SERVICE INFORMATION

Electrical motor vehicle signals

Increasing importance of the oscilloscope

Analogue signals can be measured with any commercially available multimeter. Synchronised signals require the use of an oscilloscope or the appropriate function on an engine tester.

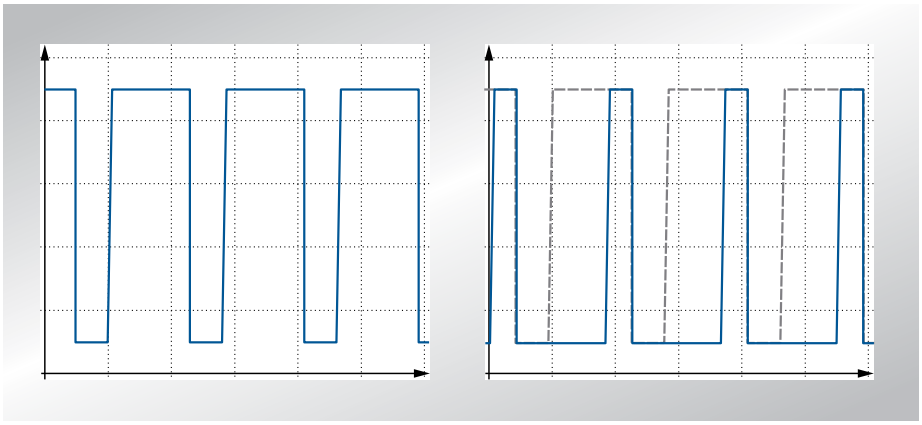
In automotive technology, increasing use is being made of signals that consist of a regularly synchronised voltage. Multimeters only show the average voltage over a period.

Pulse width modulation (PWM)
(see Fig. 1/Video 1)
- The frequency is constant.
- The pulse duty factor, i.e. the width of the pulses, varies.

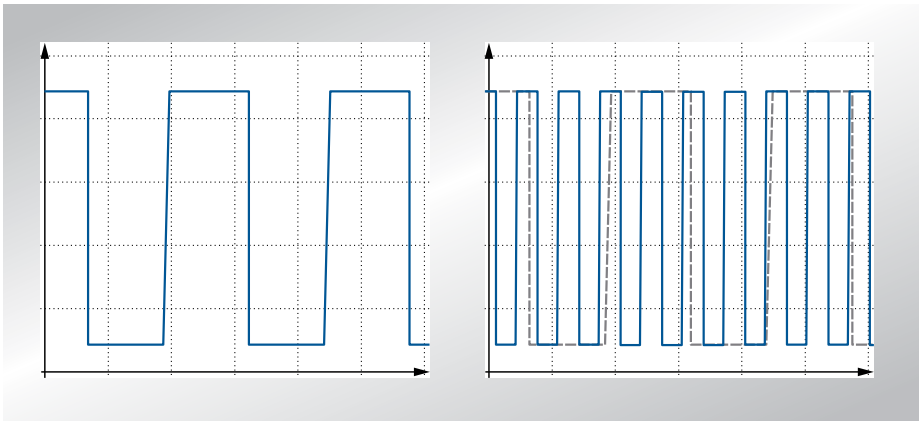
Pulse width modulation may be used as a signal input factor or for the power control system, e.g. for EGR valves, throttle valves, electro-pneumatic valves, idling actuators or for demand-controlled fuel pumps.

Pulse frequency modulation (PFM)
(see Fig. 2/Video 2)
- The frequency varies, i.e. the signal curves are compressed or elongated.
- The pulse duty factor is constant.

On some PIERBURG air mass sensors the output factors may be output as PFM signals.



Pulse width modulation (PWM)
Fig. 1: The frequency is constant. The pulse duty factor varies.
Video 1: Signal on the oscilloscope and multimeter



Pulse frequency modulation (PFM)
Fig. 2: The frequency varies. The pulse duty factor is constant.
Video 2: Signal on the oscilloscope and multimeter

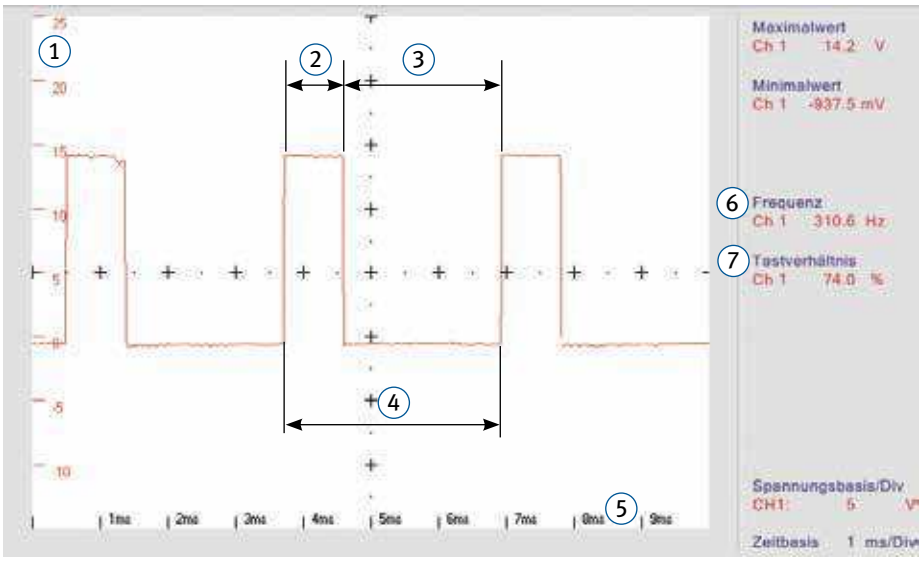
Click on the YouTube icon or scan the QR code to watch the video.
You can find further podcasts at youtube.com/motorservicegroup

Synchronised signals on the oscilloscope screen

Parameters:

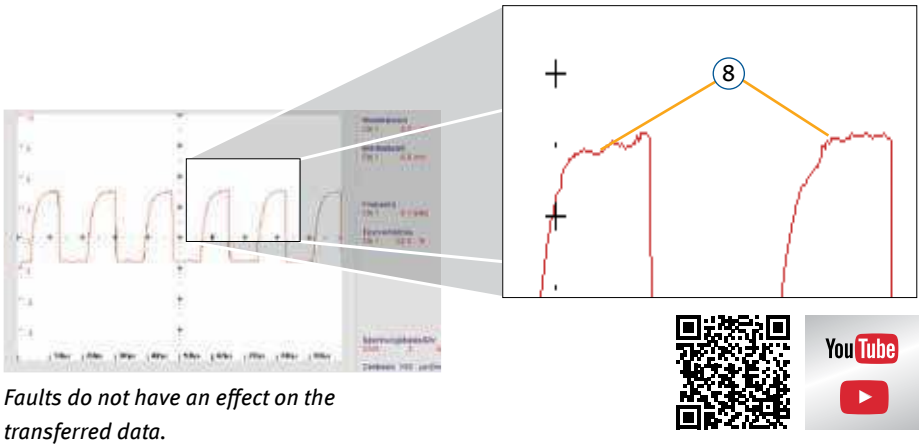
(1) Voltage U, in volts
(2) Pulse or ON time
(3) OFF time
(4) Period duration T
(5) Time axis, in seconds
(6) The frequency is inverse of the period duration: f = 1/T
(7) “Pulse duty factor”

The term “pulse duty factor” is not always defined in the same way.
Generally speaking it is understood to mean the relationship of ON time (2) to period duration (4).
The pulse duty factor is shown as a number between 0 and 1 or a percentage value between 0% and 100%.
Some oscilloscopes, as in the example here, show the pulse duty factor “upside”, in other words the OFF time (3) in relation to the period duration (4).



Example: PWM signal with a pulse duty factor of 74%

Synchronised signals are relatively insensitive to faults.
Faults in the signal flow, for example due to corrosion or moisture in the plug-in connections, may cause the voltage level (8) to vary.
This does not affect the actual “pulse duty factor” or “frequency” data.



Faults do not have an effect on the transferred data.

In automotive technology frequencies of 100 Hz are usual. This is equivalent to 100 periods per second.
Signal forms with these high frequencies can only be displayed on an oscilloscope.

On more and more products inputs and outputs are produced by synchronised signals.