SUMMARY OF THE MAF SENSOR WAVEFORMS

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1. Brief introduction and sensor types

CarScope VISO lab scope has been used for all measurements below and all waveforms have been taken from properly working engines and sensors. Common MAF (Mass Air Flow) manufacturers are Bosch, Delphi, Denso, Hitachi, Pierburg and ACDelco.

According to the type of the output signal MAF sensors are:

- With an analog output signal
- With a digital output - frequency increases with increasing airflow
- With a digital output - frequency decreases with increasing airflow (Pierburg).

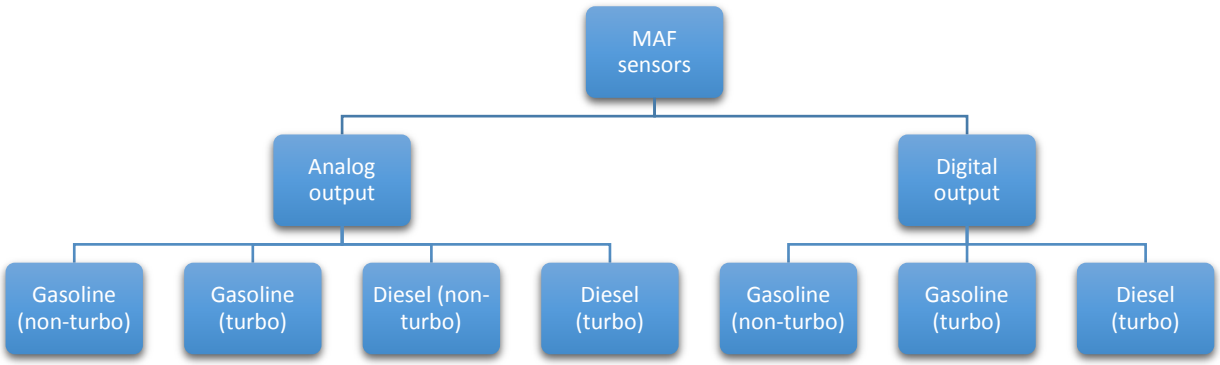
Depending on the type of construction MAF sensors are:

- Measuring the volume (l/h) of the airflow – Vane Meter Sensor (VAF). The output signal resembles the gasoline (non-turbo) Hot Wire MAF sensor output
- Measuring the mass (lbs/min) or (g/s) of the airflow – Hot Wire, Cold Wire (ACDelco) and Hot Film (HFM).
- Karman vortex flow meter - Found on Mitsubishi Eclipse, Eagle Talon, Plymouth Laser, some Toyota, Lexus and BMW cars. No mechanical moving parts.

Most common are the “Hot Wire” and the “Hot Film (HFM)” MAF sensors because they don’t have mechanical moving parts and great performance and accuracy. They are not sensitive to the pulsations associated with opening and closing of intake valves and the output reading does not depend on the density of incoming air.

2. Hierarchical diagram and waveforms information

The following hierarchical diagram below shows how the AFM sensors are subdivided according to the vehicle/fuel type:



Note: There were no significant differences in output signals between different MAF sensor manufacturers of the same MAF type.

TOP

3. Analog MAF waveforms

Gasoline (non-turbo) - analog
MAF sensor: Denso (Vehicle: Toyota Auris (Corolla) 1.4 VVT-i 2009)
Condition: snap acceleration

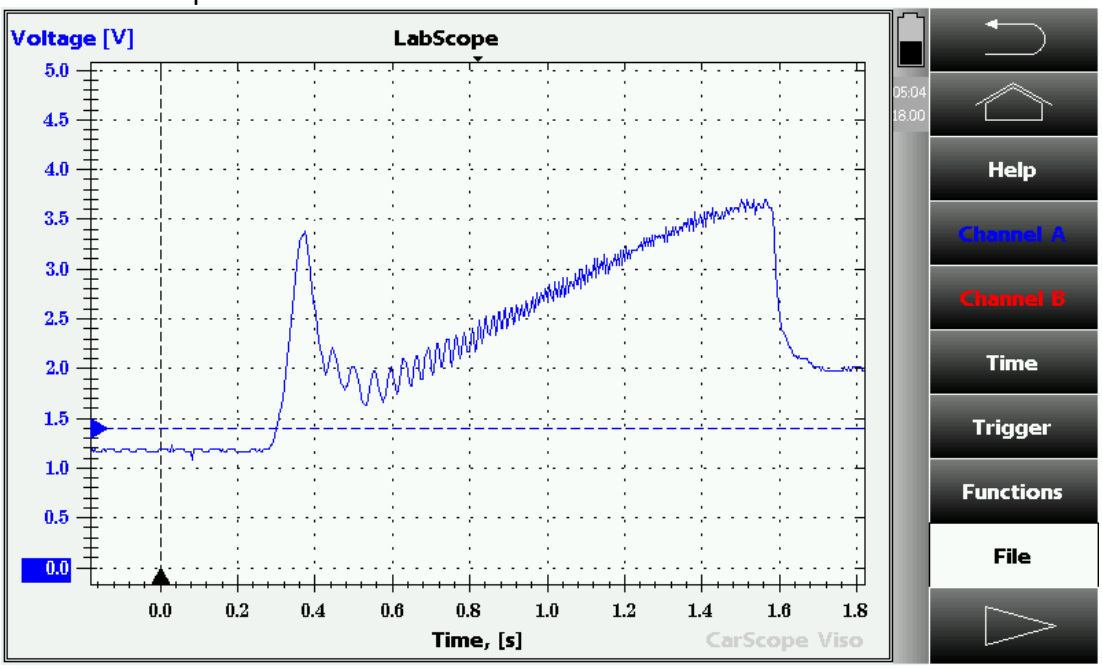


Fig.1

Gasolne (non-turbo) - analog
MAF sensor: Hitachi (Vehicle: Audi A3 1.6 1997)
Condition: snap acceleration

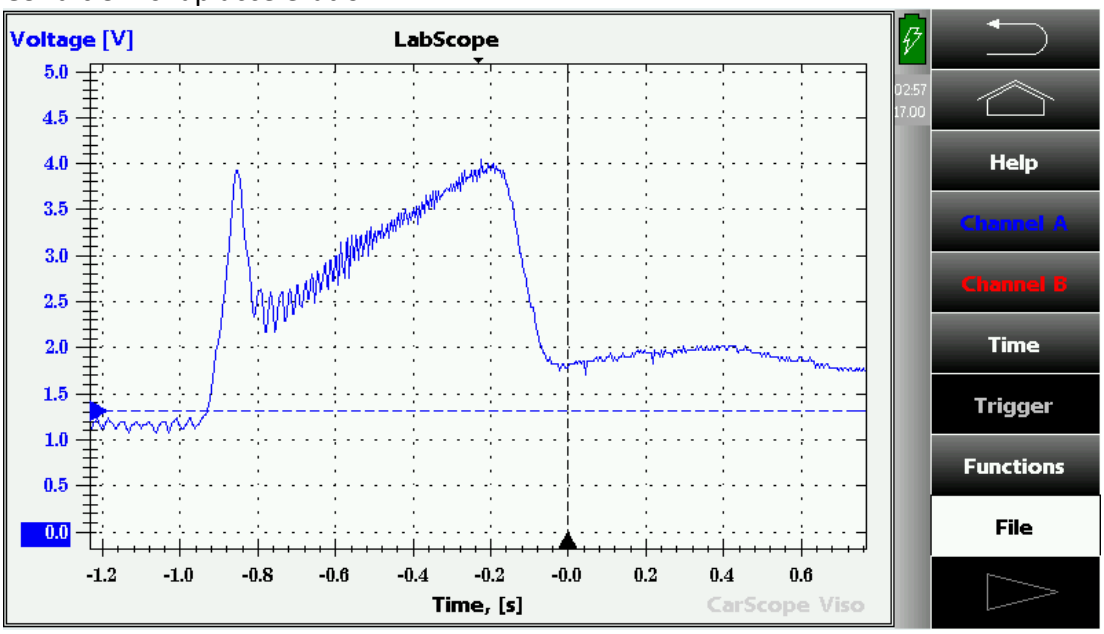


Fig.2

TOP

Gasoline (turbo) - analog
MAF sensor: Bosch (Vehicle: Seat Leon 1.8 Turbo 2004)
Condition: snap acceleration

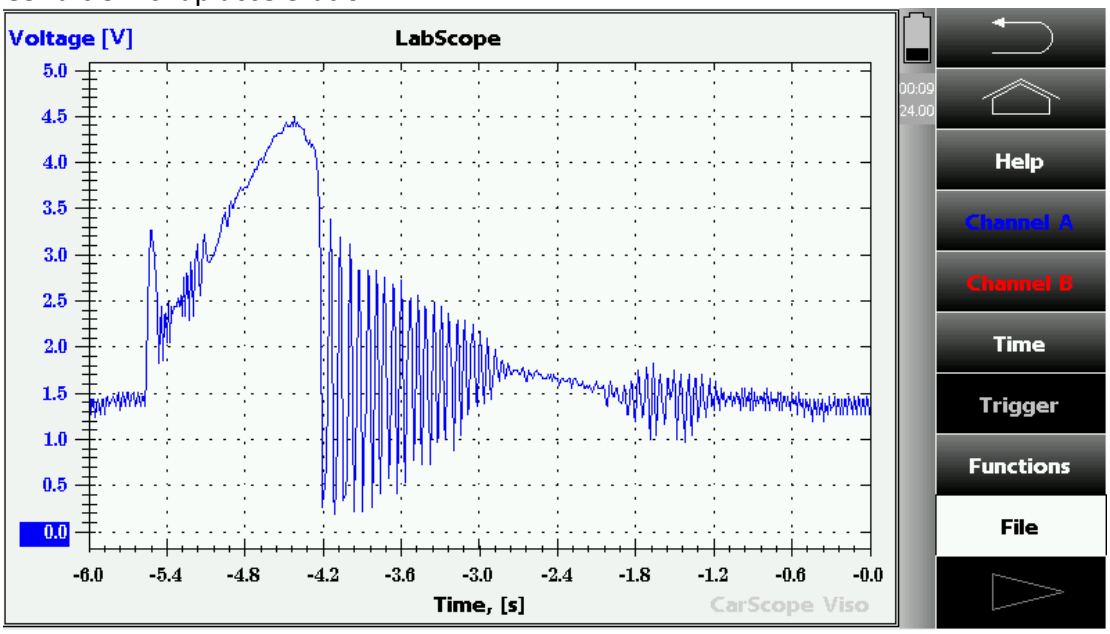


Fig.3

Diesel (non-turbo) - analog
MAF sensor: Bosch HFM5 (Vehicle: Volkswagen Golf 2.0 SDI 2004)
Condition: snap acceleration

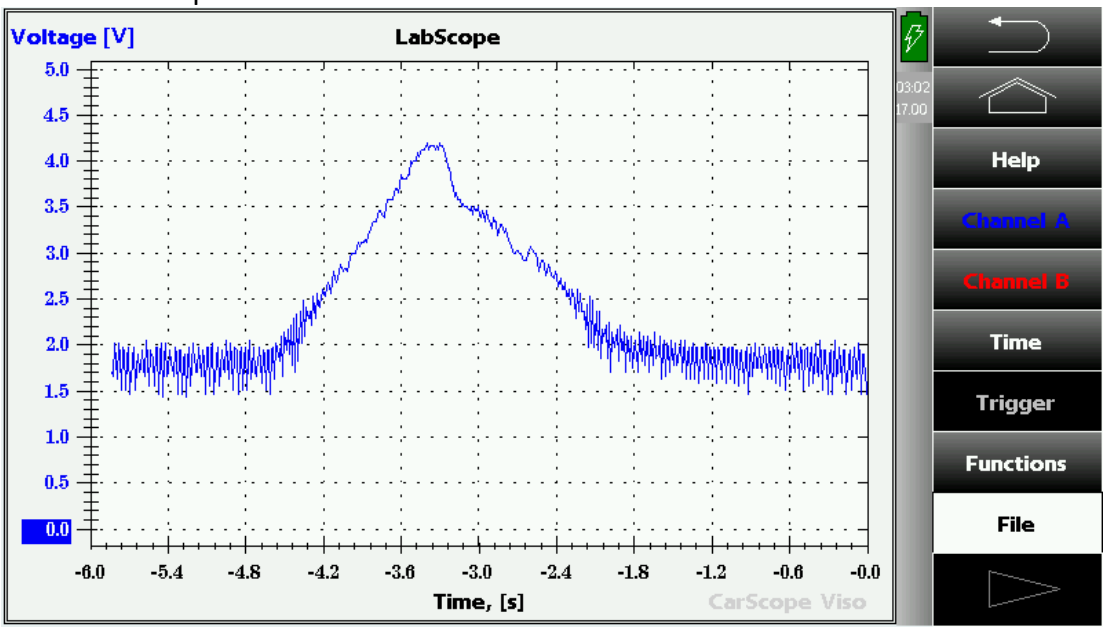


Fig.4

TOP

Diesel (turbo) - analog
MAF sensor: Denso (Vehicle: Toyota Auris (Corolla) 2.0 D4D 2008)
Condition: snap acceleration

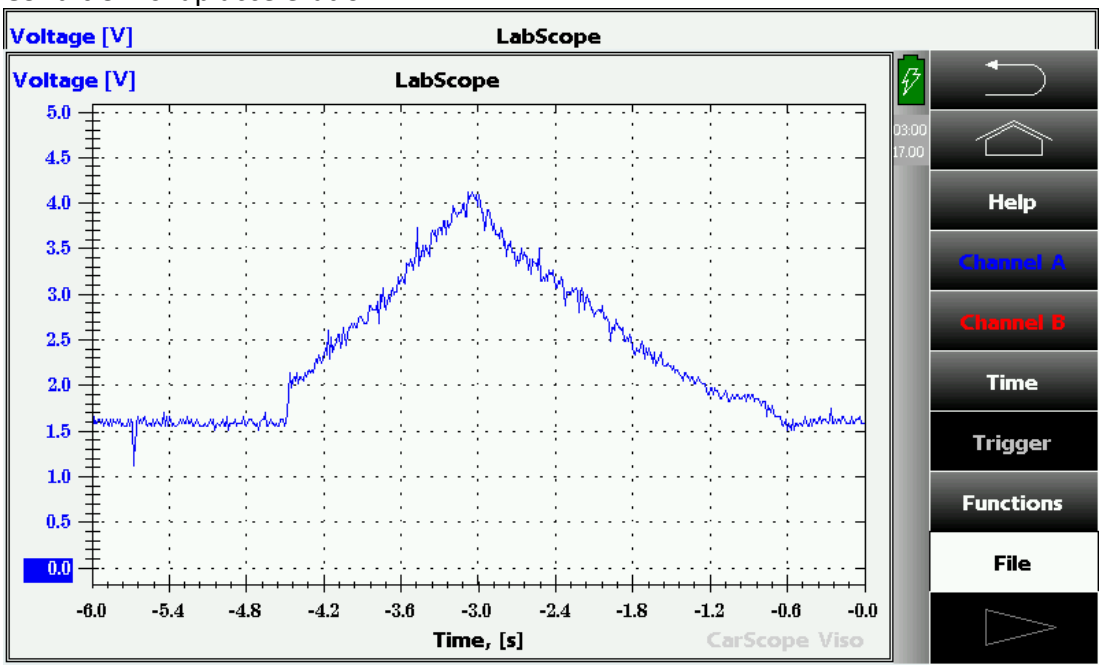


Fig.5

Diesel (turbo) - analog
MAF sensor: Bosch HFM5 (Mercedes C200CDI W204 2007)
Condition: snap acceleration

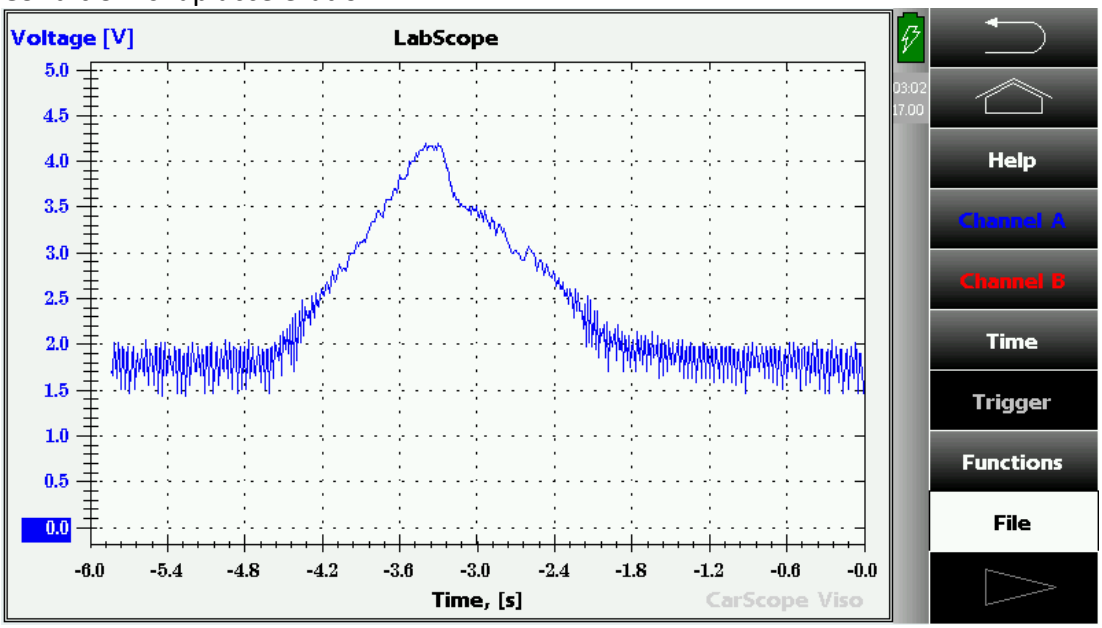


Fig.6

TOP

4. Digital MAF waveforms

Gasoline (non-turbo) - digital
MAF sensor: Karman-Vortex type (Vehicle: Mitsubishi Eclipse 1.8L 1992)
Condition: engine idling
Additional info: At idle the frequency is about 30 Hz. Due to low engine speed

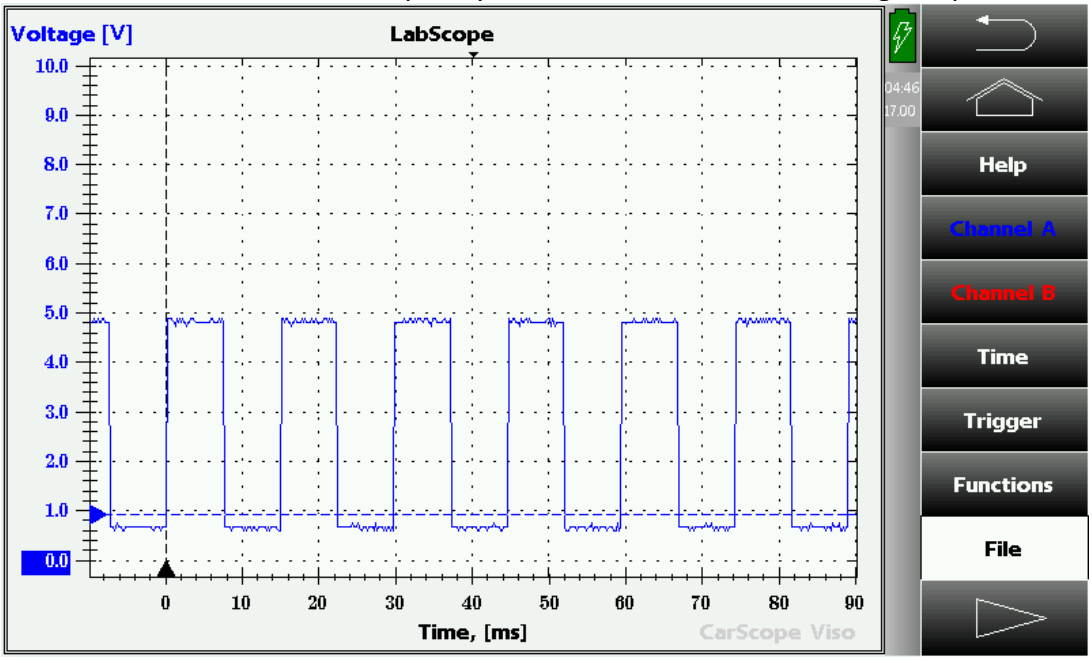


Fig.7

Gasoline (non-turbo) - digital
MAF sensor: Karman-Vortex type (Vehicle: Mitsubishi Eclipse 1.8L 1992)
Condition: snap acceleration
Additional info: At high engine speed the frequency goes to 160 Hz or higher.

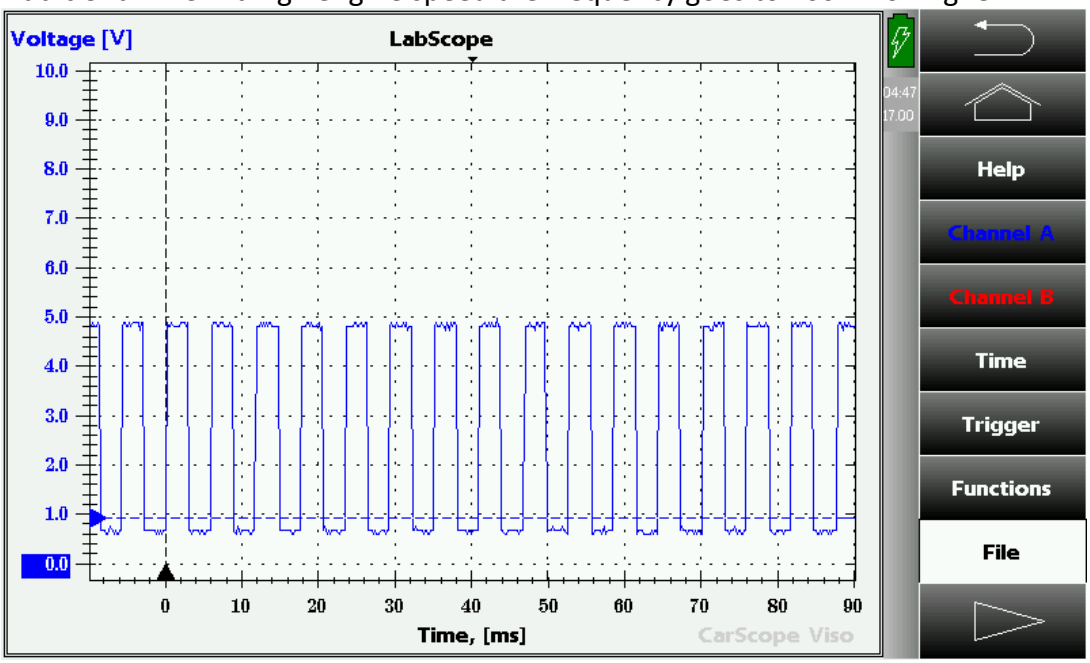


Fig.8

TOP

Gasoline (non-turbo) - digital
MAF sensor: Hitachi (Vehicle: Chevrolet Camaro 3.8L V6 2000)
Condition: engine idling
Additional info: frequency increases with the increase of the airflow

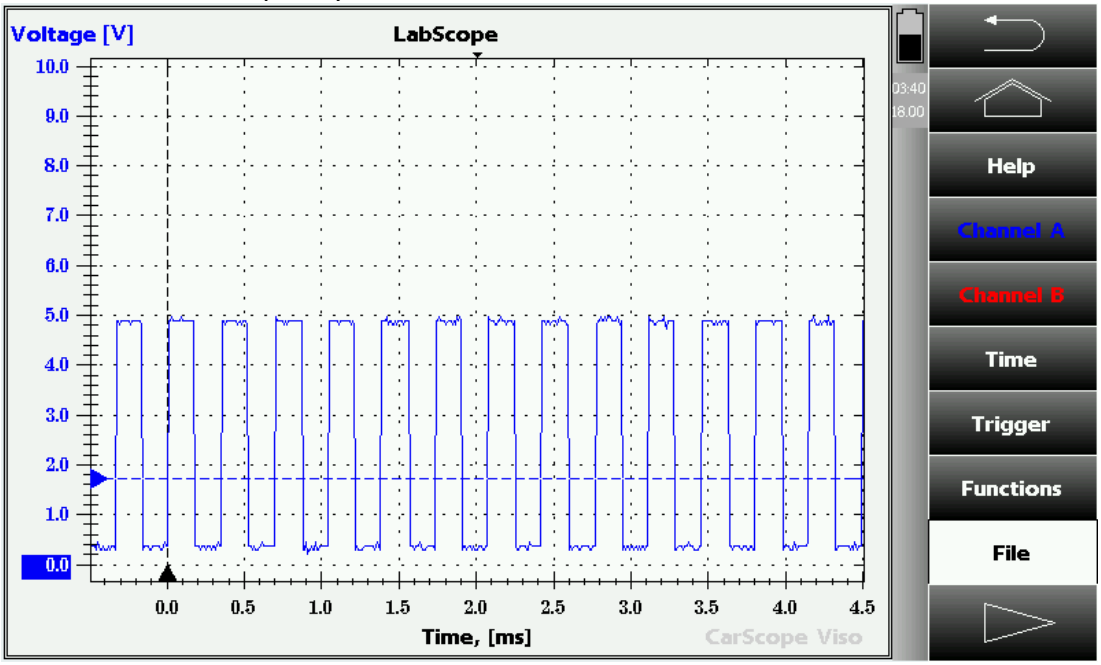


Fig.9

Gasoline (non-turbo) - digital
MAF sensor: Hitachi (Vehicle: Chevrolet Camaro 3.8L V6 2000)
Condition: snap acceleration
Additional info: frequency increases with the increase of the airflow

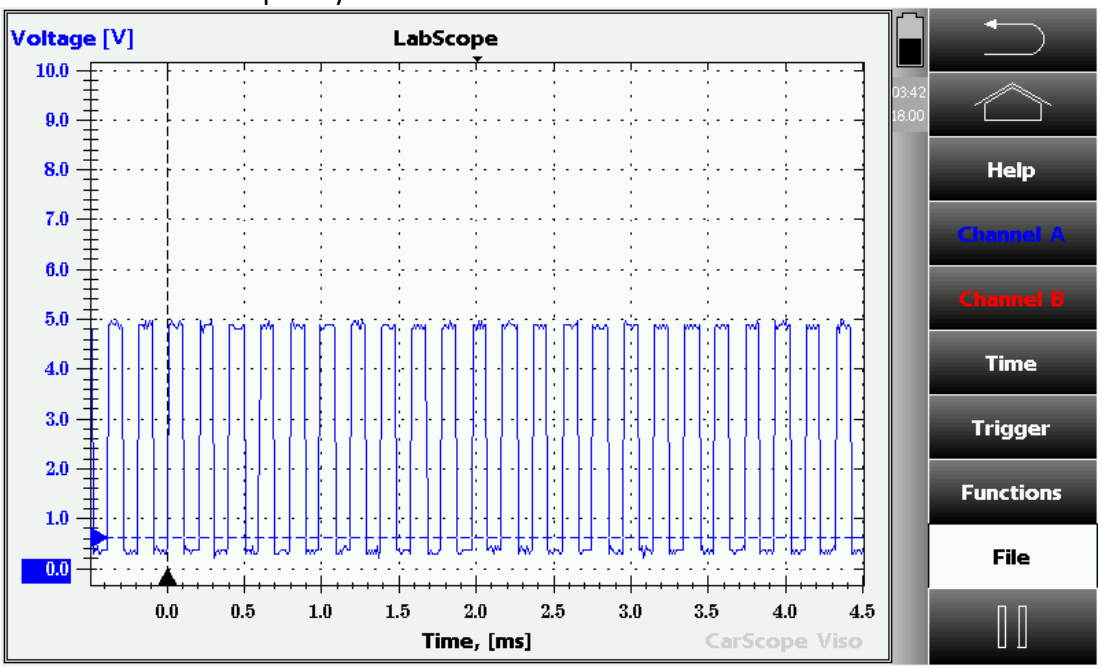


Fig.10

TOP

Gasoline (turbo) - digital
MAF sensor: Hitachi (Vehicle: Skoda Octavia 1.8TSI 2008)
Condition: engine idling

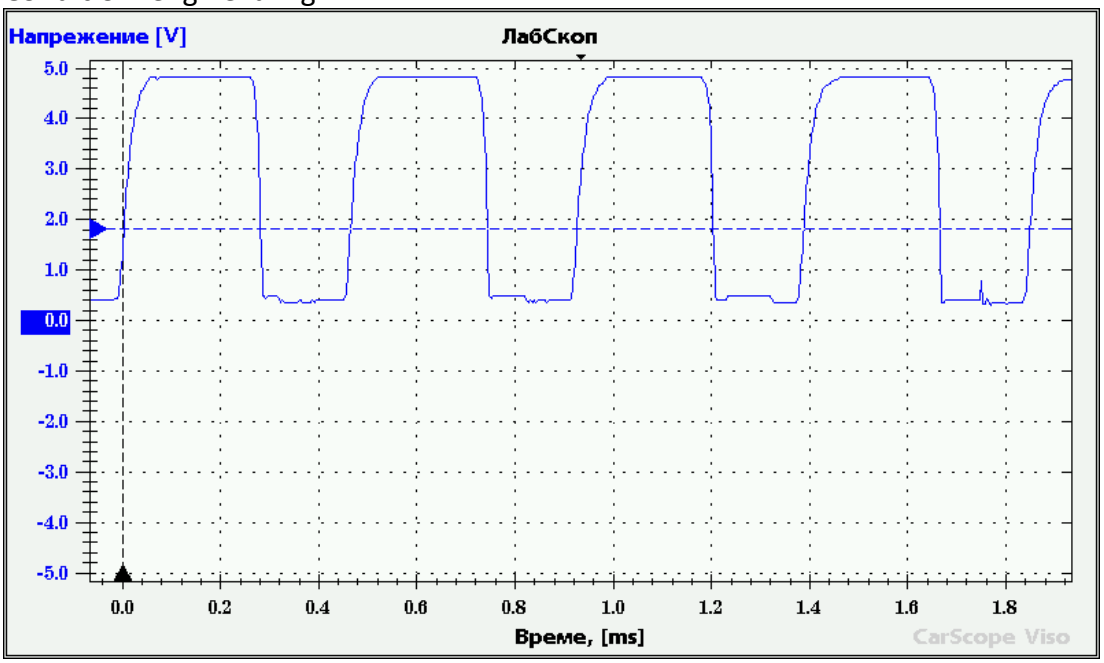


Fig.11

Gasoline (turbo) - digital
MAF sensor: Hitachi (Vehicle: Skoda Octavia 1.8TSI 2008)
Condition: snap acceleration
Additional info: frequency increases with the increase of the airflow

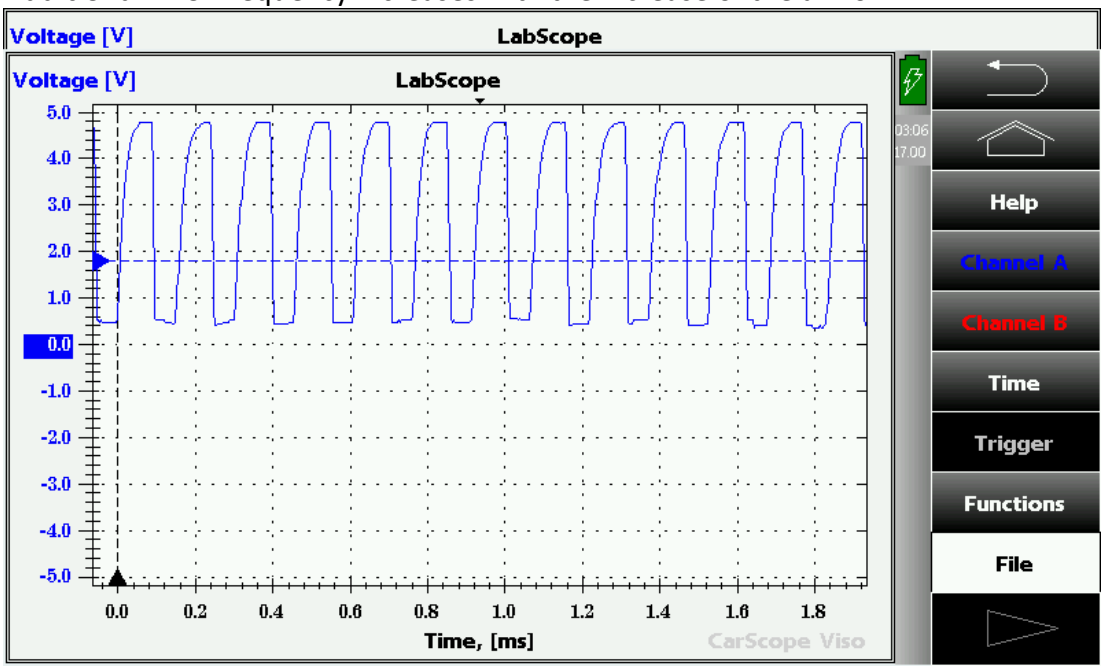


Fig.12

TOP

Gasoline (turbo) - digital
MAF sensor: ACDelco (Vehicle: Buick 2.8L V6 Turbo 1984)
Condition: engine idling
Additional info: frequency at idle speed is 30 to 50 Hz

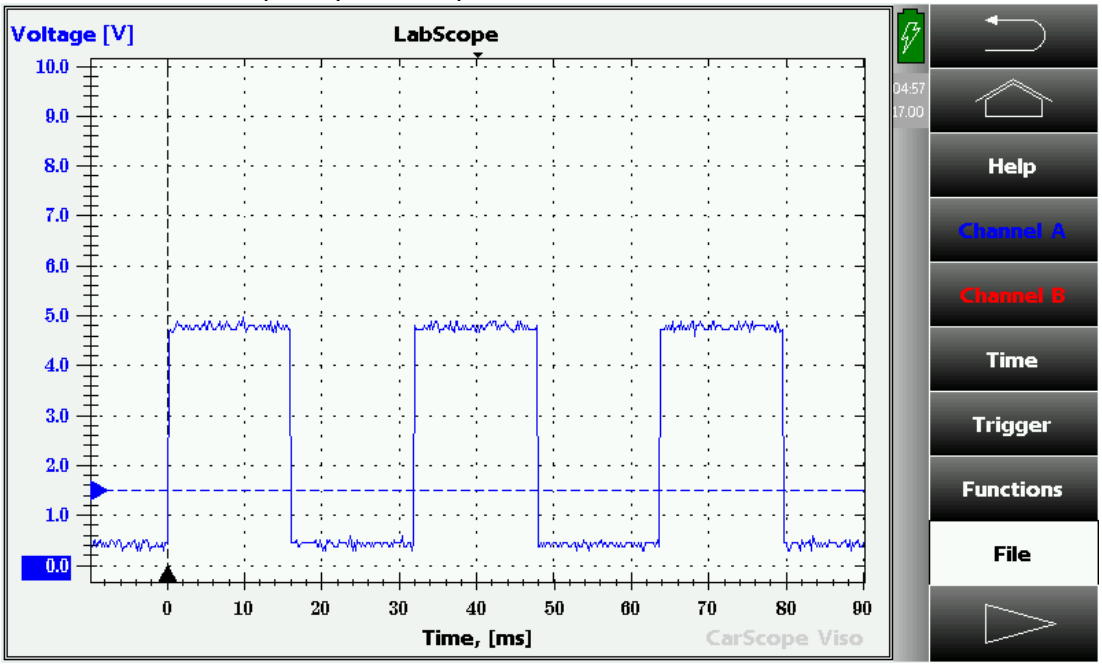


Fig.13

Gasoline (turbo) - digital
MAF sensor: ACDelco (Vehicle: Buick 2.8L V6 Turbo 1984)
Condition: at 3500 rpm
Additional info: frequency at 3500 rpm is 70 to 75 Hz

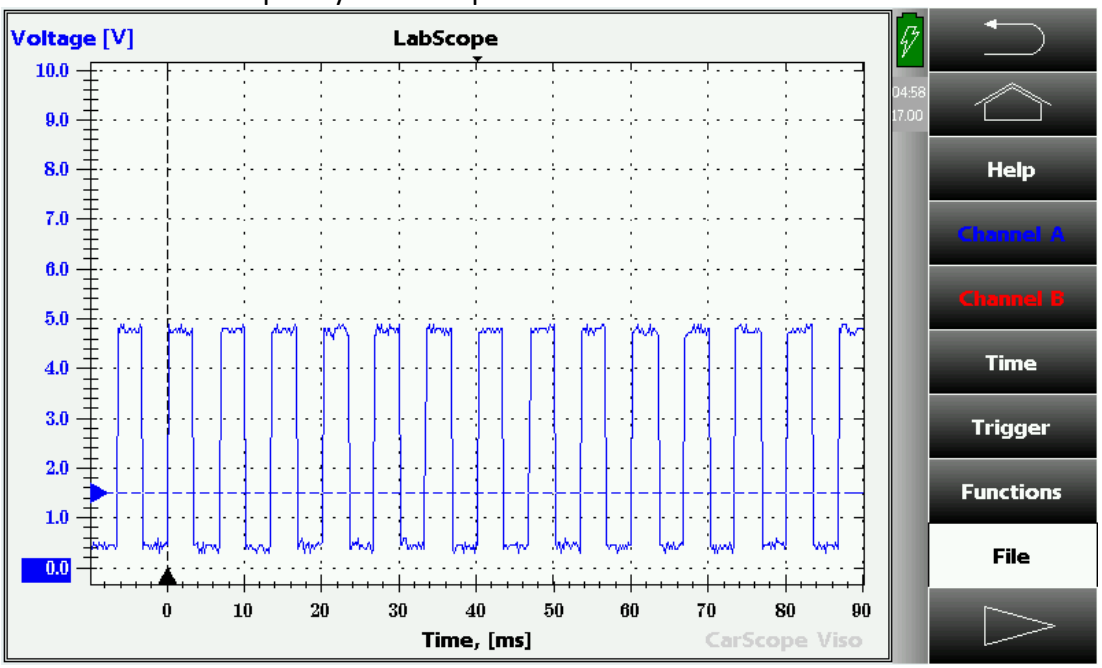


Fig.14

TOP

Diesel (turbo) - digital
MAF sensor: Delphi (Vehicle: Renault Megane II 1.9dCI 2003)
Condition: engine idling
Additional info: frequency increases with the increase of the airflow

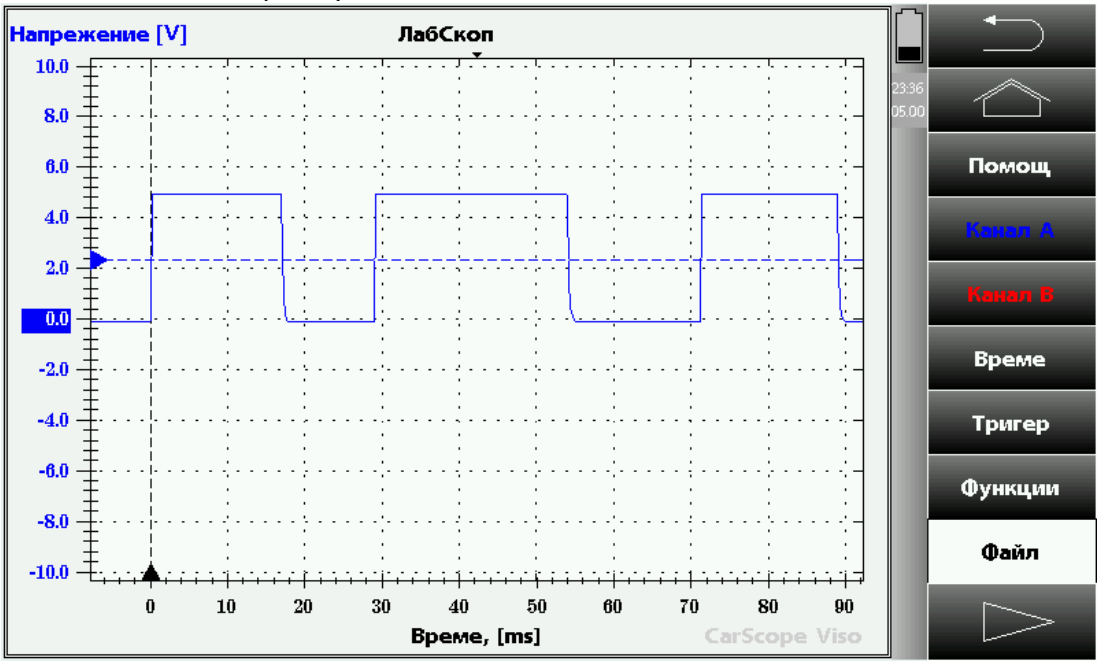


Fig.15

Diesel (turbo) - digital
MAF sensor: Delphi (Vehicle: Renault Megane II 1.9dCI 2003)
Condition: snap acceleration
Additional info: frequency increases with the increase of the airflow

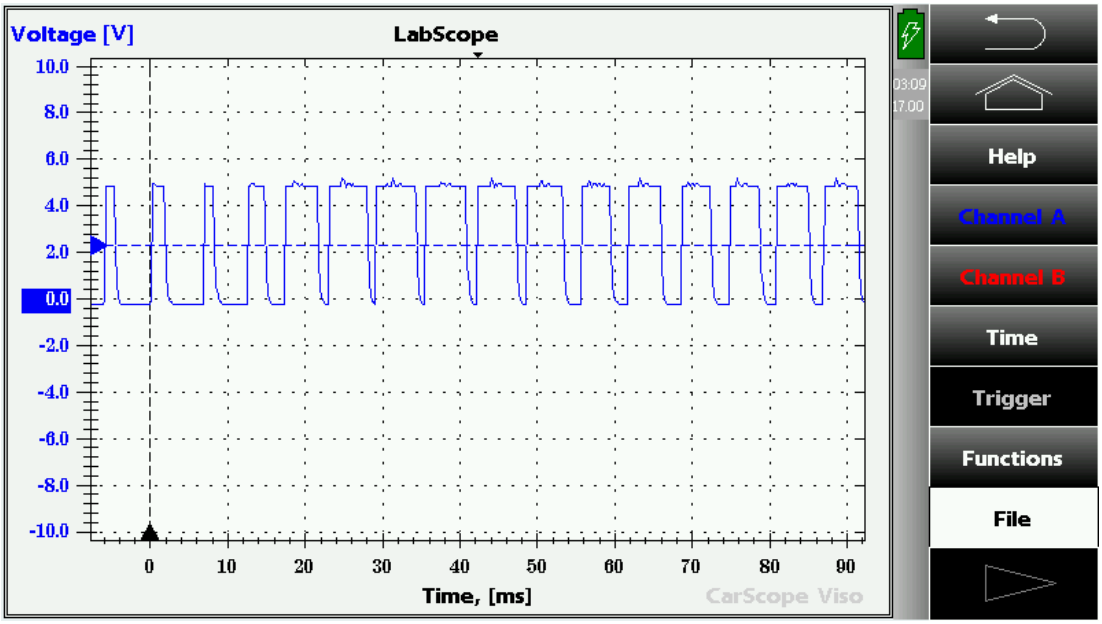


Fig.16

TOP

Diesel (turbo) - digital
MAF sensor: Bosch HFM6 (Vehicle: BMW 320d E46 2.0/110KW 2005)
Condition: engine idling
Additional info: frequency increases with the increase of the airflow

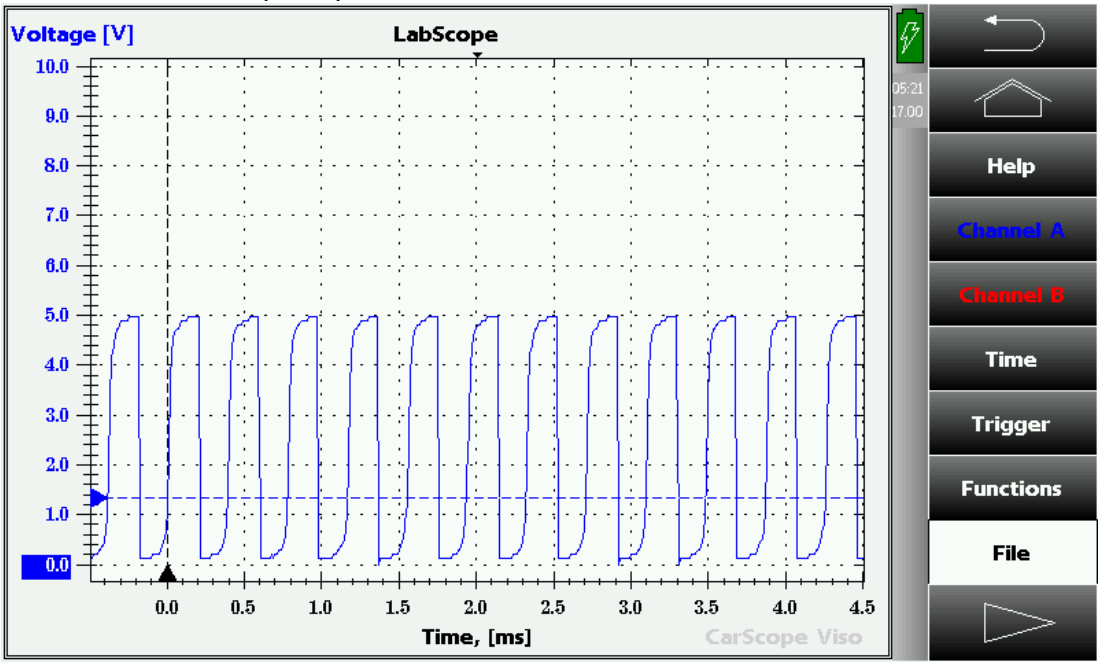


Fig.17

Diesel (turbo) - digital
MAF sensor: Bosch HFM6 (Vehicle: BMW 320d E46 2.0/110KW 2005)
Condition: snap acceleration
Additional info: frequency increases with the increase of the airflow

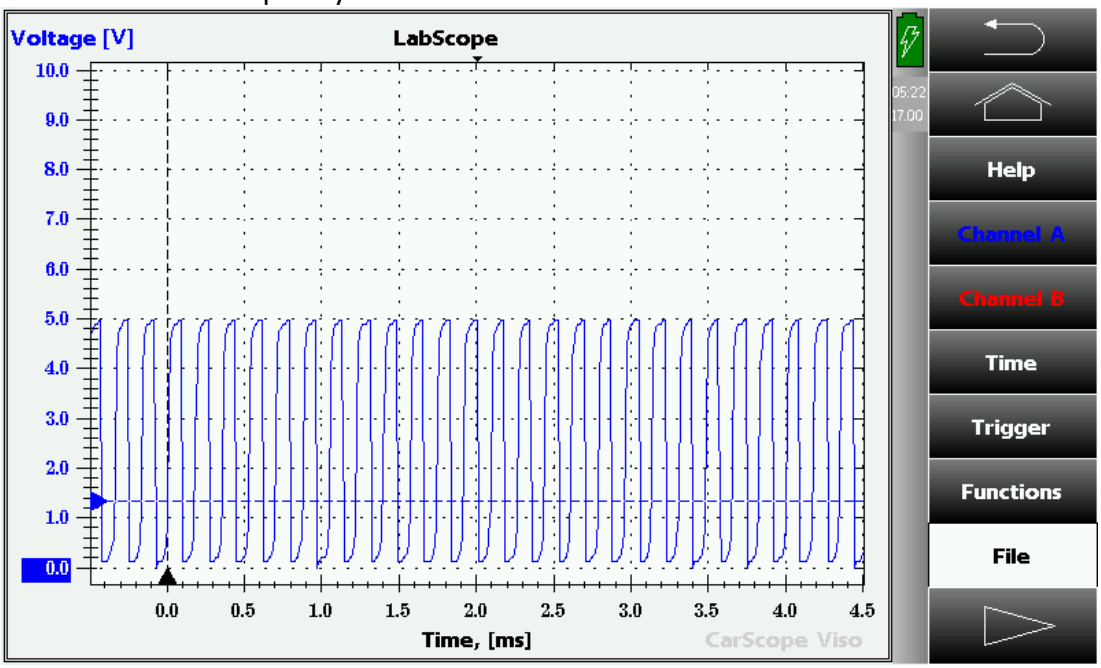


Fig.18

TOP

Diesel (turbo) - digital
MAF sensor: Pierburg (Vehicle: Peugeot 207 1.6 HDI 2007)
Condition: ignition on not running (frequency=5 KHz)

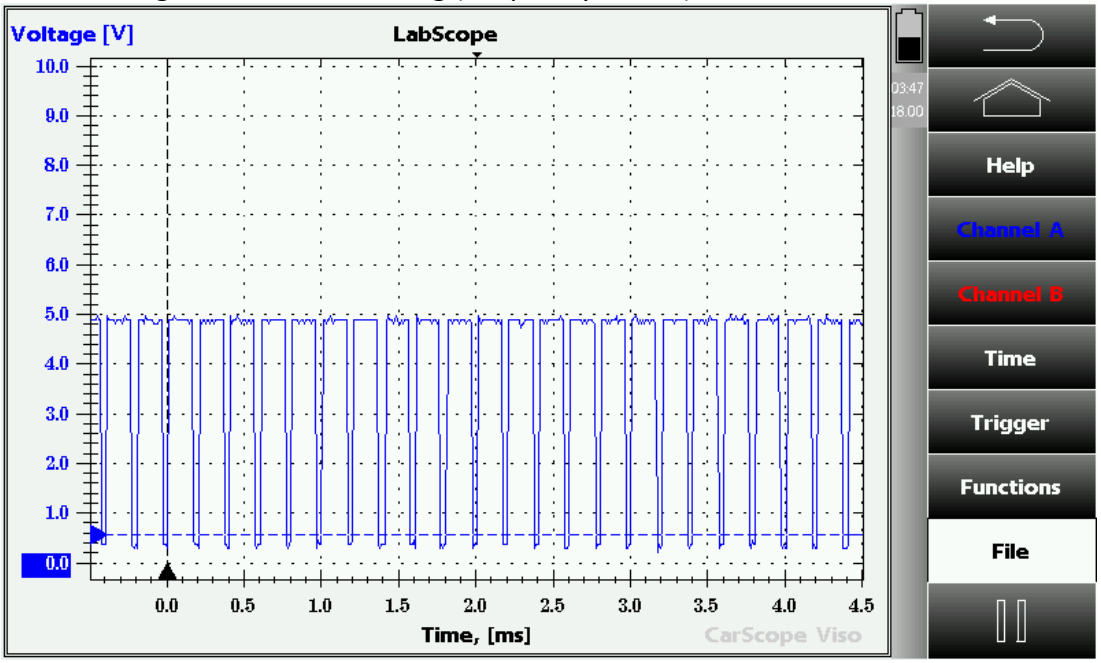


Fig.19

Diesel (turbo) - digital
MAF sensor: Pierburg (Vehicle: Peugeot 207 1.6 HDI 2007)
Condition: engine idling (frequency=3.5 KHz)
Additional info: frequency decreases with the increase of the airflow

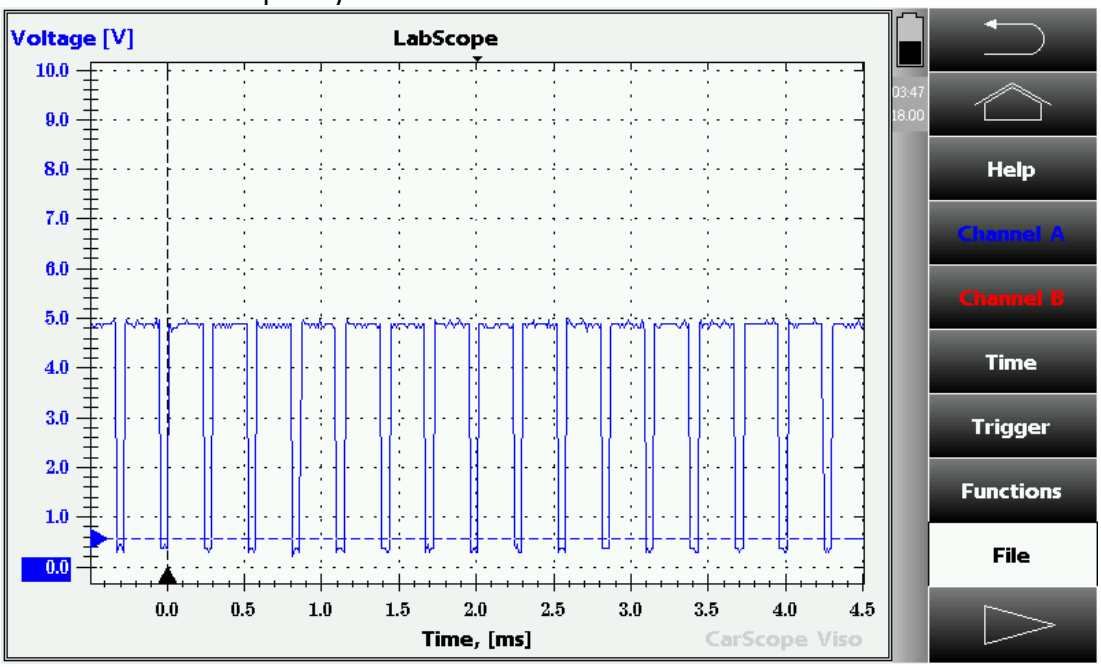


Fig.20

TOP

Diesel (turbo) - digital
MAF sensor: Pierburg (Vehicle: Peugeot 207 1.6 HDI 2007)
Condition: snap acceleration (frequency about 1 KHz)
Additional info: frequency decreases with the increase of the airflow

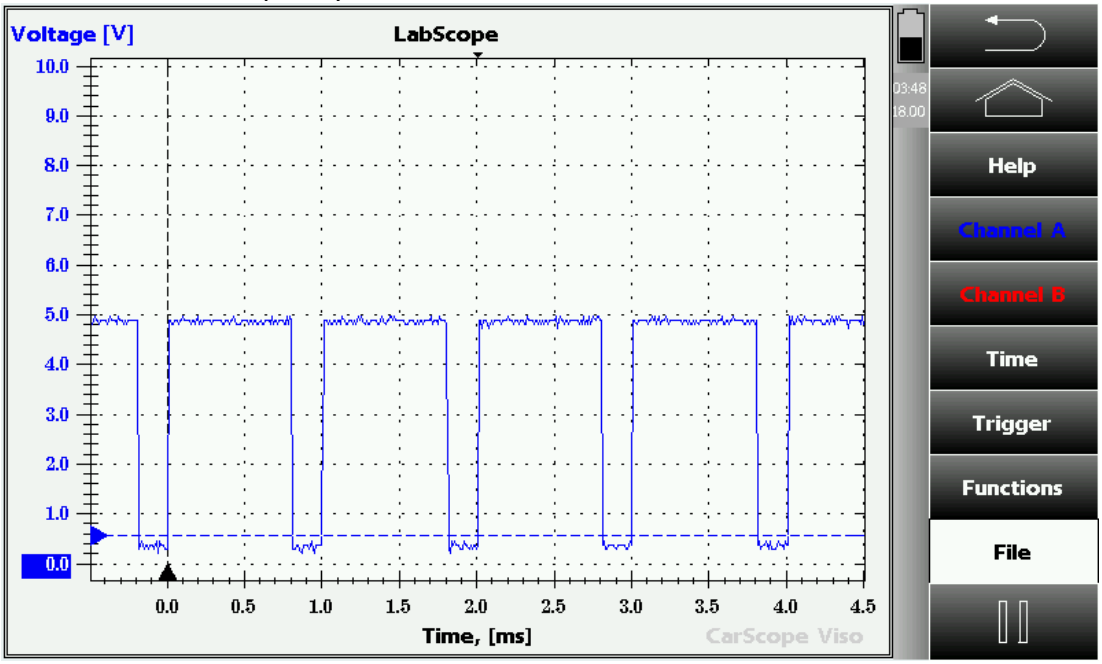


Fig.21

TOP