SDAQ measurement system, CAN-protocol specification

Document history

24.6.2019	Initial revision
28.7.2019	timestamp range changed from 65536 to 60000 (0…59999) bootloader commands added
7.8.2019	calibration related commands added
5.9.2019	Set Device Address (0x06) command added
18.9.2019	Added CAN config cmd (0x0b)
20.10.2019	Added payload types: 0x0c, 0x8b

Basic operation

1. Power-up
2. Devices starts sending ID/status messages
3. Bus-master acquires ID/status messages and queries additional device info (device type, number of channels, serial number, calibration date…)
4. Bus-master enables measurement data streams by sending start-command to the devices
5. Devices streams measurement data until power-off or received stop-command

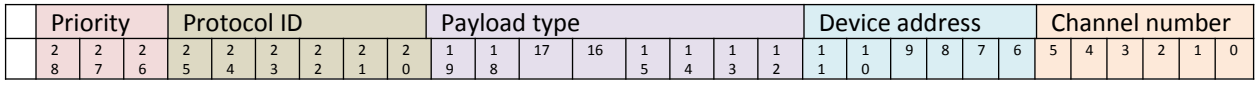
Optionally bus-master can synchronize measurements on all devices by sending sync-command. Synchronization command should be sent periodically to avoid clock drifting on bus-devices.

6.

CAN 29 bit extended identifier usage

500 kbps (1000 kbps optional)

Priority (0..7)
protocol id (6 bits) = 0b110101 = 0x35
payload type (8 bits)
device address (0-63, 0=broadcast)
channel number (0-63)



Payload type, messages from devices

ID	Name	Desc.
0x84	Measurement value	Send only when device is in running state
0x86	Device ID/status	Sent periodically (=20 sec), contains device type, serial & status, reply to 0x07 command
0x88	Device Info	Reply to 0x07 command
0x89	Calibration Date	Reply to 0x07 / 0x08 commands
0x8a	Calibration Point Data	
0x8b	Uncalibrated meas. value	
Bootloader replies		
0xa0	Bootloader Reply	
0xa1	Page Buffer Data	
Debug Data		
0xc0	Sync Info	
	raw measurement	
	debug data	
	calibration data	

Payload type, commands to devices (bit7=0)

ID	Name	Desc.
0x01	Synchronization command	
0x02	Start	Move to running state (starts streaming meas. data)
0x03	Stop	Move to standby mode (no meas. streaming)
0x06	Set Device Address	
0x07	Query Device Info	Device replies with messages 0x86, 0x88, 0x89
0x08	Query Calibration Data	Device replies with messages 0x89, 0x8a
0x09	Write Calibration Data	Device stores calibration data to its nonvolatile memory

0x0a	Write Calibration Point Data	Transfers calibration point data to device
0x0b	Write CAN-bus config	Writes new CAN-bus config and resets the device
0x0c	Configure Additional data	
Bootloader commands		
0x20	Jump to Bootloader	From application code
0x21	Erase Flash	
0x22	Write to Page Buffer	
0x23	Write Page Buffer to Flash	
0x24	Query Flash data	
0x25	Start Application Code	
	calibration command	
	debug command	
	bootloader command	
	bootloader data	

Measurement value, Uncalibrated measurement value

Priority = 0x03
payload type = Measurement value (0x84), Uncalibrated Measurement value (0x8b)
device address = 1..32
channel number = 1..32

Payload

	Measurement value, 32bit float				Unit	Status	Timestamp	
	Lsb			Msb			lsb	Msb
byte	0	1	2	3	4	5	6	7

Measurement unit types

1 – Voltage, [V]
2 – Current, [A]
3 – Temperature, [°C]
4 – Pressure, [Pa]
5 – Voltage, [mV]

Status

Bit	Name	Desc.
0	Sensor Error	0 = ok, 1 = sensor disconnected

Timestamp = 0..59999 ms

Uncalibrated values (0x8b) may use lower sampling rate.

Device ID / status

Priority = 0x04
payload type = Device ID/status (0x86)
device address = 1..32
channel number = 0

Payload

	Device serial number, uint32_t				Status	Device Type
	Lsb			Msb		
byte	0	1	2	3	4	5

Status

Bit	Name	Desc.
0	Run / Standby	0 = stdby, 1 = run
1	Sync status	0 = no sync, 1 = sync message received within 120 second
2	Error	0 = ok, 1 = error
3..6	reserved	
7	Bootloader	0 = application code, 1 = bootloader running

Device types

ID	Name	Desc.
1	1 channel thermocouple	
2	16 channel thermocouple	
3	1 channel Pt100 RTD	

Device Info

Priority = 0x04
payload type = Device Info (0x88)
device address = 1..32
channel number = 0

Payload

	Device Type	Sw revision	Hw revision	Num. of channels	Sample rate
byte	0	1	2	3	4

Device type

Check Device ID / status message for device types

Sw/Hw revision

0..255

Num of channels

1..32

Samplerate

n samples / second

Calibration Date

Priority = 0x04
payload type = Calibration date (0x89)
device address = 1..32
channel number = 1..32

Payload

	Calibration date & time, uint32_t				Number Of Points
	lsb			Msb	
byte	0	1	2	3	4

Date & time

Seconds from start of year 1970.
Example: t = 1561385711 => date: 24.6.2019, time: 14:15:11

Number Of Points = 0..8, number of calibration points

Calibration Point Data

Priority = 0x04
payload type = Calibration Point Data (0x8a)
device address = 1..32
channel number = 1..32

Payload

	Point Value				Type	Point Number
	lsb			msb		
byte	0	1	2	3	4	5

Value = 32bit float
Type = 1 – input value, 2 – output value
Point Number = 0..7

Synchronization command

Priority = 0..7
payload type = Synchronization command (0x01)
device address = 0
channel number = 0

Payload

	Timestamp	
	Lsb	Msb
byte	0	1

Timestamp = 0..59999 ms

Start command

Priority = 0..7
payload type = start (0x02)
device address = 1..32 (broadcast address 0 should work too?)
channel number = 0

No Payload

Commands device(s) to run-state allowing measurement streaming.

Stop command

Priority = 0..7
payload type = stop (0x03)
device address = 1..32 (broadcast address 0 should work too?)
channel number = 0

No Payload

Commands device(s) to standby-state forbidding measurement streaming.

Set Device Address

Priority = 0x04
payload type = Set Device Address (0x06)
device address = 0
channel number = 0

Payload

	Device serial number, uint32_t				New device addresss
	Lsb			Msb	
byte	0	1	2	3	4

New device address = 1..32

Device with matching serial number changes its address and enters to idle state (no measurement streaming). Device confirms address change by sending id/status (0x86) message.

Query Device Info

Priority = 0..7
payload type = Query device info (0x07)
device address = 1..32 (broadcast address 0 should work too?)
channel number = 0

No Payload

Device responds by sending Device Info, Calibration date & Device ID messages

Write CAN-bus config

Priority = 0x04
payload type = Write CAN-bus config (0x0b)
device address = 0, 1..32
channel number = 0

Payload

	Bitrate						
byte	0						

Bitrate 0 = 1000 kbps
1 = 500 kbps
2 = 250 kbps

Writes new CAN-bus config and resets the device.

Configure Additional data

Priority = 0x04
payload type = Configure additional data (0x0b)
device address = 0, 1..32
channel number = 0

Payload

	Config						
byte	0						

Config bit 0, uncalibrated measurement values
bit 1, internal measurements

Controls additional data sent by the device. Write bit to 1 to enable, 0 to disable.

Bootloader

Start bootloader

Erase flash (32bit start address, 32bit end address)

Write to page buffer, 8 bytes, buffer address = channel number * 8

Write buffer to flash (32bit flash start address)

Query flash data (32bit flash start address), device replies with 256 bytes of data

Debug data

Priority = 0x07
payload type = Sync Info (0xc0)
device address = 1..32
channel number = 0

Payload

	Ref Time		Dev Time					
	Lsb	Msb	lsb	Msb				
byte	0	1	2	3	4	5	6	7