uRADMonitor A3
Environmental Monitoring

uRADMonitor A3 radio variant

Temperature, Barometric pressure, Relative Humidity, Volatile organic compounds (VOC), Formaldehyde, Ozone, Particulate matter PM1, PM2.5, PM10, Carbon Dioxide, Noise level.

Features

- 7 high quality digital sensors tracking 11 air parameters
- Integrated Internet connectivity. 4 connectivity options including Ethernet, Wifi, GSM and LoraWAN
- USB port for power, data access, debug and configuration
- Built-in air pump for active flow
- Alarm and notification functions using built-in speaker
- Direct and Cloud data access via API
- Rugged design with aluminum enclosure and wall mounting support
- Low power consumption
- Compact size 110x65x25 mm

Applications

- Home monitoring
- Office and production space monitoring
- CBRN Monitoring
- Smart cities
- IOT / Internet of things

Description

Communities are increasingly interested in learning more about what pollutants are in the air. Knowing about the air quality in your community can help you decide what actions to take to protect your health. That is where new air sensors come into play. They are low-cost, highly portable, and offer new ways to measure air quality in and around a community.

uRADMonitor A3 is an automated, fixed monitoring station with an array of sensors that tracks a total of 11 important environmental parameters. It comes in a rugged aluminum enclosure with wall mounting support. The data is exported to the uRADMonitor network and can be accessed in real time using the cloud API interface or directly via the local network.

Automated monitoring provides more options over using handheld units occasionally. Mapping data trends becomes possible thanks to continuous surveillance and a permanent data flux. We have a higher detection capability for small variations and can trigger automated alarms if predefined thresholds are reached, improving reaction time while lowering costs. The uRADMonitor network is a global array of interconnected monitoring stations, focused on continuous Environmental Surveillance. Its purpose is to generate fully transparent open data, used to assert the quality of our environment.

Using the 4 available connectivity options and the low power consumption this device can be deployed for a large variety of field applications. Its versatility is combined with a convenient cloud based data access with an API interface to access the measurements directly from the uRADMonitor cloud.

Sensors

uRADMonitor model A3 uses the Bosch BME280 sensor to measure air temperature, barometric pressure and humidity. A MOX VOC sensor measures volatile organic compounds. A high quality laser scattering sensor is used to detect the Particulate Matter PM1, PM2.5 and PM10 concentration in air. There are two electrochemical sensors, one for formaldehyde and another one for ozone and a non-dispersive infrared sensor for CO2. A built in fan assures an active air flow stream across the sensing elements. There is also a noise level sensor since iteration v105.

SENSOR	PARAMETER	MINIMUM	MAXIMUM	RESOLUTION	ACCURACY	INTERVAL[1]	LIFESPAN[2]
Bosch BME280	Temperature	-40 °C	+85 °C	0.5 °C	± 1°C	-40..+100°C	5 years
	Pressure	300 hPa	1100 hPa	1 Pa	± 0.25%	-40..+100°C	
	Humidity	0% RH	100% RH	1% RH	± 2%	-40..+100°C	
Winsen ZH03A	PM1	0 µg/m³	1000 µg/m³	1 µg/m³	R=0.99 [3]	-40..+100°C	5 years
	PM2.5	0 µg/m³	1000 µg/m³	1 µg/m³		-40..+100°C	
	PM10	0 µg/m³	1000 µg/m³	1 µg/m³		-40..+100°C	
Winsen ZE08-CH2O	Formaldehyde	0 ppm	5 ppm	10 ppb	± 5%	0..+50°C	2 years
Winsen ZE25-O3	Ozone	0 ppm	10 ppm	10 ppb	± 5%	-10..+55°C	2 years
Winsen MH-Z19B	Carbon Dioxide	400 ppm	5000 ppm	1 ppm	± 5%	0..+50°C	5 years
Winsen MP503	VOCs	10 ppm[4]	1000 ppm[4]	-	± 5%	-40..+100°C	2 years
SPU414 with MAX4466	Noise level	30 dB	130 dB	1 dB	± 10%	-40..+100°C	2 years

[1] Using the sensor outside the recommended temperature interval can shorten its lifespan

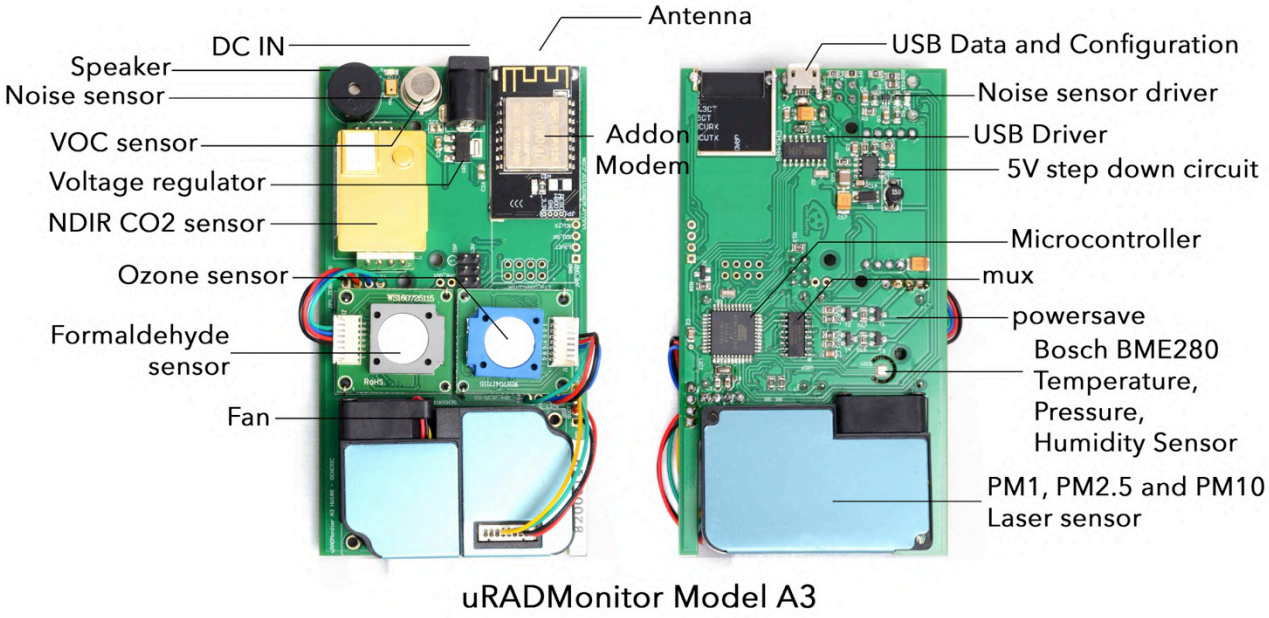
[2] Estimated for normal usage conditions. Device maintenance is recommended after the shortest sensor lifespan interval (2 years).

[3] Correlation coefficient to reference gravimetric sampler Sven Leckel LVS3 (SR EN 12341: 2014), determined by ISO17025 certified laboratory INCD-ECOIND Bucharest, per contract 14237 / 24.08.2018.

[4] Estimated for alcohol.

Specification

Parameter	uRADMonitor A3.LAN	uRADMonitor A3.Wifi	uRADMonitor A3.GSM	uRADMonitor A3.LoraWAN
Internet connection	Ethernet RJ45 10/100/1000 Base-T Networks	Wifi 2.4GHz	Cellular GPRS over GSM GPRS multi-slot class 10/12	Compliant with multiple international LoRaWAN bands
Standards	IEEE 802.3	IEEE 802.11b/g/n	n/a	IEEE 802.15.4g(FSK/GFSK)
Wireless frequencies	n/a	2400-2483.5MHz	850MHz/900MHz/ 1800MHz/1900MHz	IN865, EU868, US915, AU915, IL915, KR920, AS923
TX Power	n/a	100mW	250mW	25mW
Modem Chip	Microchip enc28j60	Espressif ESP8266	SIMCom SIM800L	Microchip RN2482 / RN2903
Modem certifications	CE, FCC, ROHS	CE, FCC	CE, GCF, FCC, TA, CTA, CCC, ROHS, REACH, ANATEL, A-TICK	CE, FCC, IC
Antenna connector	n/a	SMA male	SMA female	SMA female
Protection	IP30	IP30	IP30	IP30
Supply Voltage	6 - 28 V	6 - 28 V	6 - 28 V	6 - 28 V
Dimensions	110x65x25 mm (excl.sup)	110x65x25 mm (excl. sup)	110x65x25 mm (excl. sup)	110x65x25 mm (excl. sup)
Weight	175g	170g	170g	170g
Mounting	mounting support provided	mounting support provided	mounting support provided	mounting support provided
Recommended Use Ratings	Temperature: -20°C to +65°C Humidity: 0RH to 95RH			
Certifications	CE / ROHS 2017			



uRADMonitor A3 WIFI variant - motherboard front and bottom view HW108

Usage conditions

- **Power supply**
  The A3 detectors come with a built-in power supply. This allows to power the device with any voltage between 6V and 28V. Be careful not to exceed 28V as it will damage the unit. The units are shipped with a 9V adapter.
- **Outdoor use and exposure to elements**
  Do not expose the device to direct sunlight, rain or snow. The aluminum case is not sealed, and water getting inside will damage the appliance. Do not cover the air circulation holes.
- **Precautions**
  Do not expose the device to a large amount of dust such as in the woodworking centers. Do not expose the appliance to solvents or to a large amount of concentrated vapors of chemicals (acetone, paints, alcohol, butane, propane, etc.), because the sensors can wear out, or the measurements may become inconclusive. Do not expose the apparatus to mechanical shocks. Wherever possible, mount the appliance in a vertical position to extend the life of the built-in fan mechanisms.
- **Installing the unit**
  For mounting, use the holes in the housing. Ensure that you properly connect the power cord and network cable and secure against vibration where necessary. If your A3 is a radio unit, make sure the antenna is installed before powering the unit.

Warranty

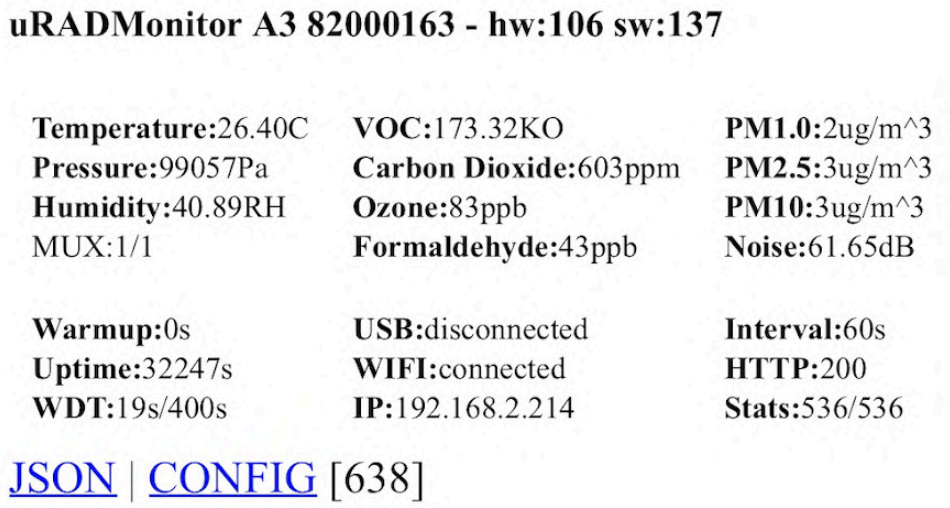
uRADMonitor A3 is covered by a 12 months warranty for any defects in material or workmanship, under normal use.

Data access

uRADMonitor is designed for easy and open data access. The data can be accessed in two ways:

- **Local access**

Applies where the uRADMonitor unit is part of a LAN network (the Ethernet and Wifi variants). The uRADMonitor unit serves an internal webpage accessible via port 80. To access the content open the unit's IP in your LAN network on a computer or a phone. The webpage served is as follows:



Internal webpage exposing raw data and debug parameters. The JSON link offers formatted data output while CONFIG is for Wifi setup

The JSON link points to a JSON formatted data source, that can be polled periodically to access the uRADMonitor unit readings. As this is done directly by connecting to the uRADMonitor unit, the server compensation layer is not used, so you would receive the raw readings. This is not the preferred way, and additional compensation must be implemented (eg. Temperature offset to compensate for internal heating, other corrections, etc). This functionality is offered rather for debugging and decentralized operation in critical situations such as server failure or malfunction.

- **Data access via the Server RESTful API**

This is the preferred data access method. REST API does not require the client to know anything about the structure of the API. Rather, the server needs to provide whatever information the client needs to interact with the service. An HTML form is an example of this: The server specifies the location of the resource, and the required fields. The browser doesn't know in advance where to submit the information, and it doesn't know in advance what information to submit. Both forms of information are entirely supplied by the server. Lookups should use GET requests. PUT, POST, and DELETE requests should be used for creation, mutation, and deletion.

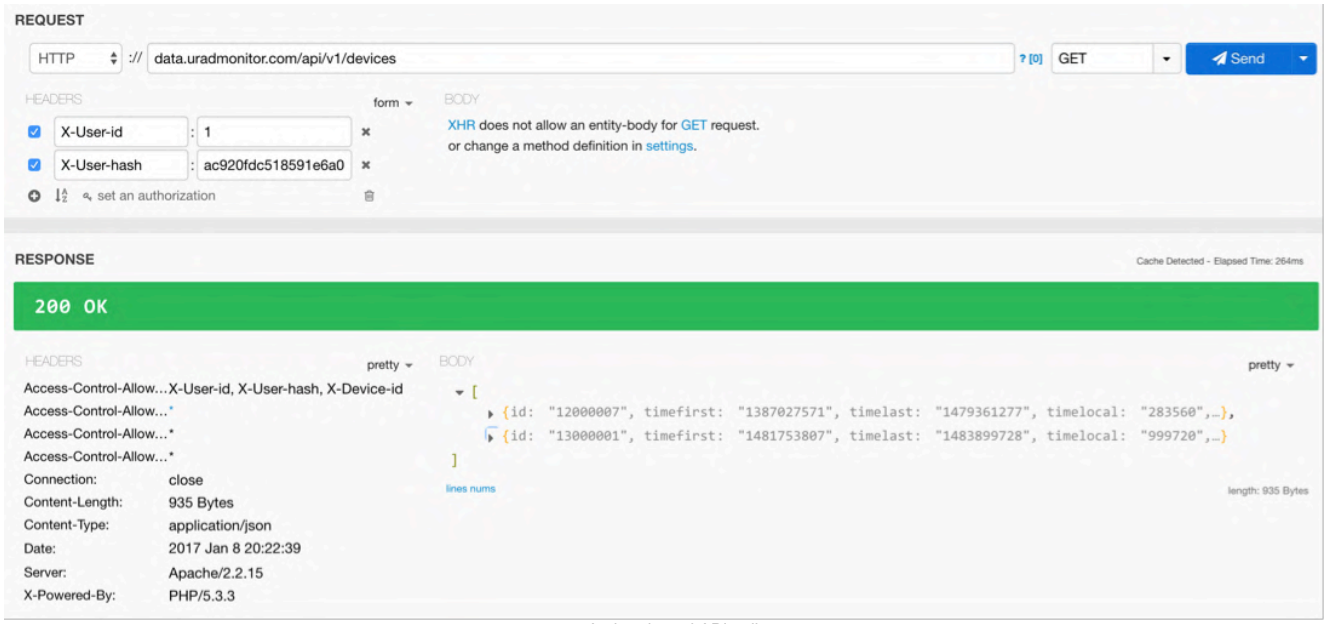
The API is called for both directions of data transfer (upload and download). The uRADMonitor devices use the API to upload their measurements to the server, for further processing and storage in the database. The API is then used to access data by the frontend, the mobile app or third party systems that need the uRADMonitor data.

Server API: Authentication

Some API calls require authentication with user ID and user Key and will return results depending on the privileges and settings of the given user. To authenticate a call, the HTTP GET header must contain two custom fields, defined as follows:

X-User-id	Will contain the user ID.
X-User-hash	Will contain the user Key.

Both the user ID and the user Key are displayed in the Dashboard. Here is call example, using the authentication headers:



Authenticated API call

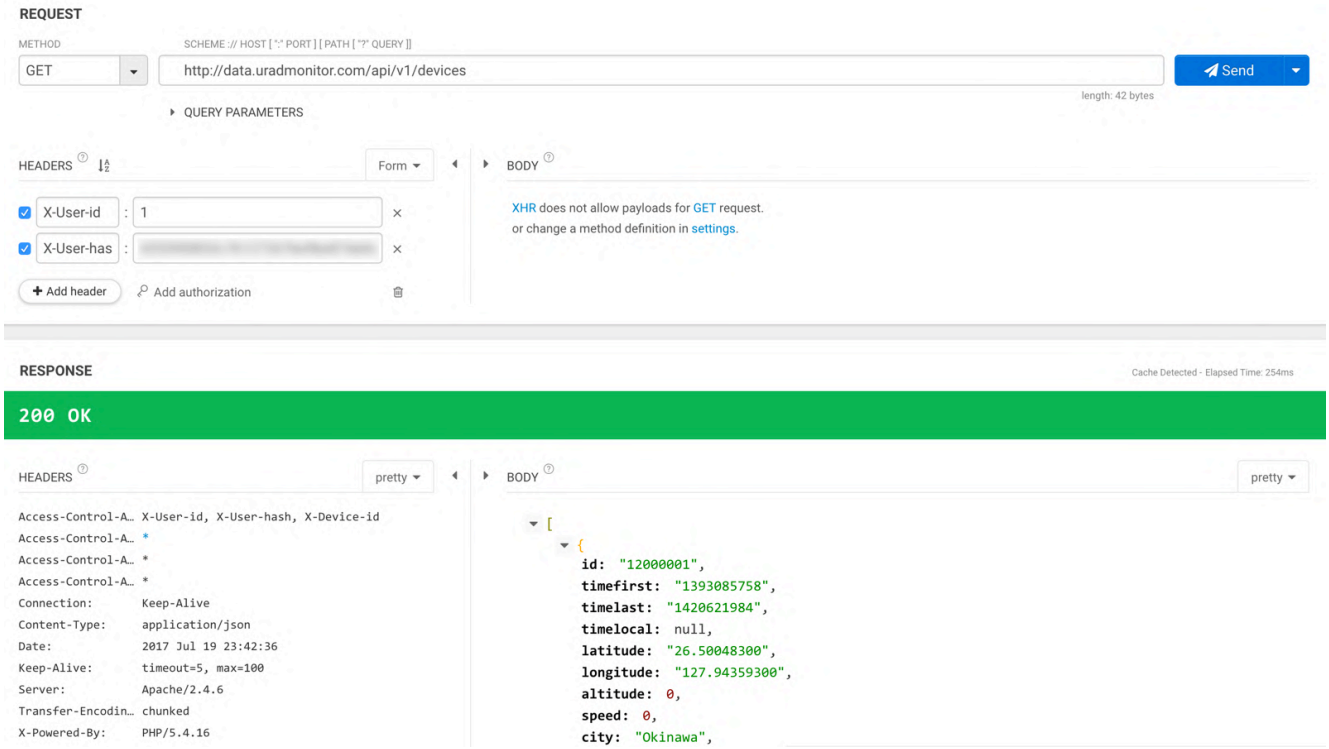
Below the list of API calls is presented. Those that require authentication will be marked accordingly.

Server API: API Calls for data access

For the uRADMonitor RESTful API, there is a common base url, defined as http://data.uradmonitor.com/api/v1/ followed by the following verbs:

1	*devices*	**Full URL**: https://data.uradmonitor.com/api/v1/devices
Method: HTTP GET		**Purpose**: data access
Description		Used to retrieve the list of uRADMonitor units assigned to the user account. The list includes the units the user is either set as owner or has global access to them.
Authentication		yes, using X-User-id and X-User-hash in HTTP Get header

Call example:



Return: summary array of uRADMonitor units in JSON format.

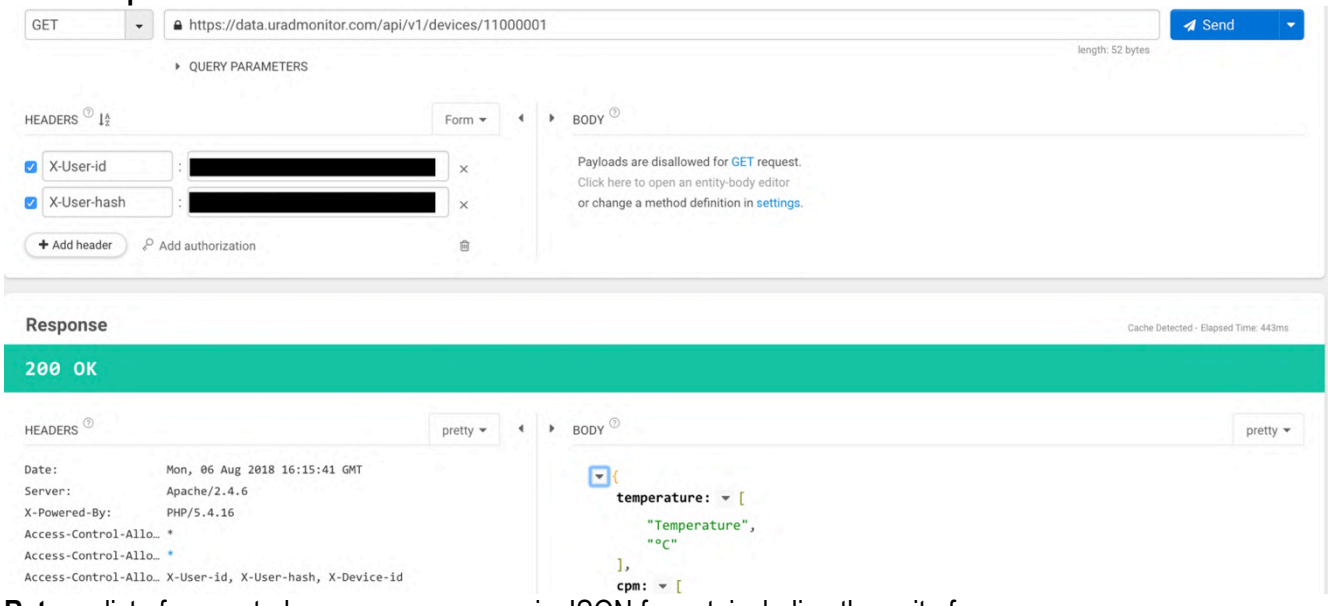
[{ **id :** "82000050", **timefirst :** "1476801965", **timelast :** "1499877474", **timelocal :** "120", **latitude :** "37.46906600", **longitude :** "-79.21035800", **altitude :** 213, **speed :** 0, **city :** "Lynchburg", **country :** "US", **versionsw :** "122", **versionhw :** "103", **status :** null, **mobile :** null, **detector :** "SI29BG", **factor :** 0.01, **avg_temperature :** "25.39", **avg_pressure :** "99268", **avg_humidity :** "67.13", **avg_voc :** "2669238", **min_voc :** "73049", **max_voc :** "11818108", **avg_co2 :** "514", **avg_ch2o :** "0.00", **avg_pm25 :** "950", **avg_noise :** "0.00", **avg_cpm :** "11.40", **avg_voltage :** "380.97", **avg_duty :** "219.68"}, {...}]

Each result in the array contains the following information:

id	the unique uRADMonitor unit ID
timefirst	unix timestamp containing the moment in time the unit first transmitted data
timelast	unix timestamp containing the moment in time of the last data transmission
timelocal	timestamp containing the number of seconds elapsed since the unit was last rebooted
latitude	latitude coordinate in decimal format
longitude	longitude coordinate in decimal format
altitude	altitude coordinate in meters
speed	unit speed in km/h
city	define base city for this unit
country	2 letter country code for the location of this unit
versionsw	firmware version
versionhw	hardware iteration version
status	1 if the unit is online, NULL if it is offline
mobile	1 if the unit is a mobile unit (eg. Model-D units or A3 units installed in buses)
detector	name of radiation detector sensor if the unit has such capabilities (only for Model A, KIT1, D and A3)
factor	CPM to Eq Dose Rate linear approximation conversion factor (dependent on "detector")
avg_XX	last 24hours average of the given sensor. Each unit model has a different number of avg_XX values returned, depending on its capabilities and the number of parameters it measures

2	*devices/[ID]*	**Full URL**: https://data.uradmonitor.com/api/v1/devices/[ID]
Method: HTTP GET		**Purpose**: data access
Description		ID is a unique uRADMonitor unit ID (eg. 110000AB) . This call is used to return the list of sensors of the specified unit.
Authentication		yes, using X-User-id and X-User-hash in HTTP Get header

Call example:

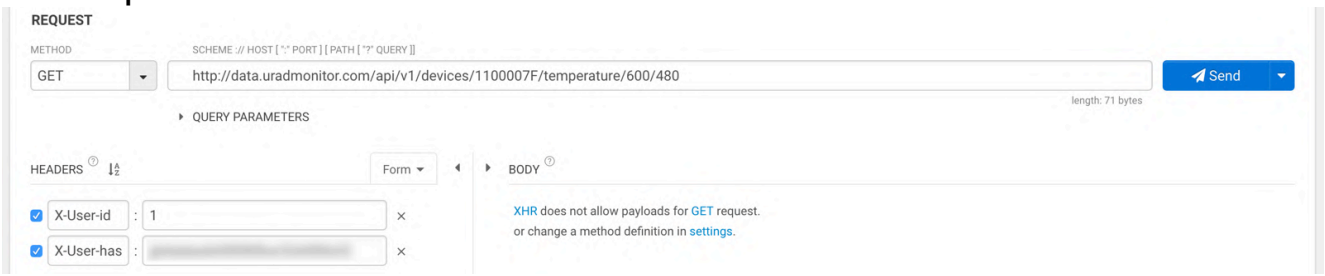


Return: list of supported sensors as an array in JSON format, including the unit of measure:

{ temperature : ["Temperature","°C"], cpm : ["Radiation","cpm"], voltage :["Voltage","V"], duty : ["Duty cycle","‰"], all : ["All",""]}

3	*devices/[ID]/[sensor]/ [startinterval]/ [stopinterval]*	**Full URL**: https://data.uradmonitor.com/api/v1/devices/[ID]/[sensor]/[startinterval]/[stopinterval]
Method: HTTP GET		**Purpose**: data access
Description		ID is a unique uRADMonitor unit ID (eg. 110000AB) . Sensor is a sensor name (eg. temperature) or you can also use the special keywork "all" to access data from all sensors installed on the unit. Startinterval is the the number of seconds from the moment of the present to get data from; "stopinterval" is optional and it represents the number of seconds from the moment of present to get data to. If "stopinterval" is not specified, the moment of present is used as the stop point. If there is no data for the query specified, you will receive an empty JSON array.
Authentication		yes, using X-User-id and X-User-hash in HTTP Get header

Call example:



Return: For the previous example call, we receive two temperature measurements, because we specified an interval of 120 seconds and the unit resolution was 1 minute:
[{ **time :** "1500498412", **latitude :** "61.11200000", **longitude :** "-149.90440000", **altitude :** "250.00", **temperature :** "22.00"},
{ **time :** "1500498472", **latitude :** "61.11200000", **longitude :** "-149.90440000", **altitude :** "250.00", **temperature :** "21.93"}]

Additional information is presented under the API tab in the uRADMonitor dashboard:
https://www.uradmonitor.com/dashboard/

Health impact

Many of the parameters measured by Model A3 can have a negative health impact, ranging from simple allergies to various cancers. Therefore the data gathered by this device is valuable for our understanding on the quality of our environment.

VOC or volatile organic compounds are a class of substances that evaporate at room temperature. Being different substances may be responsible for a broad category of disorders, including respiratory problems, allergic or weakening immunity in children. Some VOC 's are responsible for the formation of smog, irritation of eyes, nose and throat, headaches and concentration problems. In extreme circumstances, more severe complications can occur, such as damage to liver, kidney and central nervous system or cancer [1]

Particulate matter PM2.5 refers to small particles with a diameter of up to 2.5 microns. These particles can penetrate deep into the lungs , causing allergies, respiratory and cardiovascular diseases [2]

Formaldehyde is a toxic colorless gas with a pungent smell, that results from the burning of carbon based materials. It can be found in forest fires, in automobile exhaust and cigarette smoke. It is an allergenic and a known carcinogenic compound that can cause serious health effects, depending on concentration and exposure. Even in tiny quantities just above 0.1ppm it can irritate the eyes and nose, and can worsen asthma symptoms [3]

Carbon dioxide is a gas heavier than air. In small quantities of up to 5000ppm (0.5%) can cause headaches, lethargy, slowing of intellectual ability, irritability, sleep disturbance. In larger quantities can cause dizziness, loss of sight, hearing or knowledge. The fresh air contains between 360ppm and 410 ppm of CO2 [4]

Ozone can cause the muscles in the airways to constrict, trapping air in the alveoli. This leads to wheezing and shortness of breath. Long-term exposure to ozone is linked to aggravation of asthma, and is likely to be one of many causes of asthma development. Long-term exposures to higher concentrations of ozone may also be linked to permanent lung damage, such as abnormal lung development in children. [5]

Noise Induced Hearing Loss (NIHL) is the most common and often discussed health effect, but research has shown that exposure to constant or high levels of noise can cause countless adverse health affects. [6]

[1] Volatile Organic Compounds' Impact on Indoor Air Quality, US Environmental Protection Agency
[2] Health and Environmental Effects of Particulate Matter (PM), US Environmental Protection Agency
[3] ToxFAQs™ for Formaldehyde, Agency for Toxic Substances and Disease Registry
[4] Health Risk Evaluation for Carbon Dioxide, US Bureau of land management
[5] Health Effects of Ozone Pollution, US Environmental Protection Agency
[6] Noise Pollution, US Environmental Protection Agency