KanCan
Kanardia Can Bus Specification

Kanardia d.o.o.

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Draft – document in preparation.
Use with care – there are mistakes in the document.
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A lot of useful and recent information can be also found on the Internet. See http://www.kanardia.eu for more details.

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Revision History

The following table shows the revision history of this document.

Revision	Date	Description

Contents

1 Message

CAN message is the basic communication unit in the CAN network. We are using CAN extended frame format, which supports 29 bit identifier.

Initially, we tried to closely follow CANAerospace protocol. But due to specific needs required by our products, we started to depart from it. The only thing where we still mostly follow the protocol are identifier ids for normal operation data (id range 300 – 1799).

One of the major drawbacks of CANAerospace protocol is limited use of A register, which results in unnecessary increase of the network traffic.

1.1 Basic Characteristics

Basic characteristics of our CAN bus are:

- Network speed of 500 kbit/s.
- 29 bit Identifier.
- 8 byte payload (data) as 2 x 32 bit blocks (registers).
- 32 bit blocks are in *little endian* format.
- When floating point is used, it is stored in widely used IEEE754 format.

1.2 Message Structure

Each message is composed of three parts. The first part is identifier, which is followed by data in two 32 bit registers, Table 1.

Table 1: Message decomposition

29 bit	32 bit (4 bytes)	32 bit (4 bytes)
Identifier	Register A	Register B

1.2.1 Identifier

The identifier can be further decomposed into four parts as shown in Table 2.

Table 2: Identifier decomposition

28:27	26:16	15:8	7:0
Layer	Id (11 bits)	Sender	Receiver

`Layer` tells additional information to the id. Usually it means priority, but it may have other meanings as well. It can take values from 0-3. In most cases, the meaning is as follows:

0. Primary (also used as Request from A).
1. Seconday (also used as Responce from B).

2. Tertiary (also used as Data from A).
3. Quaterary (also used as Data from B).

`Id` tells the content of the data payload that follows. Possible range is 0 – 2047.

`Sender` tells dynamic address of the sending device. In the case of Kanardia devices, address is dynamically allocated starting with 255 and then going downwards towards 129.[1]

`Receiver` tells address of the receiving device. For broadcast messages the address 0 is used. In general, receiving device shall process the message only if the receiver address is 0 or if it matches devices dynamic address.

1.2.2 Registers A, B

Registers A and B may hold any payload. The structure of the payload depends in the message *Id* and sometimes also on *Layer*. Bytes in each register can be combined into various combinations. For example, as four bytes, as two 16 bit integers, as two bytes and one 16 bit integer, as 4 byte float, as two half floats, as one 32 bit integer, etc. Sometimes, both registers are combined together to hold a 64 bit float or a 64 bit integer.

For majority of messages only two combinations are used.

Table 3: Register decomposition

Register A				Register B			
LSB	LSB+1	LSB+2	MSB	LSB	LSB+1	LSB+2	MSB
Byte 0	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7

2 Standard Messages

Standard messages are messages with identifier ids between 300 and 1799. Most ids follow CANAerospace proposal.

In almost all cases (with a few exceptions, of course) registers A and B are used as shown in Table 4. Register B holds 32 bit floating point value. In few cases, byte 2 of register A is also used.

Table 4: Register decomposition for most standard messages.

Register A				Register B			
LSB	LSB+1	LSB+2	MSB	LSB	LSB+1	LSB+2	MSB
Not used		Byte 2	Not used	Float 32			

Next sections list messages that are currently used by Kanardia devices. They mostly follow CANAerospace ids for the Normal Operation Data, but there are differences.

In the future we plan to change the structure for the most frequent messages in order to reduce the network traffic. Right now register A is always empty (or carries futile information).

[1] If you are developing your own unit, which will send CAN packages on Kanardia CAN bus, please contact us and we will assign you a fixed unique sender id. For testing purposes, use fixed value 128. Do not use values above 128.

Future changes will utilize register A as Float 32 data, which means that in many cases one message may replace two messages that are in use now. Please write your code with this future changes in mind.

Next sections list message ids in several tables. Id description, id value, approximate range and unit are given. Please note that given range is not bounding – it merely gives most likely range of values.

Please note that lists below define message ids that devices *can* send. This does not mean that they *will* always send them. For example, if GPS module is not running correctly, most GPS messages will not be sent or when OAT sensor is not detected, corresponding message will not be sent. It is advisable to remember time of last reception of each id of your interests. If time of last reception is too old, this indicates an error condition.

2.1 Daqu And miniDaqu

Daqu and miniDaqu are engine monitoring units. They are sending messages with the ids listed in Table 5. Most of these messages are using only value in register B. Three of them (EGT, CHT and Battery cell voltage) also send index, which is stored in byte 2 of register A. The index is zero based. This means that EGT 1 has index 0, EGT 2 has index 1, etc.

Table 5: Message ids used by Daqu and miniDaqu.

Description	Id	Range	Unit
Outside air temperature	335	-20–70	°C
Roll trim position (-1 nose down)	402	-1–1	-
Pitch trim position (-1 left)	405	-1–1	-
Roll trim speed	409		-/s
Pitch trim speed	410		-/s
Throttle position (0 back)	414	0–1	-
Flap position (0 retracted)	430	0–1	-
Flap movement speed	443		-/s
Engine RPM 1	500	0–10000	RPM
Engine RPM 2	501	0–10000	RPM
Engine torque	508	0–1000	Nm
Engine fuel flow rate	524	0–1000	l/h
Manifold pressure 1	528	0–2	bar
Manifold pressure 2	529	0–2	bar
Engine oil pressure 1	532	0–10	bar
Engine oil pressure 2	533	0–10	bar
Engine oil temperature 1	536	-20–200	°C
Engine oil temperature 2	537	-20–200	°C
Engine coolant temperature 1	548	-20–200	°C
Engine coolant temperature 2	549	-20–200	°C
Engine power	552	0-1000	kW
Engine ambient (compartment) pressure	564	0–2	bar
Engine ignition timing	565		rad
Engine compartment temperature	654		°C
Fuel line temperature	655	-20–100	°C

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Table 5 – *Continued from previous page*

Description	Id	Range	Unit
Fuel level 1	668	0–200	liters
Fuel level 2	669	0–200	liters
Fuel level 3	670	0–200	liters
Fuel level 4	671	0–200	liters
Fuel system pressure 1	684	0–5	bar
Fuel system pressure 2	685	0–5	bar
Lambda (exhaust gases)	692	0–2	-
Rotor RPM	700	0–1000	RPM
Gearbox oil pressure	712	0–1000	bar
Gearbox oil temperature 1	720	-20–200	°C
Gearbox oil temperature 2	721	-20–200	°C
Gearbox oil temperature 3	722	-20–200	°C
Gearbox oil temperature 4	723	-20–200	°C
Gearbox oil temperature 5	724	-20–200	°C
Gearbox oil temperature 6	725	-20–200	°C
Gearbox oil temperature 7	726	-20–200	°C
Gearbox oil temperature 8	727	-20–200	°C
Voltage (DC) 1	920	0–100	V
Voltage (DC) 2	921	0–100	V
Voltage (DC) 3	922	0–100	V
Voltage (DC) 4	923	0–100	V
Battery cell voltage + index in register A	924	0–100	V
Electrical current 1	930	-100–100	A
Electrical current 2	931	-100–100	A
CHT + index in register A	1500	-20–300	°C
EGT + index in register A	1501	-20–1500	°C
Carburetor temperature	1516	-20–100	°C
Carbon monoxide level	1519	0–1000	PPM
Airbox temperature	1521	-20–100	°C

2.1.1 Special Values

Some of the values have special codes, which are specific to Daqu. They are listed below in C/C++ number format form.

`-9999.0f` ... indicates that sensor is not connected. This is only send for sensor types, where such detection is possible.

`-9997.0f` ... indicates that sensor has reached its lower limit. The limitation can be either in sensor or in Daqu (usually in Daqu).

`9.99E20f` ... indicates that sensor has reached its upper limit. The limitation can be either in sensor or in Daqu.

2.2 Airu

Airi is a sensoring module that takes care for airdata, AHRS and GPS. Airu is sending messages with ids listed in Table 6. Airu has a few exceptions. They are listed after the table.

Table 6: Message ids used by Airu.

Description	Id	Range	Unit
Acceleration in x (longitudinal)	300	-100–100	m/s2
Acceleration in y (lateral)	301	-100–100	m/s2
Acceleration in z (normal)	302	-100–100	m/s2
Pitch rate	303	-2.5–2.5	rad/s
Roll rate	304	-2.5–2.5	rad/s
Yaw rate	305	-2.5–2.5	rad/s
Pitch angle (up is positive)	311	-1.57–1.57	rad
Roll angle (right roll is positive)	312	-3.14–3.14	rad
Vertical speed	314	-100–100	m/s
Indicated airspeed	315	0–150	m/s
True airspeed	316	0–150	m/s
Barometric correction (QNH)	319	500-1500	hPa
Baro corrected altitude	320	-100–20000	m
Heading angle	321	0–6.28	rad
Standard altitude	322	-100–20000	m
Differential pressure	325	0–100	hPa
Static pressure	326	0–1100	hPa
Heading rate	327	-2.5–2.5	rad/s
Wind speed	333	0–1000	m/s
Wind into direction	334	0–6.28	rad
Outside air temperature	335	-20–70	°C
Latitude from GPS	1036	-1.57–1.57	rad
Longitude from GPS	1037	-3.14–3.14	rad
Height above WGS84 ellipsoid from GPS	1038	0–20000	m
Ground speed from GPS	1039	0–150	m/s
Tracking direction from GPS	1040	0–6.28	rad
PDOP from GPS	1045	0-10	-
VDOP from GPS	1046	0-10	-
HDOP from GPS	1047	0-10	-
Latitude from KF	1049	-1.57–1.57	rad
Longitude from KF	1050	-3.14–3.14	rad
Magnetic declination	1121	-1.57–1.57	rad
Date – in *juliand day* representation	1502	0–86400	jd
Time – seconds after UTC midnight	1503	0–86400	s
Roll gyro bias	1513	-0.02–0.02	rad/s
Pitch gyro bias	1514	-0.02–0.02	rad/s
Yaw gyro bias	1515	-0.02–0.02	rad/s
User pitch correction	1517	-0.5–0.5	rad

2.2.1 1048 – GPS Operation Status

Message with id 1048 holds GPS operation status in its B register. It is stored as two 16 bit unsigned integers.

First integer is composed by LSB and LSB+1. It stores number of satellites visible by GPS.

The second integer is composed by LSB+2 and MSB bytes. It stores GPS mode. The mode can be one of the following values: 0 – no fix has been obtained, 2 – 2D fix is obtained, 3 – 3D fix is obtained, 4 – 3D fix with WAAS is obtained. Any other value indicates an error.

2.2.2 1502 – Date

Message with id 1502 is a bit special. It is not sent as Float 32, but as a 32 bit unsigned integer. Date stored in this 32 bit unsigned integer is a *Julian Day* number. Please see `https://en.wikipedia.org/wiki/Julian_day` for more details.

2.2.3 1522 – Flight Time

Another special message has id 1522. This one defines the flight time since last takeoff. Register B holds time in seconds as 32 bit unsigned integer. Byte 3 in register A is zero if flying condition was not detected and non-zero if flying conditions were detected. It may take a few seconds after takeoff, when this byte will become nonzero. Similarly, it may take a few seconds after landing before the byte becomes zero.

2.3 Indu

Indu is a family of instruments, which combine classic needle with integrated LCD display. The needle is driven by stepper motor. Table 7 list messages that may be sent from Indu. Please note that Indu nodels are very different.

Table 7: Message ids used by Indu.

Description	Id	Range	Unit
All Indus with knob			
Screen brightness level	1528	0–1	-
Altimeter and Combo			
Vertical speed	314	-100–100	m/s
Barometric correction (QNH)	319	500-1500	hPa
Baro corrected altitude	320	-100–20000	m
Standard altitude	322	-100–20000	m
Static pressure	326	0–1100	hPa
Airspeed and Combo			
Indicated airspeed	315	0–150	m/s
True airspeed	316	0–150	m/s
Differential pressure	325	0–100	hPa
Outside air temperature	335	-20–70	°C
Flight time (section 2.2.3)	1522		
RPM			

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Table 7 – *Continued from previous page*

Description	Id	Range	Unit
Engine RPM 1	500	0–10000	RPM
Rotor RPM	700	0–1000	RPM
When logging function is enabled			
Engine total time	1510	0–10000	h
Flight total time	1523	0–10000	h
Power-on total time	1527	0–10000	h
On special request			
Almost any id from Daqu list. See Table 5.			

2.4 Nesis, Aetos, Emsis, Horis

Please note that masters have Airu device integrated. See Table 6 for the ids. Only a few message ids are in use masters only, Table 8. Slaves do not seny any standard messages.

Table 8: Message ids used by Nesis, Aetos, Emsis and Horis masters.

Description	Id	Range	Unit
Screen brightness level	1528	0–1	-
Engine total time	1510	0–10000	h
Flight total time	1523	0–10000	h
Power-on total time	1527	0–10000	h

There are a few exceptions. Horis only sends 1528 and Nesis/Aetos do not sent 1523.