Units in DBC files, propagation through the LeCroy oscilloscopes

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Context

> A **CAN DBC file** (**CAN** database) is a text **file** that contains information for decoding raw **CAN** data from an application to 'physical values' (human-readable form). ... A **CAN bus DBC file** is simply a database format structured around **CAN** messages (e.g. EEC1) and signals (e.g. RPM).
>
> The **DBC file** type was **developed** by Vector Informatik GmbH in the 1990s to provide a standard means of storing information described in a CAN network. Used by the automotive industry primarily, Vector database **files** (. **dbc**) have since become the de facto standard for exchanging CAN descriptions. 13 sept. 2019

As many other tools in the industry, LeCroy oscilloscopes can import DBC files to support the symbolic decoding of CAN traffic. The symbolic decode of CAN traffic helps users interpret the raw signals measured by the oscilloscope when decoded on screen.

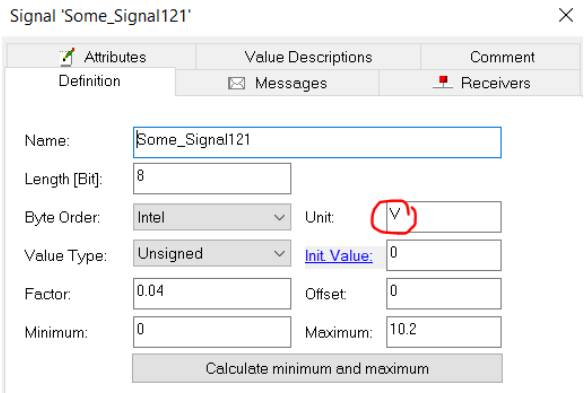
While only a fraction of the information contained in the DBC file is used by the CAN decoding system, one important information stored in the DBC file is **the unit of the signals.** The units help users interpret their signals, i.e. 12.47 V, 4.5 A, 2.3 J, etc. when using various automotive tools.

While the unit contained in the DBC file is a **free entry text string**, it flows into the oscilloscope which has a very strict unit system. The DSO's unit system allow units combinations, i.e. when multiplying a signal in Volts with a signal in Amperes, the resulting signal will be in Watts. Therefore the DSO's units system accepts SI units only. Non SI units are not suitable for unit's algebra and therefore rejected by most of the oscilloscope's processing components.

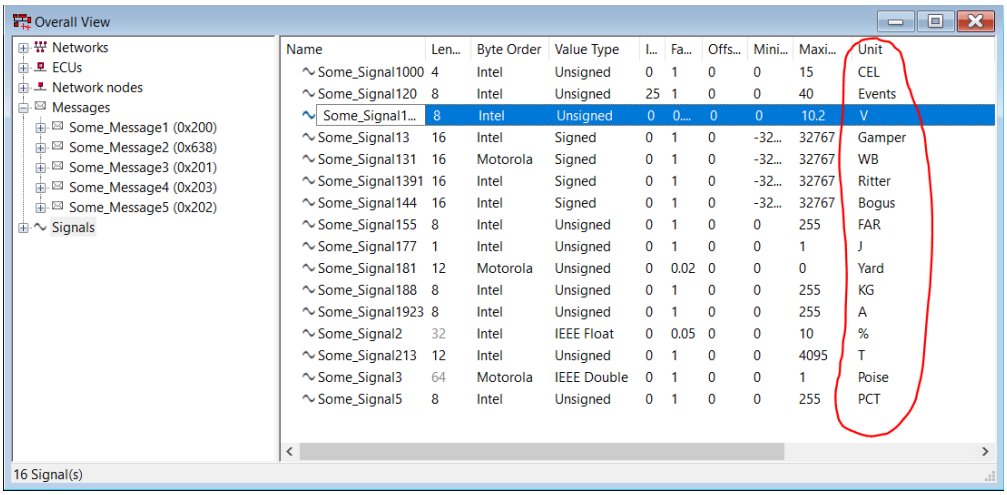
This document explains the behavior of the subsystems with respect to units, and attempts to answer many user's question over the years.

Units in the DBC file Editor by Vector

The DBC file editor allows the **attribution of a unit to every signal** with the Signal editing dialog



The Overall views conveniently shows a tabular listing of all the signals used in the database and allows a verification of their consistency and validity



Name	Len...	Byte Order	Value Type	I...	Fa...	Offs...	Mini...	Maxi...	Unit
Some_Signal1000	4	Intel	Unsigned	0	1	0	0	15	CEL
Some_Signal120	8	Intel	Unsigned	25	1	0	0	40	Events
Some_Signal1...	8	Intel	Unsigned	0	0....	0	0	10.2	V
Some_Signal13	16	Intel	Signed	0	1	0	-32...	32767	Gamper
Some_Signal131	16	Motorola	Signed	0	1	0	-32...	32767	WB
Some_Signal1391	16	Intel	Signed	0	1	0	-32...	32767	Ritter
Some_Signal144	16	Intel	Signed	0	1	0	-32...	32767	Bogus
Some_Signal155	8	Intel	Unsigned	0	1	0	0	255	FAR
Some_Signal177	1	Intel	Unsigned	0	1	0	0	1	J
Some_Signal181	12	Motorola	Unsigned	0	0.02	0	0	0	Yard
Some_Signal188	8	Intel	Unsigned	0	1	0	0	255	KG
Some_Signal1923	8	Intel	Unsigned	0	1	0	0	255	A
Some_Signal2	32	Intel	IEEE Float	0	0.05	0	0	10	%
Some_Signal213	12	Intel	Unsigned	0	1	0	0	4095	T
Some_Signal3	64	Motorola	IEEE Double	0	1	0	0	1	Poise
Some_Signal5	8	Intel	Unsigned	0	1	0	0	255	PCT

DBC Units in oscilloscopes

As outlined above the oscilloscopes units system is strict because it allows unit's algebra. A good source of documentation can be found here: https://teledynelecroy.com/doc/tutorial-rescaling

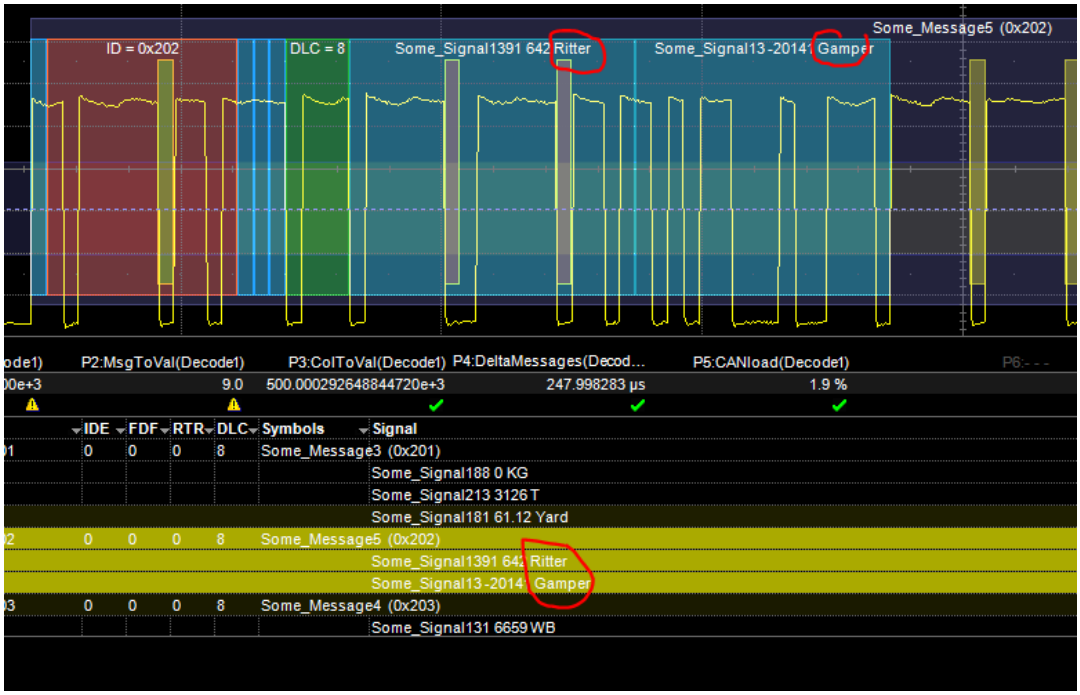
The Supported Output Units abbreviations are as follows:

1. (blank) - No units
2. A - Ampere
3. C - Coulomb
4. CYCLE - Cycles
5. DB - Decibel
6. DBC - Decibel referred to carrier
7. DBM - Decibel Milliwatt
8. DBV - Decibel Volts
9. DBUZ - Decibel Microamp
10. DEC - Decade
11. DIV - Divisions
12. Event - Events
13. F - Farad
14. G - Gram
15. H - Henry
16. HZ - Hertz
17. J - Joule
18. K - Degree Kelvin
19. CEL - Degree Celsius
20. FAR - Degree Fahrenheit
21. L - Liter
22. M - Meter
23. FT - Foot
24. IN - Inch
25. YARD - Yard
26. MILE - Mile
27. N - Newton
28. OHM - Ohm
29. PAL - Pascal
30. PCT - Percent
31. POISE - Poise
32. PPM - Parts per million
33. RAD - Radian
34. DEG - Degree (of arc)
35. MNT - Minute (of arc)
36. SAMPLE - Sample
37. SWEEP - Sweeps
38. SEC - Second (of arc)
39. S - Second
40. SIE - Siemens
41. T - Tesla
42. UI - Unit interval
43. V - Volt
44. VA - Volt amps
45. W - Watt
46. WB - Weber
47. MIN - Min
48. HOUR - Hour
49. DAY - Day
50. WEEK - Week

Only units supported as shown above will propagate through the oscilloscopes systems, with one exception the decoder, explained below.

DBC Units in the symbolic Decoder

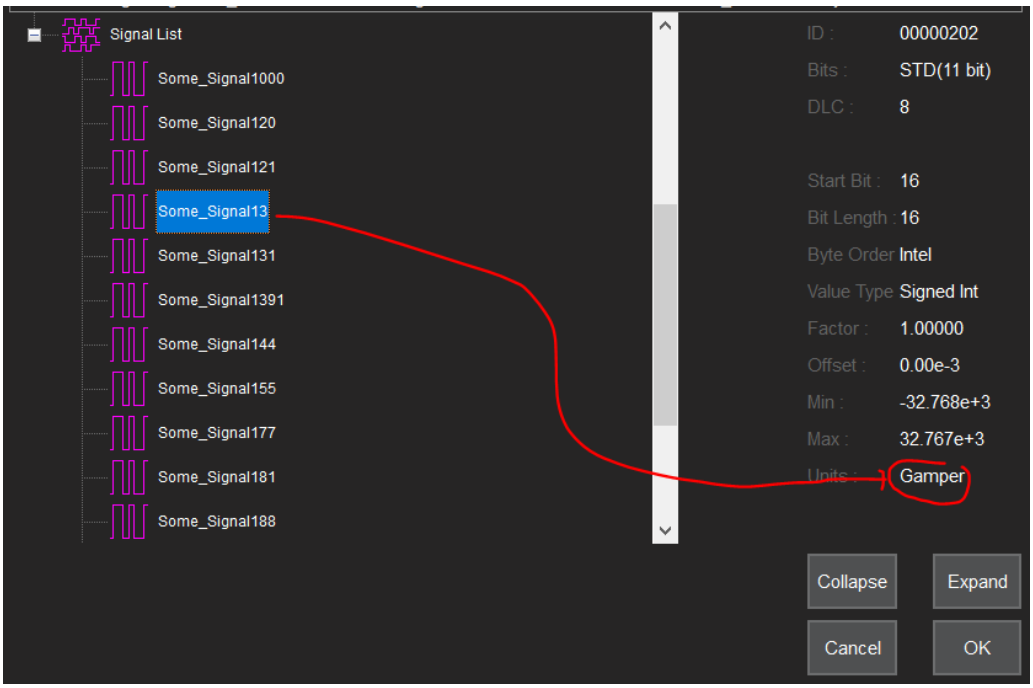
The CAN decoder's component accepts any text string from the DBC as units and displays them both in the table and the annotation as shown in the following image.



The reason for this exception is that the symbolic decoder's output does not flow into any other strict unit system. Therefore, non SI units are supported

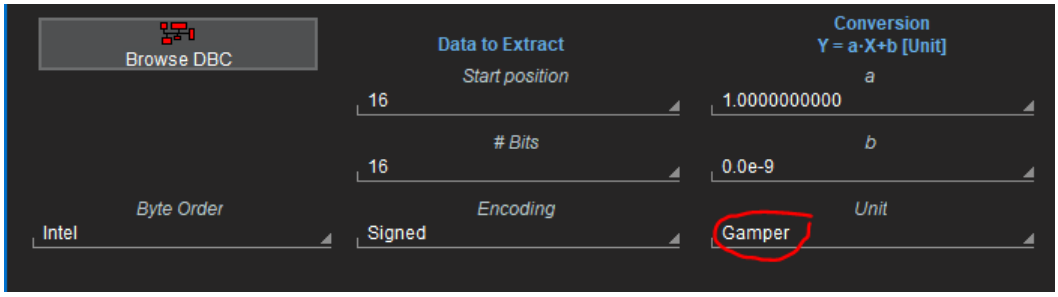
DBC Units in CAN parameters

We know look at a CAN parameter, for which interpretation elements can be selected via the symbolic picker:



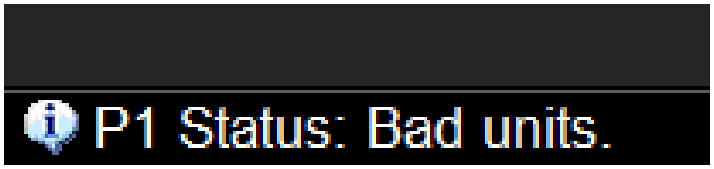
We have purposively defined a signal using the author's name as units, which is not (yet) an official SI unit and **therefore not accepted** by the unit's system.

When selected, the signals' s elements will be transferred to the DSO's parameter dialog:



since only supported units are expected the resulting parameter will compute correctly but exhibit a warning icon at the bottom of its display region.

When the yellow warning icon is clicked on, the explanation is temporarily emitted in the status line at the bottom of the scope's application window.



At this stage the engineers can either choose to disregard the fact that the value is unitless, or correct the unit in the DBC or in the parameter dialog.

Conclusion

Units introduced in CAN DBC files can be used by the oscilloscope to decode the CAN traffic. However, the oscilloscope only recognizes official SI unit for parameter computations and additional downstream computations.

The decoder accepts non-SI units.

If a non-SI unit is desired, for the sake of clarity or training purposes, it can be used but it will not propagate any further then the decoder into the system.

It is a user's choice to decide between SI and non-SI units, based on the intended use and audience for the DBC at hand.