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A2RT User Manual

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Operational Overview

At its core, the behavior of the A2RT is quite simple: perform measurements on a regular schedule, log the results, then take actions based on the measured values. Obviously, successful configuration and deployment of the device requires a more detailed understanding, but the high level view provides a useful starting point for understanding the A2RT.

Measurements can be acquired from analog sensors, from SDI-12 sensors, from the pulse counter, or from the A2RT's internal sensors. Analog sensors can be measured on a 0 - 5V scale or a 4-20mA scale and are converted to digital using a 14-bit ADC. The A2RT supports two different SDI-12 bus interfaces, each of which can interface with multiple sensors using different SDI-12 addresses. The pulse counter can be used to register switch closures from a tipping bucket, and can be configured to handle different increment sizes. Finally, the A2RT provides internal sensors for battery voltage and device temperature.

All of the A2RT's activity is scheduled around the ALERT2 TDMA frame. This is typically 1 or 2 minutes long, but can be longer or shorter depending on system size and design. Because the TDMA frame defines the minimum interval for data transmission, it also makes sense to use it as the minimum interval for measurement. Where timing and intervals are configured, the typical time unit will be TDMA frames.

Measurements will be scheduled to run shortly before the message transmission time. In this way, transmitted data is as fresh as possible.

ALERT2 TDMA and Scheduling

TDMA (Time Division Multiple Access) is a protocol that allows multiple transmitters to share a common channel without conflict. Each transmitter is allowed to transmit on the channel only during an assigned time slot, and must not transmit or interfere with transmissions at other times.

TDMA is a core part of the ALERT2 protocol. Time is first divided into chunks called frames, typically 1-3 minutes long. Each frame is then divided into slots, which can vary from 250 milliseconds to over 3 seconds in length. Each site is assigned a slot during which time it is allowed to transmit. Thus, a longer TDMA frame allows for more sites at the expense of reporting latency; a longer TDMA slot allows for the transmission of more data from each site but supports fewer total sites than would be available with a shorter TDMA slot.

The TDMA slot used by the A2RT can be configured using the “TDMA Slot Offset,” “TDMA Slot Length,” and “TDMA Frame Length” parameters, all of which are in units of milliseconds. “TDMA Slot Padding” can also be configured.

In order to be sure transmissions occur in the correct TDMA slot, the A2RT must know the current time with accuracy less than the configured TDMA slot padding. To this end, the A2RT contains an on-board high precision clock which is regularly adjusted using a GPS-based reference clock. The on-board clock may drift at up to 2 parts per million, or roughly 7ms per hour. Thus, If the clock drift for TDMA needs to be maintained at less than 25ms, the clock will need to be compared to the reference at least once every 3.5 hours. The A2RT will automatically determine an appropriate frequency for attempting a GPS clock sync, and will attempt to set the clock multiple times within the acceptable window.

If the A2RT is unable to determine the time with sufficient precision to ensure that a transmission would be inside its time slot, it switches to “random mode” where the transmission is offset a random amount of time into the slot. While in random mode, measurements still occur on the regular schedule; only the transmission time is randomized.

Each sensor is configured with a read frequency, a transmit frequency, and a transmit offset, all set in units of TDMA frames rather than in absolute time. On a device with a two-minute TDMA frame, a read frequency of 5 and a transmit frequency of 30 would produce a reading every 10 minutes, and a transmission every hour. If the transmit offset is set to 2, readings would occur shortly before the device’s TDMA slot in frames beginning at 4, 14, 24, 34, 44, and 54 minutes past the hour.

Analog Measurements and Pulse Counter

The A2RT contains two multi-function analog inputs, capable of reading 0-5V or 4-20mA signals; two single-function 0-5V inputs; and a pulse counter input for use with a tipping bucket.

When performing a 0-5V analog measurement, the voltage is converted from the input signal to a floating point value using a 14-bit ADC. Values are sampled rapidly over a period of 13 ms then averaged to produce a final reading. The resulting value will be in the range of 0-5, with units in Volts. This value can then be converted into a finished value ready for transmission by applying the configured slope and offset, then converting to the configured data type.

The 4-20mA sensors are sampled in a similar manner. Current is determined by measuring the voltage drop across a 250 Ohm resistor. After measurement, values are reported in units of mA rather than V, but are transformed to finished values in the same manner. If less than 4mA of current is supplied, the sensor will report the measured value, and this can be used to trigger an error condition at the receiving base station.

The Pulse Counter is designed to detect momentary pulses, typically resulting from a switch closure inside a tipping bucket. Internally, the positive side of the pulse counter is pulled up to 3.3v, and pulses are indicated by pulling the input to ground. In order to avoid double counting, pulses will be ignored for 50 ms after an initial pulse is detected. The pulse counter can be configured to increase the accumulator by a floating point or an integral value for each pulse. Unlike other sensors, pulse counter measurements happen continuously, but transmissions are scheduled as they are for other sensors.

SDI-12 Measurements

SDI-12 measurements are handled in a manner that is similar to their analog counterparts. Read frequency, transmit frequency, and transmit offset are specified in units of TDMA frames. Measurements are scheduled so that they are completed shortly before the TDMA slot. Returned values are then transformed to the sensor configuration.

There may be a significant amount of time between when a SDI-12 measurement is requested and when the result is ready to be returned. If the measurement is performed using an M command, the SDI-12 bus must remain idle while the measurement takes place. On the other hand, if the measurement is initiated with a C command, other measurements can be run concurrently. A third type of measurement, the R command, is also supported and returns immediately after being issued.

The A2RT implements a smart scheduling algorithm to determine the timing and the order of SDI-12 measurements. As with the analog sensors, measurements are scheduled so that they finish shortly before the TDMA slot time when they will be transmitted. In general, shorter measurements will occur closer to the start of the next TDMA slot, and longer measurements will occur sooner (further from the next slot). The main exception is that measurements with a duration longer than a TDMA frame will be scheduled to finish close to the end of the TDMA frame, assuming that they will happen infrequently and to minimize their impact on other frames.

The A2RT is capable of using a sensor's response to a measurement command to set the measurement duration. If using this option, the scheduling will likely be incorrect during the first measurement cycle while the measurement duration information is collected. If the SDI-12 sensor implements a variable measurement time, this option is not recommended as it assumes that the measurement duration reported by the sensor will be consistent from measurement to measurement.

The A2RT also implements SDI-12 Listen mode, also known as snoop mode. In this mode, the device listens on the SDI-12 bus without transmitting anything. Instead, measurement data is collected when another SDI-12 data recorder requests a measurement. Obviously, the A2RT has no control over the measurement timing in this case. Scheduled measurements will be transmitted at the specified interval, but only if there is new data available. If the transmit interval is set to 1, transmissions will occur on every TDMA frame where new data is available, effectively setting the transmit frequency to match the measurement frequency set by the other data recorder.

Post-Measurement Actions

After a measurement, the A2RT performs a series of actions:

- Write the measurement to the measurement log.
- Update the digital output port state if in "Sensor" mode and a change is indicated
- Transmit the values via ALERT2

The measurement log is in CSV format, and is stored in the on-board eMMC flash memory. Both raw and finished values are stored, and values can later be retrieved using RTControl.

If the digital output port is configured in sensor mode, it can be used to perform simple local control operations. When a measured value exceeds a "turn on" threshold, the digital output port transitions to "on," and remains on until a "turn off" threshold is crossed. Using two thresholds, it is possible to implement an amount of hysteresis to prevent rapid toggling of the digital output when the sensor is returning values that are near the threshold value. The digital output is designed to drive a low-current output or a relay, and can source up to 500 mA of current at battery voltage.

After a measurement is performed, the A2RT checks if the measured value should be transmitted. Transmissions can be triggered based on scheduling (from Transmit

Frequency and Transmit Offset) or if the newly measured sensor value differs from the last transmitted value by an amount greater than the configured “Change Threshold” setting. This configuration applies to the finished value, not the raw value, and can be disabled by setting Change Threshold to 0. It is also possible to define an “Event Threshold,” where transmissions will always be indicated when the value is above a given level.

ALERT2 Message Formation

A few seconds before the scheduled TDMA slot transmission time, the A2RT checks in any measurements have been flagged for transmission. If transmission is indicated, the A2RT will assemble a MANT PDU for transmission.

When forming a MANT PDU, the A2RT first determines the maximum message length that will fit in the current slot. It then begins adding measurements to the MANT PDU until either all measurements are added or there is insufficient space for additional measurements. Messages are processed in the following order:

- Type-3 Multi-Sensor Report
- Type-4 Multi-Sensor Report
- TBR Report (*note that tips may be truncated if there is not enough space in the MANT PDU*)
- General Sensor Reports
- Type-5 Multi-Sensor Report (A2RT status)

If there is not sufficient space in the MANT PDU for all of the measurements, the A2RT will first attempt to address the problem by truncating the list of tips included in the tipping bucket report, while leaving the accumulator intact. If there is still not sufficient space, measurements that were not transmitted will remain flagged for transmission in the next TDMA frame.

The ALERT2 protocol is a highly efficient method for packaging weather data. In typical scenarios, careful use of the protocol (e.g., using the multi-sensor reports when appropriate and using appropriate data types in general sensor reports) should be sufficient to prevent issues with slot overruns. That said, calculating the expected maximum message length based on the configured sensors, the tipping bucket size, and the maximum expected rainfall rate is an important part of system design.

Hardware Interfaces

Solar Charge Regulator

The integrated solar charge regulator is designed to accommodate a 12V lead-acid battery. When paired with an appropriate solar panel, the charge regulator will work with a range of different batteries.

It is designed to implement the following charge characteristics:

- 1A Fast charge with CC/CV characteristics at voltages up to 14.4V
- When charge current drops to 0.1A, the charger switches to 13.5V float charge mode.
- The charger re-initiates fast charge if voltages is below 13.2V
- Trickle charge at 0.15A if battery voltage below 10V.

Battery Charging requires a minimum of 16.3 VDC input. Below this level, the charger is disabled.

The charger can be configured to limit charging when the temperature of the A2RT is outside of a certain range. If this feature is enabled, charging will be enabled or disabled based on the temperature measured at the A2RT, not at the battery itself. The temperature range is configured in degrees C, and includes two degrees of hysteresis. *Note: during device start up, the solar charge regulator will be enabled and may provide current to the battery for a brief time period, until temperature measurements have been taken.*

While not optimized for this application, the solar charger should safely charge most LiFePo4 batteries. Please check the specific charging requirements of your battery to ensure that it is compatible with the charge characteristics of the A2RT.

The solar charge regulator is reverse polarity protected.

Battery

Attach a 12 VDC power supply to the battery interface to power the A2RT. Typical installations will use a 7 - 20 AH battery, paired with an appropriately sized solar panel.

If the solar charge regulator is connected, the A2RT will attempt to apply charging current / voltage to this interface.

The battery interface is reverse polarity protected.

Voltage Sources (SW V+, SW 5, V+)

The A2RT provides three different power supply ports:

- SW V+ provides switched, unregulated battery voltage for use with analog sensors, 1A max output.
- SW 5 provides switched, regulated 5 VDC for use with analog sensors, 100 mA max output.
- V+ provides always-on battery voltage output, as a convenience. 500 mA max output.

The switched power supplies are enabled for analog measurements only. They support a configurable warm up duration that can be set in RT Control. This setting determines the duration between the switched power supply being enabled and the analog measurement. If the duration is set to 0, the power supply is disabled.

Digital Output

The A2RT provides a configurable digital output port. This port can be used in any of three modes, or it may be disabled. The supported modes are:

- Follow SW V+ - For writing and connection convenience, the DO port acts as an additional SW V+ port.
- Extended Sensor Warm Up - If there is a specific sensor that requires a much longer warm up time than other sensors, the DO can be configured to provide power for that sensor’s warm up.
- Sensor Response - The output of the DO port will be determined by the state of a sensor.

In Sensor Response mode, the DO port will be switched on or off depending on the value returned when a measurement is made. Values are transformed using the specified slope and offset, but are compared with the threshold before being converted to the output data type.

There are several additional pieces of configuration required in sensor response mode:

- Comparison: determines if the DO output will be active (on) when the sensor value is above or below the threshold value.
- On Threshold: Determines the value required to turn DO on when it’s currently off
- Off Threshold: Determines the value required to then DO off when it’s currently on

By having separate thresholds, it is possible to implement some hysteresis into a local control system so the DO doesn’t toggle on and off when it’s right at the boundary.

SDI-12

The two SDI-12 ports, A and B, each implement an independent SDI-12 bus. Each SDI-12 bus can be configured in either *Polled* or *Listen* mode.

Polled mode implements the traditional SDI-12 use case. The A2RT acts as a data recorder, sending commands to the sensors on the bus to initiate measurements and retrieve data. Three different command-types are supported: ‘M’, ‘R’, and ‘C’ (see the SDI-12 specification for more details on the different command types).

For ‘M’ and ‘C’ commands, the A2RT needs to know the approximate duration of the measurement process in order to schedule the measurements appropriately (they are scheduled so that they finish as close as possible to the start of the device’s TDMA slot). Using the “Auto Adjust” configuration option, the A2RT will use the duration information reported by the sensor to update the configuration for future measurements.

In Listen mode, the A2RT does not send any commands on the SDI-12 bus. Instead, it is designed to “listen in” on a bus controlled by a different data record. The address, command, and measurement index must all be configured. When the A2RT sees a corresponding measurement, it will record the value as a new measurement.

In Listen mode, the A2RT has no control over measurement scheduling, and the clock of the other system will likely drift with respect to the ALERT2 TDMA frame. This adds some complexity to sending periodic transmissions, since the new measurement may arrive just before or just after the transmission window. To address these challenges, the A2RT will not transmit the same measurement more than once. Thus, if the data recorder is set to poll a sensor every 10 minutes and the A2RT is configured to transmit every frame, a new report will be send each time a new measurement is overheard, resulting in a 10-minute reporting frequency. If, instead, the A2RT is configured to transmit hourly (every 30 frames, with 2-minute frames), the most recent measurement will be transmitted at the scheduled time.

Pulse Counter

The pulse counter is designed to count momentary switch closures between the + and - terminal of the PULSE port. The A2RT will provide 3.3V on the + side of the line, supplied by a weak pull-up resistor. When the + terminal is pulled down to 0 V by closing the switch, the pulse counter will register an increment. In order to handle jitter or noise robustly, 50ms must pass after the first increment before another will be counted.

Analog Inputs

The A2RT implements four analog inputs: two multi-function inputs that can read a 4-20mA current loop or a 0-5 VDC sensor, and two voltage-only inputs. AIN1 and AIN2 are the multi-function inputs, while AIN3 and AIN4 are the single function inputs.

These inputs are single ended. The negative terminals on the AIN1-4 connectors are connected to the common ground.

The mode of the multi-function analog inputs may be selected using the “Measurement Type” selector in the sensor configuration dialog in RTControl. When in 4-20 mA mode, the end-of-line resistance should be (nominally) 250 Ohms, so a 20mA input is achieved at a voltage of 5V.

Console

Connect a USB-C cable to the console port and your windows laptop to configure and control the device using RTControl. The A2RT supports drawing power from the USB-C port at a 5V input level. When powered solely from the console port, the V+ and SW V+ terminals will remain unpowered, but the 3.3V and 5V functionality of the device will work. This is important to note, as it may appear that sensors are not working if they are expecting a 12V power supply.

When attached to a PC, the A2RT communicates using the USB CDC-ACM protocol to emulate a serial connection to the PC. No divers or additional software are required.

When a connection is detected to a PC on the console port, MANT PDUs will be created with the test flag set.

GPS

Connect an active antenna to the GPS SMA connector. Care must be taken to ensure appropriate cabling, terminations, and antenna are used, as the cable and antenna has a major impact on GPS signal quality.

An active antenna is recommended, with a maximum current draw of 40mA. Signal gain at the A2RT (Antenna gain - cabling losses) should be between 15 and 30 dB. Noise should be less than 1.5 dB.

GPS signal quality is displayed in real time using the GPS tab in RTControl. The values displayed are the Carrier-to-Noise Density (C/N0) ratio for each of the different space vehicles (SV) the GPS is tracking. In general, a value >= 30 dB-Hz indicates a sufficient signal for clock sync, while values >= 40 dB-Hz indicate excellent reception. A minimum of five SVs are required to be used in the fix to determine time to sufficient precision for TDMA.

Status LED

The A2RT includes a tri-color LED used to indicate the status of the device. IT has the following modes:

Light	**Indication**
Blue, Infrequent Flash	Idle, clock drifted or never synchronized
Green, Infrequent Flash	Idle, clock synchronized
Green, Solid	GPS on
Cyan, Solid	SDI-12 or Analog Measurement (SW V+, SW 5) Active
Blue, Solid	Measurement and Transmit Cycle Active (Transmit Button Pressed)
Purple	Radio Transmit Active
Red, 4 Rapid Blinks	Sensor or Measurement Fault
Red, 6 Rapid Blinks	GPS or SW 5 overcurrent fault
Red, 10+ Rapid Blinks	A2RT Error - See logs for details

Transmit Button

When pressed, the transmit button initiates a measurement and transmit cycle. A measurement is queued and performed as soon as possible for each enabled sensor. Once all sensor measurements have been acquired, a transmission is sent at the next TDMA slot. If the data collection cycle takes longer than a single TDMA frame or runs across multiple frames, this may result in multiple transmissions. The status LED will remain on in a solid blue state until the measurement and transmit cycle is complete.

The transmit button does not automatically set the test flag on MANT PDUs. Rather, the test flag is controlled by the connection of the console cable to a PC. It is recommended that, after completing site maintenance and reassembling the site, the user detach the console cable and press the transmit button to trigger a measurement and transmit cycle. New measurements will be acquired before transmission, so this acts both as a final validation that the site has been assembled correctly and to clear any data from sensor testing or calibration from device memory.

If the transmit button is pressed and held for three seconds, the A2RT initiates a “test tone transmission”. This is designed to support different radio tests, for example a VSWR. The test tone transmission will power up the radio for the configured warm up duration, then transmit a 2400 Hz tone for 3 seconds.

Radio

The A2RT has been testing using both Ritron DTX-Ls and Maxon SD-125Ev2 radios, though many other radios should work as well. See the AirLink section of the ALERT2 specification for more details on radio requirements.

The A2RT supports software configurable audio modulation levels to interface with different radios, as well as allowing for a configurable radio warm up time.

Radio Connector Pinout (from left, facing the A2RT):

Pin Number	Pin Function
1	RF Data (output from A2RT)
2	Ground
3	Push to Talk
4	12V power (provided by A2RT)
5	Channel Select

The TX radio connector is made by Harting Elektronik, part number 14310513101000.

Please Note: The TX Radio power path is designed to handle up to 2.5 amps of current. If the radio will draw current in excess of this amount, power to the radio must be supplied externally.

Serial Port

When transmitting a message, the A2RT also outputs the message on the serial port, using the API 2.0 message API. This port could be connected to a cellular modem to forward data to a receiver as a redundant means of communication.

Serial port Pinout (from left, facing the A2X):

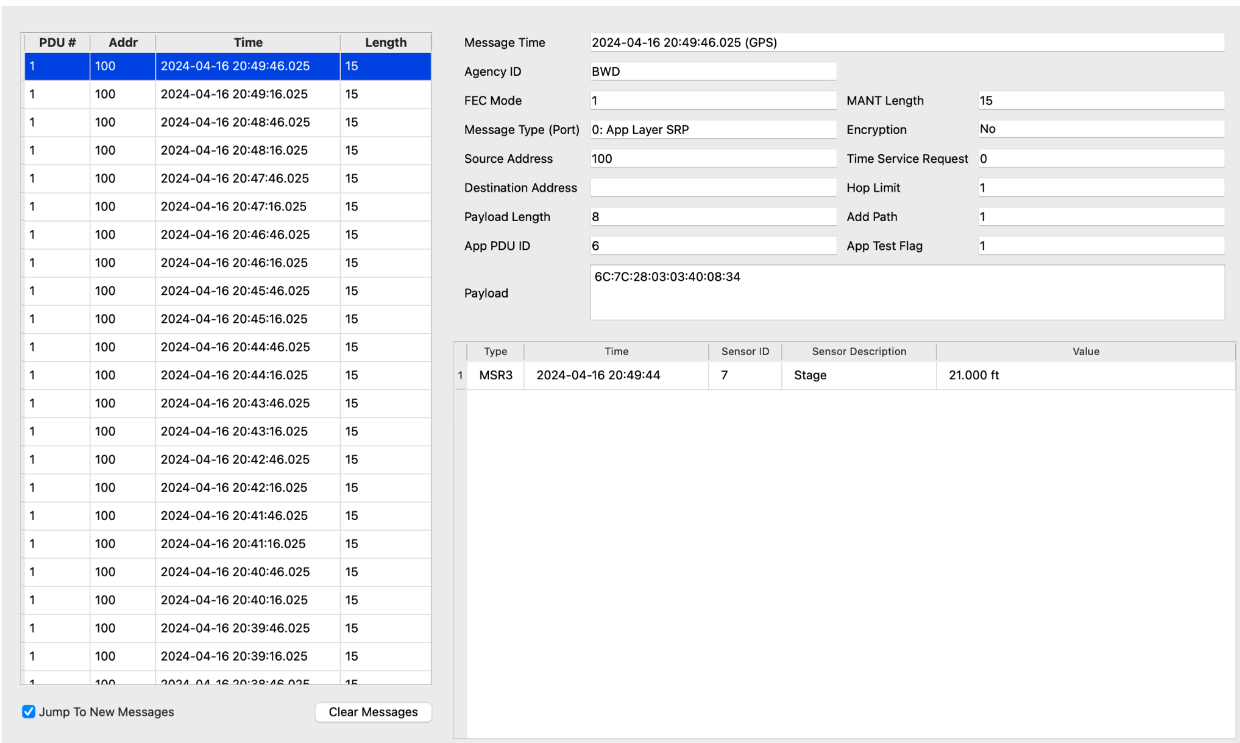
Pin Number	Pin Function
1	TX (data output from A2M)

2	RX (data input to A2M)
3	Ground

Control Software

RTControl is the control and configuration application for the A2RT. The software implements a number of different views, each of which address a different aspect of the device. They are described below.

Messages



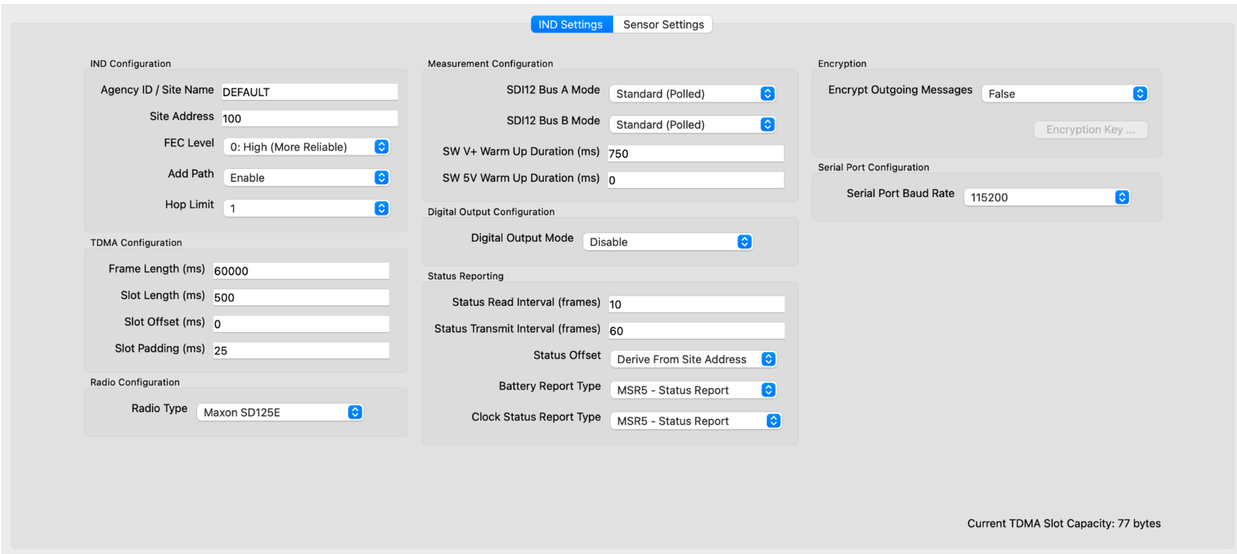
The messages tab displays messages that are transmitted while RTControl is connected to the A2RT. Remember that the application layer test flag will be set while the console cable is connected.

See the ALERT2 MANT and Application Layer specification documents for more detailed information on the fields displayed on the messages tab.

A2RT Configuration

The A2RT Configuration interface is divided into two sections: “IND settings,” which apply to the general operation of the device, and “Sensor Settings,” which define the sensors used for A2RT input.

IND Settings



IND Settings are detailed below:

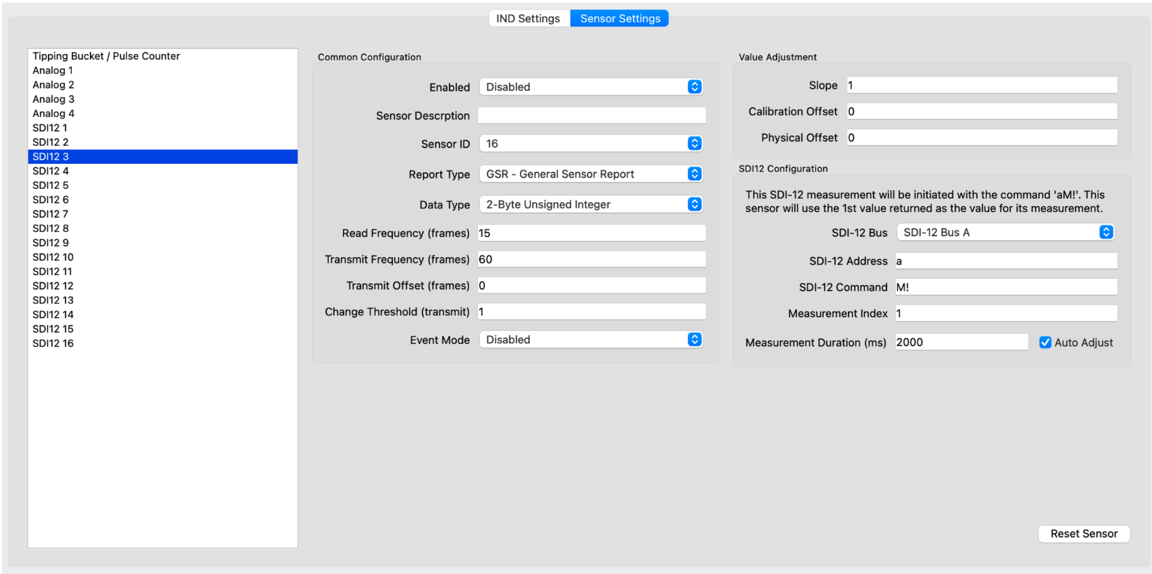
Configuration Option	**Notes**
Agency ID / Site Name	Used to populate the AgencyID Field in the API2.0 Message API output and as a default in log and save filenames.
Site Address	ALERT2 Source Address
FEC Level	**0**: Most error correction, lowest throughput **1**: Balanced error correction and throughput **2**: Least error correction, highest throughput
Add Path	Request that repeaters add their ID to the MANT headers when repeating this message
Hop Limit	Maximum number of times this message should be repeated
Frame Length	ALERT2 TDMA Frame Length (ms)
Slot Length	ALERT2 TDMA Slot Length (ms)

Slot Offset	ALERT2 TDMA Slot Offset (ms) from start of frame
Slot Padding	ALERT2 TDMA Slot Padding. Divide by 7.2 to determine maximum duration (in hours) that the A2RT can go without getting a clock sync before switching to random mode.
Radio Type	Maxon, Ritron, or Custom
Radio AGC Time	Duration, in ms, that the AGC tone will be sent at the start of a message.
Output Level	Audio output modulation level, in mV, peak to peak
Modulation Polarity	Set this to inverted if the modulation polarity on the receive radio doesn't match the modulation polarity on the transmit radio.
Radio Warm Up Time	Duration, in ms, that the radio is be powered on before initiating a transmission
SDI-12 Bus Mode	**Standard**: polled mode with A2RT as data recorder **Listen**: "snoop" mode with an external data recorder
SW V+ Warm Up Duration	Amount of time, in ms, that SW V+ will be powered on before taking an analog measurement. Set to 0ms to disable SW V+.
SW 5V Warm Up Duration	Amount of time, in ms, that SW 5V will be powered on before taking an analog measurement. Set to 0ms to disable SW 5V.
Digital Output Mode	**Disable**: DO off **Follow SW V+**: Act as an extra SW V+ port **Extended Sensor Warm Up**: Provide extra warm up time for a single sensor (specify sensor and warm up duration) Sensor Response: Set DO in response to a sensor reading (specify sensor, comparator, on threshold and off threshold; a gap between the on and off threshold allows for hysteresis)
Status Read Interval	Frequency, in frames, to read and record status sensors (temperature and input voltage)
Status Transmit Interval	Frequency, in frames, to transmit the status report over the air.
Status Offset	**Derive From Site Address**: Determine offset automatically based on the site address (as address modulo transmit interval)

	Specify: Specify an offset (in frames)
Battery Report Type	**MSR5**, **MSR3**, or **MSR4**. Included to allow for consistency with other solutions if desired.
Clock Status Report Type	**MSR5** or **GSR**. Included to allow for consistency with other solutions if desired. When using GSR, specify sensor address.
Encrypt Outgoing Messages	Must configure an encryption key as well. Changes to the encryption key take effect immediately.
Serial Port Baud Rate	Other settings are fixed at 8,N,1

Sensor Settings

The sensor settings dialog manages the configuration of the attached sensors. Each measurement that the A2RT will make is associated with an ALERT2 message (sensor id, report type, and report data type) and has some configuration about when to record a measurement and when the results of that measurement should be transmitted. Additionally, each measurement can be adjusted linearly using the slope and offset configuration.



The list on the left-hand side of the window allows selection of which sensor to configure. Enabled sensors are flagged with a green check mark, and modified sensors are displayed in bold text.

The ALERT2 Application Layer specification provides more details on ALERT2 sensor ids, report types, and data types.

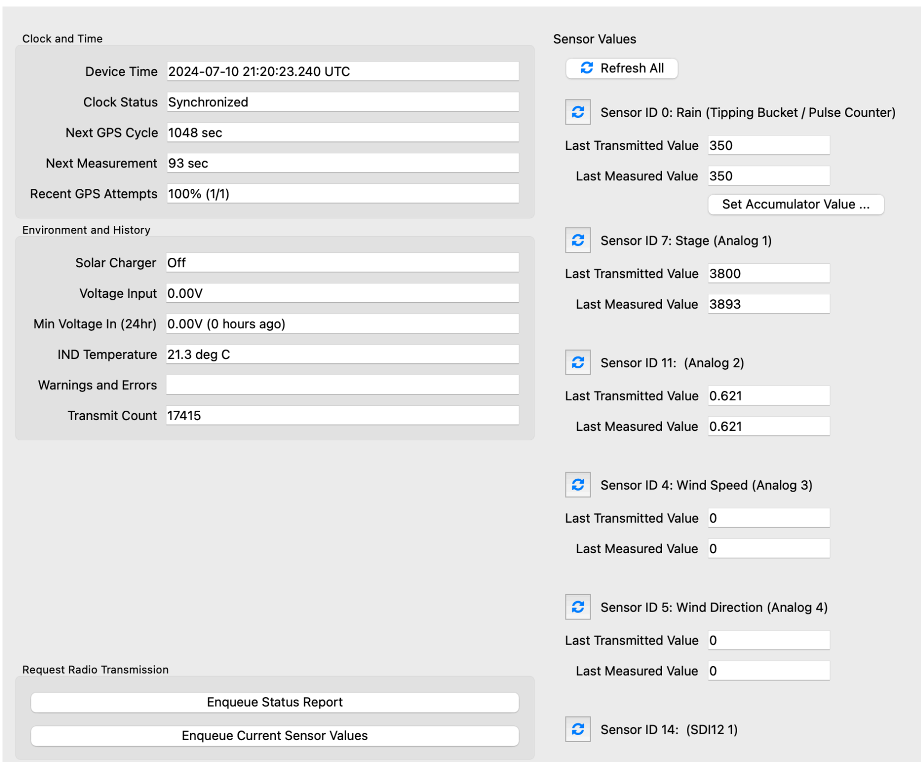
The configuration options are as follows:

Configuration Option	**Notes**
Enabled	Determines if this sensor will be used by the A2RT. It may be desirable to configure a number of potential sensors in a template, then enable only those that are actually used at a given site.
Sensor Description	Provide a short name or description of the sensor. Used only for display in RTControl.
Sensor ID	ALERT2 Sensor ID.
Report Type	**GSR**, **MSR** (sensors 1-8), or **TBR** (sensor 0).
Data Type	Measurement data type. Be mindful of the limitations of the chosen data type (e.g., size, range and resolution).
Read Frequency	Frequency (frames) at which this sensor will be read. After reading the sensor, the data is recorded and checks are made to determine if a transmission is needed.

Transmit Frequency	Frequency (frames) for periodic transmission. Must be an even multiple of the read frequency, or 0 to disable periodic transmission.
Transmit Offset	Number of frames by which the measurement and transmit cycles are offset. If frame length is 1 minute, read frequency is 10, and transmit frequency is 30, an offset of 3 would result in measurements coming at 3, 13, 23, 33, 43, and 53 minutes after the hour and transmissions occurring at 3 and 33 minutes.
Change Threshold	If the measured value differs from the last transmitted value by at least the change threshold, a transmission will be initiated. Note that this uses the finished measurement value for the calculation. Set to 0 to disable.
Event Mode	If enabled, Event Mode Threshold must also be set. Any measurements exceeding this threshold will result in a transmission.
Slope	The finished value is determined by computing: <Measurement> * Slope + Calibration Offset + Physical Offset Calibration and Physical offset are separated for convenience. Notionally, the physical offset will remain static and the calibration offset may change when a sensor is recalibrated. For the pulse counter / tipping bucket input, these values are replaced by a single "Increment" setting which determines by how much the accumulator is incremented with each tip.
Calibration Offset	
Physical Offset	
Measurement Type	For Analog 1 and 2, this configuration setting determines if the measurement is a 0-5V measurement or a 4-20mA measurement. The raw value of the measurement will be in the native units (that is, V if a 0-5V measurement or mA if a 4-20mA measurement).
SDI-12 Bus	**A** or **B**. Note that the A2RT will perform concurrent measurements on the two SDI-12 interfaces if both are configured, reducing the latency between measurement and transmission.
SDI-12 Address	The address of the SDI-12 sensor: 'a' - 'z', 'A' - 'Z', or '0' - '9'
SDI-12 Command	The measurement command: 'M', 'C', and 'R' commands are

	supported.
Measurement Index	The index of the value of interest in the return. This setting is ‘1’ indexed, so a value of ‘1’ indicates the first measurement.
Measurement Duration	The amount of time that the sensor requests between sending an ‘M’ or a ‘C’ command and returning a result. Check the “Auto Adjust” button to let the A2RT set the value automatically.

Device Status



The device status page contains information on the current state of the A2RT.

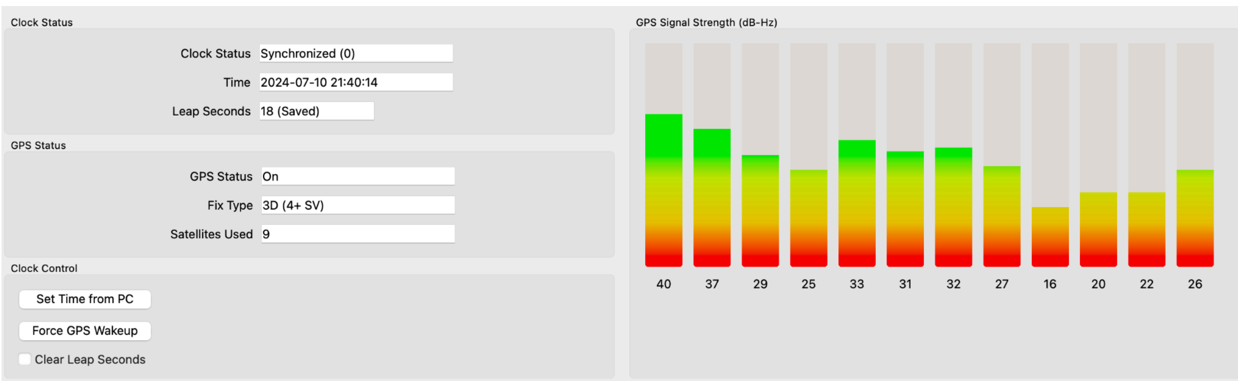
In the “Clock and Time” group, you can see the A2RT’s current understanding of the time and the state of the clock. The recent GPS attempts box shows the number of successes over the last 72 attempts at GPS clock synchronization. This gives a quick “at a glance” overview of GPS performance.

The “Environment and History” group shows information about the battery voltage (0 if powered via the console port with no battery connected) and the IND temperature. The transmit count is a simple 16-bit accumulator, and the value persists across reboots.

The most recent measured and transmitted values for each enabled sensor are displayed on the right side of the page. A measurement can be requested by clicking on the small refresh button next to each sensor, or by clicking the “Refresh All” button at the top of the page.

The “Enqueue Current Sensor Values” button works the same way as pressing the “Transmit” button on the front of the A2RT. The “Enqueue Status Report” button triggers transmission of a status report with the current device state.

GPS Interface



The GPS Interface provides a visual indication of the GPS signal quality, by displaying the Carrier-to-Noise Density values reported by the GPS module. Higher numbers are better, with values over 40 indicating excellent reception and values under 30 indicating marginal reception. In order to enable the timing output from the GPS, the module used by the A2RT requires a minimum of 5 satellites to be included in the fix.

Using the “Clock Control” buttons, it’s possible to set an approximate time from the PC or to force the GPS to wake up immediately. If the “Clear Leap Seconds” checkbox is ticked when the “Force GPS Wakeup” button is pressed, stored leap second information will be cleared and the information will be reacquired from the GPS module.

SDI-12 Console

The SDI-12 Console provides a means to view what data is being sent over the SDI-12 bus, and to interact with sensors on the bus.

When you first open the SDI-12 console, it will show a view of the data traveling over both SDI-12 buses. This view is useful for troubleshooting SDI-12 measurement issues as you can see what’s happening on the bus during normal interaction. It is important to note that, in polled mode, the A2RT is not always “listening” on the bus, so if there is traffic being sent when the

A2RT does not expect it, it may not be visible in the console. In “Listen” mode, the A2RT will report all traffic on the bus.

In order to interact with the sensors, click the “Enable Console Mode” button. This stops the A2RT’s normal SDI-12 measurements, and enables the command entry field at the bottom of the page. Select the appropriate SDI-12 bus, enter the desired command, then press enter and it will be transmitted. Any responses will be displayed on the console.

File Transfer

The A2RT stores three kinds of logs:

- Diagnostic Logs, in the *log* folder
- Measurement Results, in the *measurement* folder
- Transmitted Messages, in the *transmit* folder

Log files are named following a pattern:

<type>-<site_name>-<site_id>-<restart_count>-<date>

Where,

- type is *log, measurement,* or *transmit*
- site_name is the value configured in the Site Name / Agency ID field
- site_id is the value configured in the Site ID field
- restart_count is a counter indicating the number of times the device has been restarted
- date is the current date, in the YYYY-MM-DD format

Restart count is included to facilitate the tracking of logs in the event of a system restart because the time is not known when the device first reboots. In post-event analysis, it should be possible to compute the approximate time of the reboot using the logged information and the time information from the first successful clock synchronization.

Diagnostic logs provide information about the functioning of the A2RT and are intended to aid in troubleshooting and analysis efforts.

Measurement logs are in CSV format and record every measurement taken by the A2RT, regardless of transmission status.

Transmit logs contain the values of the transmitted MANT PDUs, as “:” separated hexidecimal bytes.

All log messages are time stamped and are stored in a file corresponding to the date in the timestamp.

To view or download these files, begin by clicking on the caret (>) symbol to the left of a directory name. Expanding the directories, you will see a list of files. A double click will open the file in the integrated file viewer on the right hand side of the application. To download the file, click the download file button (page with an arrow).

It is possible to download all of the files on the A2RT to your computer for later analysis. Clicking on the synchronize button will cause all files on the A2RT to be downloaded to the local computer. Files that already exist and which are the same size as the version on the A2RT will be skipped. Downloaded files are stored in the folder selected on the bottom of the file viewer pane. By default, the site ID is appended to the selected directory, so data from different A2RT's will be stored separately.

Message Parser

The message parser is a tool for exploring and understanding the ALERT2 IND API 2.0 message interface. To view a message in the parser, you can right click on the message in the "Messages" table and select "View In Parser". Alternatively, you can enter the message as a series of colon separated hexadecimal values. The resulting parsed message will be displayed below.

This tool offers a useful way to view and understand ALERT2 message interface messages, regardless of their origin.