Cellocator Fleet Safety Solution

Integration Manual

Version 1.1

Revised and Updated: August 3, 2011

Cellocator Division
Pointer Telocation Ltd.

POINTER

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1 Introduction

This document describes the integration of the Cellocator Compact CAN unit with the Mobileye C2 unit for providing Cellocator Fleet Safety Solution.

It includes detailed descriptions of the coupling between the two units and configuration aspects, as well as the parsing of received messages triggered by the Mobileye system on the server side.

This document does not include instructions on how to operate or install the Mobileye or Compact units.

1.1 Revision History

Version	Date	Description
1.0	03/07/11	Original document
1.1	03/08/11	Change document name

1.2 References

No.	Document Name	Version
1	C2-270_Standart_CAN_Output_Protocol_with_TSR_v2.8	2.8
2	Cellocator Wireless Communication Protocol v28 (rev9)	Rev9
3	Programming Manual Fw28y	28y
4	Compact CAN Integration Overview 283	2.83
5	Compact Installation Manual	

2 Mobileye C2 Overview

Mobileye C2-270/C2-170 Systems are installed in passenger and commercial vehicles (such as cars, buses and trucks) and provide the driver with audio and visual warnings when in a dangerous situation. The warnings are as follows:

- **FCW/PCW:** (Forward Collision Warning/Pedestrian Collision Warning): This warning is given when the driver is in danger of hitting the vehicle or pedestrian in front.
- **UFCW:** (Urban Forward Collision Warning): As above, but operates in slow-moving traffic, when a crash at low speed is imminent.
- **LDW:** (Lane Departure Warning): This warning is given whenever the driver crosses a lane marking without using the turn signal.
- **HMW:** (Headway Monitoring and Warning): This warning warns when the distance from the car in front (measured by the Mobileye system in seconds) is not sufficiently safe.

Information about the driver's behavior, which can easily be derived from the warnings the Mobileye system provides, is forwarded to the Central Control for future analysis by Cellocator Compact CAN unit.

3 Interconnection between Mobileye C2 and Compact

The Compact CAN is receiving data from the Mobileye unit through its CAN interface.

The following table contains the interconnected pins of Compact and Mobileye C2.

	Pin on Compact's 20 pin connector	**Pin on Mobileye C2 CAN-A connector**
CANL	5	2
CANH	11	1

For installation instructions of other pins of Mobileye and Compact units, refer to the appropriate installation manuals.

3.1 C2-270 CAN Interface

The Mobileye C2-270 CAN interface (CAN Bus) is located in the SeeQ unit, CAN-A channel.

The CAN-A Channel is accessible for physical connection in two different ways, depending on the specific C2-270 model (**PS3** or **PS2.5**).

3.1.1 *PS3 Model*

The CAN-A Channel is accessible for physical connection in two ways:

- Using the CAN-A female connector (marked as A) on the PS3 unit.
- Using a DB9 connector that will connect to the standard CAN-A cable used by Mobileye installers for Calibration.

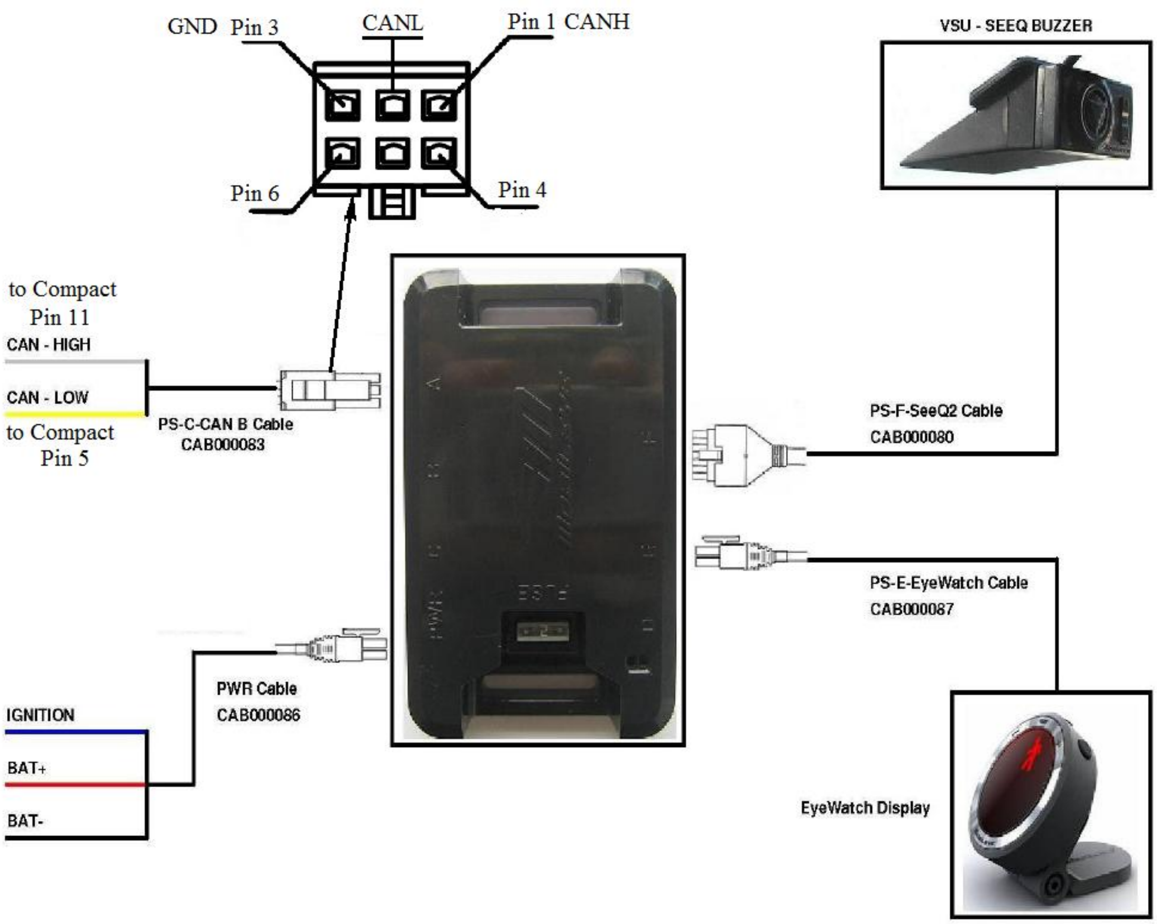
3.1.2 *PS2.5 Model*

The CAN-A Channel is accessible for physical connection through the SeeQ BLUE Cable labeled as "CAN-A" (3 Pin Male connector).

3.2 Compatible Compact CAN

For Mobileye integration the Compact CAN P/N GT6600095-TR3N (Telit, 25 sensors, 500kB/s) and the Compact harness P/N 711-00199 should be used.

3.3 Typical Installation of Mobileye C2-270 Model PS3


GND Pin 3
CANL
Pin 1 CANH
Pin 6
Pin 4
VSU - SEEQ BUZZER
to Compact
Pin 11
CAN - HIGH
CAN - LOW
to Compact
Pin 5
PS-C-CAN B Cable
CAB000083
PS-F-SeeQ2 Cable
CAB000080
PS-E-EyeWatch Cable
CAB000087
PWR Cable
CAB000086
IGNITION
BAT+
BAT-
EyeWatch Display

4 Mobileye C2 CAN message

4.1 General Message Flow Description

Mobileye generates a few types of CAN messages. This document refers to integration with the Sound Type field of message 0x700 (for all available CAN message types of Mobileye unit refer to *Appendix: Supported CAN messages of Mobileye System* or to *Mobileye_C2_Standard_CAN_Output_Protocol_with_TSR*).

Every time the Mobileye C2 system detects a driving violation it alerts the driver via a dedicated sound.

This alert is reflected in CAN traffic, continually sent to the Compact unit. The Compact unit, in turn, reacts on a change in the Sound Type field in a CAN Message 0x700 by generating the appropriate OTA message to Central Control.

In this way, Central Control receives updates on the start and end of the following driving violations:

- Lane Departure (Right/Left)
- Forward Collision Warning/Pedestrian Collision Warning
- Urban Forward Collision Warning
- Headway

4.2 CAN Message 0x700

4.2.1 *Format and Frequency of the Message*

- The message is transmitted in an 11bit CAN header format.
- The default baud rate is 500Kbps.
- The CAN message is transmitted approximately every 66-100 ms.

<table>
<tr><th>Bit</th><th>7(msb)</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0(lsb)</th></tr>
<tr><td>Byte 0</td><td colspan="3">Undocumented</td><td colspan="2">Time indicator</td><td colspan="3">Sound type (0-7) *</td></tr>
<tr><td>Byte 1</td><td colspan="2">Reserved</td><td>Zero Speed</td><td colspan="4">Reserved</td><td>0x0</td></tr>
<tr><td>Byte 2</td><td colspan="7">Headway measurement</td><td>Headway valid</td></tr>
<tr><td>Byte 3</td><td colspan="7">Error code</td><td>0x0: error
0x1: no error</td></tr>
<tr><td>Byte 4</td><td>Failsafe</td><td>Maintenance (error)</td><td colspan="2">Undocumented</td><td>FCW on</td><td>Right LDW ON</td><td>Left LDW ON</td><td>LDW OFF</td></tr>
<tr><td>Byte 5</td><td>TSR enabled</td><td colspan="4">Reserved</td><td>Peds in DZ</td><td>Peds FCW</td><td>0x0</td></tr>
<tr><td>Byte 6</td><td colspan="8">Reserved</td></tr>
<tr><td>Byte 7</td><td colspan="5">Reserved</td><td>HW repeatable enabled</td><td colspan="2">Headway Warning Level</td></tr>
</table>

4.2.2 *Sound Type Field*

Number	Description
0	Silent
1	Left Lane Departure (Given whenever the driver crosses a left lane marking without using the turn signal)
2	Right Lane Departure (Given whenever the driver crosses a right lane marking without using the turn signal)
3	Headway alert (Mobileye products measure the distance from the car in front in seconds, and warns when the distance is not sufficiently safe)
4	Not used
5	Urban Forward Collision Warning (Given when the driver is in danger of hitting the vehicle or pedestrian in front, but operates in slow-moving traffic when a crash at low speed is imminent)
6	Forward Collision Warning/Pedestrian Collision Warning (Given when the driver is in danger of hitting the vehicle or pedestrian in front)
7	Not used

5 Processing CAN Data by Compact

5.1 Compact CAN

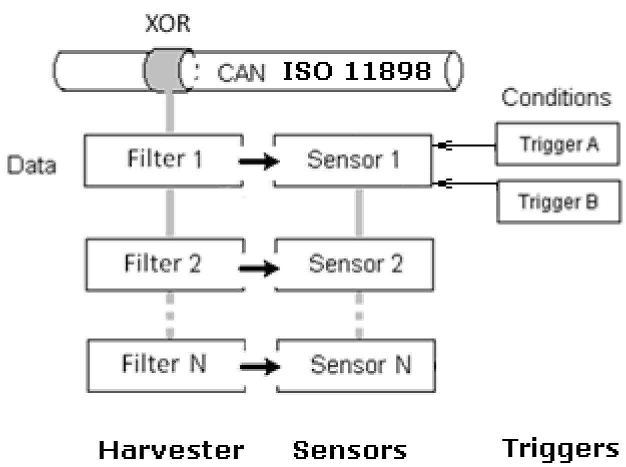
The CAN bus extensions in the Cellocator unit are designed with flexibility in mind, with no presumptions about the higher-level protocols in use above the CAN interface.

The unit, by default, takes an active part in the error management protocol of the CAN data layer, namely generating passive and active errors upon detecting erroneous conditions. However, the unit does not take any part in higher-level communications.

This approach provides two main benefits:

- The higher layer passiveness assures the unit will not cause any disturbance or interference with the workings of other systems in the vehicle.
- Not specializing in any specific higher layer allows the unit to simultaneously adapt to a broad range of communication protocols, with the ability to adapt to newer protocols in the future.

The Compact CAN unit is installed as one of the nodes on the bus; this way it is exposed to the entire CAN bus traffic and allowing the selecting and processing of only the relevant parameters.



The Cellocator CAN processing is based on the following 3 main modules:

- CAN Harvester
- Sensors Array
- Sensor Triggers

5.1.1 *The CAN Harvester*

The CAN harvester is an array of filters. Each packet (frame) sent over the bus is examined by this filter. The filter's condition, which is actually the XOR mask, defines which CAN frames will pass through the filter.

A received CAN frame may match more than one filter, in which case it will pass through all of the matching filters.

If it matches none of the filters, the frame is discarded without any further processing.

For Mobileye integration:

The CAN harvester will filter out the 3 first bits of CAN message 0x700.

5.1.2 *The Sensors Array*

The sensors array is a storage space for information extracted by the CAN Harvester module. Each sensor is linked with one of the filtered parameters in the array. Every time, when the containing frame will be filtered out from the CAN traffic, the value in the corresponding sensor will be updated with the new value received from CAN.

For Mobileye integration:

The Sensor Array will contain only one sensor, containing the Sound Field (the 3 first bits) of CAN message 0x700.

5.1.3 *The Sensor Triggers*

The sensor trigger defines the logical condition for generating messages to the Central Control. This condition is checked every time the content of a sensor is updated with newly extracted data from the bus.

It is possible to assign more than one condition (trigger) to a single sensor; it is also possible to assign a single trigger to two sensors (the Complex Trigger).

For Mobileye integration:

The only simple delta type trigger will be applied to the only trigger. Any change in a sound field will cause the unit to generate an appropriate message.

5.2 Possibilities of CAN data delivery

The CAN data is delivered by the Compact CAN unit to the Central Control in two cases:

- The CCC interrogates the unit for the content of the CAN sensors.
- The unit generates an active CAN message as a result of violation in one of the logical conditions (triggers) assigned to the selected CAN sensors.

5.2.1 *OTA Status Interrogation*

In case of interrogation, the unit will deliver the content of all CAN sensors in a single message of type 9, sub data type 2 (refer to *Cellocator Wireless Protocol*). The sensors in this message will not be indexed, and will be allocated in the same order as they are programmed in the EEPROM.

Each sensor consumes 6 bytes, and the infrastructure of OTA message type 9 allows for the requesting of the GPS stamp to be sent as a part of the same packet:

Cellocator header	Sensor 1 (Sound Field of CAN message 0x700)	GPS Stamp (Optional)	Cellocator Check Sum

For Mobileye integration:

In a reply to the interrogation the unit will deliver the content of Sound Field of CAN message 0x700 in a message type 9, sub data type 2. The GPS data (sub data type 4) might be attached to the same packet.

5.2.2 *Detailed: Interrogation Command*

Byte no	Description and content
1-4	System Code, ASCII "MCGP"
5	Message Type byte (a value of 9 for Modular Data Packet)
6-9	Destination Unit's ID (total 32 bits)
10	Command Numerator (will be received in message numerator field of the reply)
11-14	Spare (sent as 0)
15	Packet Control Field – 0x80
16	Total Length - 4
17	First Sub-data Type - 2
18	First Sub-data Length - 0
19	2nd Sub-data Type - 4
20	Nth Sub-data Length - 0
21	Error Code Detection – 8-bit additive checksum (excluding system code)

5.2.2.1 Packet Control Field

Bit 7	Bit 6	Bits 5-0
Direction	Out of space indication	unused

Direction

0 – Data from the unit

1 – Request (unit-bound)

Out of Space indication

0 – All the requested data is present in the message.

1 – Some sub-data was not returned due to data size.

5.2.3 *Detailed: Response to Interrogation Command*

<table>
<tr><td>1-4</td><td>System code, bytes 1-4</td><td>ASCII “MCGP”</td></tr>
<tr><td>5</td><td>Message type</td><td>9</td></tr>
<tr><td>6-9</td><td>Unit’s ID (total 32 bits)</td><td rowspan="3"></td></tr>
<tr><td>10-11</td><td>Communication Control field</td></tr>
<tr><td>12</td><td>Message Numerator (will contain command numerator of the request)</td></tr>
<tr><td>13</td><td>Packet Control Field</td><td>0x00</td></tr>
<tr><td>14</td><td>Total Data length</td><td>0d33</td></tr>
<tr><td>15</td><td>Sub-Data Type</td><td>2</td></tr>
<tr><td>16</td><td>Sub-Data Length</td><td>0d6</td></tr>
<tr><td>17</td><td>Options byte<table><tr><td>Data receiving flag</td><td>Spare</td><td>Sensor data effective bit length</td></tr><tr><td>Bit 7</td><td>Bit 6</td><td>Bits 0 - 5</td></tr></table></td><td>0d3</td></tr>
<tr><td>18</td><td>Spare</td><td>0</td></tr>
<tr><td>19</td><td rowspan="4">CAN Sensor Value</td><td rowspan="4"></td></tr>
<tr><td>20</td></tr>
<tr><td>21</td></tr>
<tr><td>22</td></tr>
<tr><td>23</td><td>Sub-Data Type</td><td>4</td></tr>
<tr><td>24</td><td>Length</td><td>25</td></tr>
<tr><td>25</td><td colspan="2">Location status (flags)</td></tr>
<tr><td>26</td><td colspan="2">Mode 1 (from GPS)</td></tr>
<tr><td>27</td><td colspan="2">Mode 2 (from GPS)</td></tr>
<tr><td>28</td><td colspan="2">Number of satellites used (from GPS)</td></tr>
<tr><td>29-32</td><td colspan="2">Longitude</td></tr>
<tr><td>33-36</td><td colspan="2">Latitude</td></tr>
<tr><td>37-39</td><td colspan="2">Altitude</td></tr>
</table>

40-41	Ground speed
42-43	Speed direction (true course)
44	UTC time – seconds
45	UTC time – minutes
46	UTC time – hours
47	UTC date – day
48	UTC date - month
49	UTC date - year minus 2000 – 1 byte (e.g. value of 7 = year 2007)

5.2.4 *CAN Message Generated by Violation of Trigger*

In this case the unit generates an active message upon violation of the condition, defined in a trigger. The trigger infrastructure defines also the message generation method.

It is possible to generate such active triggers in one of three ways:

- **As a logged message of type 9, sub data type 3.**

  This is the main way of CAN event generation: a generated event will contain an index(s) of the triggering sensor according to its place in a programmed array, the content of this sensor(s) and (optionally) content of other indexed sensors and the GPS stamp.

  The message will be created according to one of four content patterns (user configurable). For example: the first pattern will only include the triggered sensor itself with the GPS stamp.

  The message will be logged and will require Generic ACK from CCC (message type 4, refer to Wireless Protocol) in order to be deleted from the memory. If ACK is not received, the message will be resent.

  The message consumes the same amount of memory as a plain position event (message type 0), physically allocated in the same memory and threaded by the unit in the same way as message type 0; therefore the unit can store the same number of CAN events – 2256.

  Although the message is constructed according to a pre-set pattern, the pattern's structure has a constant length and is limited to the following structure:

Cellocator Header	Index of triggered sensor (a)	Index of triggered sensor (b) or spare	Number of included sensors 1-3	Content of triggered sensor with index	Content of second triggered sensor with index or zeros	Content of additional sensor with index or zeros	GPS Stamp	Cellocator Check Sum

  The only variable item in this pattern is an index of the additional sensor. If the message carries less than the allowed 3 sensors, the unused bytes are sent as zeros.

- **As a <u>real-time</u> message of type 9, sub data type 3**

  This message type is very similar to the one explained above, except for two main differences:

  - This message is not logged and does not require any ACK from the server. In absence of connection generated messages are lost.
  - There is no limitation of message size.

  This generation type is not covered in this document.

- **As a real-time message of type 9, sub data type 2.** This generation type is not covered in this document.

5.2.5 *Detailed: Self Generated Message*

Byte no.	Description	Containing
1-4	System code	ASCII "MCGP"
5	Message type	9
6-9	Unit's ID (total 32 bits)	
10-11	Communication Control field	
12♠	Message Numerator	
13♠	Packet Control Field	0x00
14♠	Total Data length	0d55
15♠	Sub-Data Type	3
16♠	Sub-Data Length	0d24
17♠	Index of triggered CAN sensor	0
18♠	Spare	0
19♠	Number of included sensors	1
20-26♠	First included sensor	Sensor index -0
		Options byte 0d3
		Spare -0
		4 bytes of CAN sensor value
27-33 ♠	Second included sensor	zeros

Byte no.	Description	Containing
34-40♠	3rd included sensor	zeros
41♠	Sub-data Type	4
42♠	Sub-data Length	0d25
43♠	Location status (flags)	
44♠	Mode 1 (from GPS)	
45♠	Mode 2 (from GPS)	
46♠	Number of satellites used (from GPS)	
47-50♠	Longitude	
51-54♠	Latitude	
55-57♠	Altitude	
58-59♠	Ground speed	
60-61♠	Speed direction (true course)	
62♠	UTC time – seconds	
63♠	UTC time – minutes	
64♠	UTC time – hours	
65♠	UTC date – day	
66♠	UTC date - month	
67♠	UTC date - year minus 2000 – 1 byte (e.g. value of 7 = year 2007)	
68-69♠	Spare	zeros
70	Check Sum	

5.2.6 *Examples of received messages*

The following example contains messages received upon activation from silence (21/10/2010 11:35:38) to Urban Forward Collision Warning (21/10/2010 11:40:53) and back to silence (21/10/2010 11:40:55)

4D434750095B080300000A550027030A00000100830000000000004190004020AADED9F0
39C3C5703420A002503940039210915OA0AB5

4D434750095B080300000A560027030A00000100830005000000004190004020765E69F0
35A405703F21200D800BF130E2709150A0AAC

4D434750095B080300000A570027030A00000100830000000000004190004020765E69F0
35A405703F21200D800BF130E2709150A0AA8

5.3 Configuration of Compact

5.3.1 *Plain Fleet Management Features*

The fleet management functionality of Compact CAN is not covered in this document; refer to the Programming Manual for more details. This document contains only the data related to the integration with a Mobileye C2 unit.

5.3.2 *Compatible Cellocator Programmer version*

Use version 8.0.0.42 (or later) of Cellocator Programmer.

5.3.3 *Data on Mobileye CAN*

Before describing the configuration process it is important to understand how the data on the bus looks like. Below is a short example of the Mobileye CAN log, recorded upon normal driving:

```
1792        8 160   0   8   1   1   0   0   3     562.596710 R
1792        8 160   0   8   1   1   0   0   3     562.677230 R
1792        8 133   0   8   1   9   0   0   3     562.757760 R
1792        8   5   0   8   1   9   0   0   3     562.839710 R
1792        8   5   0   8   1   9   0   0   3     562.921060 R
1792        8   5   0   6   1   9   0   0   3     563.001890 R
1792        8   5   0   6   1   9   0   0   3     563.079880 R
1792        8   5   0   4   1   9   0   0   3     563.166660 R
1792        8   5   0   4   1   9   0   0   3     563.251660 R
1792        8   5   0   4   1   9   0   0   3     563.336050 R
1792        8   5   0   4   1   9   0   0   3     563.417130 R
1792        8 160   0   4   1   1   0   0   3     563.496240 R
1792        8 160   0   4   1   1   0   0   3     563.576850 R
```

The right column contains the header of the message (0x700), length of data (always 8 bytes), the 8 bytes of data itself and the timestamp in seconds. The field that we are looking for (Sound type) is allocated just after the length of data.

In the sample above the value of Sound type changes from 160 (3 last bits = 0b000 = silence) to 133 and 5 (3 last bits in both cases 0b101 = Urban Forward Collision Warning); then back to silence.

Here the Compact unit will generate two messages:

- From silence to UFCW alert.
- From UFCW alert back to silence.

5.3.4 *Selecting Sensors*

Cellocator's configuration tool (CAN Filter Editor), integrated in both wire and wireless communication software packets, enables the easy creation of a new sensor or the selection of the pre-set one from the dropdown list.

For Mobileye integration:

1. Open CAN Editor.
2. Select 25 Sensor's edition.
3. Select from the Mobileye dropdown list ( ) the **Sound Type** sensor.
4. The selected sensor is automatically assigned with an index.
5. If the required sensor is not in the list, create a new one by choosing the name, the PGN according to the document, the length of data and other attributes of a required sensor.

5.3.5 *Creating Template*

Once the required sensor(s) is selected, it is required to generate a template, which will be used by the trigger generation algorithm.

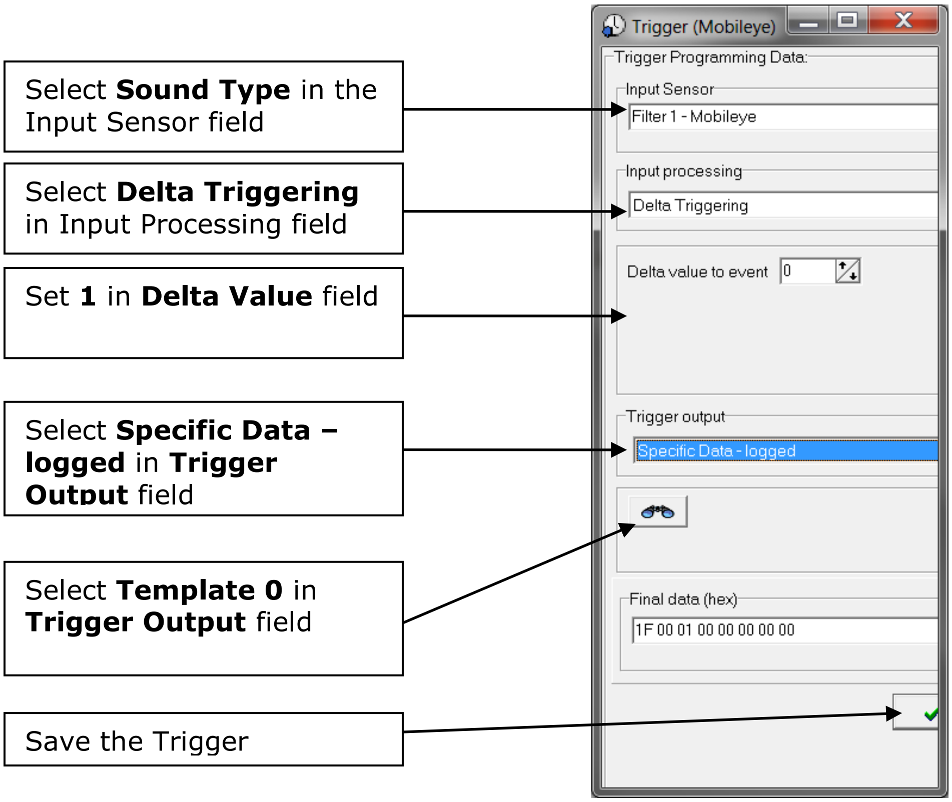
The template construction form is activated by the "T" button on an instrument panel.

For Mobileye integration:

1. Activate template construction form.
2. Double-click **Template 0**.
3. Select the **Add GPS Stamp** checkbox.
4. Save your settings.

5.3.6 *Assigning Simple Trigger*

Open the Trigger Generation form by clicking the **Add new trigger** button on the instrument pannel.



6 Appendix: Supported CAN messages of Mobileye System

Message	Code	Description
C2 Display and warnings	0x700	Provides data about: 1. Display sound type 2. Lane Departure Warning left and right 3. Low Speed detection off 4. Headway in seconds 5. FCW 6. Pedestrian detection and warning 7. Hi/Low beam decision 8. HMW level 9. Failsafe events: Low visibility, Maintenance
Car signals	0x760	Provides the signals status from the vehicle: 1. Left blink 2. Right Blink 3. Speed 4. Brakes 5. High beam 6. Wipers
TSR message - Sign Type and Position	0x720… 0x726	Provides data about: 1. Sign Type 2. Supplementary Sign Type 3. Sign Position X 4. Sign Position Y 5. Sign Position Z 6. Filter Type
Sign Type	0x727	Provides data about 1. Sign Type – Display 1 2. Supplementary Sign Type – Display 1 3. Sign Type – Display 2 4. Supplementary Sign Type – Display 2 5. Sign Type – Display 3 6. Supplementary Sign Type – Display 3 7. Sign Type – Display 4 8. Supplementary Sign☐Type – Display 4