

Accident detection

Introduction

When accident detection feature is active, UBI device monitors its acceleration in all directions and generates records every time when the acceleration exceeds configured limits. Clients can use accident detection to get notifications to the server about such events.

Accident detection feature is available with UBI device.

You can get the latest information about configurator from our documentation website: doc.ruptela.it

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Document change log

Date	Version	Change details
2016-10-11	1.0	Initial draft.
2017-01-05	1.1	Added option to select parameters that will be monitored by the device.

UBI device features

UBI device is based on the FM-Eco4 device. It has many of the same features, but there are also few exceptions. Currently UBI device does not support:

- 1Wire functionalities such as:
 - iButton Driver Registration;
 - iButton Ignition Blocking;
 - Unlimited iButton;
 - Passenger and driver registration;
 - iButton Dallas DS197 support;
- Internal Geozones;
- ECO-Driving from GPS.

Gathering accident data

Device continuously monitors a specific set of parameters and stores this information in its RAM. What data will be send to the server can be selected in the device's configuration. Data sampling frequency is 2 Hz. Monitoring is done continuously, but only data recorded during the last 5 seconds is saved. When new information is available, device deletes the oldest data points and writes new information instead.

Device monitors these parameters:

- Time
- Date
- Longitude and Latitude (location)
- Altitude
- Speed
- Angle (between the direction in which the device is pointing and a reference direction - north)
- Acceleration (accelerations in x, y, z axis)

After the accident, device transfers saved data from its RAM to the external flash memory. It also saves an additional data set gathered during 5 seconds after the actual event. Once information from both periods is saved to the external flash, device immediately sends all accumulated information (before and after the event) to the server. If transmission is successful, devices deletes information about this accident from the external flash memory.

Device cannot detect other accidents until all actions related to the previous accident are finished. Also device can store information only about a single accident.

Note

Currently UBI device is not compatible and should not be used with TrustTrack system.

Operation in Sleep / Deep sleep

If accident detection is enabled, device cannot enter sleep mode or deep sleep mode.

Accident detection principles

Definitions

- Discrimination threshold – all acceleration values below this limit will be ignored.
- Peak-Limit – a minimum acceleration value that needs to be reached in order to register an accident.
- Duration-Limit – a minimum accident duration required for it to be registered as an accident event.

Operation logic

The device can detect accelerations along all three axis separately. In our calculations we use a magnitude (or length) of a resultant acceleration vector, which is composed of three acceleration components. These components are accelerations in x, y and z axis. A magnitude of a resultant acceleration vector can be easily calculated as follows: $\|a\| = \sqrt{a_x^2 + a_y^2 + a_z^2}$

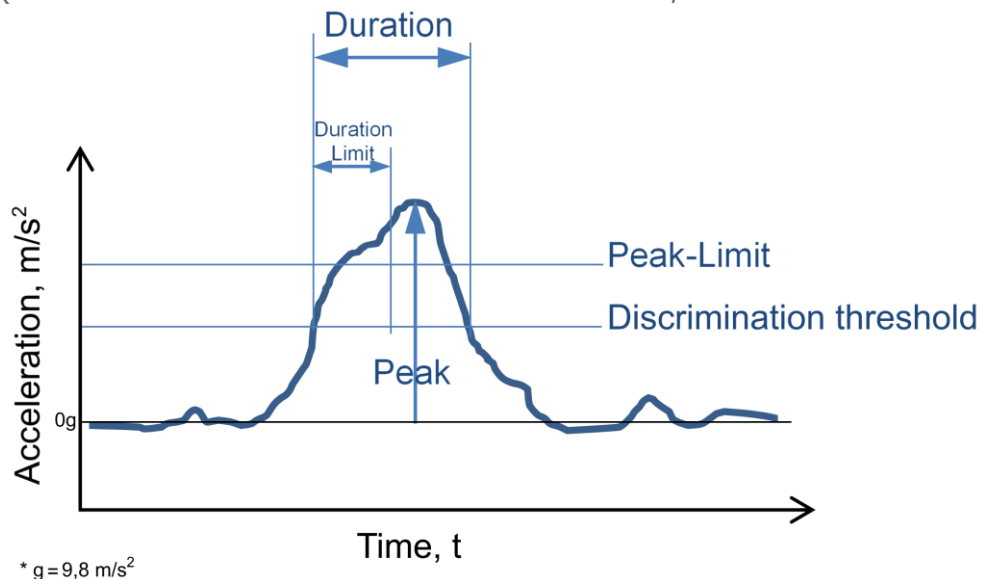
Boundary conditions for the resultant vector are defined by the "Discrimination threshold" and the "Peak-Limit". When the resultant vector crosses the discrimination threshold an accident event can be generated. Note that the resultant vector is then decomposed into its constituent accelerations and records with accident data contain values of these three acceleration components: a_x ; a_y ; a_z .

Note

Only acceleration experienced from the accident itself is included in the results. Permanent component due to earth's gravity, present in the z axis direction is subtracted from the results. Therefore, in a default state acceleration measured by the device will be 0 m/s² in all directions.

Accident evaluation procedure:

1. Only accidents with an acceleration amplitude that exceeds the configurable "Discrimination threshold" are processed.
2. The accident "Duration" is measured at the "Discrimination threshold" level.
3. The accident acceleration amplitude is measured at the "Peak" acceleration value.
4. Only the accident with an amplitude higher than a configurable "Peak-Limit" and a "Duration" longer than a configurable "Duration-Limit" is processed further.
5. Processing further means that the FM device sends an I/O event data with the records to the server (or stores the event data and sends it the next time, when a transmission occurs).



Accident detection configuration

Enable accident detection

First part of configuration is about setting correct limiting values for the accident detection.

1. In the main configurator window choose your device (*UBI4*).
2. Under **Global** settings, in the **Impact detection** section locate and click on the "Options" button. It opens up a new "Impact Detection" popup window.
3. In the "Impact Detection" window, put a tick next to the **Accident detection enable** this will enable the detection and unlock the settings for it.
4. **Discrimination Threshold** – When the amplitude exceeds this level the measurement of the accident event starts. Range is from 0,98 m/s² to 39,2 m/s². Default value is 4,9 m/s².
5. **Peak-limit** – Only accidents with equal or higher acceleration amplitudes are processed further. Range is from 0,98 m/s² to 39,2 m/s². Default value is 9,8 m/s².
6. **Duration-limit** - Only accidents with equal or longer durations are processed further. Range is from 20 ms to 1000 ms. Default value is 50 ms.
7. **Frequency** - Determines how often the device uses the accelerometer to check, if an accident has occurred (this is not the same as data sampling frequency described earlier). Values to choose from: 2, 4, 5, 10, 20, 25, 50 Hz. Default frequency is 50Hz.
8. Choose a set of parameters that will be continuously monitored by the device.

The screenshot displays the FM4 Configurator 00.02.36 - UBI v2 software interface. The main window shows the 'Global' settings section, with the 'Impact detection' section highlighted. The 'Impact detection' section includes a 'Send data without GPS fix' checkbox (disabled), a 'Towing detection' section with an 'Options' button, and an 'Impact detection' section with an 'Options' button. The 'Impact Detection' popup window is open, showing the following settings:

- Accident detection enabled 3.
- Shock detection
 - 4. Discrimination Threshold: 4.90 m/s²
 - 5. Peak-Limit: 9.80 m/s²
 - 6. Duration-Limit: 50 ms
 - 7. Frequency: 50 Hz
- 8. Location
- Altitude
- Speed
- Angle
- X acceleration
- Y acceleration
- Z acceleration

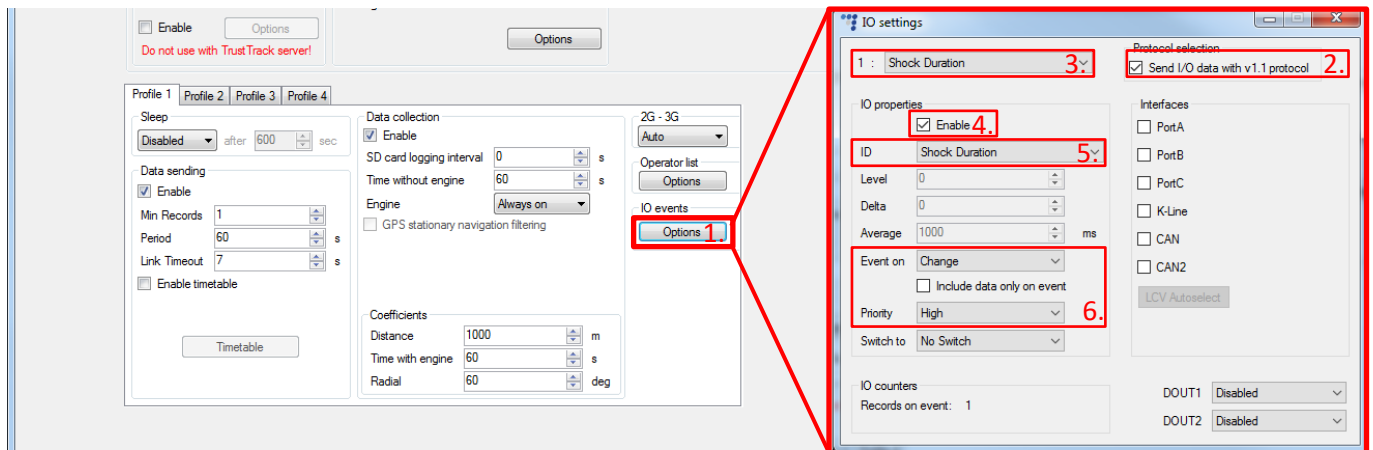
The 'Options' button in the 'Impact detection' section is highlighted with a red box and labeled '2.'. The 'UBI4' device is selected in the main window, highlighted with a red box and labeled '1.'. The 'Impact Detection' popup window is highlighted with a red box.

Enable accident detection IO parameters

To register accidents you have to enable shock detection IO parameters.

1. In the **IO events** section click on the "Options" button. It opens up a new "IO settings" window, here you can enable or disable IO parameters.
2. In **Protocol selection** section put a tick in **Send I/O data with v1.1 protocol** checkbox. After this step, shock detection IO parameters will be displayed in the IO list.
3. Select a slot that you want to enable.
4. In the **IO properties** section tick the **Enable** check box, otherwise the slot will remain empty.
5. **ID** contains the parameters list. Choose a parameter you want to enable for the selected slot. For the accident detection functionality choose *UBI process*, *Shock duration*, *G Peak X*, *G Peak Y*, *G Peak Z* IO parameters.
6. Parameters can be configured to generate records with Event on *Hysteresis*, *Monitoring* or on *Change*. More information available in the table below. We recommend to set *UBI Process* IO parameter to generate records with Event on *Hysteresis*, *On Falling edge*, *Priority High*. Also set *Debounce 1000 ms*, *Level 0*, *Delta 0*. With this configuration you would get notifications about accidents as soon as they occur.

More details about these parameters available below.



UBI and shock detection IO parameters

IO ID	Parameter name	Size, B	Min. value	Max. value	IO factor	Description
559	UBI process	1	0	1		1 - UBI information saving in progress, 0 - UBI information saved
576	Shock Duration	2	20	5000	1ms per bit	Shock duration in milliseconds
584	G Peak X	2	-4000	4000	$\frac{g}{1000}$ per bit	Acceleration in x axis expressed via gravitational (free-fall) acceleration constant $g=9,8m/s^2$
585	G Peak Y	2	-4000	4000	$\frac{g}{1000}$ per bit	Acceleration in y axis expressed via gravitational (free-fall) acceleration constant $g=9,8m/s^2$
586	G Peak Z	2	-4000	4000	$\frac{g}{1000}$ per bit	Acceleration in z axis expressed via gravitational (free-fall) acceleration constant $g=9,8m/s^2$

576, 584, 585 and 586 I/O ID parameters can be configured to generate records with Event on *Monitoring* and on *Change*.

I/O ID parameter 559 can be configured to generate records with Event on *Hysteresis, Monitoring* and on *Change*.

Note

To enable "UBI process", "Shock duration", "G Peak X", "G Peak Y" and "G Peak Z" parameters you have to use an extended v1.1 protocol version.

Axis notation

After calibration accelerations in different axis directions will be arranged as follows:

- G Peak X – Acceleration sideways
- G Peak Y - Acceleration forward / backward
- G Peak Z - Acceleration upward / downward

Accelerometer calibration

The FM device uses a built-in accelerometer to register accident events. Detection is largely based on accelerometer's measurements. To ensure proper operation you have to calibrate your accelerometer. Calibration must be performed after accident detection configuration (limiting values are set, IO events enabled). If accelerometer was calibrated earlier (before accident detection implementation), you must recalibrate it.

A detailed accelerometer calibration process description is available in the "[Eco-Drive from Accelerometer](#)" document.