

CAN data bus communication

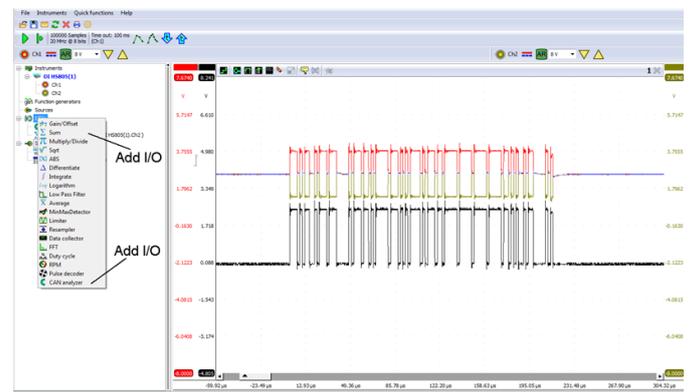
CAN data bus communication analysed with the ATS scope

The following article is a modified extract of the AECS EMS 2-2 training seminar. The subject was added, as it has raised many questions over the years, with some technical people even stating that the value of scope analyses on the CAN data bus is not possible, or not conclusive.

Nothing could be further from the truth. In the following sample a simple (delayed) 'communication error' message on a scan tool due to a fault in the CAN bus is analysed.

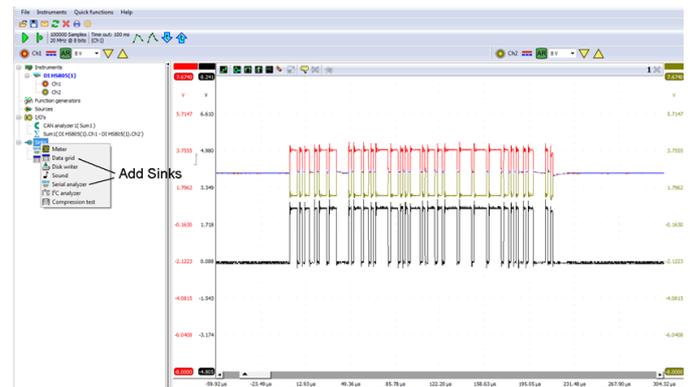
The scope is simply hooked up into the OBD data link connector of a vehicle, which had all sorts of 'weird' issues. Nothing conclusive with the scan tool, except that the error code U1000 (CAN Data communication error) came up in a multitude of ECU's.

Setting up the ATS scope to record CAN data is simple and can be selected from the ATIS software menu. To add the CAN analyser to the screen takes a few further advanced steps:



Add in the tool ribbon I/O's 'Sum' and 'CAN analyser'

The ATS scope is connected to the CAN hi (Channel1) and CAN lo (Channel2).

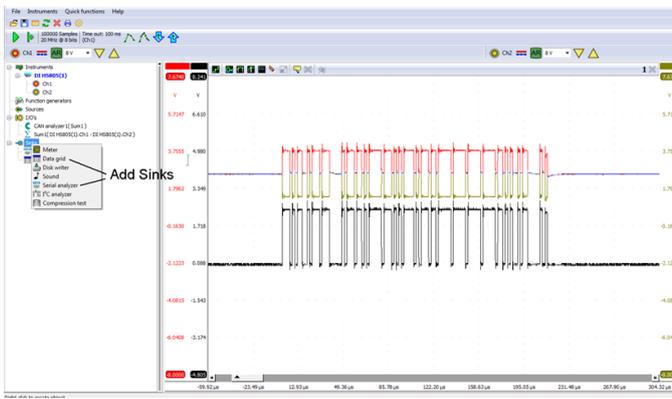


Add under the chapter Sinks; 'Data grid' and 'Serial analyser'

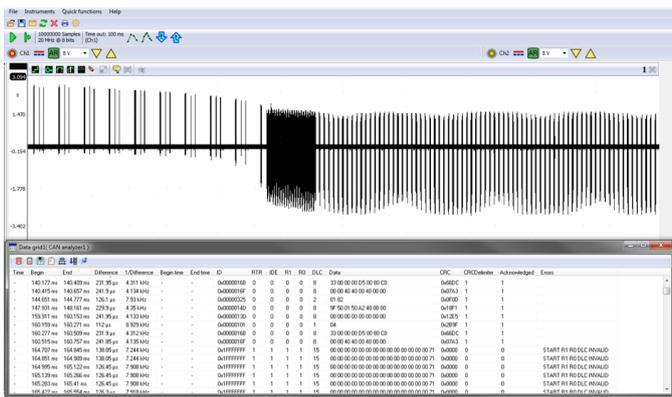
Some of the information discussed in this article is studied in great detail in EMS 2-2.

EMS 2-1 also mentioned in this article will be run on the 18th & 19th July 2012. Limited numbers! Ring us now.

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Add under the chapter Sinks; 'Data grid' and 'Serial analyser'.



A data grid will become visible, showing the raw data flowing on the CAN data bus. Please note that in the illustration above a partial short happens in the middle of the recorded screen.

The data-recording file can be saved as CSV format. CSV means Comma Separated Value. Microsoft Excel and most other (spread sheet) programs can open .CSV files. In a spread sheet the values from the data grid look as in the picture below:

The data has been scrolled down to where the communication error happened. Please take note of the ID, Data and Errors columns, they show that the plot is lost.

The short in the data bus was isolated and repaired, after which the ATS scope data analyser stayed connected for a little while to see if in the last column any more data errors popped up. It did not so we were confident that the issue was resolved.

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Data deciphering

The used CAN communication in this sample is the ISO 15765-4 Protocol. In that protocol the following data, columns are of relevance, (only some data has been identified for educational purposes):

Time	Begin	End	Difference	1/Differer	Begin time	End time	ID	RTR	RDE	RL	RD	DLC	Data	CRC	CRCDelim	Acknowledge	Errors
493	33:07.9	17.033 ms	17.274 ms	240 µs	4.167 kHz	33:07.9	33:07.9	0x000007DF	0	0	0	0	8 02 01 0C 00 00 00 00 00	0x5649		1	1
494	475	33:08.1	15.89 ms	16.13 ms	240 µs	4.167 kHz	33:08.1	33:08.1	0x000007DF	0	0	0	8 02 01 08 00 00 00 00 00	0x0C8D		1	1
495	496	33:08.6	6.404 ms	6.648 ms	244 µs	4.098 kHz	33:08.6	33:08.6	0x000007DF	0	0	0	8 02 01 05 00 00 00 00 00	0x7C9C		1	1
496	512	33:09.1	9.93 ms	10.16 ms	240 µs	4.167 kHz	33:09.1	33:09.1	0x000007DF	0	0	0	8 02 01 00 00 00 00 00 00	0x4865		1	1
497	525	33:09.4	18.632 ms	18.872 ms	240 µs	4.167 kHz	33:09.4	33:09.4	0x000007DF	0	0	0	8 02 01 00 00 00 00 00 00	0x4865		1	1
498	599	32:56.8	7.973 ms	8.208 ms	235.8 µs	4.241 kHz	32:56.8	32:56.8	0x000007E8	0	0	0	8 04 41 0C 08 10 00 00 00	0x25C2		1	1
500	84	32:58.7	2.292 ms	3.162 ms	240 µs	4.167 kHz	32:58.8	32:58.8	0x000007E8	0	0	0	8 03 41 05 40 00 00 00 00	0x5148		1	1
501	254	33:03.1	14.903 ms	15.143 ms	239.8 µs	4.17 kHz	33:03.1	33:03.1	0x000007E8	0	0	0	8 03 41 05 40 00 00 00 00	0x5148		1	1
502	323	33:04.5	21.089 ms	21.329 ms	240 µs	4.167 kHz	33:04.6	33:04.6	0x000007E8	0	0	0	8 03 41 05 40 00 00 00 00	0x5148		1	1

The ID column shows in the first highlighted area a string of numbers, for example: 0x000007DF

0x000007DF means: the scan tool wants to establish communication with the ECU and

0x000007E8 means: the ECU wants to establish communication with the scan tool

In the second Data column behind 0x000007E8 (ECU answering to scan tool) shows for example

03 41 0D 00 00 00 00 00 of which

- 03 = the number of bites (e.g. 41 is one bite, 0D is also one bite)
- 41 = the data following is a response to a question.
- 0D = Vehicle speed value
- 13 = actual engine speed in Hex value. The conversion from Hex to Decimal makes this 19 (**19 Km/h**).
- the 00's have no value

04 41 0C 0A DF 00 00 00

- 04 = the number of bites
- 41 = the data following is a response to a question.
- 0C = Engine speed value
- 0A DF = actual engine speed in 16bit Hex value. The conversion from Hex to Decimal makes this 2783, which according to the ISO 15765-4 protocol needs to be divided by 4, which equals 695 (**695 RPM**).
- the 00 have no value

The Data column behind 7DF (scan tool re-
questing data from ECU) shows for example

02 01 0D 00 00 00 00 00 of which

- 02 = the number of bites
- 01 = the data following is a question.
- 0D = Vehicle speed value
- the 00 have no value

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I hope that the above small portion of training content increases your understanding of what we do in our advanced level training seminars (EMS 2-2).

In for example the EMS 2-1 seminar which will be held in Auckland later in the year we teach technicians how to program chips from the ground up. That seminar is designed to make you understand and appreciate the inner workings of an ECU. Along the way, you will learn to make software and electronic circuits that can be used in cars to solve certain problems without having to buy new parts.

I also hope that you can see the versatility of the ATS scope, which standard has the data analyser built in, and how without a decent scope you really work with your eyes closed.

Herbert

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