FMB1YX Protocols
V0.15

Contents

1. FMB1YX DATA PROTOCOL

1.1 AVL data packet

Below table represents AVL data packet structure.

4 zeroes	Data field length	Codec ID	Number of Data 1	AVL Data	Number of Data 2	CRC-16
4 Bytes	*4 Bytes*	*1 Byte*	*1 Byte*	*30- 147 Bytes*	*1 Byte*	*4 bytes*

Number of data – number of encoded data (number of records).
In FMB1YX codec ID is constant 08.
Data field length is the length of bytes [codec id, number of data 2].
Number of data 1 should always be equal to number of data 2 byte.
CRC-16 is 4 bytes, but first two are zeroes and last two are CRC-16 calculated for [codec id, number of data 2]
Minimum AVL packet size is 45 bytes (all IO elements disabled).
Maximum AVL packet size for one record is 783 bytes

1.2 AVL Data

Timestamp	Priority	GPS Element	IO Element
8 Bytes	*1 Byte*	*15 Bytes*	*6-123*

Timestamp – difference, in milliseconds, between the current time and midnight, January 1, 1970 UTC.

1.3 Priority

0	Low
1	High
2	Panic

1.4 GPS Element

Longitude	Latitude	Altitude	Angle	Satellites	Speed
4 Bytes	*4 Bytes*	*2 Bytes*	*2 Bytes*	*1 Byte*	*2 Bytes*

X   Longitude[1]
Y   Latitude[1]
Altitude   In meters above sea level[1]
Angle   In degrees, 0 is north, increasing clock-wise [1]
Satellites Number of visible satellites[1]
Speed   Speed in km/h. 0x0000 if GPS data is invalid[1]

Longitude and latitude are integer values built from degrees, minutes, seconds and milliseconds by formula.

$$\left(d + \frac{m}{60} + \frac{s}{3600} + \frac{ms}{3600000}\right) * p$$

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[1] If record is without valid coordinates – (there were no GPS fix in the moment of data acquisition) – Longitude, Latitude and Altitude values are last valid fix, and Angle, Satellites and Speed are 0.

	Degrees
d	Degrees
m	Minutes
s	Seconds
ms	Milliseconds
p	Precision (10000000)

If longitude is in west or latitude in south, multiply result by –1. To determine if the coordinate is negative, convert it to binary format and check the very first bit. If it is 0, coordinate is positive, if it is 1, coordinate is negative.

Example:

Received value: 20 9c ca 80
Converted to BIN: 00100000 10011100 11001010 10000000 first bit is 0, which means coordinate is positive
Convered to DEC: 547146368
For more information see two's compliment arithmetics.

1.5   IO element

Event IO ID	N of **Total IO**	N1 of **One Byte** IO	1'st IO ID	1'st IO Value	...	N1'th IO ID	N1'th IO Value	N2 of **Two Bytes**	1'st IO ID	1'st IO Value	...	N2'th IO ID	N2'th IO Value	N4 of **Four Bytes**	1'st IO ID	1'st IO Value	...	N4'th IO ID	N4'th IO Value	N8 of **Eight Bytes**	1'st IO ID	1'st IO Value	...	N8'th IO ID	N8'th IO Value
1 Byte	1 Byte	1 Byte	1 Byte	1 Byte		1 Byte	1 Byte	1 Byte	1 Byte	2 Bytes		1 Byte	2 Bytes	1 Byte	1 Byte	4 Bytes		1 Byte	4 Bytes	1 Byte	1 Byte	8 Bytes		1 Byte	8 Bytes

Event IO ID – if data is acquired on event – this field defines which IO property has changed and generated an event. If data cause is not event – the value is 0.

N	total number of properties coming with record (N=N1+N2+N4+N8)
N1	number of properties, which length is 1 byte
N2	number of properties, which length is 2 bytes
N4	number of properties, which length is 4 bytes
N8	number of properties, which length is 8 bytes

Permanent I/O elements									
Property ID in AVL packet	Property Name	Bytes	Type	Min	Max	Multiplier	Units	Description	HW support
239	Ignition	1	Unsigned	0	1	-	-	Logic: 0/1 (depends on Ignition source)	All
240	Movement	1	Unsigned	0	1	-	-	Logic: 0/1 (depends on Movement source)	All
80	Data Mode	1	Unsigned	0	5	-	-	0 – Home On Stop 1 – Home On Moving 2 – Roaming On Stop 3 – Roaming On Moving 4 – Unknown On Stop 5 – Unknown On Moving	All
21	GSM Signal	1	Unsigned	0	5	-	-	Value in range 1-5	All
200	Sleep Mode	1	Unsigned	0	2	-	-	0 – No Sleep 1 – GPS Sleep 2 – Deep Sleep 3 – Online Sleep	All
69	GNSS Status	1	Unsigned	0	3	-	-	0 – OFF 1 - ON with fix 2 - ON without fix 3 - In sleep state	All
181	GNSS PDOP	2	Unsigned	0	500	0.1	-	Probability	All
182	GNSS HDOP	2	Unsigned	0	500	0.1	-	Probability	All
66	External Voltage	2	Unsigned	0	65535	-	mV	Voltage, mV	All
24	Speed	2	Unsigned	0	350	-	km/h	Value, km/h	All
205	GSM Cell ID	2	Unsigned	0	65535	-	-	GSM base station ID	All
206	GSM Area Code	2	Unsigned	0	65535	-	-	Location Area code (LAC), it depends on GSM operator. It provides unique number which assigned to a set of base GSM stations. Max value: 65536	All
67	Battery Voltage	2	Unsigned	0	65535	-	mV	Voltage, mV	FMB120, FMB122, FMB125
68	Battery Current	2	Unsigned	0	65535	-	mA	Current, mA	FMB120, FMB122, FMB125
241	Active GSM Operator	4	Unsigned	0	4294967295	-	-	Currently used GSM Operator code	All
199	Trip Odometer	4	Unsigned	0	4294967295	-	m	Trip Odometer value in meters	All

16	Total Odometer	4	Unsigned	0	4294967295	-	m	Total Odometer value in meters	All
1	Digital Input 1	1	Unsigned	0	1	-	-	Logic: 0/1	All
9	Analog input 1	2	Unsigned	0	65535	-	mV	Voltage, mV	All
179	Digital Output 1	1	Unsigned	0	1	-	-	Logic: 0/1	All
12	Fuel Used GPS	4	Unsigned	0	4294967295	-	ml	Fuel Used, ml	All
13	Fuel Rate GPS	2	Unsigned	0	32767	100	l/h, *100	Average Fuel Use, l/h,	All
17	Asis X	2	Signed	-8000	8000	-	mG	X axis value, mG	All
18	Asis Y	2	Signed	-8000	8000	-	mG	Y axis value, mG	All
19	Asis Z	2	Signed	-8000	8000	-	mG	Z axis value, mG	All
11	ICCID	8	Unsigned	0	0xffffffffffffffff	-	-	Value of SIM ICCID	All
10	SD Status	1	Unsigned	0	1	-	-	Logic: 0 – not present, 1 – present	All
2	Digital Input 2	1	Unsigned	0	1	-	-	Logic: 0/1	FMB100, FMB120, FMB122
3	Digital Input 3	1	Unsigned	0	1	-	-	Logic: 0/1	FMB100, FMB120, FMB122
6	Analog input 2	2	Unsigned	0	65535	-	mV	Voltage, mV	FMB100, FMB120, FMB122
180	Digital Output 2	1	Unsigned	0	1	-	-	Logic: 0/1	FMB100, FMB120, FMB122
72	Dallas Temperature	4	Signed	-550	1150	0.1	°C	Degrees (°C), -55 - +115, if 3000 – Dallas error	All
73	Dallas Temperature	4	Signed	-550	1150	0.1	°C	Degrees (°C), -55 - +115, if 3000 – Dallas error	All
74	Dallas Temperature	4	Signed	-550	1150	0.1	°C	Degrees (°C), -55 - +115, if 3000 – Dallas error	All
75	Dallas Temperature	4	Signed	-550	1150	0.1	°C	Degrees (°C), -55 - +115, if 3000 – Dallas error	All
76	Dallas Temperature ID 1	8	Unsigned	0	0xffffffffffffffff	-	-	Dallas sensor ID	All
77	Dallas Temperature ID 2	8	Unsigned	0	0xffffffffffffffff	-	-	Dallas sensor ID	All
79	Dallas Temperature ID 3	8	Unsigned	0	0xffffffffffffffff	-	-	Dallas sensor ID	All
71	Dallas Temperature ID 4	8	Unsigned	0	0xffffffffffffffff	-	-	Dallas sensor ID	All
78	iButton	8	Unsigned	0	0xffffffffffffffff	-	-	iButton ID	All
207	RFID	8	Unsigned	0	0xffffffffffffffff	-	-	RFID ID	FMB125

201	LLS Fuel 1	2	Unsigned	0	65535	-	kvants or ltr	Fuel level measured by LLS sensor via RS232 in kvants or liters	FMB125
202	LLS Temperature 1	1	Signed	-128	127	-	°C	Fuel temperature measured by LLS via RS232 in degrees Celsius	FMB125
203	LLS Fuel 2	2	Unsigned	0	65535	-	kvants or ltr	Fuel level measured by LLS sensor via RS232 in kvants or liters	FMB125
204	LLS Temperature 2	1	Signed	-128	127	-	°C	Fuel temperature measured by LLS via RS232 in degrees Celsius	FMB125
210	LLS Fuel 3	2	Unsigned	0	65535	-	kvants or ltr	Fuel level measured by LLS sensor via RS232 in kvants or liters	FMB125
211	LLS Temperature 3	1	Signed	-128	127	-	°C	Fuel temperature measured by LLS via RS232 in degrees Celsius	FMB125
212	LLS Fuel 4	2	Unsigned	0	65535	-	kvants or ltr	Fuel level measured by LLS sensor via RS232 in kvants or liters	FMB125
213	LLS Temperature 4	1	Signed	-128	127	-	°C	Fuel temperature measured by LLS via RS232 in degrees Celsius	FMB125
214	LLS Fuel 5	2	Unsigned	0	65535	-	kvants or ltr	Fuel level measured by LLS sensor via RS232 in kvants or liters	FMB125
215	LLS Temperature 5	1	Signed	-128	127	-	°C	Fuel temperature measured by LLS via RS232 in degrees Celsius	FMB125
15	Eco Score	2	Unsigned	0	65535	0.01	-	Average amount of events on some distance	All
238	User ID	8	Unsigned	0	0xffffffffffffffff	-	-	MAC address of NMEA receiver device connected via Bluetooth	All
25	BLE Temperature #1	2	Signed	-400	1250	0.1	°C	Degrees (°C), -40 - +125; Error codes: 4000 – abnormal sensor state 3000 – sensor not found 2000 – failed sensor data parsing	
26	BLE Temperature #2	2	Signed	-400	1250	0.1	°C	Degrees (°C), -40 - +125; Error codes: 4000 – abnormal sensor state 3000 – sensor not found 2000 – failed sensor data parsing	
27	BLE Temperature #3	2	Signed	-400	1250	0.1	°C	Degrees (°C), -40 - +125; Error codes: 4000 – abnormal sensor state 3000 – sensor not found 2000 – failed sensor data parsing	
28	BLE Temperature #4	2	Signed	-400	1250	0.1	°C	Degrees (°C), -40 - +125; Error codes: 4000 – abnormal sensor state 3000 – sensor not found 2000 – failed sensor data parsing	
29	BLE Battery voltage #1	1	Unsigned	0	100	-	%	Battery voltage of sensor #1	

20	BLE Battery voltage #2	1	Unsigned	0	100	-	%	Battery voltage of sensor #2	
22	BLE Battery voltage #3	1	Unsigned	0	100	-	%	Battery voltage of sensor #3	
23	BLE Battery voltage #4	1	Unsigned	0	100	-	%	Battery voltage of sensor #4	
86	BLE Humidity #1	2	Unsigned	0	1000	0.1	%RH		
104	BLE Humidity #2	2	Unsigned	0	1000	0.1	%RH		
106	BLE Humidity #3	2	Unsigned	0	1000	0.1	%RH		
108	BLE Humidity #4	2	Unsigned	0	1000	0.1	%RH		
8	Authorized iButton	8	Unsigned	0	0xffffffffffffffff	-	-	If ID is shown in this I/O that means that attached iButton is in iButton List	All
4	Pulse Counter Din1	4	Unsigned	0	4294967295	-	-	Counts pulses, count is reset when recors is saved	All
5	Pulse Counter Din2	4	Unsigned	0	4294967295	-	-	Counts pulses, count is reset when recors is saved	FMB100, FMB110, FMB120, FMB122
7	Records In Flash	2	Unsigned	0	65535	-	-	Shows record count left in device memory.	All

OBD elements									
Property ID in AVL packet	**Property Name**	**Bytes**	**Type**	**Min**	**Max**	**Multiplier**	**Units**	**Description**	**HW support**
30	Number of DTC	1	Unsigned	0	255	-	-	Number of DTC	All
31	Calculated engine load value	1	Unsigned	0	100	-	%	Calculated engine load value, %	All
32	Engine coolant temperature	1	Signed	-128	127	-	°C	Engine coolant temperature, °C	All
33	Short term fuel trim 1	1	Signed	-100	99	-	%	Short term fuel trim 1, %	All
34	Fuel pressure	2	Unsigned	0	765	-	kPa	Fuel pressure, kPa	All
35	Intake manifold absolute pressure	1	Unsigned	0	255	-	kPa	Intake manifold absolute pressure, kPa	All
36	Engine RPM	2	Unsigned	0	16384	-	rpm	Engine RPM, rpm	All
37	Vehicle speed	1	Unsigned	0	255	-	km/h	Vehicle speed, km/h	All
38	Timing advance	1	Signed	-64	64	-	°	Timing advance, degrees °	All
39	Intake air temperature	1	Signed	-128	127	-	°C	Intake air temperature, °C	All
40	MAF air flow rate	2	Unsigned	0	65535	0.01	g/sec	MAF air flow rate, g/sec	All

Property ID	Property Name	Bytes	Type	Min	Max	Multiplier	Units	Description	HW support
41	Throttle position	1	Unsigned	0	100	-	%	Throttle position, %	All
42	Run time since engine start	2	Unsigned	0	65535	-	s	Run time since engine start, s	All
43	Distance traveled MIL on	2	Unsigned	0	65535	-	km	Distance * ormattin MIL on, km	All
44	Relative fuel rail pressure	2	Unsigned	0	5178	0.1	kPa	Relative fuel rail pressure, kPa	All
45	Direct fuel rail pressure	2	Unsigned	0	656	0.1	kPa	Direct fuel rail pressure, kPa	All
46	Commanded EGR	1	Unsigned	0	100	-	%	Commanded EGR, %	All
47	EGR error	1	Signed	-100	100	-	%	EGR error, %	All
48	Fuel level	1	Unsigned	0	100	-	%	Fuel level, %	All
49	Distance * ormattin since codes cleared	2	Unsigned	0	65535	-	km	Distance * ormattin since codes cleared, km	All
50	Barometric pressure	1	Unsigned	0	255	-	kPa	Barometric pressure, kPa	All
51	Control module voltage	2	Unsigned	0	65535	-	mV	Control module voltage, mV	All
52	Absolute load value	2	Unsigned	0	25700	0.001	%	Absolute load value, %	All
53	Ambient air temperature	1	Signed	-128	127	-	°C	Ambient air temperature, °C	All
54	Time run with MIL on	2	Unsigned	0	65535	-	min	Time run with MIL on, min	All
55	Time since trouble codes cleared	2	Unsigned	0	65535	-	min	Time since trouble codes cleared, min	All
56	Absolute fuel rail pressure	2	Unsigned	0	65535	0.1	kPa	Absolute fuel rail pressure, kPa	All
57	Hybrid battery pack remaining life	1	Unsigned	0	100	-	%	Hybrid battery pack remaining life, %	All
58	Engine oil temperature	1	Signed	-128	127	-	°C	Engine oil temperature, °C	All
59	Fuel injection timing	2	Signed	-21000	30200	0.01	°	Fuel injection timing, degrees °	All
60	Engine fuel rate	2	Unsigned	0	32767	0.01	l/100km	Engine fuel rate, l/100km	All
256	VIN	17	String	0	255	-	-	VIN number	All
LVCAN elements									
Property ID in AVL packet	**Property Name**	**Bytes**	**Type**	**Min**	**Max**	**Multiplier**	**Units**	**Description**	**HW support**

81	LVCAN Speed	1	Unsigned	0	255	-	km/h	Value in km/h	All
82	LVCAN Accelerator Pedal Position	1	Unsigned	0	102	-	%	Value in persentages, %	All
83	LVCAN Total Fuel Used	4	Unsigned	0	2147483647	0.1	l	Value in liters, L	All
84	LVCAN Fuel Level (liters)	2	Unsigned	0	65535	0.1	l	Value in liters, L	All
85	LVCAN Engine RPM	2	Unsigned	0	16384	-	rpm	Value in rounds per minute, rpm	All
87	LVCAN Vehicle Distance	4	Unsigned	0	4294967295	-	m	Value in meters, m	All
89	LVCAN Fuel Level (percentage)	1	Unsigned	0	6553	-	%	Value in percentages, %	All
90	LVCAN Door Status	2	Unsigned	0	16128	-	-	Door status value: Min – 0, Max – 16128 Door status is represented as bitmask converted to decimal value. Possible values: 0 – all doors closed, 0x100 (256) – front left door is opened, 0x200 (512) – front right door is opened, 0x400 (1024) – rear left door is opened, 0x800 (2048) – rear right door is opened, 0x1000 (4096) – hood is opened, 0x2000 (8192) – trunk is opened, 0x3F00 (16128) – all doors are opened, or combinations of values	All
100	LVCAN Program Number	4	Unsigned	0	999	-	-	Value: Min – 0, Max – 999	All
101	LVC ModuleID	8	Unsigned	0	0xffffffffffffffff	-	-	Module ID	All
102	LVC Engine Work Time	4	Unsigned	0	16777215	-	min	Engine work time in minutes	All
103	LVC Engine Work Time (counted)	4	Unsigned	0	16777215	-	min	Total Engine work time in minutes	All
105	LVC Total Mileage (counted)	4	Unsigned	0	4294967295	-	m	Total Vehicle Mileage, m	All
107	LVC Fuel Consumed (counted)	4	Unsigned	0	2147483647	0.1	l	Total Fuel Consumed, l	All
110	LVC Fuel Rate	2	Unsigned	0	32768	0.1	l/h	Fuel Rata, l/h	All
111	LVC AdBlue Level (percent)	1	Unsigned	0	6553	-	%	AdBlue, %	All

112	LVC AdBlue Level (liters)	2	Unsigned	0	65535	0.1	l	AdBlue level, L	All
114	LVC Engine Load	1	Unsigned	0	130	-	%	Engine load, %	All
115	LVC Engine Temperature	2	Signed	-600	1270	0.1	°C	Engine Temperature, °C	All
118	LVC Axle 1 Load	2	Unsigned	0	32768	-	kg	Axle 1 load, kg	All
119	LVC Axle 2 Load	2	Unsigned	0	32768	-	kg	Axle 2 load, kg	All
120	LVC Axle 3 Load	2	Unsigned	0	32768	-	kg	Axle 3 load, kg	All
121	LVC Axle 4 Load	2	Unsigned	0	32768	-	kg	Axle 4 load, kg	All
122	LVC Axle 5 Load	2	Unsigned	0	32768	-	kg	Axle 5 load, kg	All
123	LVC Control State Flags	4	Unsigned	0	4294967295	-	-	Control state flags	All
124	LVC Agricultural Machinery Flags	8	Unsigned	0	0xffffffffffffffff	-	-	Agricultural machinery flags	All
125	LVC Harvesting Time	4	Unsigned	0	16777215	-	min	Harvesting Time, minutes	All
126	LVC Area of Harvest	4	Unsigned	0	4294967295	-	m^2	Area of Harvest, m^2	All
127	LVC Mowing Efficiency	4	Unsigned	0	4294967295	-	m^2/h	Mowing efficiency, (m^2)/h	All
128	LVC Grain Mown Volume	4	Unsigned	0	4294967295	-	kg	Mown Volume, kg	All
129	LVC Grain Moisture	2	Unsigned	0	6553	-	%	Grain Moisture in proc, %	All
130	LVC Harvesting Drum RPM	2	Unsigned	0	65535	-	rpm	Harvesting Drum RPM, RPM	All
131	LVC Gap Under Harvesting Drum	1	Unsigned	0	255	-	mm	Gap Under Harvesting Drum, mm	All
132	LVC Security State Flags	8	Unsigned	0	0xffffffffffffffff	-	-	Security State Flag	All
133	LVC Tacho Total Vehicle Distance	4	Unsigned	0	4294967295	-	m	Tacho Total Vehicle Distance, m	All
134	LVC Trip Distance	4	Unsigned	0	4294967295	-	m	Trip Distance, m	All
135	LVC Tacho Vehicle Speed	2	Unsigned	0	256	-	km/h	Tacho Vehicle Speed, km/h	All
136	LVC Tacho Driver Card Presence	1	Unsigned	0	3	-	-	Tacho Driver Card Presence	All
137	LVC Driver1 States	1	Unsigned	0	255	-	-	Driver1 States	All
138	LVC Driver2 States	1	Unsigned	0	255	-	-	Driver2 States	All
139	LVC Driver1 Continuous Driving Time	2	Unsigned	0	65535	-	min	Driver1 Continuous Driving Time, minutes	All

140	LVC Driver2 Continuous Driving Time	2	Unsigned	0	65535	-	min	Driver2 Continuous Driving Time, minutes	All
141	LVC Driver1 Cumulative Break Time	2	Unsigned	0	65535	-	min	Driver1 Cumulative Break Time, minutes	All
142	LVC Driver2 Cumulative Break Time	2	Unsigned	0	65535	-	min	Driver2 Cumulative Break Time, minutes	All
143	LVC Driver1 Duration Of Selected Activity	2	Unsigned	0	65535	-	min	Driver1 Duration Of Selected Activity, minutes	All
144	LVC Driver2 Duration Of Selected Activity	2	Unsigned	0	65535	-	min	Driver2 Duration Of Selected Activity, minutes	All
145	LVC Driver1 Cumulative Driving Time	2	Unsigned	0	65535	-	min	Driver1 Cumulative Driving Time, minutes	All
146	LVC Driver2 Cumulative Driving Time	2	Unsigned	0	65535	-	min	Driver2 Cumulative Driving Time, minutes	All
147	LVC Driver1 ID High	8	Unsigned	0	0xffffffffffffffff	-	-	Driver1 ID High	All
148	LVC Driver1 ID Low	8	Unsigned	0	0xffffffffffffffff	-	-	Driver1 ID Low	All
149	LVC Driver2 ID High	8	Unsigned	0	0xffffffffffffffff	-	-	Driver2 ID High	All
150	LVC Driver2 ID Low	8	Unsigned	0	0xffffffffffffffff	-	-	Driver2 ID Low	All
151	LVC Battery Temperature	2	Signed	-600	1270	0.1	°C	Degrees, °C	All
152	LVC Battery Level (percent)	1	Unsigned	0	6553	-	%	Value in percentages, %	All
160	LVC DTC Faults	1	Unsigned	0	255	-	-	DTC Faults	All
161	LVC Slope Of Arm	2	Signed	-3276	3276	-	°	Slope Of Arm, degrees °	All
162	LVC Rotation Of Arm	2	Signed	-180	180	-	°	Rotation Of Arm, degrees °	All
163	LVC Eject Of Arm	2	Unsigned	0	6553	-	m	Eject Of Arm, m	All
164	LVC Horizontal Distance Arm Vehicle	2	Unsigned	0	6553	-	m	Horizontal Distance Arm Vehicle, m	All
165	LVC Height Arm Above Ground	2	Unsigned	0	6553	-	m	Height Arm Above Ground, m	All
166	LVC Drill RPM	2	Unsigned	0	65535	-	rpm	Drill RPM, RPM	All

167	LVC Amount Of Spread Salt square Meter	2	Unsigned	0	655	-	g/m^2	Amount Of Spread Salt Square Meter, g/m^2	All
168	LVC Battery Voltage	2	Unsigned	0	6553	-	V	Battery Voltage, V	All
169	LVC Amount Of Spread Fine Grained Salt	4	Unsigned	0	1677722	-	T	Amount Of Spread Fine Grained Salt, T	All
170	LVC Amount Of Coarse Grained Salt	4	Unsigned	0	1677722	-	T	Amount Of Coarse Grained Salt, T	All
171	LVC Amount Of Spread DiMix	4	Unsigned	0	1677722	-	T	Amount Of Spread DiMix, T	All
172	LVC Amount Of Spread Coarse Grained Calcium	4	Unsigned	0	1677722	-	m^3	Amount Of Spread Coarse Grained Calcium, m^3	All
173	LVC Amount Of Spread Calcium Chloride	4	Unsigned	0	1677722	-	m^3	Amount Of Spread Calcium Chloride, m^3	All
174	LVC Amount Of Spread Sodium Chloride	4	Unsigned	0	1677722	-	m^3	Amount Of Spread Sodium Chloride, m^3	All
176	LVC Amount Of Spread Magnesium Chloride	4	Unsigned	0	1677722	-	m3	Amount Of Spread Magnesium Chloride, m^3	All
177	LVC Amount Of Spread Gravel	4	Unsigned	0	1677722	-	T	Amount Of Spread Gravel, T	All
178	LVC Amount Of Spread Sand	4	Unsigned	0	1677722	-	T	Amount Of Spread Sand, T	All
183	LVC Width Pouring Left	2	Unsigned	0	655	-	m	Width Pouring Left, m	All
184	LVC Width Pouring Right	2	Unsigned	0	655	-	m	Width Pouring Right, m	All
185	LVC Salt Spreader Working Hours	4	Unsigned	0	1677722	-	h	Salt Spreader Working Hours, h	All
186	LVC Distance During salting	4	Unsigned	0	1677722	-	km	Distance During salting, km	All
187	LVC Load Weight	4	Unsigned	0	16777215	-	kg	Load Weight, kg	All
188	LVC Retarder Load	1	Unsigned	0	130	-	%	Retarder Load, %	All
189	LVC Cruise Time	4	Unsigned	0	16777215	-	min	Cruise Time, minutes	All
232	LVC CNG Status	1	Unsigned	0	1	-		CNG Status	All
233	LVC CNG Used	2	Unsigned	0	16777215	-	Kg	CNG Used	All

| 234 | LVC CNG Level | 2 | Unsigned | 0 | 16777215 | - | % | CNG Level | All |
| 235 | LVC Oil Level | 1 | Unsigned | 0 | 255 | - | | Oil Level | All |

	Eventual I/O elements (generate and send record to server only if appropriate conditions are met)								
Property ID in AVL packet	**Property Name**	**Bytes**	**Type**	**Min**	**Max**	**Multiplier**	**Units**	**Description**	**HW support**
155	Geofence zone 01	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
156	Geofence zone 02	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
157	Geofence zone 03	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
158	Geofence zone 04	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
159	Geofence zone 05	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
61	Geofence zone 06	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
62	Geofence zone 07	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
63	Geofence zone 08	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
64	Geofence zone 09	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
65	Geofence zone 10	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
70	Geofence zone 11	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All

88	Geofence zone 12	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
91	Geofence zone 13	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
92	Geofence zone 14	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
93	Geofence zone 15	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
94	Geofence zone 16	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
95	Geofence zone 17	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
96	Geofence zone 18	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
97	Geofence zone 19	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
98	Geofence zone 20	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
99	Geofence zone 21	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
153	Geofence zone 22	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
154	Geofence zone 23	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
190	Geofence zone 24	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
191	Geofence zone 25	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All

192	Geofence zone 26	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
193	Geofence zone 27	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
194	Geofence zone 28	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
195	Geofence zone 29	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
196	Geofence zone 30	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
197	Geofence zone 31	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
198	Geofence zone 32	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
208	Geofence zone 33	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
209	Geofence zone 34	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
216	Geofence zone 35	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
217	Geofence zone 36	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
218	Geofence zone 37	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
219	Geofence zone 38	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
220	Geofence zone 39	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All

221	Geofence zone 40	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
222	Geofence zone 41	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
223	Geofence zone 42	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
224	Geofence zone 43	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
225	Geofence zone 44	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
226	Geofence zone 45	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
227	Geofence zone 46	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
228	Geofence zone 47	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
229	Geofence zone 48	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
230	Geofence zone 49	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
231	Geofence zone 50	1	Unsigned	0	3	-	-	Event: 0 – target left zone, 1 – target entered zone, 2 – over speeding end, 3 – over speeding start	All
175	Auto Geofence	1	Unsigned	0	1	-	-	Event: 0 – target left zone, 1 – target entered zone	All
250	Trip	1	Unsigned	0	1	-	-	1 – trip start, 0 – trip stop From 01.00.24 FW version available with BT app new values: 2 – Business Status; 3 – Private Status; 4-9 – Custom Statuses	All
255	Over Speeding	1	Unsigned	0	255	-	km/h	At over speeding start km/h, at over speeding end km/h	All

251	Idling	1	Unsigned	0	1	-	-	0 – moving, 1 – idling	All
253	Green driving type	1	Unsigned	1	3	-	-	1 – harsh acceleration, 2 – harsh braking, 3 – harsh cornering	All
246	Towing	1	Unsigned	0	1	-	-	0 – steady, 1 – towing	All
252	Unplug	1	Unsigned	0	1	-	-	0 – battery present, 1 – battery unpluged	FMB120, FMB122, FMB125
247	Crash detection	1	Unsigned	0	1	-	-	0 – no crash, 1 – crash	All
248	Immobilizer	1	Unsigned	0	2	-	-	0 – iButton not connected, 1 – iButton connected (Immobilizer), 2 – iButton connected (Authorized Driving)	All
254	Green driving value	1	Unsigned	0	255	acc and braking: 0.01	G or rad	Depending on green driving type: if harsh acceleration or braking – g*100 (value 123 -> 1.23g), if harsh cornering – degrees (value in radians)	All
249	Jamming	1	Unsigned	0	1	-	-	1 – jamming start, 0 – jamming stop	All
14	ICCID2	8	Unsigned	0	0xffffffffffffffff	-	-	Value of SIM ICCID, LSB	All
243	Green driving event duration	2	Unsigned	0	65535	-	ms	Duration of event that did generate Green Driving	All
244	DIN2/AIN2 spec event	1	Unsigned	0	1	-	-	Generates after spec DIN2/AIN2 scenario	All
109	Delimiter	Variable	Hex	0	254	-	-	Packet received on RS232	All

*ICCID Full Value Calculation, Example

1) Calculate ID:14 length as string
2) If length < 10, then add_zeros = 10 – length
3) Else no zeros must be added
4) Concat strings to get final value. Final value = String(ID 11) + String(add_zeros) + String(ID 14).

ID:11 Len as string	ID:14 Len as string	Full Value	Full Value Len
9	9	String(ID 11) + „0" + String(ID 14)	19
9	10	String(ID 11) + String(ID 14)	19
10	10	String(ID 11) + String(ID 14)	20

9	11	String(ID 11) + String(ID 14)	20
11	8	String(ID 11) + „00" + String(ID 14)	21
11	10	String(ID 11) + String(ID 14)	21
12	10	String(ID 11) + String(ID 14)	22
12	9	String(ID 11) + „0" + String(ID 14)	22

1.6   Example

Received data:
```
000000000000008c080100000013feb55ff740000f0ea850209a690000940000120000001e0901000200030004001601470
3f0001504c8000c0900730a00460b00501300464306
d7440000b5000bb60007422e9f180000cd0386ce000107c700000000f10000601a4600
0001344800000bb84900000bb84a00000bb84c0000000024e0000000000000000cf00
0000000000000001000003fca
```
In total 152 Bytes.

```
00000000 4 zeroes, 4 bytes
0000008c data length, 4 bytes
08 – Codec ID
    01– Number of Data (1 record)

        1'st record data

            0000013feb55ff74 – Timestamp in milliseconds
(1374042849140)
            GMT: Wed, 17 Jul 2013 06:34:09 GMT
            00 – Priority

        GPS Element

            0f0ea850        – Longitude 252618832 = 25,2618832° N
            209a6900        – Latitude 546990336 = 54,6990336 ° E
            0094            – Altitude 148 meters
            0000            – Angle 214°
            12              – 12 Visible sattelites
            0000            – 0 km/h speed

        IO Element

        00 – IO element ID of Event generated (in this case when
        00 – data generated not on event)
        1e – 30 IO elements in record (total)
        09 – 9 IO elements, which length is 1 Byte
            0       – IO element ID = 01
            0       – IO element's value = 0
            02      – IO element ID = 02
            0       – IO element's value = 0
            03      – IO element ID = 03
            0       – IO element's value = 0
            04      – IO element ID = 04
            0       – IO element's value = 0
            16      – IO element ID = 22 (dec)
            0       – IO element's value = 1
            47      – IO element ID = 71 (dec)
            03      – IO element's value = 3
            F0      – IO element ID = 240 (dec)
```

```
0        - IO element's value = 0
15       - IO element ID = 21 (dec)
04       - IO element's value = 0
C8       - IO element ID = 200 (dec)
0        - IO element's value = 0
```

0C   – 12 IO elements, which value length is 2 Bytes

```
09       - IO element ID = 9 (dec)
0073     - IO element's value
0a       - IO element ID = 10 (dec)
0046     - IO element's value
0b       - IO element ID = 11 (dec)
0050     - IO element's value
13       - IO element ID = 19 (dec)
0046     - IO element's value
43       - IO element ID = 67 (dec)
06d7     - IO element's value
       0 - IO element ID = 68 (dec)
0        - IO element's value
B5       - IO element ID = 181 (dec)
000b     - IO element's value
B6       - IO element ID = 182 (dec)
0007     - IO element's value
42       - IO element ID = 66 (dec)
2e9f     - IO element's value
       1 - IO element ID = 24 (dec)
0        - IO element's value
cd       - IO element ID = 205 (dec)
       2 - IO element's value
CE       - IO element ID = 206 (dec)
0        - IO element's value
```

07 – 7 IO elements, which value length is 4 Bytes

```
C7          - IO element ID = 199 (dec)
0        - IO element's value
f1          - IO element ID = 241 (dec)
0000601a    - IO element's value
46          - IO element ID = 70 (dec)
00000134    - IO element's value
48          - IO element ID = 72 (dec)
00000bb8    - IO element's value
       3 - IO element ID = 73 (dec)
00000bb8    - IO element's value
4a          - IO element ID = 74 (dec)
00000bb8    - IO element's value
4c          - IO element ID = 76 (dec)
1        - IO element's value
```

02 – 2 IO elements, which value length is 8 Bytes

```
4e                 - IO element ID = 78 (dec)
```

```
            0         – IO element's value
            cf                   – IO element ID = 207 (dec)
            0         – IO element's value
```

```
0    –Number of Data (1 record)
00003fca      - CRC-16, 4 Bytes (first 2 are always zeroes)
```

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2. SENDING DATA OVER TCP/IP

First when module connects to server, module sends its IMEI. First comes short identifying number of bytes written and then goes IMEI as text (bytes).

For example IMEI 356307042441013 would be sent as 000f333536333037303432343431303133

First two bytes denote IMEI length. In this case 000F means, that imei is 15 bytes long.

After receiving IMEI, server should determine if it would accept data from this module. If yes server will reply to module 01 if not 00. Note that confirmation should be sent as binary packet. I.e. 1 byte 0x01 or 0x00.

Then module starts to send first AVL data packet. After server receives packet and parses it, server must report to module number of data received as integer (four bytes).

If sent data number and reported by server doesn't match module resends sent data.

Example:
Module connects to server and sends IMEI:
000f333536333037303432343431303133
Server accepts the module:
01
Module sends data packet:

AVL data packet header	AVL data array	CRC
Four zero bytes, 'AVL data array' length – 254	CodecId – 08, NumberOfData – 2. (Encoded using continuous bit stream. Last byte padded to align to byte boundary)	CRC of 'AVL data array'
0000000000000FE	0802...(data elements)...02	00008612

Server acknowledges data reception (2 data elements):
00000002

3. SENDING DATA OVER UDP/IP

3.1 UDP channel protocol

UDP channel is a transport layer protocol above UDP/IP to add reliability to plain UDP/IP using acknowledgment packets. The packet structure is as follows:

UDP datagram			
UDP channel packet x N	Packet length	2 bytes	Packet length (excluding this field) in big endian byte order
	Packet Id	2 bytes	Packet id unique for this channel
	Packet Type	1 byte	Type of this packet
	Packet payload	m bytes	Data payload

Packet Type	
1	Data packet requiring acknowledgment

Acknowledgment packet should have the same *packet id* as acknowledged data packet and empty data payload. Acknowledgement should be sent in binary format.

Acknowledgment packet		
Packet length	2 bytes	0x0003
Packet id	2 bytes	same as in acknowledged packet
Packet type	1 byte	0x02

3.2 Sending AVL data using UDP channel

AVL data are sent encapsulated in UDP channel packets (*Data payload* field).

AVL data encapsulated in UDP channel packet		
AVL packet id (1 byte)	Module IMEI	AVL data array

AVL packet id (1 byte) – id identifying this AVL packet
Module IMEI – IMEI of a sending module encoded the same as with TCP
AVL data array – array of encoded AVL data

Server response to AVL data packet	
AVL packet id (1 byte)	Number of accepted AVL elements (1 byte)

AVL packet id (1 byte) – id of received AVL data packet
Number of AVL data elements accepted (1 byte) – number of AVL data array entries from the beginning of array, which were accepted by the server.

Scenario:

Module sends UDP channel packet with encapsulated AVL data packet (*Packet* type=1 or 0). If packet type is 0, server should respond with valid UDP channel acknowledgment packet. Since server should respond to the AVL data packet, UDP channel acknowledgment is not necessary in this scenario, so *Packet type=1* is recommended.

Server sends UDP channel packet with encapsulated response (*Packet type=1* – this packet should not require acknowledgment)

Module validates *AVL packet id* and *Number of accepted AVL elements*. If server response with valid *AVL packet id* is not received within configured timeout, module can retry sending.

Example:
Module sends the data:

UDP channel header	AVL packet header	AVL data array
Len – 253, Id – 0xCAFE, Packet type – 01 (without ACK)	AVL packet id – 0xDD, IMEI – 1234567890123456	CodecId – 08, NumberOfData – 2. (Encoded using continuous bit stream)
00FDCAFE01	DD000F31323334353637383930313132333435	0802…(data elements)…02

Server must respond with acknowledgment:

UDP channel header	AVL packet acknowledgment
Len – 5, Id – 0xABCD, Packet type – 01 (without ACK)	AVL packet id – 0xDD, NumberOfAcceptedData – 2
0005ABCD01	DD02

Another example, with all IO id's enabled

```
Server received data:
00a1cafe011b000f333536333330373034323434313033133308010000013febdd19c8000f
0e9ff0209a718000690000120000001e090100020003000400016014703f0001504c800
0c0900910a00440b004d130044431555440000b5000bb60005422e9b180000cd0386ce
000107c700000000f10000601a460000013c4800000bb84900000bb84a00000bb84c00
000000024e0000000000000000cf0000000000000000001
```

Data length: 00a1 or 161 Bytes (not counting the first 2 data length bytes)
Packet identification: 0xCAFE 2 bytes
Packet type: 01
Packet id: 1b
Imei length: 000f
Actual imei: 333536333330373034323434313033133
Codec id: 08
Number of data: 01
Timestamp: 0000013febdd19c8
Priority: 00
GPS data: 0f0e9ff0209a718000690000120000

UDP protocol is the same as TCP except message header is 7 bytes, which consist of: data length, packet identification, packet type and packet id.
Then goes imei length and imei itself.
And after that goes AVL data.
And at the very end number of data byte. There is no CRC in UDP.

4.   SENDING DATA USING SMS

AVL data or events can be sent encapsulated in binary SMS. TP-DCS field of these SMS should indicate that message contains 8-bit data (for example: TP-DCS can be 0x04).

SM data (TP-UD)	
AVL data array	*IMEI:* 8 bytes

AVL data array – array of encoded AVL data
IMEI – IMEI of sending module encoded as a big endian 8-byte long number.

5. SMS EVENTS

When configured to generate SMS event user will get this SMS upon event

\<Year/Month/Day\> \<Hour:Minute:Second\> Lon:\<longitude\> **Lat**:\<latitude\> **Q:**\<HDOP\> **\<SMS Text\> Va**l:\<Event Value\>

Example:
2016/04/11 12:00:00 Lon:51.12258 Lat: 25.7461 Q:0.6 Digital Input 1 Val:1

6. CHANGE LOG

Nr.	Date	New version number	Comments
1	2017.04.21	0.0	First release
2	2017.04.24	0.1	Minor formatting changes
3	2017.04.24	0.2	Geofence description and UDP/IP packet type updated
4	2017.04.27	0.3	Updated elements' table (added type, min, max, multiplier, units columns)
5	2017.04.28	0.4	Added Eco Score, updated some ranges
6	2017.05.02	0.5	Updated EcoScore multiplier
7	2017.06.16	0.6	Updated IO GNSS state values
8	2017.07.03	0.7	Description added: ICCID Full Value Calculation
9	2017.07.25	0.8	Updated OBD fuel rate parameter.
10	2017.07.27	0.9	Updated Eco Score multiplier.
11	2017.10.11	0.10	Added LVCAN IO: CNG Status, CNG Used, CNG Level, OIL Level
12	2017.12.20	0.11	Added BLE IO element IDs.
13	2018.01	0.12	Added VIN element.
14	2018.01.24	0.13	Dallas Temperature max value changed. AVL ID 250 Trip – added new BT app description.
15	2018.02.05	0.14	Added parameters: Delimiter, DIN2/AIN2 spec event, Green driving event duration, ICCID2, User ID, Authorized iButton, Pulse Counter Din1, Pulse Counter Din2, Records In Flash
16	2018.05.28	0.15	Corrected record example