Collision Avoidance System CAS-M light

Manual

Version 2.0 26/09/2019

Content

1 System Overview

The CAS-M light helps the driver to focus on the track and warns him if a car is approaching from behind. The system provides information about relative speed and distance on the CAN bus. The benefit is even more increased during nighttime or in bad weather conditions.

The interface is very intuitive and adaptable to the drivers liking – so there is no need in special driver trainings.

1.1 Function principle

CAS-M light provides information for distance and relative speed of the closest vehicle behind via two LEDs (left and right) in the driver display. Only the closest vehicle behind is considered. All other objects are suppressed.

In large (green) and medium (yellow) distance both LEDs (left and right) are used in parallel to provide the available information. In close (red) distance a left/right determination is done, and only the appropriate left or right LED is used to provide information about the object behind the driver.

All distance and delta speed thresholds based on the physical raw values to control the object detection and LED visualization can be adjusted individually via CAN (depending on pilot and race category different settings may be required).

CAS-M light contains a pre-defined visualization concept to allow for a quick starting with the system. The pre-defined thresholds are based on Bosch Motorsport know how and experience with the system.

1.2 Hardware

The CAS-M light system consists of a Bosch automotive mid range radar sensor, shown in the following picture/drawing.

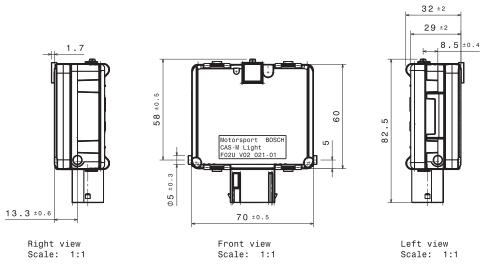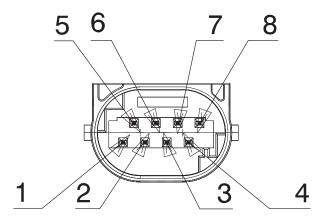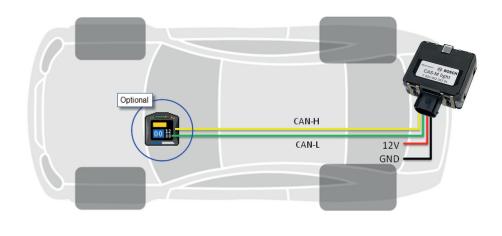
Illustration 1: CAS-M light sensor

Right view
Scale: 1:1

Front view
Scale: 1:1

Left view
Scale: 1:1

Illustration 2: CAS-M light dimensions

1.3 Wiring

The sensor needs to be connected to the vehicle CAN bus (connection to display needed) and supplied with 12 V from the supply system on board. For the speed calculation of the approaching cars, the sensor needs to know the vehicle's speed.

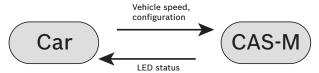| Pin	Designation	Description
1	GND	Sensor Ground
2	CAN-H	CAN High
3	CAN-L	CAN Low
4	Not connected	Not connected
5	Not connected	Not connected
6	Not connected	Not connected
7	Not connected	Not connected
8	V+	Supply voltage for sensor (12 V)

Illustration 3: Wiring schematic

1.4 CAN communication

Since the system provides the information on the CAN bus (car approaching left/right, distances, relative speeds …), it is mandatory to connect the sensor to it. In addition the sensor needs to get the vehicle's speed via CAN.

CAN Baud rate: 500 kBaud or 1 MBaud

CAN update rate of Sensor: 50 Hz

Vehicle Speed

Information that needs to be send from the car to the system:

Message	CAN ID	Byte order	Value type	Start bit	Length [bit]	Factor	Offset
Speed	0x616	Intel	Unsigned	24	16	0.1	0

Predefined Messages

Information that is send from the sensor to the car:

Message	CAN ID	Byte order	Value type	Start bit	Length [bit]	Factor	Offset
Object_left_dist_range	0x3F3	Intel	Unsigned	58	3	1	0
Object_left_approach_spd_range	0x3F3	Intel	Unsigned	61	3	1	0
Object_right_dist_range	0x3F5	Intel	Unsigned	58	3	1	0
Object_right_approach_spd_range	0x3F5	Intel	Unsigned	61	3	1	0

Raw values

Information that is send from the sensor to the car:

Message	CAN ID	Byte order	Value type	Start bit	Length [bit]	Factor	Offset
Object_left_dx	0x3F3	Intel	Unsigned	0	12	0.0625	0
Object_left_vx	0x3F3	Intel	Signed	12	12	0.0625	0
Object_left_dy	0x3F3	Intel	Signed	24	14	0.015625	0
Object_right_dx	0x3F5	Intel	Unsigned	0	12	0.0625	0
Object_right_vx	0x3F5	Intel	Signed	12	12	0.0625	0
Object_right_dy	0x3F5	Intel	Signed	24	14	0.015625	0

Important note

Do not use the messages 0xB9, 0x757 or 0x7C1 on the sensor CAN. These Messages are not needed but if used the sensor will be affected.

The sensor sends the additional message 0xB9 on the CAN. This message is not needed for the CAS-M light system but already used by the sensor.

2 Installation Guide

2.1 Mounting the radar sensor

A mounting frame with 4xM6 threaded bushings are delivered with the sensor. An individual concept for each car mounting situation must be developed by the car manufacturer. The following mounting restrictions must be fulfilled to secure a proper function of the system.

– The radar sensor must be longitudinally and laterally leveled, aligned with the vehicle's longitudinal axis and mounted on the vehicle's lateral centerline. Sensor mounting height of 20 cm to 90 cm off the ground will ensure maximum range.
If a mounting in the vehicle centre line is not possible, the offset must be configured via the appropriate CAN message (see chapter Configuration of the sensor position [▶ 8]).

– The sensor may be mounted flush mounted with the rear fascia.

– It is critical that the radar sensor has an unobstructed (or radar-transparent) view out the rear of the vehicle. Optimum is a mounting without any material in front of the sensor.
If it must be mounted behind, the plane in front of the sensor surface must be free of conductive materials (e.g. a thin layer of vinyl, fiberglass or Kevlar).
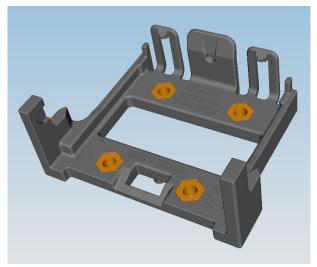The distance between sensor and surface depends on the used material and should be approximately 5 mm.

Illustration 4: CAS-M light frame

2.2 Configuration of the sensor position

Definition of sensor position and orientation

Message	CAN ID	Byte order	Value type	Start bit	Length [bit]	Factor	Offset
Orientation	0x618	Intel	Signed	28	2	1	0
Position_X	0x618	Intel	Signed	30	10	0.01	0
Position_Y	0x618	Intel	Signed	40	8	0.01	0
Position_Z	0x618	Intel	Unsigned	48	8	0.01	0

The Message 0x618 has to be send to the sensor once after every power cycle. Otherwise the default values are used by the sensor.

See appendix table 1 for assignment of signed integer values in hex.

Conversion of negative values into hex with two´s complement:

10bit: Hex value = Decimal to hex (Physical value / Factor + **1024**)

8bit: Hex value = Decimal to hex (Physical value / Factor + **256**)

Example for Position X (10Bit value) = -1m

Decimal value = -1 / 0,01 + 1024 = 954

Hex value = Decimal to hex (954) = 39C

Orientation

Description	Value	Default
Connector facing up	-1	1
Connector facing down	+1	

Position_X

Description	Comment	Default
Sensor position in X direction	Distance from rear axle in [m]	+1
	X-axis is positive if sensor behind rear axle	

Position_Y

Description	Comment	Default
Sensor position in Y direction	Distance from vehicle symmetry axle [m] Left is positive	0

Position_Z

Description	Comment	Default
Sensor position in Z direction	Distance to ground [m]	0.5

2.3 Configuration of the system threshold values

Illustration 5: Distance schematic

Message	CAN ID	Byte order	Value type	Start bit	Length [bit]	Factor	Offset
Distance_Near	0x620	Intel	Unsigned	0	8	1	0
Distance_Medium	0x620	Intel	Unsigned	8	8	1	0
Distance_Far	0x620	Intel	Unsigned	16	8	1	0
Speed_medium	0x620	Intel	Unsigned	24	8	1	0
Speed-high	0x620	Intel	Unsigned	32	8	1	0

Distance thresholds

Description	Comment	Default
Distance_Near	Threshold between near range and medium range [m]	12
Distance_Medium	Threshold between medium range and far range	30
Distance_Far	Threshold between far range and out of range (no warning)	75

Speed thresholds

Description	Comment	Default
Speed_medium	Speed of approaching vehicle [km/h] for low frequency flashing	7.2
Speed_high	Speed of approaching vehicle [km/h] for high frequency flashing	14.4

3 Using the CAS-M light Information

3.1 Predefined messages

The system provides predefined CAN-messages with evaluated values for distance and relative speed.

3.1.1 Configuration distance

Object_left/right_dist_range defines the distance of the car behind into a color for an LED.

Value	Color	Description
0x0	off	inactive
0x1	green	large distance
0x2	yellow	medium distance
0x4	red	close distance

3.1.2 Configuration relative speed

Object_left/right_approach_spd_range defines the relative speed of the car behind into a blinking frequency for an LED.

Value	LED-Status	Description
0x0	off	inactive
0x1	LED on	low relative speed
0x2	LED flash low frequency	medium relative speed
0x4	LED flash high frequency	high relative speed

3.2 Using raw values

As an alternative to the predefined messages it is possible to use the raw values provided by the system. Every value is provided for each side (left and right).

Object_left/right_dx

Distance to the car behind [m]

Object_left/right_vx

Relative speed of the car behind [m/s]

Object_left/right_dy

Position of the car behind (relating to the mid axis of the car) [m]

4 Available Packages

4.1 CAS-M light + connector (500 kBaud)

The CAS-M light system can be ordered without loom and display. The system includes:

– CAS-M light sensor with 500 kBaud CAN speed & mating connector

Part number: F 02U V02 021-01

4.2 CAS-M light + connector (1 MBaud)

The CAS-M light system can be ordered without loom and display. The system includes:

– CAS-M light sensor with 1 MBaud CAN speed & mating connector

Part number: F 02U V02 220-01

4.3 CAS-M light + DDU 9 (500 kBaud)

The CAS-M light system can be ordered directly with a DDU 9. The set includes:

– CAS-M light sensor with 500 kBaud CAN speed + mating connector

– DDU 9

Part number: F 02U V02 591-01

4.4 CAS-M light + DDU 9 (1 MBaud)

The CAS-M light system can be ordered directly with a DDU 9. The set includes:

– CAS-M light sensor with 1 MBaud CAN speed + mating connector

– DDU 9

Part number: F 02U V02 592-01

5 Disposal

Hardware, accessories and packaging should be sorted for recycling in an environment-friendly manner.

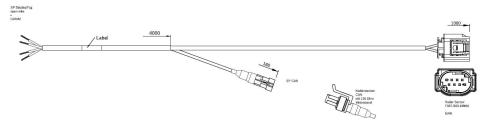**Do not dispose of this electronic device in your household waste.**

6 Loom Options

6.1 Open End

The open end loom can be used to connect the sensor to an existing display unit. The loom is compatible with the CAS-M light packages F 02U V02 021-01 and F 02U V02 220-01.

The loom includes:

– Sensor matting connector F 037 B00 168-01

– Removable 120 Ω terminating resistor

– Open end loom for display unit

Part number: F 02U V02 105-01

7 Appendix

7.1 Table 1

Orientation		
Decimal	Hex	Physical
-1	3	-1
1	1	1

Position X		
Decimal	Hex	Physical [m]
-150	36A	-1,5
-149	36B	-1,49
-148	36C	-1,48
-147	36D	-1,47
-146	36E	-1,46
-145	36F	-1,45
-144	370	-1,44
-143	371	-1,43
-142	372	-1,42
-141	373	-1,41
-140	374	-1,4
-139	375	-1,39
-138	376	-1,38
-137	377	-1,37
-136	378	-1,36
-135	379	-1,35
-134	37A	-1,34
-133	37B	-1,33
-132	37C	-1,32
-131	37D	-1,31
-130	37E	-1,3
-129	37F	-1,29
-128	380	-1,28
-127	381	-1,27
-126	382	-1,26
-125	383	-1,25
-124	384	-1,24
-123	385	-1,23
-122	386	-1,22
-121	387	-1,21

-120	388	-1,2
-119	389	-1,19
-118	38A	-1,18
-117	38B	-1,17
-116	38C	-1,16
-115	38D	-1,15
-114	38E	-1,14
-113	38F	-1,13
-112	390	-1,12
-111	391	-1,11
-110	392	-1,1
-109	393	-1,09
-108	394	-1,08
-107	395	-1,07
-106	396	-1,06
-105	397	-1,05
-104	398	-1,04
-103	399	-1,03
-102	39A	-1,02
-101	39B	-1,01
-100	39C	-1
-99	39D	-0,99
-98	39E	-0,98
-97	39F	-0,97
-96	3A0	-0,96
-95	3A1	-0,95
-94	3A2	-0,94
-93	3A3	-0,93
-92	3A4	-0,92
-91	3A5	-0,91
-90	3A6	-0,9
-89	3A7	-0,89
-88	3A8	-0,88
-87	3A9	-0,87
-86	3AA	-0,86
-85	3AB	-0,85
-84	3AC	-0,84
-83	3AD	-0,83
-82	3AE	-0,82
-81	3AF	-0,81
-80	3B0	-0,8
-79	3B1	-0,79

-78	3B2	-0,78
-77	3B3	-0,77
-76	3B4	-0,76
-75	3B5	-0,75
-74	3B6	-0,74
-73	3B7	-0,73
-72	3B8	-0,72
-71	3B9	-0,71
-70	3BA	-0,7
-69	3BB	-0,69
-68	3BC	-0,68
-67	3BD	-0,67
-66	3BE	-0,66
-65	3BF	-0,65
-64	3C0	-0,64
-63	3C1	-0,63
-62	3C2	-0,62
-61	3C3	-0,61
-60	3C4	-0,6
-59	3C5	-0,59
-58	3C6	-0,58
-57	3C7	-0,57
-56	3C8	-0,56
-55	3C9	-0,55
-54	3CA	-0,54
-53	3CB	-0,53
-52	3CC	-0,52
-51	3CD	-0,51
-50	3CE	-0,5
-49	3CF	-0,49
-48	3D0	-0,48
-47	3D1	-0,47
-46	3D2	-0,46
-45	3D3	-0,45
-44	3D4	-0,44
-43	3D5	-0,43
-42	3D6	-0,42
-41	3D7	-0,41
-40	3D8	-0,4
-39	3D9	-0,39
-38	3DA	-0,38
-37	3DB	-0,37

-36	3DC	-0,36
-35	3DD	-0,35
-34	3DE	-0,34
-33	3DF	-0,33
-32	3E0	-0,32
-31	3E1	-0,31
-30	3E2	-0,3
-29	3E3	-0,29
-28	3E4	-0,28
-27	3E5	-0,27
-26	3E6	-0,26
-25	3E7	-0,25
-24	3E8	-0,24
-23	3E9	-0,23
-22	3EA	-0,22
-21	3EB	-0,21
-20	3EC	-0,2
-19	3ED	-0,19
-18	3EE	-0,18
-17	3EF	-0,17
-16	3F0	-0,16
-15	3F1	-0,15
-14	3F2	-0,14
-13	3F3	-0,13
-12	3F4	-0,12
-11	3F5	-0,11
-10	3F6	-0,1
-9	3F7	-0,09
-8	3F8	-0,08
-7	3F9	-0,07
-6	3FA	-0,06
-5	3FB	-0,05
-4	3FC	-0,04
-3	3FD	-0,03
-2	3FE	-0,02
-1	3FF	-0,01
0	0	0
1	1	0,01
2	2	0,02
3	3	0,03
4	4	0,04
5	5	0,05

6	6	0,06
7	7	0,07
8	8	0,08
9	9	0,09
10	A	0,1
11	B	0,11
12	C	0,12
13	D	0,13

Position Y		
Decimal	Hex	Physical [m]
-128	80	-1,28
-127	81	-1,27
-126	82	-1,26
-125	83	-1,25
-124	84	-1,24
-123	85	-1,23
-122	86	-1,22
-121	87	-1,21
-120	88	-1,2
-119	89	-1,19
-118	8A	-1,18
-117	8B	-1,17
-116	8C	-1,16
-115	8D	-1,15
-114	8E	-1,14
-113	8F	-1,13
-112	90	-1,12
-111	91	-1,11
-110	92	-1,1
-109	93	-1,09
-108	94	-1,08
-107	95	-1,07
-106	96	-1,06
-105	97	-1,05
-104	98	-1,04
-103	99	-1,03
-102	9A	-1,02
-101	9B	-1,01
-100	9C	-1
-99	9D	-0,99

-98	9E	-0,98
-97	9F	-0,97
-96	A0	-0,96
-95	A1	-0,95
-94	A2	-0,94
-93	A3	-0,93
-92	A4	-0,92
-91	A5	-0,91
-90	A6	-0,9
-89	A7	-0,89
-88	A8	-0,88
-87	A9	-0,87
-86	AA	-0,86
-85	AB	-0,85
-84	AC	-0,84
-83	AD	-0,83
-82	AE	-0,82
-81	AF	-0,81
-80	B0	-0,8
-79	B1	-0,79
-78	B2	-0,78
-77	B3	-0,77
-76	B4	-0,76
-75	B5	-0,75
-74	B6	-0,74
-73	B7	-0,73
-72	B8	-0,72
-71	B9	-0,71
-70	BA	-0,7
-69	BB	-0,69
-68	BC	-0,68
-67	BD	-0,67
-66	BE	-0,66
-65	BF	-0,65
-64	C0	-0,64
-63	C1	-0,63
-62	C2	-0,62
-61	C3	-0,61
-60	C4	-0,6
-59	C5	-0,59
-58	C6	-0,58
-57	C7	-0,57

-56	C8	-0,56
-55	C9	-0,55
-54	CA	-0,54
-53	CB	-0,53
-52	CC	-0,52
-51	CD	-0,51
-50	CE	-0,5
-49	CF	-0,49
-48	D0	-0,48
-47	D1	-0,47
-46	D2	-0,46
-45	D3	-0,45
-44	D4	-0,44
-43	D5	-0,43
-42	D6	-0,42
-41	D7	-0,41
-40	D8	-0,4
-39	D9	-0,39
-38	DA	-0,38
-37	DB	-0,37
-36	DC	-0,36
-35	DD	-0,35
-34	DE	-0,34
-33	DF	-0,33
-32	E0	-0,32
-31	E1	-0,31
-30	E2	-0,3
-29	E3	-0,29
-28	E4	-0,28
-27	E5	-0,27
-26	E6	-0,26
-25	E7	-0,25
-24	E8	-0,24
-23	E9	-0,23
-22	EA	-0,22
-21	EB	-0,21
-20	EC	-0,2
-19	ED	-0,19
-18	EE	-0,18
-17	EF	-0,17
-16	F0	-0,16
-15	F1	-0,15

-14	F2	-0,14
-13	F3	-0,13
-12	F4	-0,12
-11	F5	-0,11
-10	F6	-0,1
-9	F7	-0,09
-8	F8	-0,08
-7	F9	-0,07
-6	FA	-0,06
-5	FB	-0,05
-4	FC	-0,04
-3	FD	-0,03
-2	FE	-0,02
-1	FF	-0,01
0	0	0
1	1	0,01
2	2	0,02
3	3	0,03
4	4	0,04
5	5	0,05
6	6	0,06
7	7	0,07
8	8	0,08
9	9	0,09
10	A	0,1
11	B	0,11
12	C	0,12
13	D	0,13
14	E	0,14
15	F	0,15
16	10	0,16
17	11	0,17
18	12	0,18
19	13	0,19
20	14	0,2
21	15	0,21
22	16	0,22
23	17	0,23
24	18	0,24
25	19	0,25
26	1A	0,26
27	1B	0,27

28	1C	0,28
29	1D	0,29
30	1E	0,3
31	1F	0,31
32	20	0,32
33	21	0,33
34	22	0,34
35	23	0,35
36	24	0,36
37	25	0,37
38	26	0,38
39	27	0,39
40	28	0,4
41	29	0,41
42	2A	0,42
43	2B	0,43
44	2C	0,44
45	2D	0,45
46	2E	0,46
47	2F	0,47
48	30	0,48
49	31	0,49
50	32	0,5
51	33	0,51
52	34	0,52
53	35	0,53
54	36	0,54
55	37	0,55
56	38	0,56
57	39	0,57
58	3A	0,58
59	3B	0,59
60	3C	0,6
61	3D	0,61
62	3E	0,62
63	3F	0,63
64	40	0,64
65	41	0,65
66	42	0,66
67	43	0,67
68	44	0,68
69	45	0,69

70	46	0,7
71	47	0,71
72	48	0,72
73	49	0,73
74	4A	0,74
75	4B	0,75
76	4C	0,76
77	4D	0,77
78	4E	0,78
79	4F	0,79
80	50	0,8
81	51	0,81
82	52	0,82
83	53	0,83
84	54	0,84
85	55	0,85
86	56	0,86
87	57	0,87
88	58	0,88
89	59	0,89
90	5A	0,9
91	5B	0,91
92	5C	0,92
93	5D	0,93
94	5E	0,94
95	5F	0,95
96	60	0,96
97	61	0,97
98	62	0,98
99	63	0,99
100	64	1
101	65	1,01
102	66	1,02
103	67	1,03
104	68	1,04
105	69	1,05
106	6A	1,06
107	6B	1,07
108	6C	1,08
109	6D	1,09
110	6E	1,1
111	6F	1,11

112	70	1,12
113	71	1,13
114	72	1,14
115	73	1,15
116	74	1,16
117	75	1,17
118	76	1,18
119	77	1,19
120	78	1,2
121	79	1,21
122	7A	1,22
123	7B	1,23
124	7C	1,24
125	7D	1,25
126	7E	1,26
127	7F	1,27

8 Revision History

No.	Page	Revision	Date	BEG/MSD4
01	-	First Edition	12.11.2014	Arnold, Germund
02	4, 5, 9	CAN description, schematics, ty-pos, packages	19.01.2015	Arnold
03	6	CAN speed start bit	27.03.2015	Arnold
04	6	CAN baud rate	30.03.2015	Arnold
05	8	Position Z	16.04.2015	Arnold
06	6, 12, 14	1 MBaud version, new part no., Loom options	11.05.2015	Schick
07	7	Byte order vehicle speed	29.06.2015	Schick
08	1.4	CAN update rate	02.10.2015	Schick
09	1.4, 2.2., 2.3	Date values, CAN cycles, CAN messages	13.10.2015	Schick
10	2.2, 4, 5, 6	Hex values for signed integer, DDU 9 replaces DDU 7	30.01.2017	Schick

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