Application Note

How to configure an Anybus Communicator CAN to consume SAE J1939 messages

Revision 1.02

Document History

Date	Revision	Name	Description
2012.02	0.10	ALK	Draft
2012.05.25	1.00	ALK	First release
2012.05.30	1.01	ALK	CAN Trace Window and minor changes added
2012.06.06	1.02	ALK	Byte order added

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1. Requirements

- Anybus Communicator CAN™ with firmware version ≥ 1.04.02
- Software Tool *Anybus Configuration Manager – Communicator CAN*
- Existing SAE J1939 network for data exchange

2. Introduction to SAE J1939

Based on the CAN bus, the SAE J1939 standard is used primarily to network electronic control units (ECUs) in commercial vehicles like trucks, buses, and heavy-duty machinery. ECUs are connected using linear shielded twisted pair wiring. Communication is based on 29 bit message identifiers according to CAN 2.0B at a fixed data rate of 250 kbit/s. Unique about the standard is a manufacturer-independent common table defining so-called parameter groups. These are individually labeled by their parameter group number (PGN). Parameter groups are CAN messages with well-defined identifiers and message cycle times specifying the length and position of each specific parameter within the 8 byte data payload. Byte order is MSB first. The parameter group numbers are embedded in the 29 bit CAN message identifiers.

The document *SAE J1939-71 Vehicle Application Layer* that is part of the J1939 standard collection lists all specified parameter group (PG) definitions. There is for example the engine fluid level and pressure constituting a parameter group containing among others engine oil and coolant level and pressure. Vendors will not necessarily implement all PGs or all parameters within a PG.

2.1 Relation between PGN and 29 bit message ID

In SAE J1939 the 29 bit message ID is composed of the following fields: priority (3 bits), reserve (1 bit, = 0), data page (1 bit), PDU format (8 bits), PDU specific/group extension (8 bits), and source address (8 bits).

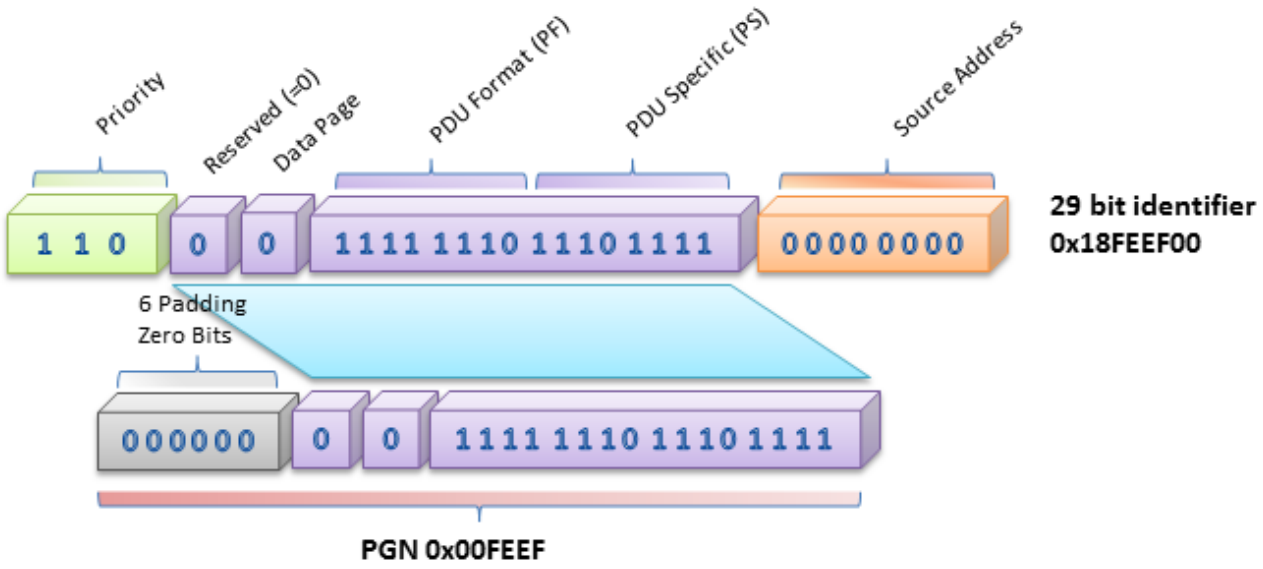
For specific parameter groups values for these fields can be found in the *SAE J1939-71* specification. Let's take a look at the Engine Fluid Level/Pressure parameter group definition as an example:

5.3.29 ENGINE FLUID LEVEL/PRESSURE

Transmission repetition rate:	0.5 s
Data length:	8 bytes
Data page:	0
PDU format:	254
PDU specific:	239
Default priority:	6
Parameter group number:	65 263 (00FEEF16)

Byte:			
	1	Fuel delivery pressure	5.2.5.27
	2	Extended crankcase blow-by pressure	5.2.5.241
	3	Engine oil level	5.2.5.72
	4	Engine oil pressure	5.2.5.28
	5,6	Crankcase pressure	5.2.5.40
	7	Coolant pressure	5.2.5.38
	8	Coolant level	5.2.5.73

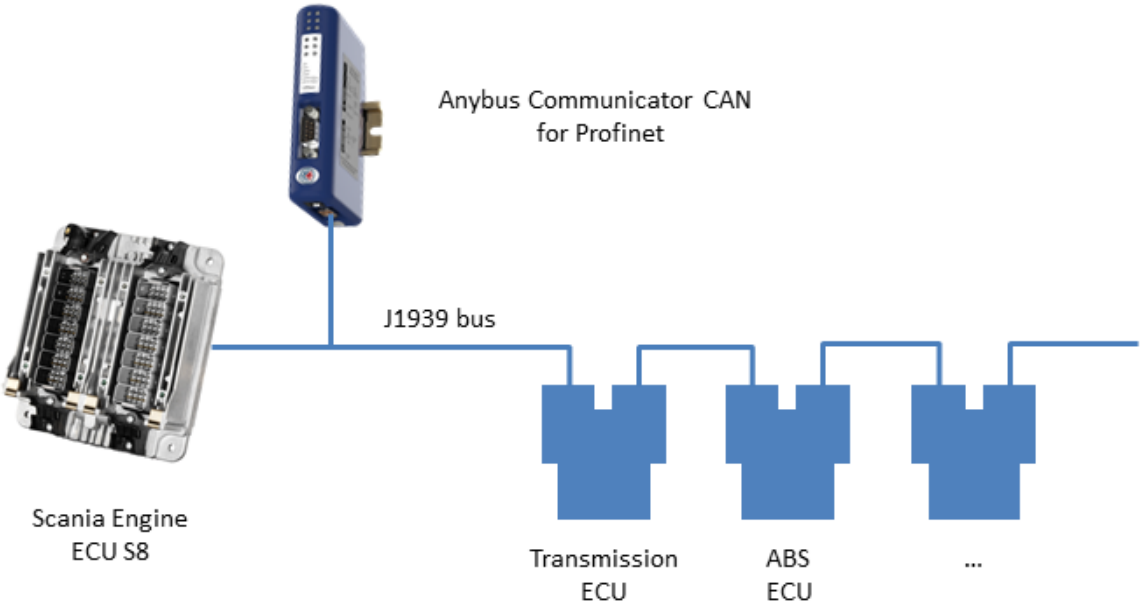
This parameter group has priority 6, data page 0, PDU format 0xFE, and PDU specific 0xEF. If we assume a source address of 0 for the transmitting ECU of this message we obtain the complete 29 bit message ID 0x18FEEF00 as follows:



As you can see the PGN 0x00FEEF for this parameter is padded with six leading logic 0 bits, followed by a logic 0 reserve bit, the logic 0 data page bit, and the PDU format/PDU specific fields. Thus the PGN is embedded inside the 29 bit ID between the message priority and the source address.

3. Solution Overview

This application note describes how to configure an Anybus Communicator CAN for Profinet to consume SAE J1939 messages from a CAN bus. As an example a Scania industrial engine ECU S8 is taken communicating with several other ECUs. The Anybus Communicator CAN for Profinet is used to pass data from the J1939 bus to a Profinet master. It will not be configured to produce data on the J1939 bus. Depending on which Anybus Communicator CAN is used the data may be converted to almost any other common fieldbus.



4. Application Example

4.1 Parameter Group Definition for Engine Fluid Level/Pressure

This is a typical PGN definition for the engine fluid level/pressure implemented in a Scania industrial engine ECU S6/S8.

Engine Fluid Level / Pressure - E

Identifier	Tmin	Tmax	PGN	Default Priority	R1	DP	Source	Destination	Group Extension
18 FE EF 00	500	500	00 FE EF	6	0	0	00		EF

EMS S6	EMS S8	Byte	Bit	Length	Explanation	State	Resolution	Limits
		1..2			Not Used			
	X	3	1	8	**Engine Oil Level**		0,4 %	0 bis 100 %
					Error	FE		
					Not Available	FF		
X	X	4	1	8	**Engine Oil Pressure**		4 kPa	0 bis 1.000 kPa
					Error Indicator	FE		
					Not Available	FF		
		5..7			Not Used			
X	X	8	1	8	**Coolant Level**		0,4 %	0 bis 100 %
					Error Indicator	FE		
					Not Available	FF		

First of all, you see that some parameters are not used at all (bytes 1..2 and 5..7) and some only for specific ECUs (marked with an “X” for S6 or S8). Furthermore, the message cycle time is specified as 500 ms (Tmin/Tmax), i.e. the message is transmitted with 2 Hz on the CAN bus by the ECU. The resolution and limits of the parameters are also given.

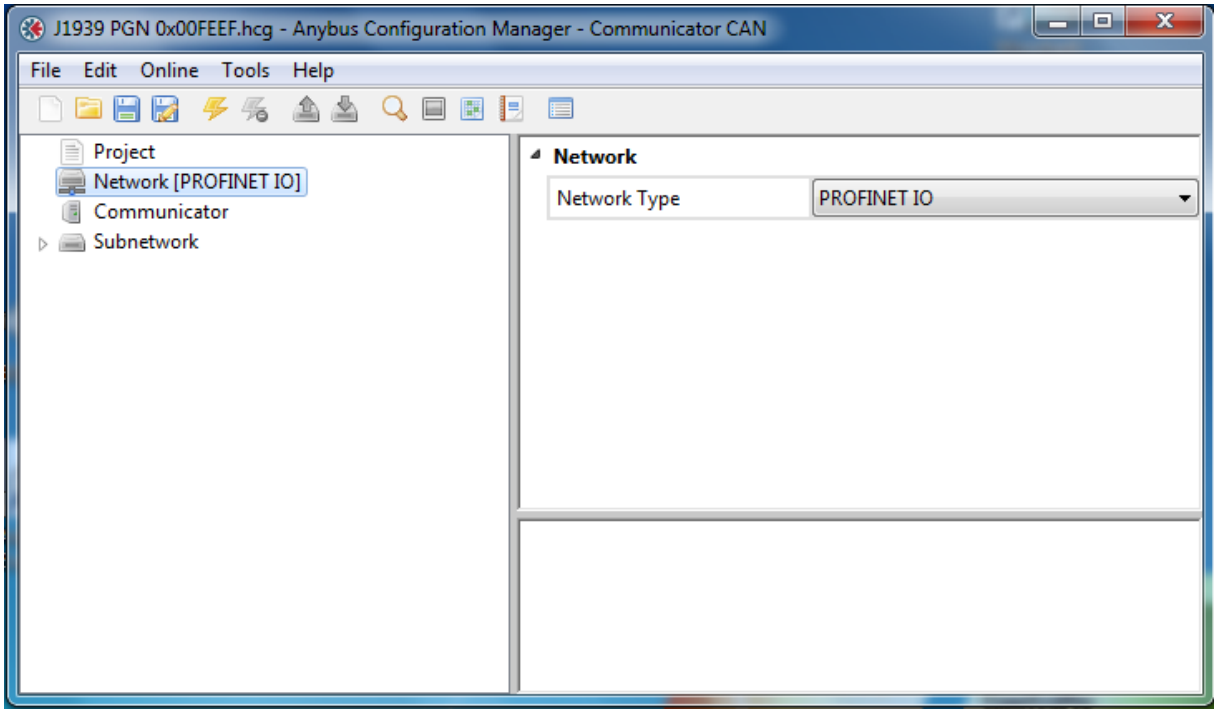
4.2 Configuring the Anybus Communicator CAN for Profinet

The Anybus Communicator CAN will be configured according to above PGN 0x00FEEF definition for a Scania ECU S8. The freely available configuration tool from HMS *Anybus Configuration Manager – Communicator CAN*, Version 1.1.1.5 will be used.

4.3 Anybus Configuration Manager Settings

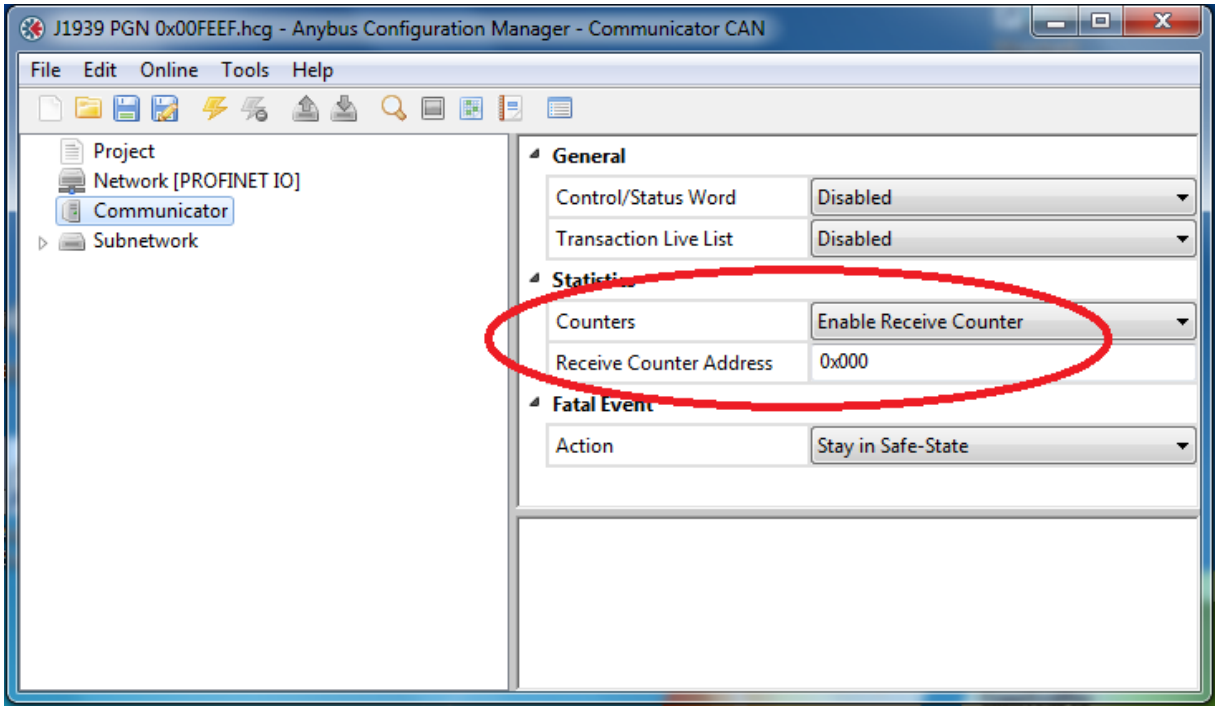
4.3.1 Fieldbus

Select the applicable fieldbus type for the Communicator CAN (some fieldbuses may have other sub-settings than those shown in this example). Here, select PROFINET-IO.



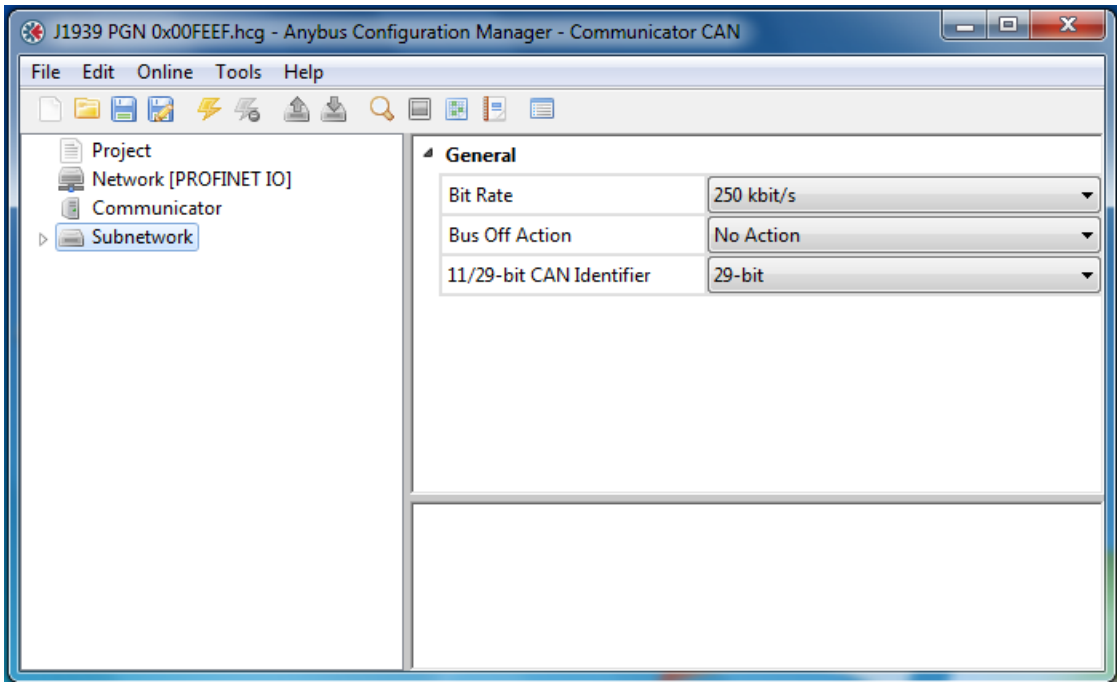
4.3.2 Communicator Settings

These are the global settings for the Anybus Communicator CAN. For this example we will activate the Receive Counter which takes up the first two bytes of the Communicator input buffer.

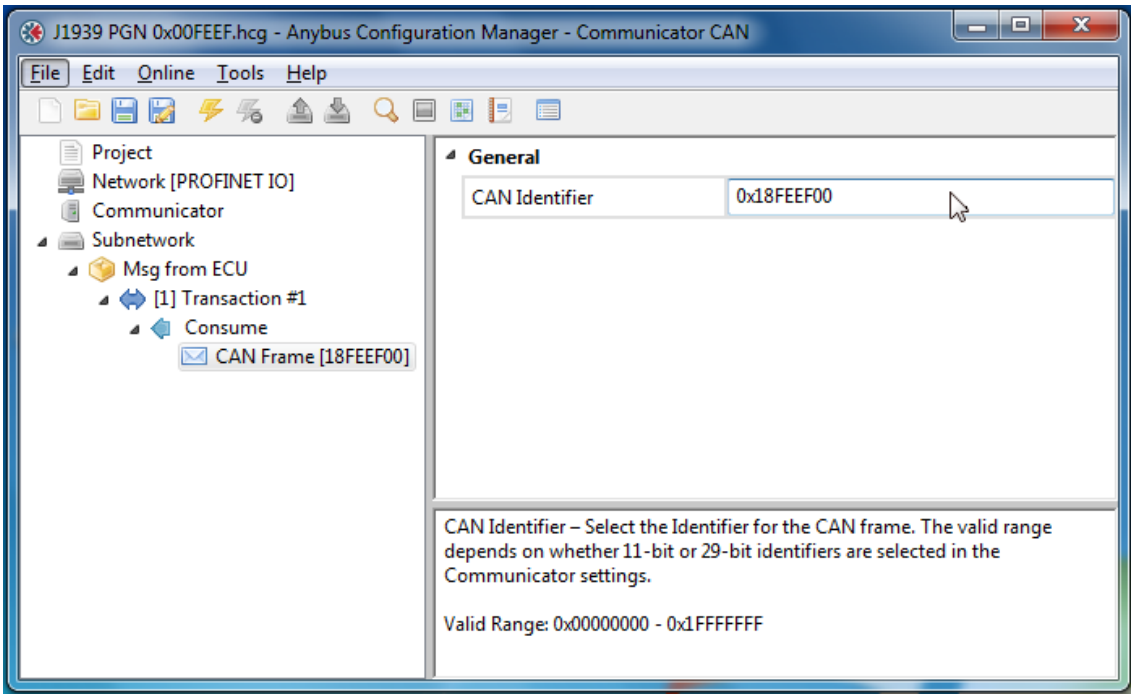


4.3.3 Subnetwork Settings

Set the physical CAN bus communication properties. For SAE J1939 a bit rate of 250 kbit/s and a CAN identifier length of 29 bit are required.

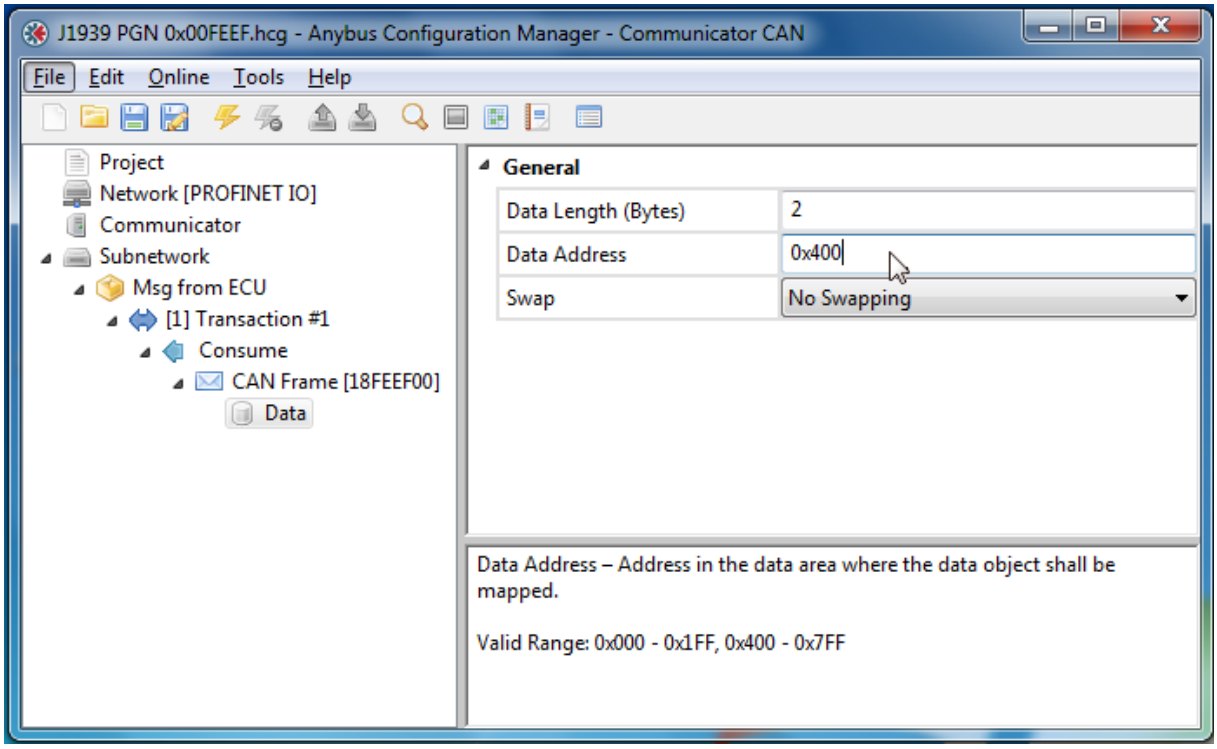


A group and a consume is added and labeled. The CAN identifier in this example is 0x18FEEF00.

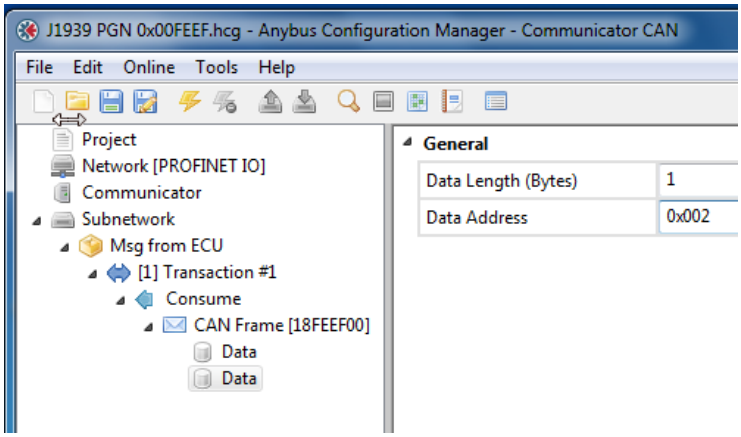


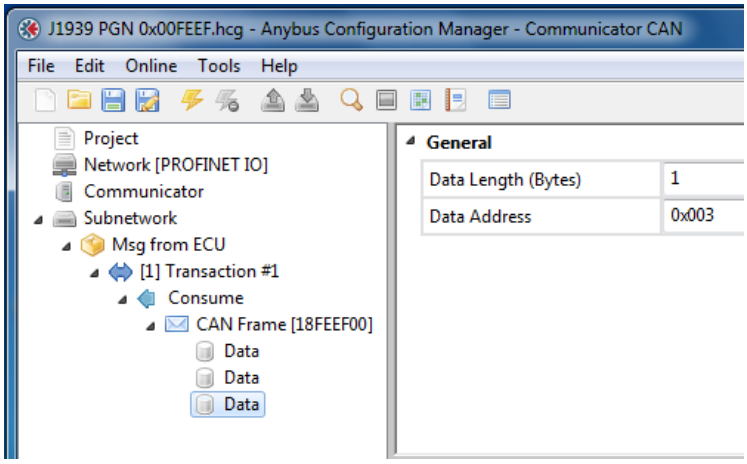
4.3.4 Add data objects to the CAN frame

Add a data object to the CAN frame that will be received by the Anybus Communicator CAN. Since the first two bytes of PGN 0x18FEEF00 are not used we assign them to the general data area starting at address 0x400. This area is an internal data buffer with no access to and from the Profinet network.

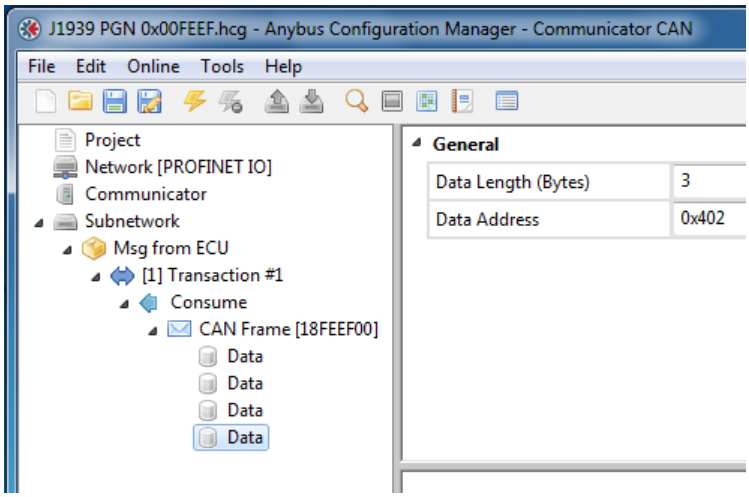


Add data objects of one byte length for the engine oil level and engine oil pressure. The configuration tool will automatically set the input buffer address to 0x002 to take account of the receive counter.

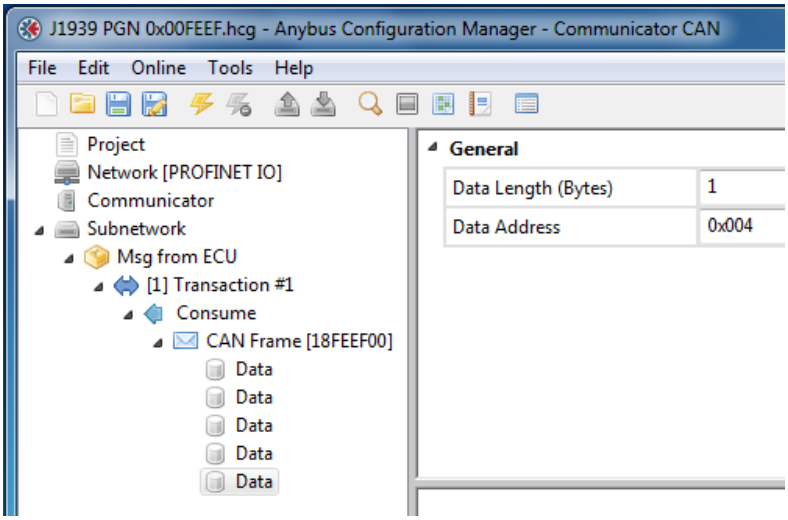




Now insert yet another data object with a length of three bytes pointing to the general area for another three unused bytes.

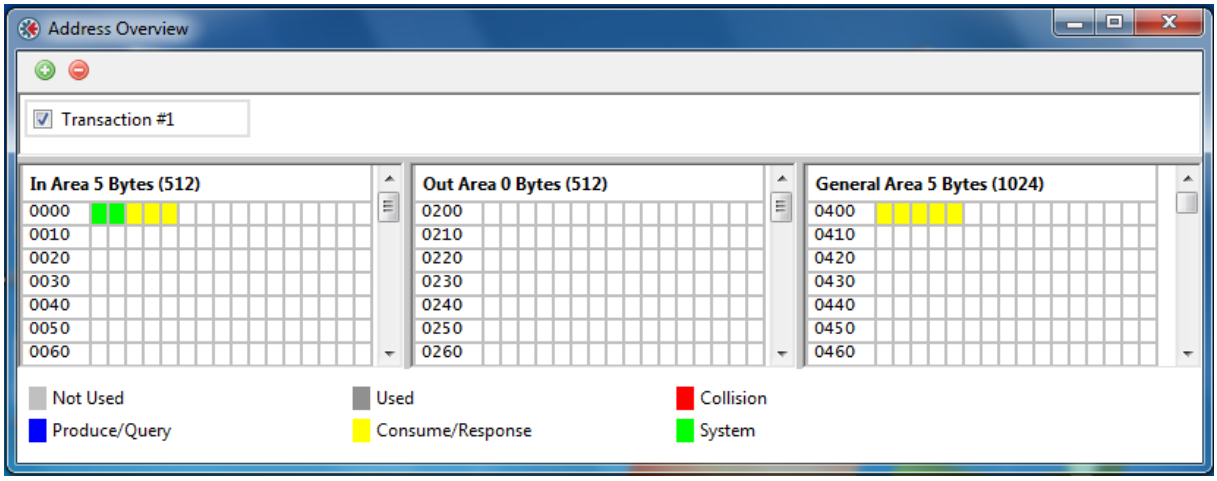


Finally create a last single byte data object for the coolant level.



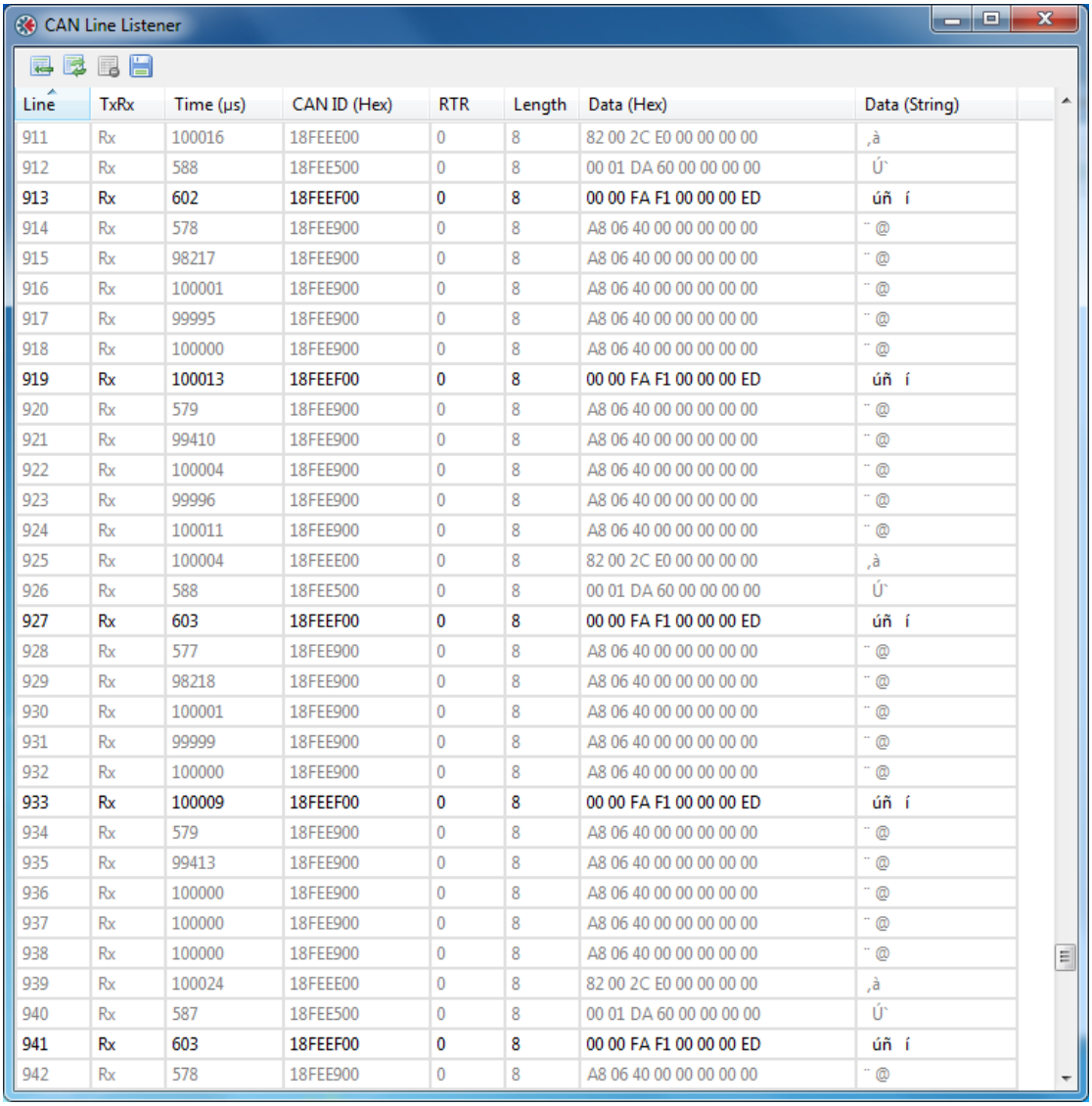
4.3.5 Data Buffer Overview

Your address overview of the data buffers should now look like this (menu Tools > Address Overview).



4.3.6 CAN Trace Window

Menu Tools > CAN Line Listener shows you a trace of the CAN messages on the J1939 network. Since the Anybus Communicator CAN is configured to consume frames with CAN-ID 0x18FEEF00 these will appear in black. You can recognize a message time interval of approximately 500 ms.



Line	TxRx	Time (µs)	CAN ID (Hex)	RTR	Length	Data (Hex)	Data (String)
911	Rx	100016	18FEEE00	0	8	82 00 2C E0 00 00 00 00	‚à
912	Rx	588	18FEE500	0	8	00 01 DA 60 00 00 00 00	Ú`
913	Rx	602	18FEEF00	0	8	00 00 FA F1 00 00 00 ED	úñ í
914	Rx	578	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
915	Rx	98217	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
916	Rx	100001	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
917	Rx	99995	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
918	Rx	100000	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
919	Rx	100013	18FEEF00	0	8	00 00 FA F1 00 00 00 ED	úñ í
920	Rx	579	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
921	Rx	99410	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
922	Rx	100004	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
923	Rx	99996	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
924	Rx	100011	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
925	Rx	100004	18FEEE00	0	8	82 00 2C E0 00 00 00 00	‚à
926	Rx	588	18FEE500	0	8	00 01 DA 60 00 00 00 00	Ú`
927	Rx	603	18FEEF00	0	8	00 00 FA F1 00 00 00 ED	úñ í
928	Rx	577	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
929	Rx	98218	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
930	Rx	100001	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
931	Rx	99999	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
932	Rx	100000	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
933	Rx	100009	18FEEF00	0	8	00 00 FA F1 00 00 00 ED	úñ í
934	Rx	579	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
935	Rx	99413	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
936	Rx	100000	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
937	Rx	100000	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
938	Rx	100000	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @
939	Rx	100024	18FEEE00	0	8	82 00 2C E0 00 00 00 00	‚à
940	Rx	587	18FEE500	0	8	00 01 DA 60 00 00 00 00	Ú`
941	Rx	603	18FEEF00	0	8	00 00 FA F1 00 00 00 ED	úñ í
942	Rx	578	18FEE900	0	8	A8 06 40 00 00 00 00 00	¨ @

4.3.7 Data Mapping

Input Area	J1939 PGN	Description
0	n/a	Receive Counter Byte 1
1	n/a	Receive Counter Byte 2
2	18 FE EF 00	Engine Oil Level
3	~	Engine Oil Pressure
4	~	Coolant Level

5. References

- Anybus Communicator CAN for Profinet IO User Manual
- Application Note How to configure an Anybus PROFINET IO device with Siemens Step7
- SAE J1939 Core Standards

6. Further Information

Information on Anybus Communicator CAN

http://www.anybus.com/products/abccan.shtml

7. Technical Support

You can reach HMS technical support for the Anybus Communicator CAN at

http://www.anybus.com/support/support_home.asp