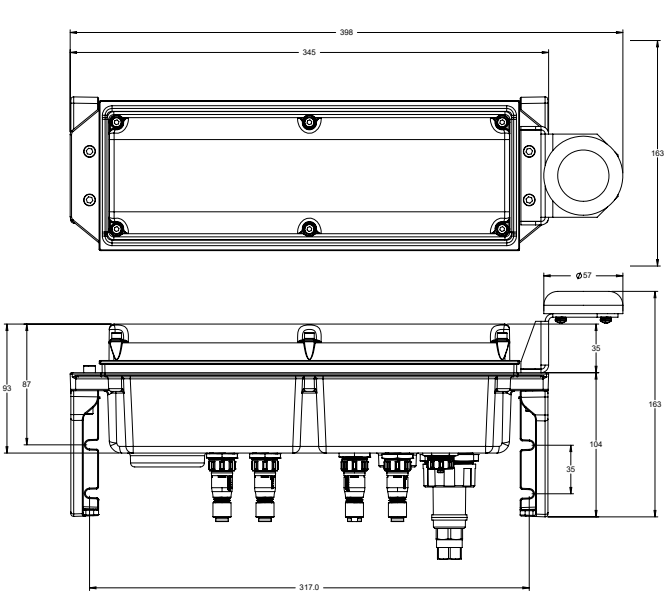


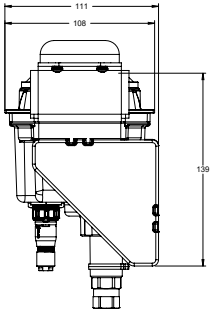



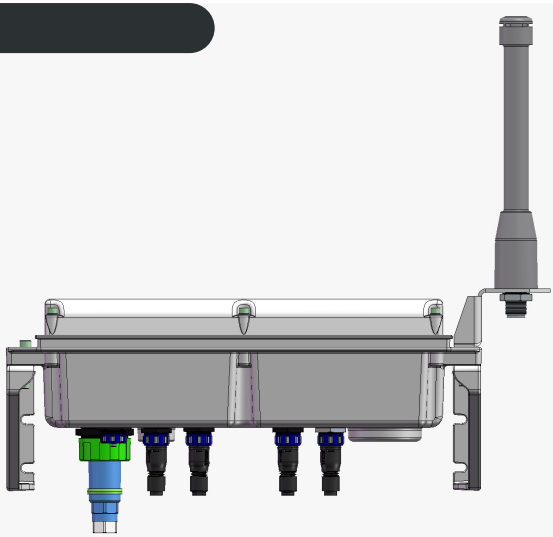
## SATCOM

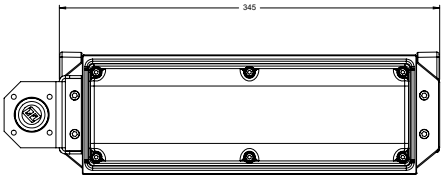


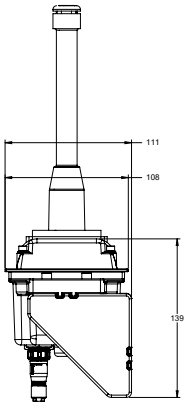


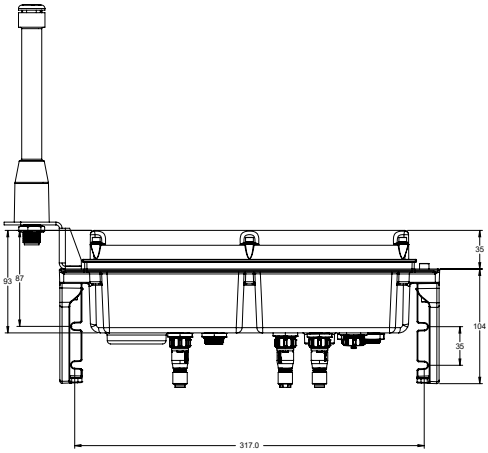



## RF

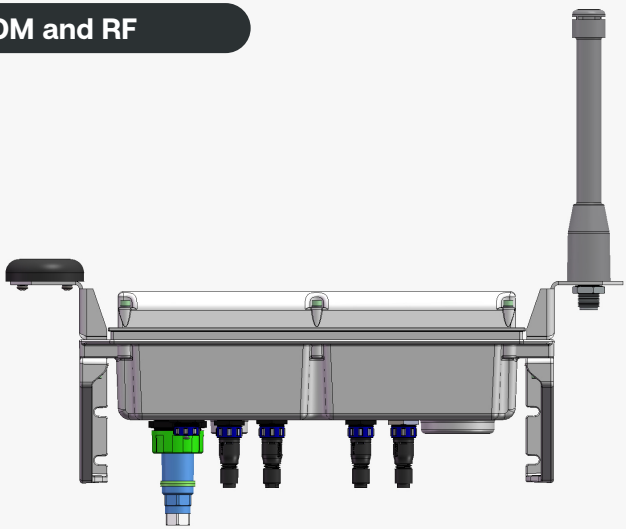


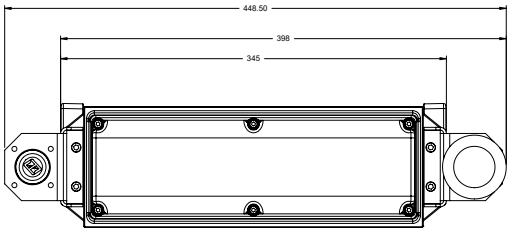


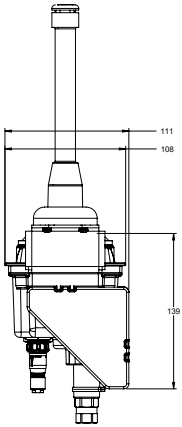



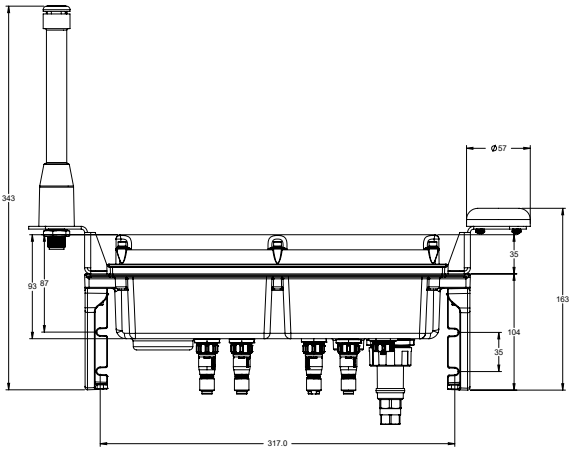



## SATCOM and RF





| S2M-UGW | DC | UM |
|---|---|---|

Electrical Characteristics

| | | |
|---|---|---|
| Input Voltage | 12 - 48 VDC | 100 - 240 VAC |
| Input Frequency | 50 - 60Hz | |
| Operating Temperature | -40 to 55° C | |

Power Consumption

| | | |
|---|---|---|
| Peak | 1.3W | 70 VAC |
| Average | 1.05W | N/A |

Interfaces

| | |
|---|---|
| Standard | • Serial configuration interface via USB<br>• MODBUS TCP/IP<br>• MODBUS RTU via RS-485<br>• Discrete IO via general-purpose input/outputs |
| Optional | • RF mesh network communication<br>• Satellite communication (SATCOM) interface<br>• GSM communication interface<br>• Dry contact relay interface via electromechanical or high current variants (Contol only) |

Physical Characteristics

| | |
|---|---|
| Body Material | Polycarbonate |
| Height (mm/inches)<br>Base Build, SATCOM, RF, RF and SATCOM | Base Build: 188mm / 7.40 in<br>SATCOM: 199mm / 7.83 in<br>RF: 385mm / 15.15 in<br>RF and SATCOM: 385mm / 15.15 in |
| Width (mm/inches)<br>Base Build, SATCOM, RF, RF and SATCOM | Base Build: 344mm / 13.54 in<br>SATCOM: 394mm / 15.51 in<br>RF: 394mm / 15.51 in<br>RF and SATCOM: 445mm / 17.52 in |
| Depth (mm/inches)<br>Base Build, SATCOM, RF, RF and SATCOM | Base Build: 111mm / 4.37 in<br>SATCOM: 111mm / 4.37 in<br>RF: 111mm / 4.37 in<br>RF and SATCOM: 111mm / 4.37 in |
| Mass (kg/lbs)<br>Base Build, SATCOM, RF, RF and SATCOM | Base Build: 1.35kg / 2.98 lbs<br>SATCOM: 1.5kg / 3.31 lbs<br>RF: 1.6kg / 3.53 lbs<br>RF and SATCOM: 1.8kg / 3.97 lbs |
| Service Life | 12 years + |

Environmental Standards

| | |
|---|---|
| Shock | MIL-STD-202G, method 213B |
| Vibration | MIL-STD-202G, method 204D |
| Humidity | 0 to 100% |

| S2M-UGW | DC | UM |
|---|---|---|

Compliance

| | |
|---|---|
| FCC (North America and IC (Canada) | FCC Part 15B/ICES 003<br>FCC/IC MPE Assessment, Co-location |
| CE (Europe) | EN 301489-1/17/19/20/52<br>EN 301908-1, EN 300328, EN 301441, EN 303413, EN 62311 |
| RCM (Australia/New Zealand) | EN 55032, AS/CA S042.1, AS/CA S042.4, RSE<br>AS/NZS 62368.1, AS/NZS 2772.2, IEC 62368.1, IEC 60529<br>ARPANSA RPS3 |
| Quality Assurance | ISO9001:2015 |

Other

| | |
|---|---|
| Warranty * | 3 years |
| Options Available | Cable Kit<br>Star2M<br>Mounting Accessories |
| Terms and Conditions | Please refer to the installation manuals for further specifications<br><br>Warranty Terms and Conditions available on www.star2m.com |

# 6.0 Unpacking, Installation, Wiring and Setup

## 6.1 Unpacking

Unpack all hardware and inspect for damage. If there is any damage, please contact your Star2M Office.

Retain original packing material for possible future use in shipping.

## 6.2 Installation


**WARNING:**
**DO NOT** connect directly to the DC output of a generator, or any other unregulated power source. Connecting to an unregulated source may result in damage.


**WARNING:**
**Always** follow the instructions outlined in the product manual when cleaning the equipment. Improper cleaning methods and use of unauthorized cleaning agents can damage equipment.

## 6.3 Factory Configuration

For Standalone Variant: Preassembled Universal Gateway Unit complete with internal wiring and side brackets. External antenna mounting fixtures are included depending on product variant (i.e. SATCOM and RF variants only). Software configuration can be provided upon request, or carried out by the end-user.

For Board Only Variant: Universal Gateway PCA preinstalled in required enclosure complete with internal wiring. Software configuration can be provided upon request, or carried out by the end-user.

## 6.4 Cabling and Connector Requirements

**Cabling Requirements**

The installation of the UGW enclosure requires the below cables (as specified by product variant). Cable kits are available for purchase from Sealite/Avlite or can be user supplied.

| Reference Point | Cable Size | Max Length |
|---|---|---|
| General Purpose Input Interface Cable | 0.25mm$^2$, 10 Conductor | Max Length is 20m. Other cable lengths less than 20m available upon request |
| General Purpose Output Interface Cable | 0.5mm$^2$, 8 Conductor | |
| Modbus TCP/IP Interface Cable | 0.25mm$^2$, 8 Conductor | |
| Modbus RTU Interface Cable | 0.25mm$^2$, 8 Conductor | |
| DC Input Interface Cable | 0.75mm$^2$, 2 Conductor | |
| AC Input Interface Cable | 1mm$^2$, 2 Conductor | |
| Relay Contacts Interface Cable | 1.5mm$^2$, 7 Conductor | |

**Connector Requirements**

The installation of the UGW enclosure requires the below connectors (as specified by product variant). Connectors are available for purchase from Sealite/Avlite or can be user supplied.

| Interface | Mating Cable Connector Part Number | Connector Manufacturer |
|---|---|---|
| General Purpose Input | PX0410/10S/6065 | Bulgin |
| General Purpose Output | PX0410/08P/6570 | Bulgin |
| Modbus TCP/IP | PX0834/B | Bulgin |
| Modbus RTU | PX0410/08S/6065 | Bulgin |
| DC Input | PX0410/02S/5055 | Bulgin |
| AC Input | PXP4010/02S/6570 | Bulgin |
| Relay Contacts | RTS6BS14N7S03 | Bulgin |

## 6.5 Installation Recommendation

The Universal Gateway is user configurable by the end-user. This is done through the Universal Gateway Configuration Application. Please see section *7.0 Universal Gateway Configuration Application.*

The Universal Gateway can be installed as a standalone assembly or as a board only component to be integrated into third party equipment.

**Note:** The sequence of steps can be adjusted for site requirements.

**NOTICE:**
Installation of Board Only Variants must adhere to mandated and approved integration design and cabling guidelines. If these are not followed, satisfactory RF performance cannot be guaranteed.

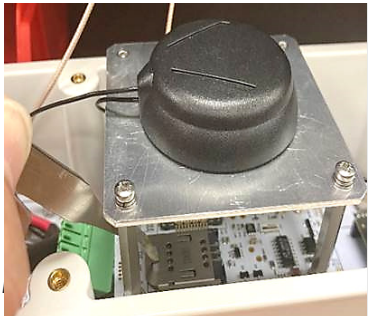
### 6.5.1 Standalone Assembly

For UGW variants with either SATCOM and/or RF Control, external antenna mounting hardware will be provided and will be pre-attached to the UGW by default. However, if the user has specifically requested that these mounts be separated for spacing or clearance purposes, these mounts will have to be attached onto the UGW before it is mounted using a Size 4mm Allen Key.

Step 1: For GSM Variants Only: Install the SIM card into the UGW Enclosure

a. Remove the screws in the lid of the enclosure using a size 3 Allen Key and lift off the lid. (See figure 4 if required).

b. The SIM card holder will be located underneath the GPS/GSM antenna mount. Use a small flathead screwdriver to gently open the SIM card holder.



### Step 2: Configure the UGW Unit

Please see section *7.0 UGW Configuration Application* for more information.

### Step 3: Attach mating connectors to the UGW base plate

The mating connectors are provided either stand-alone or pre-terminated as part of the optional cable kit for the UGW. Connectors can also be sourced directly by users. Please see section 6.4 for further information.

The mating connectors can be simply threaded into the appropriate ports underneath the unit. The connectors are not provided with the UGW unit.

Cable kits of user defined lengths are available to purchase from Avlite. These can be simply connected to the UGW base plate as specified by the selected interfaces.

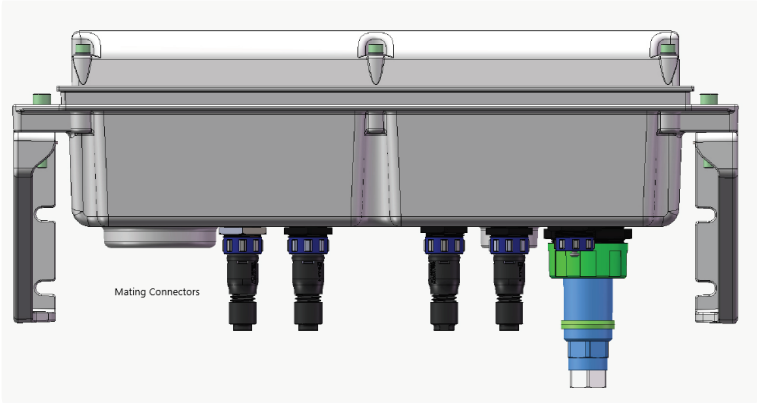



***Figure 7***

### Step 4: Mount the UGW Unit

The Universal Gateway Unit can be wall or pole mounted.

For wall mounting, the UGW can be attached to the wall via the pre-attached side brackets using the provided bolts. The UGW should be placed in a reasonable location at eye level to ensure that it is easily accessible for servicing and maintenance.

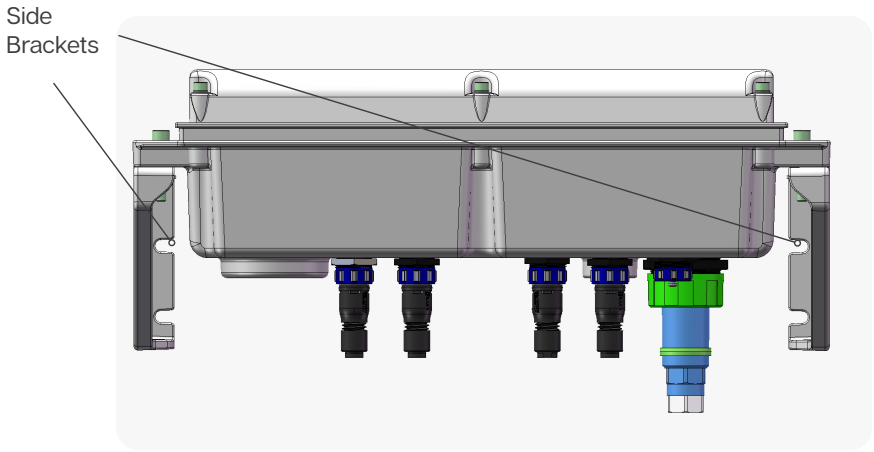



***Figure 8:*** *Pole Mounting*

For pole mounting, attach the required mounting hardware (User or Sealite/Avlite supplied) to the back of the UGW Unit. This assembly can then be mounted to the pole using steel strapping as shown in the image below.

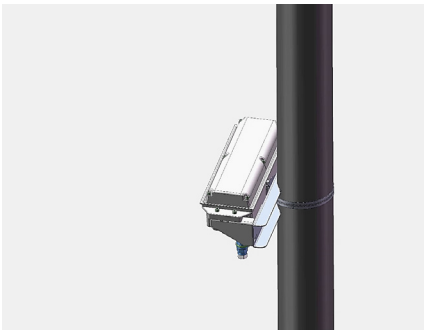


***Figure 9:*** *Pole Mounting*

### Step 5: For SATCOM and/or RF Variants Only: Mount the Antennas

Attach the provided antennas to the antenna mounts. The antennas come with the required cabling to connect them to the UGW unit. Please see section *5.4.1 Product Design.*

# 7.0 Universal Gateway Configuration Application

## 7.1 Minimum System Requirements

The UGW Configuration Application can be downloaded on any operating system that uses Windows 7 (SP1, 32-bit & 64-bit), Windows 8 (32-bit & 64-bit), Windows 8.1 (32-bit & 64-bit) and Windows 10.

## 7.2 Software Installation

The user will be provided with the UGW Configuration Application to download onto a PC or laptop.

1. Launch the Universal Gateway Configurator from the supplied file select '**Next**'.

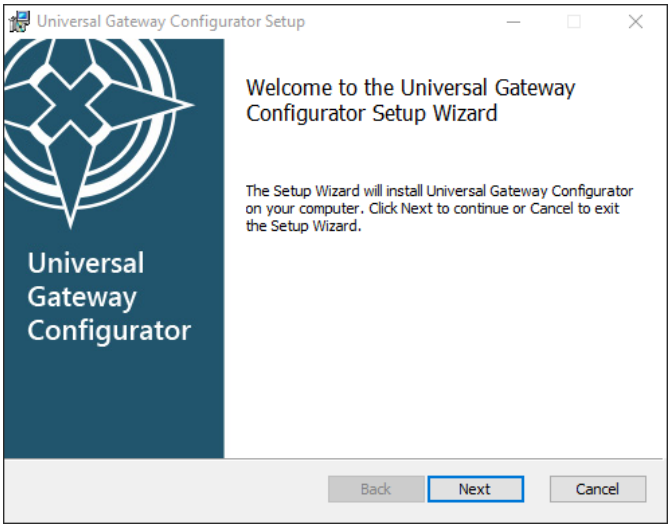



*Figure 10*

2. Accept the terms of the license agreement and select '***Next***'.


*Figure 11*

3. Choose the appropriate destination folder location and select '**Next**'.

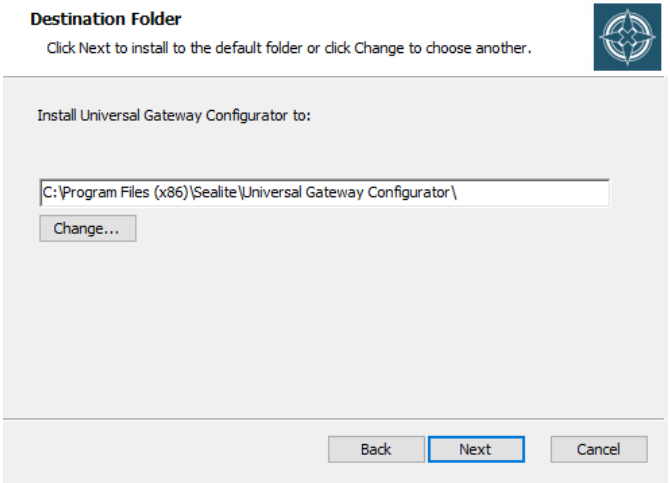



*Figure 12*

4. Select '**Install**'.

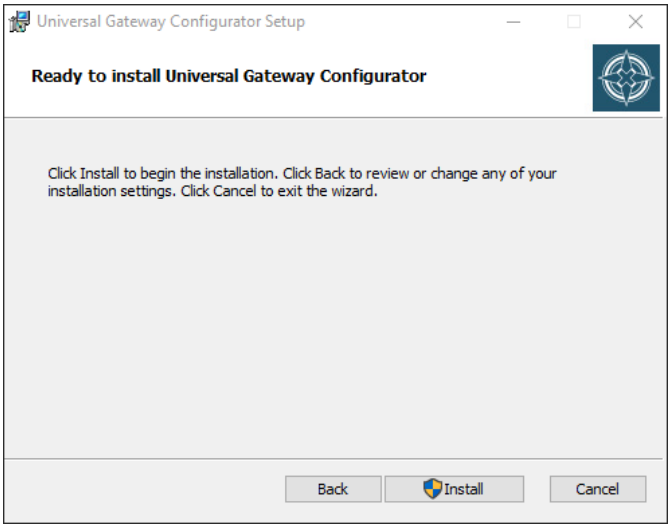



*Figure 13*

5. Launch the Universal Gateway Configurator once installation is complete.


*Figure 14*

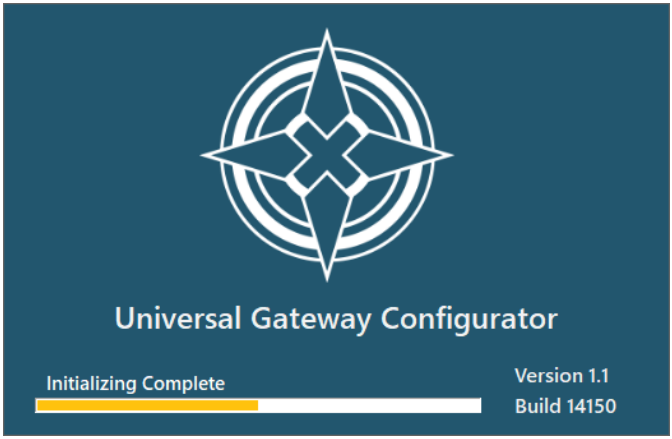



*Figure 15*

6. Launch process is complete once the System Dashboard is shown.


*Figure 16*

**NOTICE:**
The connection status of a Universal Gateway unit can be viewed immediately in the top right-hand corner of the screen.

## 7.3 Connecting a Universal Gateway to the Configuration Application

1. After connecting an AC or DC power input into the UGW enclosure, download the UGW Configuration Application onto a PC or laptop.

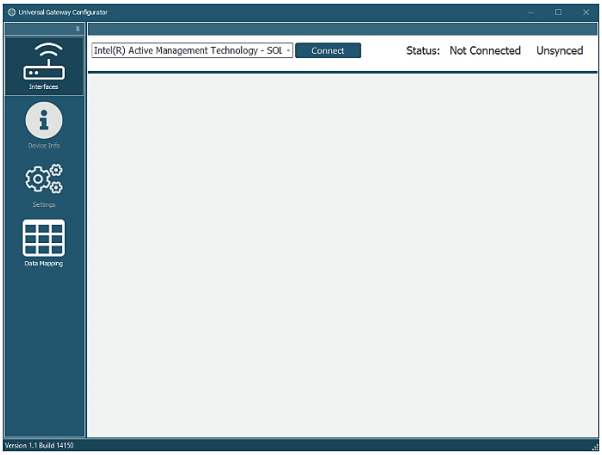



*Figure 17*

2. Connect the provided programming cable from the UGW enclosure to the PC or laptop via the USB port. Please see section 5.4.2 Connectors for the USB port location. Alternatively, the UGW can be connected via Bluetooth.
3. Select the appropriate COMMS port from the drop-down menu and select '**Connect**'. After a few seconds, the Connection Status should now be displayed as '**Connected**' and '**Synced**'.

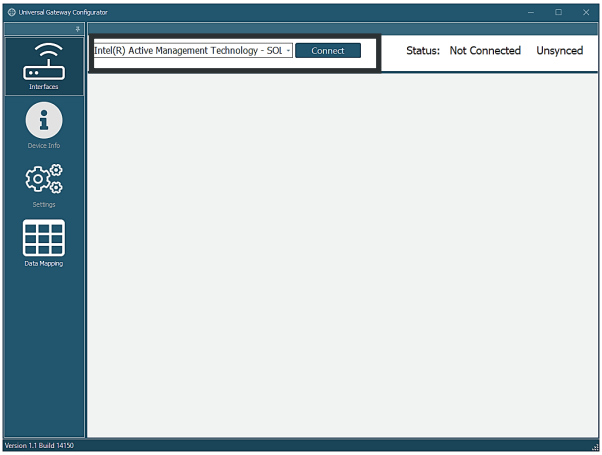



*Figure 18*

4. Select ‘Device Info’ in the left-hand side menu and check that the firmware version is up to date.

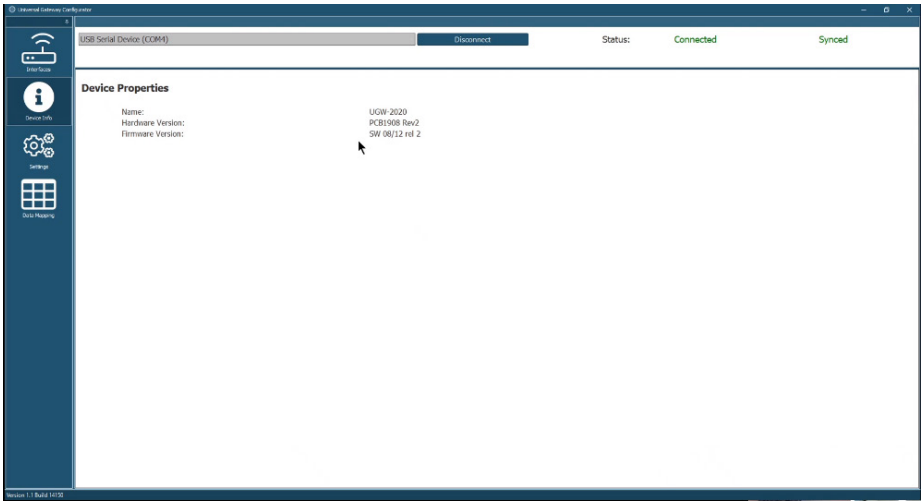



*Figure 19*

**NOTICE:**
If the firmware is not up to date, please see *section 7.10 Updating the Universal Gateway Firmware.*

## 7.4 Interface Data Mapping

The user is able to map an input trigger (event) on one interface to an equivalent output (response) on the second interface.

The table below shows the various pairs of interfaces that can be mapped logically:

| | | Input Interface | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | **GPIO** | **MODBUS TCP/IP Client** | **MODBUS TCP/IP Server** | **MODBUS RTU Master** | **MODBUS RTU Slave** | **SATCOM** | **GSM** | **AvMesh** |
| **Output Interfaces** | **GPIO** | NO | YES | YES | YES | YES | YES | YES | YES |
| | **MODBUS TCP/IP Client** | YES | NO | NO | NO | NO | YES | YES | YES |
| | **MODBUS TCP/IP Server** | YES | NO | NO | NO | NO | YES | YES | YES |
| | **MODBUS RTU Master** | YES | NO | NO | NO | NO | YES | YES | YES |
| | **MODBUS RTU Slave** | YES | NO | NO | NO | NO | YES | YES | YES |
| | **SATCOM** | YES | YES | YES | YES | YES | NO | NO | YES |
| | **GSM** | YES | YES | YES | YES | YES | NO | NO | YES |
| | **AvMesh** | YES | YES | YES | YES | YES | YES | YES | NO |
| | **Relay** | YES | YES | YES | YES | YES | YES | YES | YES |

**NOTICE:**
The Input interface cannot be the same as the Output Interface.

1. Select '**Data Mapping**' in the left-hand side menu. Initially, this page will be blank, however, the selected input triggers and responses will be listed here.

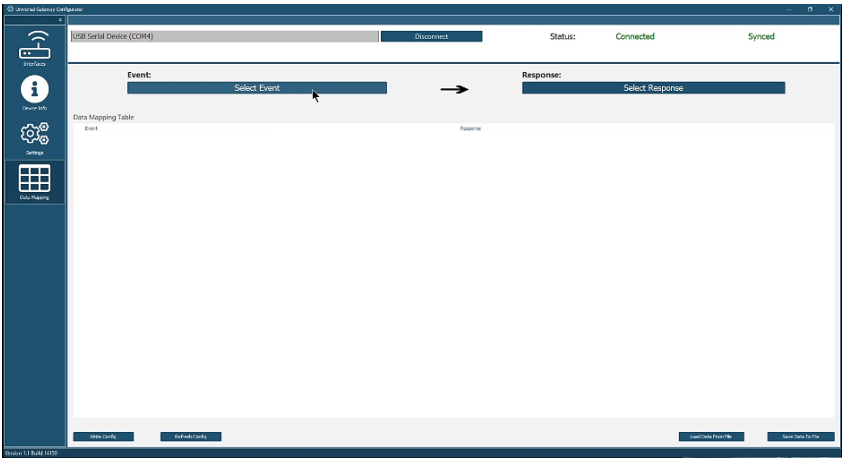



*Figure 20*

2. Select the '**Select Event**' tab. This will display the '**Event Interface Selection**' popup.

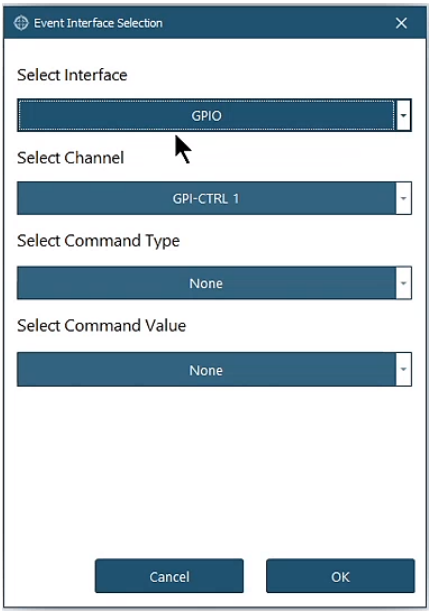



*Figure 21*

3. Select the appropriate interface from the drop-down menu.

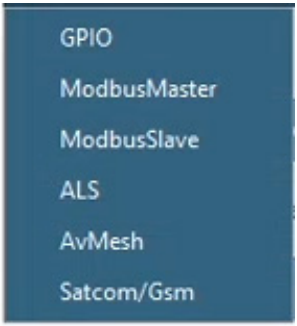



*Figure 22*

4. Select the appropriate Channel from the '**Select Channel**' drop-down menu. The options shown here will be dependent on the selected input interface. See figure 21.
5. Select the appropriate Command Type from the '**Command Type**' drop-down menu. The options shown here will be dependent on the selected input interface. See figure 21.
6. Select the appropriate Command Value from the '**Command Value**' drop-down menu. The options shown here will be dependent on the selected input interface. See figure 21.
7. Select '**OK**' at the bottom of the Event Interface Selection popup. See figure 21. The selected Event should now be visible in the Data Mapping Table. The 'Response' field will be displayed as 'TBD' until a response is defined by the user.

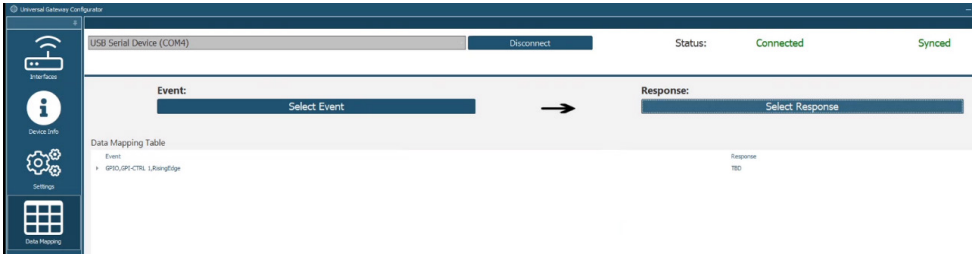



*Figure 23*

8. Select the '**Select Response**' tab to display the '**Response Interface Selection**' popup. This will allow the user to define what the UGW unit needs to do once the previously selected input event is triggered.

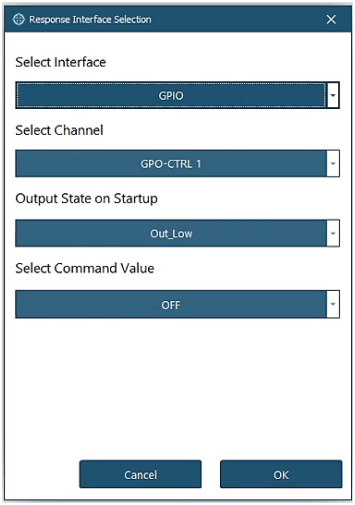



*Figure 24*

9. Select the appropriate interface from the drop-down menu.

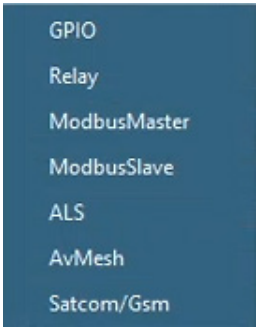



*Figure 25*

10. Select the appropriate Channel from the '**Select Channel**' drop-down menu. The options shown here will be dependent on the selected output interface. See figure 24.
11. Select the appropriate '**Output State on Startup**' from the drop-down menu. The options shown here will be dependent on the selected output interface. See figure 24.
12. Select the appropriate '**Command Type**' from the drop-down menu. The options shown here will be dependent on the selected output interface. See figure 24.

13. Select '**OK**' at the bottom of the Response Interface Selection popup. See figure 24. The 'TBD' in the Response column should now be replaced with the previously defined Response.

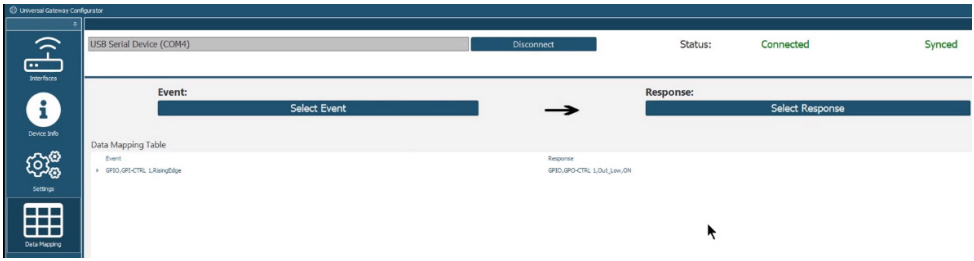



*Figure 26*

14. Select the '**Write Config**' tab in the bottom left-hand corner of the screen. This will upload the defined events and response to the UGW unit. The process of uploading the configuration to the UGW unit will be completed once the below popup confirmation is displayed:

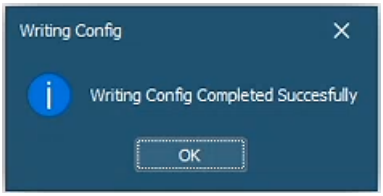



*Figure 27*

## 7.5 Delete an entry in the Data Mapping Table

1. Right click on the entry in the Data Mapping Table that needs to be deleted.

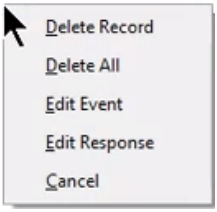



*Figure 28*

2. Selecting 'Delete Record' will remove the Event and associated Response from the Data Mapping Table. Selecting 'Delete All' will delete all of the entries in the Data Mapping Table.
3. If the entry is still visible in the Data Mapping Table, the page may need to be refreshed via the 'Refresh Config' tab at the bottom of the screen.

## 7.6 Edit an Event or Response in the Data Mapping Table

1. Right click on the entry in the Data Mapping Table that needs to be edited. See Figure 26 above.
2. To Edit an Event in the Data Mapping Table, select '**Edit Event**' from the drop-down menu. The '**Event Interface Selection**' popup will be displayed. See figure 21. Similarly, to edit a Response, select '**Edit Response**' in the drop-down menu to display the '**Response Interface Selection**' popup. See Figure 24.

**NOTICE:**
When editing an Event or Response in the Data Mapping Table, the Interface Type cannot be changed. If the interface type needs to be changed, the whole entry will need to be deleted and re-added.

3. If the new details of the edited Event or Response are not immediately shown on the Data Mapping Table, the page may need to be refreshed via the '**Refresh Config**' tab at the bottom of the screen.

## 7.7 Disconnecting the Universal Gateway from the Configurator Application

1. Select '**Disconnect**' at the top of the screen.

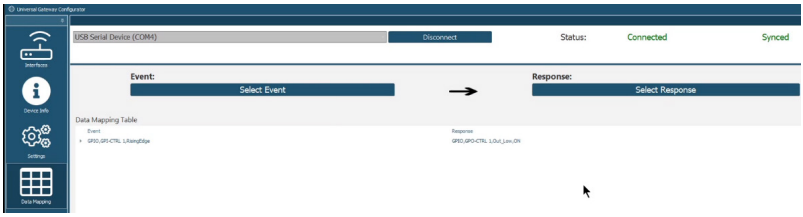



*Figure 29*

Once 'Disconnect' is selected, the Connection Status in the top right-hand corner of the screen will be displayed as 'Not Connected' and 'Unsynced'.

2. Remove the USB cable from the USB configuration port underneath the UGW unit.

## 7.8 Saving Data Mapping information to file

The mapped Events and Responses in the Data Mapping Table can be saved to the user's PC or laptop.

1. Select the '**Save Data to File**' tab at the bottom of the 'Data Mapping' page.

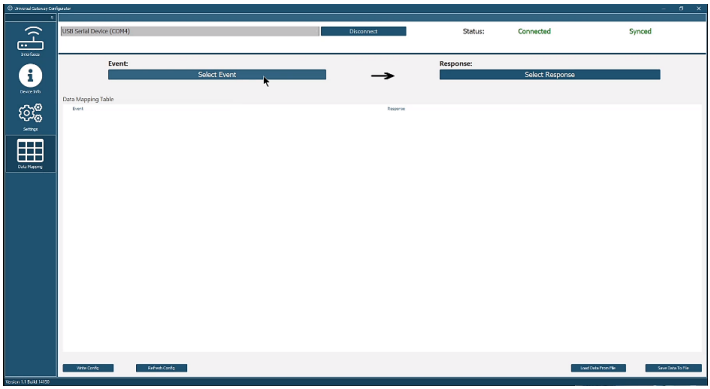



*Figure 30*

2. Select the appropriate destination via the popup window and select 'Save'.

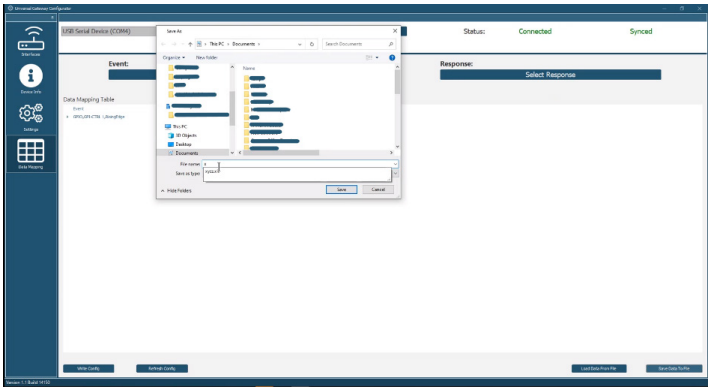



*Figure 31*

**NOTICE:**
When editing an Event or Response in the Data Mapping Table, the Interface Type cannot be changed. If the interface type needs to be changed, the whole entry will need to be deleted and re-added.

## 7.9 Loading Data Mapping Information from a file

The previously saved mapped Events and Responses can be loaded into the Data Mapping Table at any time.

1. Select the '**Load Data From File**' tab at the bottom of the 'Data Mapping' page. Select the previously saved data file via the popup window and select 'Open'.

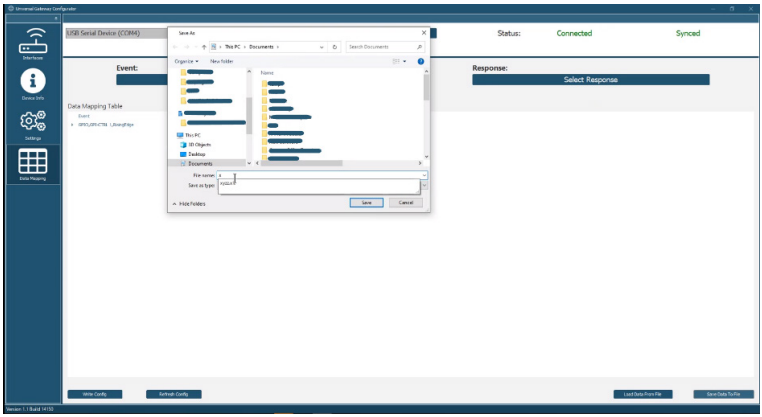



*Figure 32*

3. Once opened, the data will be automatically populated in the 'Event' and 'Response' columns of the Data Mapping Table.

## 7.10 Updating the Universal Gateway Firmware

Updates to the UGW firmware can be carried out via Bluetooth or USB connection. Please ensure that the Connection on the Universal Gateway Configurator is displayed as 'Connected' and 'Synced'.

1. Download the updated firmware hex file onto a PC or laptop.

2. Select **Settings** in the left-hand side menu. This will display the device properties.

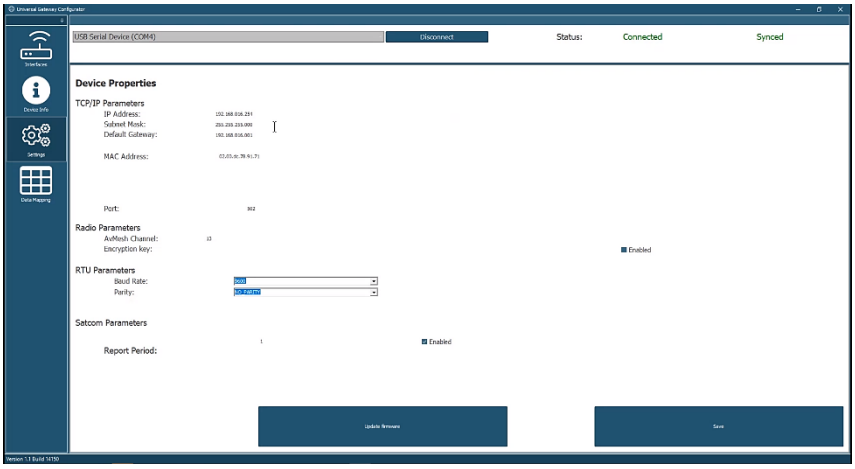



*Figure 33*

3. Select 'Update Firmware'. This will open a popup window to allow the user to select the appropriate saved firmware version file. Select '**Open**' on the popup window.

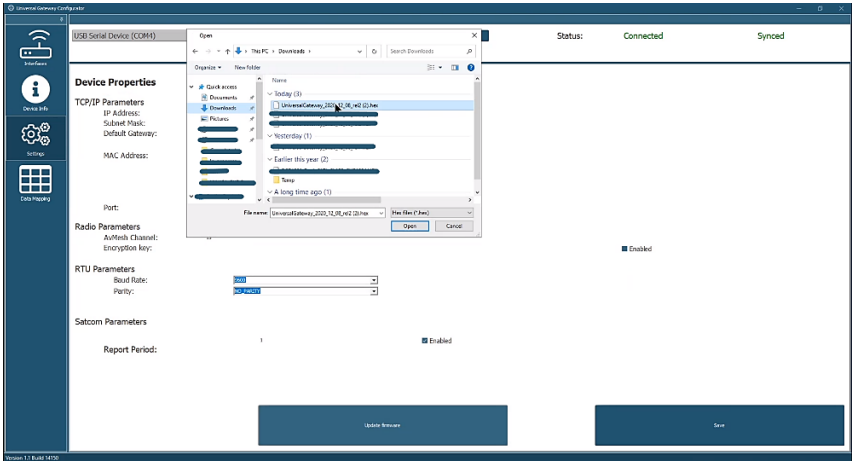



*Figure 34*

**NOTICE:**
Once the latest hex file has been opened, the updated firmware will start downloading automatically. This process should take between 10 and 20 seconds.

Once complete, the below window will be displayed:

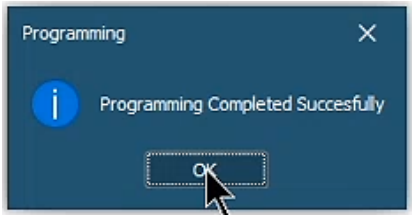



*Figure 35*

4. Select '**Device Info**' in the left-hand side menu. The most updated Firmware Version should now be displayed.

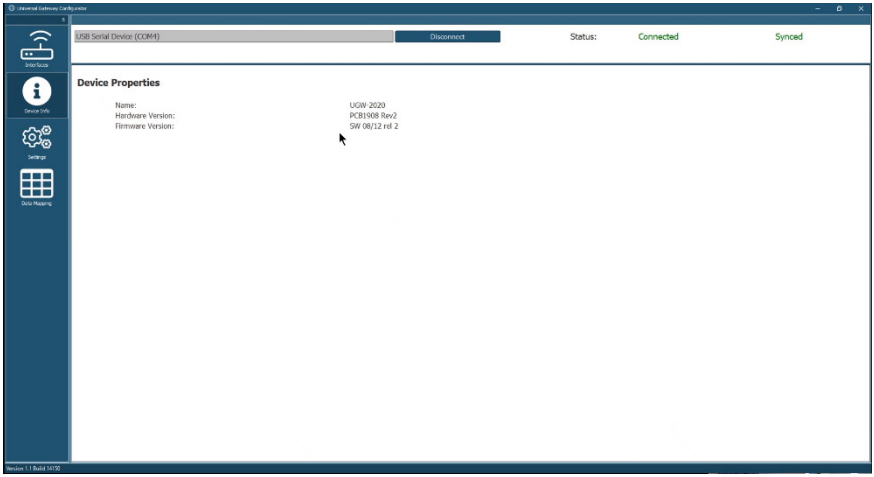



*Figure 36*

# 8.0 Maintenance and Servicing

Inspect the UGW enclosure for evidence of damage, dust and water penetration.

Inspect connectors for evidence of damage, dust and water penetration. Replace connectors as required.

Inspect cabling for failing insulation, open conductors or other wiring flaws and repair as required.

# Notes

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