

1-WIRE TEMPERATURE MONITORING

Application note rev. 1.0.0

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REVISION HISTORY

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1.0.0	19.12.2017	Ala/JSa	MHe	Original version

1 INTRODUCTION

1.1 Purpose of the document

This document describes the usage of the temperature monitoring feature and the protocol used for sending data to server.

1.2 Intended audience

Developers, maintainers and integrators of the temperature monitoring feature.

1.3 Requirements

The temperature monitoring feature requires following A-series SW versions or higher:

A9 TRIX

- Telematics SW release v. 4.2.0
- A9 SDK release v. 4.2.0
- COP SW release 3.5.6

A11, A11W

- Telematics SW release 1.6.0
- A11 SDK release v. 1.6.0
- COP SW release 1.3.2

A-series SW configurator's advanced editing supports temperature monitoring starting from version 11.2.6.

1-Wire temperature sensor types DS18B20 and DS18S20 are supported. Both sensors must be powered via external power supply pin, parasite power supply via the data line is not supported. Maximum of twelve (12) sensors can be used at the same time.

The 1-Wire temperature sensor support is built in Aplicom telematics SW functionality and CO-processor functionality.

The temperature measurement use is provided as standard feature in A9 and A11 products, not needing specific SW options. The 1-Wire temperature measurements are also supported in Java SDK programming.

The measured temperature values are sent to the backend system in Aplicom D-and G-protocol (A11) as event specific data. The data contains temperature reading of each connected sensor and their unique 64bit ID of each sensor.

The reporting time intervals and other conditions to trigger the temperature reading from sensors can be configurable in A-series unit telematics SW configuration and also commanded from backend system. SDK programmers have freedom to trigger the reading of sensors and further processing of the measure values if needed.

Aplicom provided sensors are based on Maxim DS18B20 1-Wire sensors. The accuracy of temperature measurement is transmitted in 12bit resolution and the nominal accuracy is $\pm 0.5^{\circ}$ C from -10° C to $+85^{\circ}$ C in normal use range. Max. operating range: -55° C to $+125^{\circ}$ C. The sensors are factory calibrated, thus not needing calibration at field. The power for the temperature sensor is taken from the 1-Wire connector power output pin.

Note: When 1-Wire sensors are used, iButton reader or 3PAD cannot be used at the same installation. For possible special solutions, contact support@aplicom.fi

1.4 Scope

This feature supports temperature monitoring with sensors connected to 1-Wire and sending temperature data in default format. It must be noted that temperature monitoring that is made with this solution is only for monitoring purposes. It don't fulfill the official requirements of Cold Chain temperature directives.

2 COMMUNICATION

There is a specific event TEMPERATURE_DATA_EVENT (dec 186) to handle temperature monitoring event in case of 1-Wire temperature monitoring from the device. The TEMPERATURE_DATA_EVENT's source in the case of 1-Wire temperature monitoring is "1WIRE".

2.1 Default format

The measured temperature data is sent to the server in D protocol's TEMPERATURE_DATA_EVENT's event specific bytes field and it is formatted to default format. In default format the device sends the sensor ID and the last measured temperature from all the connected 1-Wire temperature sensors as presented in the following chapter.

2.2 Message format

The default message format is: <sensorID1><temperature1><sensorID2><temperature2>...<sensorIDn><temperaturen>

Following table presents the fields in the default message.

Field	Туре	Length
Sensor ID	Unique ID for identifying the sensor	8 bytes
Temperature	Integer, unit is 0.1 degrees centigrade	2 bytes

2.3 Example: Default format message with 6 sensors

0x281620 b c 0400001200 e c 28 c e ad 230900003 b 00 e 2288544230900009 f 00 e 728 f f e 62 e 4 d 040071012 f 1096 b 90 f 03080000 e 1000 e 61013 a e 0 f 030800600 e 1000 e 1000 e 61013 a e 0 f 030800600 e 1000 e 10000 e 1000 e 1000 e 10000 e 1000 e 10000 e 10000 e 1000 e 10000 e 10000 e 1000

Sensor id1: 281620bc04000012	Temperature: 00ec (23,6 degrees centigrade)
Sensor id2: 28cead230900003b	Temperature: 00e2 (22,6)
Sensor id3: 288544230900009f	Temperature: 00e7 (23,1)
Sensor id4: 28ffe62e4d040071	Temperature: 012f (30,3)
Sensor id5: 1096b90f0308004c	Temperature: 00e6 (23,0)
Sensor id6: 1013ae0f03080060	Temperature: 00e1 (22,5)

3 CONFIGURING

1-Wire temperature monitoring feature is configured to use LEDOUT pin of the 1-Wire connector to supply the power to temperature sensors.

With action-triggered 1-Wire temperature monitoring, connected sensors are detected during the device's startup procedure. If there is temperature sensors connected run-time use <code>lWIRE_TEMPERATURE_SENSOR_SCAN</code> action for run-time detection.

3.1 ACTION-TRIGGERED TEMPERATURE MONITORING

Configuration needed for action-triggered 1-Wire temperature monitoring contains action to trigger 1-Wire temperature read and event and action pair for sending the temperature data to the server.

Interval for reading temperature data in case of action-triggered 1-Wire temperature monitoring is 10 seconds.

3.1.1 1WIRE_TEMPERATURE_SENSOR_READ action

This action will read previously scanned sensors and create <code>TEMPERATURE_DATA_EVENT</code> including collected temperature data.

```
<actions>
        <action id="1WireTempRead" type="1WIRE_TEMPERATURE_SENSOR_READ">
        </action>
</actions>
```

3.1.2 TEMPERATURE_DATA_EVENT

Event handler TEMPERATURE_DATA_EVENT for gathering the collected temperature monitoring data for SEND_SNAPSHOT action.

3.1.3 SEND_SNAPSHOT action

Action for sending temperature monitoring data to server using defined transport.

3.2 SENSOR SCANNING

1WIRE_TEMPERATURE_SENSOR_SCAN action is mandatory for run-time detection of connected temperature sensors.

3.2.1 1WIRE_TEMPERATURE_SENSOR_SCAN action

This action will scan the connected temperature sensors.

```
<actions>
        <action id="1WireTempRead" type="1WIRE_TEMPERATURE_SENSOR_SCAN">
        </action>
</actions>
```

Note! If there is temperature sensors connected run-time and scan is not performed, data from those sensors cannot be received before sensor scanning has been performed.

4 1-WIRE SENSOR CONNECTIONS AND INSTALLATION PRINCIPLES

1-Wire interface is a bus where several devices can communicate and share the same data connection. The bus works with different device families and with individual unique addressing of the actual devices. Each device family support must be built in if several type of 1-Wire devices are used in the bus, so not all type devices can be used unless they are dedicatedly supported in A-series COP firmware and application.

Aplicom A-series A9 NEX/TRIX and A11(W) supports 1-Wire temperature sensors based on Maxim DS18B20 and DS18S20. Aplicom provided sensor D250020 is DS18B20 type and used with 12bit resolution.

Up to twelve (12) 1-Wire sensors can be connected to 1-Wire interface of A-series unit. 3-pin connector in A9 NEX/TRIX and 4-pin connector in A11. All the sensors are parallel connected to the 1-Wire port pins. Only one sensor can be making active measurement at a time, so all connected sensors are read sequentially. Each sensor provides measurement result in less than a second. This must be noted since the measurement results are not instantly available from large number of sensors. While measurements are active, nothing else will happen on 1-Wire bus.

The Aplicom sensor has 5m cable with open ends for connecting them to A9 or A11 with open end cables that are available from Aplicom. The cable has 3 wires, Power (VCC 3,0-5,5V), Data and GND. Note: Two wire connected (no VCC) sensors can't be used with A-series units.

In installations where there are more than six (6) sensors in use and/or the total cable length from A-series unit 1wire port to sensors is more than 30m an additional pull up resistor must be connected between sensor data line and the VCC power line. This will ensure that cable- and other residual capacitances will not affect to the signal quality on 1-wire bus. The resistor should be 2.7 kOhm, (~0,25W). The resistor will also be beneficial in cases where electrical noise or other disturbances may effect to the 1-wire signal. The installation cables should be good quality, preferably shielded type. All excessive cable should be avoided when installing the sensors to keep the 1wire signal safe.

The Aplicom sensor delivery package include the sensor with 5m cable and screw mount clip for fixing the sensor to surfaces. The interface cable to 1-wire of A9 NEX/TRIX or A11 needs to be ordered separately.

1-Wire temperature sensors are connected to A-series device 1-Wire port. The interfacing can be made with Aplicom provided cables:

-	A9 TRIX Data/1-Wire cable, open ends	D337056
-	A11 1-Wire cable 0,5m, open ends	D338165

The sensor network can be organized in many ways (A9 TRIX connection examples):

1-Wire temperature sensors: In line network, parallel connected



1-Wire temperature sensors: Star netwok, parallel connected



The sensor placement and practical connections needs to be made per installation and temperature measurement requirements. Placing the sensor in right place in vehicle cooled department is essential for good results in temperature monitoring.

For installation instructions see: K530006 1-wire Temperature Sensor Installation guide -document on Aplicom Partner Extranet.