

TFT100 Accelerometer Features settings

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Accelerometer Calibration

Accelerometer auto calibration functionality has one purpose - determine how TFT100 device is mounted in a vehicle. After the calibration process *eco driving* functionality becomes active and calibration data will be used to determine harsh acceleration, braking and cornering events.

There are two conditions when auto calibration takes place:

- If on device startup no calibration was detected;
- If the device receives an SMS/GPRS message with *auto_calibrate:set* text.

After functionality has started TFT100 device periodically checks current appliance GNSS, ignition and movement source parameters and if the conditions match:

- GPS fix is valid;
- GNSS speed is zero;
- ignition is ON;
- first calibration vector was not saved yet;

Then first vector is taken. Saved vector will be considered as ground vector and it will be used at further calibration calculations.

Note: When TFT100 device saves first ground vector vehicle must be parked on flat ground. Crooked vector may have an impact on further calculations.

Afterwards first ground vector was taken, device analyses conditions:

- position fix got;
- GNSS speed is at least 7 km/h;
- ignition is ON;
- second vector was not saved yet;
- vehicle driving in the same direction with 5° tolerance;
- vehicle speed increase by 1.5km/h within 1 second.

For next vector. Second vector will be taken if all conditions match. Immediately after second vector is received, it will be multiplied by first (ground) vector, the result of these vectors is vector

multiplication cross product which is the right side of a car. By using same vector multiplication method, device front, left side will be calculated. At this point calibration is successfully ended as indication device sends an SMS/GPRS message with *Device is calibrated, to recalibrate send:auto_calibrate:set*.

Note: SMS/GPRS message will be sent only if auto calibration functionality was triggered by SMS/GPRS message.

For user convenience in case auto calibration functionality fails then notification message will be sent. For exact messages, check algorithm section.

Note: SMS/GPRS message will be sent only if auto calibration functionality was triggered by SMS/GPRS message.

To get current calibration status *auto_calibrate:get* SMS/GPRS command must be sent to the device. If device is calibrated it will respond with *Calibration state: calibrated* or otherwise *Calibration state: not calibrated*. Also this command returns saved Ground and Side vectors.

After every TRIP START event, device starts shadow calibration. This type of calibration is running in parallel with already saved vectors (this means that vectors does not reset until shadow calibration have both new vectors). After shadow calibration is done, device updates the vector values to the new ones. There are two conditions when shadow calibration does not run at TRIP start event:

- Normal calibration is still running.
- Shadow calibration is still running from previous TRIP event.

To take ground vector these conditions should be met:

- Ignition is ON
- Device got GPS FIX
- Vehicle speed = 0km/h

Device will check these conditions every 1sec until they will pass.

To take side vector these conditions should be met:

- Vehicle speed \geq 7km/h
- Device got GPS FIX
- Ignition is ON
- Device angle does not change more than 5 degrees in past 1 sec
- Speed need to increase by 1.5km/h in 1s period.

Device will check these conditions every 1 sec until they will pass.

Excessive Idling

Excessive Idling

Scenario Settings

| | |
|---------------|----------------|
| Disable | Low Priority |
| High Priority | Panic Priority |

Eventual Records

| | |
|---------|--------|
| Disable | Enable |
|---------|--------|

Time To Stopped (s)

Time To Moving (s)

Output Control

| | |
|--------|--------|
| None | DOUT 1 |
| DOUT 2 | |

DOUT ON Duration (ms)

DOUT OFF Duration (ms)

Send SMS To

SMS Text

When vehicle stops for a specific amount of time the scenario is activated, a record will be generated and digital output status will be changed to 1 when configured. You can configure the time it takes to turn on this scenario (*Time to Stopped*). Scenario is activated until the vehicle starts moving (movement is detected only by the accelerometer) and keeps moving for an amount of time that is configured. You can configure the time it takes to turn off this scenario (*Time to Moving*)

Towing Detection



Towing Detection feature helps to inform the driver about unexpected car movement when it was parked. TFT100 generates an event when car is being towed or lifted, for example, in a case of vehicle evacuation. TFT100 activates towing function when following conditions are met:

1. Ignition (configured Ignition Source) is OFF.
2. *Activation Timeout* is reached.

When towing function is engaged TFT100 monitors accelerometer data. If acceleration *Threshold* or *Angle* reach configured values for a configured *Duration*, and Ignition is still OFF for a period of time that is longer than *Event Timeout*, then an event is generated. When configured, *Make Call To* and *Send SMS To* functions make a call or send an SMS to a predefined phone number. Towing function will be reactivated after TFT100 detects a change of Ignition state from ON to OFF.

Flex Towing Scenario



If Towing is enabled, FLEX CAN protocol is selected and scooter is locked, when Towing event is detected, TFT100 will automatically request Immobilizer alarm drive state. After Towing scenario reactivation TFT100 will automatically request OFF drive state, if other state was not requested by SMS/GPRS command during movement stop delay timeout. Towing scenario is not running if vehicle is unlocked.

| | |
|--------------|---|
| NOTE! | FLEX Towing Detection only available on the 55.01.06.Rev.00 FW or newer and only if FLEX CAN protocol is enabled. |
|--------------|---|

Crash Detection



If *Crash Detection* is enabled, it monitors acceleration on each axis which helps to detect an accident. *Threshold* and *Duration* values are set depending on the impact magnitude that is required to be detected. TFT100 can detect events ranging between a slight tapping on the device and a severe accident.

If *Crash Trace* is disabled only one eventual crash record will be generated when *Duration (ms)* and *Threshold (mg)* values are exceeded.

If *Crash Trace* is enabled, TFT100 will collect crash trace data with frequency defined by *Trace ODR (Hz)* parameter. Acceleration, GNSS and IO data monitoring duration during the crash event is defined by these parameters:

- *Accel duration (s)*. Acceleration data duration can be set for up to 15 seconds before crash event and 15 seconds after;
- *GNSS duration (s)*. GNSS data duration can be set for up to 30 seconds before crash event and 30 seconds after.
- *IO duration (s)*. IO data duration can be set for up to 30 seconds before crash event and 30 seconds after.

There are two configurable Crash Trace modes:

Trace Full

- Data tracked: all GNSS and acceleration data

Trace Changes

- Data tracked: GNSS and acceleration data, when acceleration values are changed by more than 50mG

NOTE: with Crash Trace mode enabled, it is recommended to use *Codec 8 Extended* Data Protocol. This helps to optimize crash trace data sending from device to server.

Each record will have accurate timestamps in milliseconds.



Crash Detection functionality



Device continuously reads data from accelerometer. By default this data is passed through EMA filter. When accelerometer's axes magnitude is above configured threshold for defined duration, crash event is detected. Eventual record is generated and SMS (configured) sent.

Additionally, I/O elements', which priority is set above none, values are included in crash record, if Crash Trace is disabled and Add I/O To Record is enabled.



Crash Trace



After crash is detected, crash trace is performed. Crash trace functionality collects accelerometer, GNSS and additional configured IO data. Collected data holds configured seconds of information before crash and configured seconds of information after crash. Another crash can be detected when previous crash trace is collected and processed.

Crash trace can have 1 s misalignment of event compared to other records due to asynchronous work of GPS and accelerometer. This means crash event can be +/- 1s from the middle data piece.

NOTE! Example: accel and GNSS duration set to 2s. Total data length will be 4s (2 before event 2 after event), but due to GPS and accelerometer asynchronization, crash event record might be visualized on 2nd, 3rd or 4th seconds.

Trace ODR (Hz) - crash event output data event rate. $\text{Time}(\text{sec}) \times \text{frequency}(\text{hz}) = \text{crash events generated}$. Down sampling functionality is used to reduce gathered accelerometer data to user requested output data rate. This allows accelerometer to be sensitive and output required output data rate. Image bellow represents real accelerometer data and down sampled data.

