DMOC645 Gen II CANBus Protocol

Collin Kidder

Feb 6, 2013

Reference for terminology:

CANBus frames can have 0 – 8 bytes of data. These bytes can, in turn, be broken up into 8 bits each. This yields 0, 8, 16, 24, 32, 40, 48, 56, or 64 bits of data per frame. These bits and bytes are related in the following way:

Byte	0	1	2	3	4	5	6	7
Bits	7-0	15-8	23-16	31-24	39-32	47-40	55-48	63-56

That is, bit 7 is the bit farthest to the left while bit 56 is the bit farthest to the right. Each byte is stored one after the other and each has its highest bit to the left and lowest to the right.

Additionally, canbus frames come in two forms: standard and extended. Standard frames have 11 bit IDs while extended frames have 29 bit IDs. For the purposes of this document all frames are standard and thus will have an ID of 0 – 2047 (0-0x7FF in hexadecimal)

It is traditional to deal with all data within canbus in hexadecimal. However, for ease of understanding this document will mostly stick with decimal by default and give hexadecimal equivalents in parenthesis where appropriate.

All multi-byte values are most significant byte first. That is, if byte 0 is 0x7E and byte 1 is 0x10 then the value is 0x7E10 not 0x107E.

When values are only a certain number of bits they are specified as the byte they start in, a dot, and then the bit they start on. For instance, 5.4 means to start on bit 4 in byte 5 and continue toward bit 0 in that byte. If a value is wider than can be found in the current byte then continue to bit 7 of the next byte.

Command Frames:

Id: 562 (0x232)

Bytes	Desc	Scale	Offset	Range	Units
0-1	Speed Setpoint	1	-20000	-20000 – 20000	RPM
5.1 – 5.0	Key Position	1	0	0 – 3	n/a
6.7 – 6.6	Operating State Cmd	1	0	0 – 3	n/a
6.5 – 6.4	Gear State Cmd	1	0	0 – 3	n/a
6.3 – 6.0	Alive Counter	1	0	0 – 15	n/a
7	Checksum	1	0	0 – 255	n/a

Key Position

Value	Meaning
0	Off
1	On
2	Reserved
3	No Action

Operating State

Value	Meaning
0	Disable
1	Standby
2	Enable
3	Power Down

Gear State

Value	Meaning
0	Neutral
1	Drive
2	Reverse
3	Error

Id: 563 (0x233)

Bytes	Desc	Scale	Offset	Range	Units
0-1	Torque Upper Limit	0.1	-3000	-3000 – 3000	Nm
2-3	Torque Lower Limit	0.1	-3000	-3000 – 3000	Nm
4-5	Standby Torque	0.1	-3000	-3000 – 3000	Nm
6.3 – 6.0	Alive Counter	1	0	0 – 15	n/a
7	Checksum	1	0	0 – 255	n/a

Id: 564 (0x234)

Bytes	Desc	Scale	Offset	Range	Units
0-1	Electrical Limit RegenBraking	4	-260000	-260000 – 0	W
2-3	Electrical Limit	4	0	0 – 260000	W

	Accelerator				
5	Ambient Air Temp	1	-40	-40 – 200	Deg C
6.7 – 6.6	Power Train Cool	1	0	0 – 3	n/a
6.5 – 6.4	Instant Torque Reduction Cmd	1	0	0 – 3	n/a
6.3 – 6.0	Alive Counter	1	0	0 – 15	n/a
7	Checksum	1	0	0 – 255	n/a

Power Train Cooling

Value	Meaning
0	?
1	?
2	?
3	?

Instant Torque Reduction

Value	Meaning
0	Off
1	On
2	Invalid
3	No Action

Status Frames:

Id: 1616 (0x650)

Bytes	Desc	Scale	Offset	Range	Units
0-1	High Voltage DC Bus Volts	0.1	0	0 – 1000	V
2-3	High Voltage DC Bus Amps	0.1	-500	-500 – 500	A
4	Fault Info	1	0	0 – 255	n/a
5	Performance Derating %	1	0	0 – 100	%
7.3 – 7.2	AC HV IL	1	0	0 – 3	n/a
7.1 – 7.0	Power Down Status	1	0	0 – 3	n/a

AC HVIL

Value	Meaning
0	Closed
1	Open
2	Error
3	Unavailable

Power Down Status

Value	Meaning
0	Inactive
1	Active
2	Error
3	Unavailable

Id: 1617 (0x651)

Bytes	Desc	Scale	Offset	Range	Units
0	Rotor Temperature	1	-40	-40 – 200	Deg C
1	Inverter Heatsink Temp	1	-40	-40 – 200	Deg C
2	Stator Temperature	1	-40	-40 – 200	Deg C
3	Non im Can IF???	1	0	0 – 255	n/a
4.7 – 4.6	Cooling system status	1	0	0 – 3	n/a

Id: 570 (0x23A)

Bytes	Desc	Scale	Offset	Range	Units
0 – 1	Actual Torque	0.1	-3000	-3000 – 3000	Nm
2 – 3	Max Pos	0.1	0	0 – 3000	Nm

	Torque				
4 – 5	Max Neg Torque	0.1	-3000	-3000 – 0	Nm
6.3 – 6.0	Torque Report Alive	1	0	0 – 15	n/a
7	Torque Report Checksum	1	0	0 – 255	n/a

Id: 571 (0x23B)

Bytes	Desc	Scale	Offset	Range	Units
0 – 1	Actual Speed	1	-20000	-20000 – 20000	RPM
5.1 – 5.0	Power Stage Disable	1	0	0 – 3	n/a
6.7 – 6.4	Operation Status	1	0	0 – 15	n/a
6.3 – 6.0	Speed Status 1 Alive	1	0	0 – 15	n/a
7	Speed Status 1 Checksum	1	0	0 – 255	n/a

Operation Status

Value	Meaning
0	Initializing
1	Disabled
2	Ready
3	Enabled
4	Power Down
5	Fault
6	Critical Fault
7	LOS

Id: 574 (0x23E)

Bytes	Desc	Scale	Offset	Range	Units
0 – 1.6	AC Direct Amps	1.3	-650	-650 – 650	A
1.5 – 2.4	AC Quadrature Amps	1.3	-650	-650 – 650	A
2.3 – 3.2	AC Direct Volts	0.5	-250	-250 – 250	V
3.1 – 4.0	AC Quadrature Volts	0.5	-250	-250 – 250	V
5 – 6.6	Stator Frequency	2	-1000	-1000 – 1000	Hz
6.3 – 6.0	Electric 2 Alive	1	0	0 – 15	n/a
7	Electric 2 Checksum	1	0	0 – 255	n/a

Id: 1682 (0x692)

Bytes	Desc	Scale	Offset	Range	Units
0	Command	1	0	0 – 1	n/a
1	Index	1	0	0 – 1	n/a

For all frames with checksum the value is calculated like so: Into an 8 bit variable sum up data bytes (0-8 bytes) plus also add the frame ID. Since the variable is 8 bit it will overflow from 255 to 0 as appropriate. Add 3 to the resulting value (potentially also overflowing). Now, subtract the resulting value from 256 (0x100). This value is the checksum. The explanation is almost more difficult than the reality. Here is a working implementation:

```
byte calcChecksum(Frame thisFrame) {
      byte cs;
      byte i;
      cs = thisFrame.id;
      for (i = 0; i < thisFrame.length; i++) cs += thisFrame.data[i];
      i = cs + 3;
      cs = ((int)256 - i);
      return cs;
}
```