Aplicom®

FUEL ALERT SW OPTION FOR A1/A11

A1 D245006
A11 D246006

Application note rev. 2.1.0
(A1 SW version 10.6 and later)
(All A11 SW versions)

Document code K505030

1 Contents

REVISION HISTORY

Rev.	Date	Editor	Description
2.1.0	31.10.2016	AKo	A11 added
2.0.0	24.04.2014	MHe	Support for two tanks and minimum moving time added. SW version updated + some editorial changes.
1.0.2	9.12.2013	AKo / AMu	Chapter 1.4.1 added A1 MAX RDL unit
1.0.0	20.11.2013	MHe	Original

1. INTRODUCTION

1.1 Purpose of the document

This document describes the functionality of the A1 Fuel Alert SW option D245006 and A11 Fuel Alert option D246006.

1.2 Intended audience

Users, maintainers and integrators of the A1/A11 SW with Fuel Alert SW option (hereinafter Fuel Alert).

1.3 Overview

The Fuel Alert provides a warning system that generates an event when a significant fuel level decrease or increase is detected. The main use case is to detect fuel thefts.

The system uses vehicle's own fuel sensor(s), so any additional sensors are not needed. Two types of potentiometer sensors are supported currently. See chapter *4.1 Sensor types* for further information about the supported sensor types.

The Fuel Alert uses an A1/A11's AD input to measure the fuel level and it is kept active also when the vehicle's ignition is switched off. When the ignition is off and the vehicle's system is not supplying the fuel sensor it is supplied by the A1/A11's +5V power output.

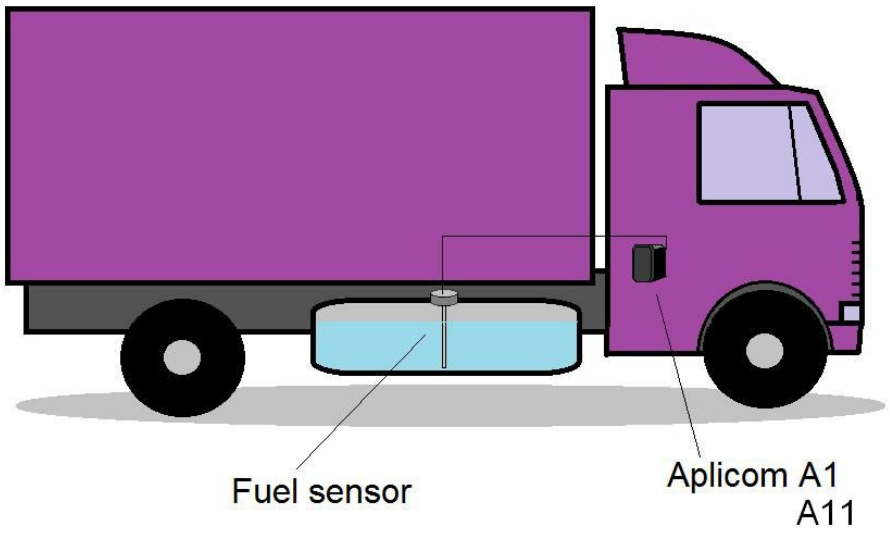


Figure 1. Fuel Alert overview

1.4 Hardware and software requirements

1.4.1 Hardware

A1 and A11 units with Aplicom software.

1.4.2 Software

The required A1 SW version is 10.6 or greater. A11 units with Aplicom software supports this functionality.

2 FUNCTIONALITY

The basic principle of the Fuel Alert is to regularly check if there has been a change in fuel level when the vehicle is not moving.

The A1/A11 unit uses its AD input to measure the sensor voltage. The voltage is monitored and analyzed for changes and when needed, the Fuel Alert generates alarm events for A1/A11 event action handling to react to detected situations.

While the vehicle's ignition is switched off the A1/A11 unit is kept running normally. Since the vehicle's system is not supplying the sensor when the ignition is off, it is supplied by the A1/A11's +5V power output with a suitable serial resistor. The switching between power supplies is defined in the unit configuration.

2.1 Using the Fuel Alert

The simplest way to start using Fuel Alert is to select the used fuel sensor type in the configuration. All the other parameters can have their default values.

To optimize the monitoring for different fuel tank sizes it is recommended to adjust the value of the `fuel_level_threshold` parameter. The value is for determining how much the current fuel sensor voltage can differ from the stored reference voltage. If the difference is more than the `fuel_level_threshold`'s value, an alarm event is generated. The value is given in millivolts and the default value is 100mV.

The alarm event can be used for e.g. sending a snapshot or triggering an alarm siren.

See chapter *3 Configuring the Fuel Alert* for all configurable parameters.

2.2 SW functionality

After the vehicle has stopped (`STOP_MOVING` event) and not moved for configurable delay, the current fuel sensor voltage level is stored and after that the level is measured in every AD poll and compared to the stored value.

Note! The new value is stored only when the vehicle has been moving for at least 30 seconds continuously. The 30 second minimum time is for preventing short movements to cause Fuel Alert to store a new fuel level value.

If the difference between the current level and the stored level exceeds the configured threshold, a corresponding counter variable is increased. If the threshold is not exceeded in the next measurement, the same counter is decreased. There is a counter for both directions (fuel level decrease and increase). If the threshold is exceeded in the opposite direction, the previously increased counter is set to 0 and the counter for this direction is increased.

For example if the stored reference level is 800mV, the threshold is set to 100mV and the current level is 950mV, the fuel level increase counter is increased. If the current level is for example 670mV in the next measurement (and reference level is still the same 800mV), the previously increased counter is set to 0 and the fuel level decrease counter is increased.

When either counter reaches a configurable limit, an event is generated. If the limit is set to 1, the first threshold exceeding generates an event.

Both the direction of the fuel level change and the number of the tank are included in the event and can be seen in the D-protocol event information field.

For more information about the event and the D-protocol see document *S100300 Aplicom D protocol*.

The sensor voltage level is stored also when there is a change detected in the ignition line. The value is stored with a delay (`fuel_delay`). That is to prevent false alarms caused by possible supply voltage level changes.

See *Figure 2*.

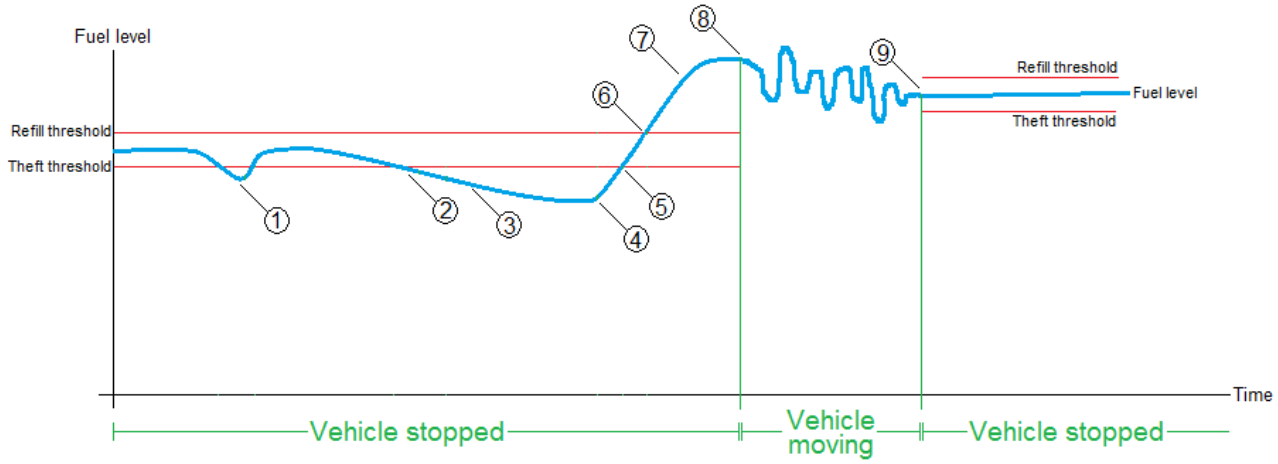


Figure 2. Fuel level over time

1) The fuel level drops below the threshold but rises above it before theft counter reaches the limit.
2) The fuel level drops again below the threshold.
3) The counter reaches the limit and a theft event is generated.
4) Refilling starts.
5) The fuel level rises above the theft threshold.
6) The fuel level exceeds the refill threshold.
7) The counter reaches the limit and a refill event is generated.
8) Vehicle starts moving and fuel level measuring is stopped.
9) Moving has stopped, a new reference level is stored in the memory and measuring continues.

3 CONFIGURING THE FUEL ALERT

This chapter describes the A1/A11 SW XML configuration requirements to get the Fuel Alert working. See documents *K503050 A1 Track SW and Telematics SW User Manual, K530100 A11 SW User Manual* and *K503021 A1 SW Configurator User Manual* for more information about configuring the A1/A11.

3.1 IO configuration parameters

There can be five parameters given for Fuel Alert. Only `fuel_sensor` is mandatory.

```
<ioConfig>
     <param name="adPollingInterval_s" value="5"/>
     <param name="dlkpType" value="0"/>
     <param name="fuel_level_threshold" value="100"/>
     <param name="fuel_channel" value="1"/>
     <param name="fuel_delay" value="30"/>
     <param name="fuel_sensor" value="1"/>
     <param name="fuel_counter_limit" value="3"/>
</ioConfig>
```

`fuel_level_threshold`
Threshold in millivolts. For example, if the reference level is 800mV and threshold is set to 100mV, the corresponding counter is increased when measured value is more than 900mV or less than 700mV. Default value for `fuel_level_threshold` is 100mV.

Note! The absolute minimum value for the threshold is 5mV due to the accuracy of the A1/A11's AD converter. To achieve reliable measuring a recommended minimum value is 10mV.

`fuel_channel`
The AD-input channel used for reading fuel level sensor. Channels 1-4 are available. Channel 1 is selected as default.

`fuel_delay`
The system measures the current fuel sensor voltage level when the vehicle has stopped. To avoid getting false level information caused by fuel splashing in the tank after stopping, there has to be a delay before measuring the value. The delay time is given in seconds and the default is 30 seconds. The same parameter is used to set the delay for storing the level after a change in the ignition line.

`fuel_sensor`
There can be two types of fuel level sensors used with Fuel Alert. Value "-1" represents negatively proportional sensor and value "1" positively proportional sensor. See chapter *4 Fuel Sensor* for further information. The default value for `fuel_sensor` parameter is "0", meaning no sensor connected. If the sensor parameter is not set in configuration, Fuel Alert will be inactive.

`fuel_counter_limit`
Number of threshold exceeds needed to generate an event. For example if the value is "3" the fuel level has to be over the threshold for three consecutive polling cycles. Default value is "3".

Configuring the second Fuel Alert instance is done similarly as explained above but with a "2" added at the end of each parameter name. For example:

```
     <param name="fuel_level_threshold2" value="100"/>
     <param name="fuel_channel2" value="1"/>
     <param name="fuel_delay2" value="30"/>
     <param name="fuel_sensor2" value="1"/>
     <param name="fuel_counter_limit2" value="3"/>
```

Note!
For the Fuel Alert to work, the AD polling interval must be set to a meaningful value, for example 5…30 seconds.

To ensure reliable operation it is mandatory that the accelerometer is used for motion detecting. To enable the accelerometer there has to be values given for at least one of the two delay parameters. For example:

```
<param name="AccMovingStartTime_s" value="5"/>
<param name="AccMovingStopTime_s" value="30"/>
```

3.2 Configuring the power output

When using the Fuel Alert with ignition both on and off, the switching between sensor power supplies (A1/A11 and the vehicle's system) can be made by configuring the A1/A11 appropriately.

Two actions are needed for this. One for setting output active and one for setting it inactive.

```
<action id="pwrOutputOn" type="SET_OUTPUT_ACTIVE">
    <param name="outputId" value="11"/>
</action>
<action id="pwrOutputOff" type="SET_OUTPUT_INACTIVE">
    <param name="outputId" value="11"/>
</action>
```

The actual switching between the power supplies is done by assigning the activating action to the `ignitionOff` event handler and inactivating action to the `ignitionOn` event handler.

```
<eventHandler id="ignitionOff" type="IGN_OFF">
    <action id="pwrOutputOn"/>
</eventHandler>
<eventHandler id="ignitionOn" type="IGN_ON">
    <action id="pwrOutputOff"/>
</eventHandler>
```

This way when the ignition is off, A1/A11 supplies the sensor and when it is turned on the A1/A11 power output is set inactive and the sensor is powered by the vehicle's own system.

If the power output is needed to be active all the time, the activating action can be assigned to the startup event handler.

```
<eventHandler id="startup" type="SOFTWARE_START">
    <action id="pwrOutputOn"/>
</eventHandler>
```

3.3 Event handler for Fuel Alert event

The event handler type for Fuel Alert is `FUEL_LEVEL_EVENT`. There can be two parameters given for the event handler, a direction parameter and a tank parameter. Only the direction parameter is mandatory.

The value of the direction parameter represents the changing direction of the fuel level. Value “1” represents fuel level increasing and value “0” fuel level decreasing e.g. if the value is set to “1”, event is generated when the fuel level is more than stored value + set threshold and if the value is set to “0”, event is dispatched when the fuel level is less than stored value - set threshold.

The value of the tank parameter assigns the event handler either for the tank number 1 or tank number 2. If the parameter is set to 0 or is not given the event handler accepts events from both tanks.

```
<!-- Event handler for tank nr. 1 -->
      <eventHandler id="tank1_refill" type="FUEL_LEVEL_EVENT">
            <param name="direction" value="1"/>
            <param name="tank" value="1"/>
            <action id="tank1_refill_log"/>
      </eventHandler>
      <eventHandler id="tank1_theft" type="FUEL_LEVEL_EVENT">
            <param name="direction" value="0"/>
            <param name="tank" value="1"/>
            <action id="tank1_theft_log"/>
      </eventHandler>

<!-- Event handler for tank nr. 2 -->
      <eventHandler id="tank2_refill" type="FUEL_LEVEL_EVENT">
            <param name="direction" value="1"/>
            <param name="tank" value="2"/>
            <action id="tank2_refill_log"/>
      </eventHandler>
      <eventHandler id="tank2_theft" type="FUEL_LEVEL_EVENT">
            <param name="direction" value="0"/>
            <param name="tank" value="2"/>
            <action id="tank2_theft_log"/>
      </eventHandler>
```

4 FUEL SENSOR

4.1 Sensor types

There can be one of two types of fuel level sensors used with the Fuel Alert. Both sensor types are based to a changing resistance value, typically the sensor is simply a potentiometer turned by a rod connected to a float. As the fuel level varies so does the resistance of the sensor.

The difference between the two sensor types is their changing direction. If the sensors resistance increases as the fuel level increases it is a positively proportional sensor. If the resistance decreases as the fuel level increases it is a negatively proportional sensor. The used sensor type has to be set in the configuration for the Fuel Alert to work.

When the ignition is off, the sensor is supplied by A1/A11 power output and when it is on the vehicle's own system supplies the sensor. The two supplies cannot be on at the same time to prevent disturbance for the vehicle's fuel gauge.

Note! If the A1/A11 device is powered only by its internal battery, the power output cannot be used. It is only available when the device is connected to an external power supply.

4.2 Sensor connections

When using the power output there must be an external resistor connected in series with the sensor. See *Figure 3.* A suitable resistance for the serial resistor is ca. 100Ω when using sensors with maximum resistance of less than 500Ω

If two fuel sensors are used, both of them are connected the same way. They both use A1/A11 power output as a voltage supply and both are connected to the same ground. The only difference is the AD input connection. The sensors are connected to different AD input pins so that they can be monitored individually. For example sensor 1 can be connected to AD Input 1 and sensor 2 to AD Input 2.

For more information about connecting the A1/A11 AD Input pins see *K503001 A1 Installation Guide or K530001 A11 Installation Guide.*

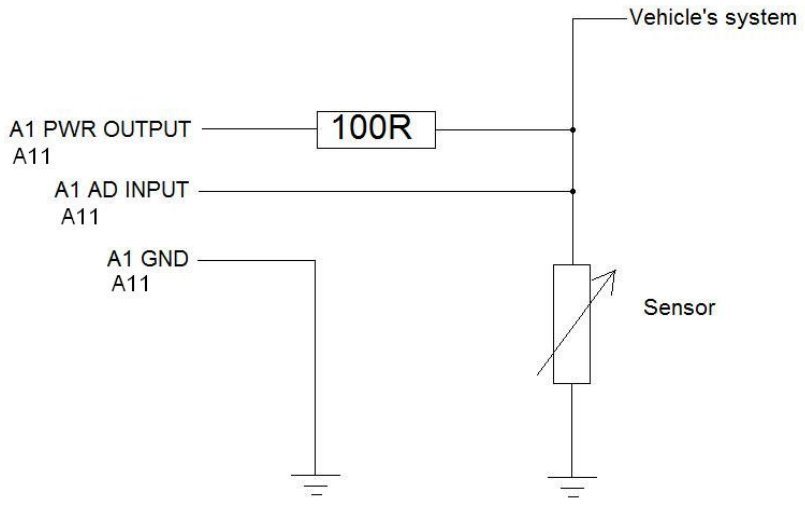
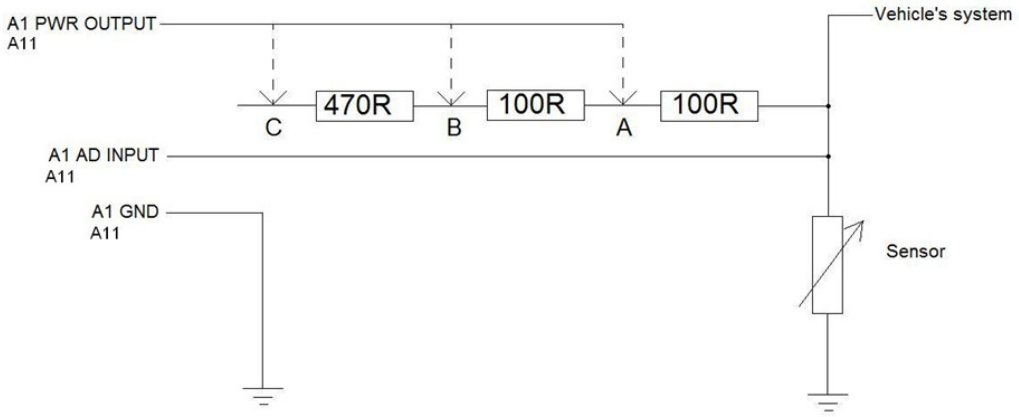


Figure 3. Fuel level sensor connection.

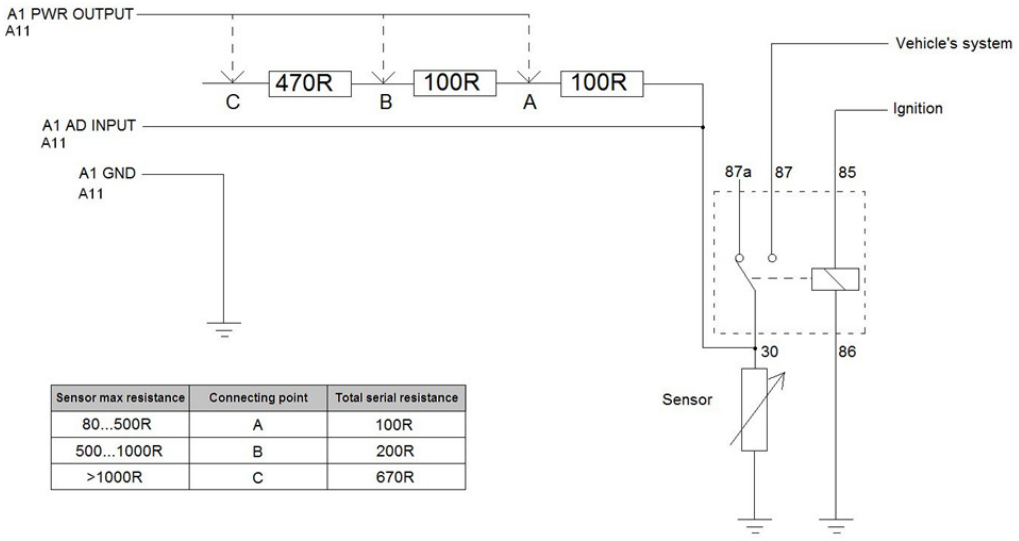
There is a cable available for connecting A1/A11 to the fuel sensor, *D335035 Fuel Alert Cable For A-Series*. The cable makes it possible to choose the serial resistance by connecting the power output to one of three points of the cable and cutting off the rest. See *Figure 4*.



Sensor max resistance	Connecting point	Total serial resistance
80...500R	A	100R
500...1000R	B	200R
>1000R	C	670R

Figure 4. Sensor connection with *D335035 Fuel Alert Cable For A-Series.*

In case the vehicle's instrument system draws the sensor voltage to GND and keeps the sensor voltage at 0V an isolation relay is needed to disconnect the instrument system from the fuel measuring circuit while the ignition is off. Aplicom automotive relay D324330 for 12V or D324331 for 24V can be used to make the following set up. See *Figure 5.*



Sensor max resistance	Connecting point	Total serial resistance
80...500R	A	100R
500...1000R	B	200R
>1000R	C	670R

Figure 5. Sensor connection with external relay.

For more information about connecting the A1/A11 power output see *K503001 A1 Installation Guide or K530001 A11 Installation Guide.*

REFERENCES

K503001 A1 Installation Guide

K530001 A11 Installation Guide

K503021 A1 SW Configurator User Manual

K503050 A1 Track SW and Telematics SW User Manual

K530100 A11 SW User Manual

S100300 Aplicom D protocol