User's guide for DT-M006

MEASURING ENGINE SPEED AND CRANKSHAFT POSITION

EXOTEST® EDUCATION

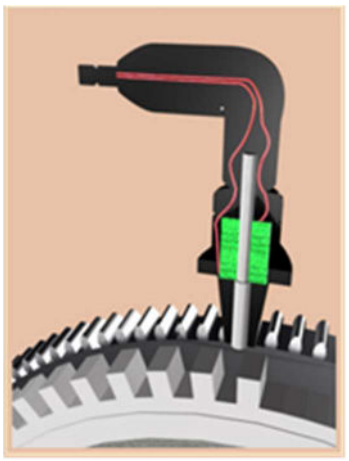
DM No.00308622-v1

1. RESOURCES FILE

1.1. Inductive engine speed and crankshaft position sensor

1.1.1. Setup

This sensor is placed opposite a 60-tooth ring gear from which two teeth have been removed to determine the TDC (Top Dead Centre) position. This ring gear is mounted on the flywheel.



1.1.2. Role

The inductive sensor is used to determine engine speed and the TDC position. This information is transmitted to the engine ECU for the purpose of determining spark advance, coil charge and the rate and quantity of petrol to be injected, and to control idling speed.

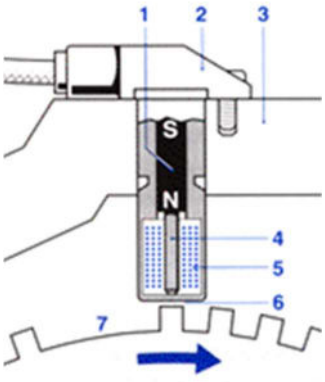
1.1.3. Description

This sensor is termed “active” as its operation is not dependent on power supply. Its operation is based on the principle of electromagnetic induction. It comprises a permanent magnet, a soft iron pole pin and an inductive coil with two connections.

The physical principle relating to the production of an inductive voltage is based on the variation of the magnetic field over time.

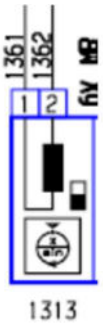
For our application, a variation in the magnetic field is created when a ferromagnetic ring gear rotates in front of the sensor. This variation induces an alternating current (sine-wave signal) in the winding. The frequency and amplitude of this signal are proportional to the crankshaft rotational speed.

Number	Description
1	Permanent magnet
2	Sensor housing
3	Crankcase
4	Pole pin
5	Winding
6	Air gap
7	Target wheel with reference marker



1.1.4. Electrical features

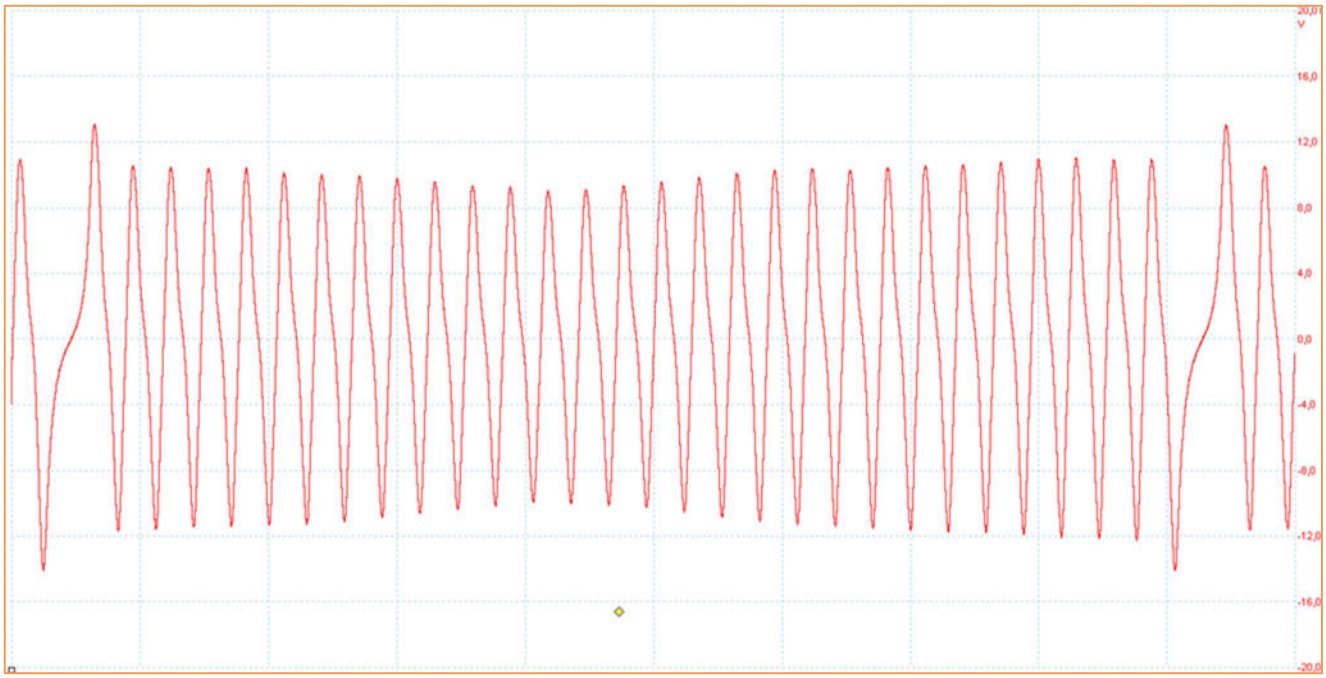
Connector channel allocation.



Channel number	Wire number	Signal
1	1361	**“+”** engine speed sensor signal
2	1362	**“–”** engine speed sensor signal

Note: The channel 2 signal is the reverse of the channel 1 signal.

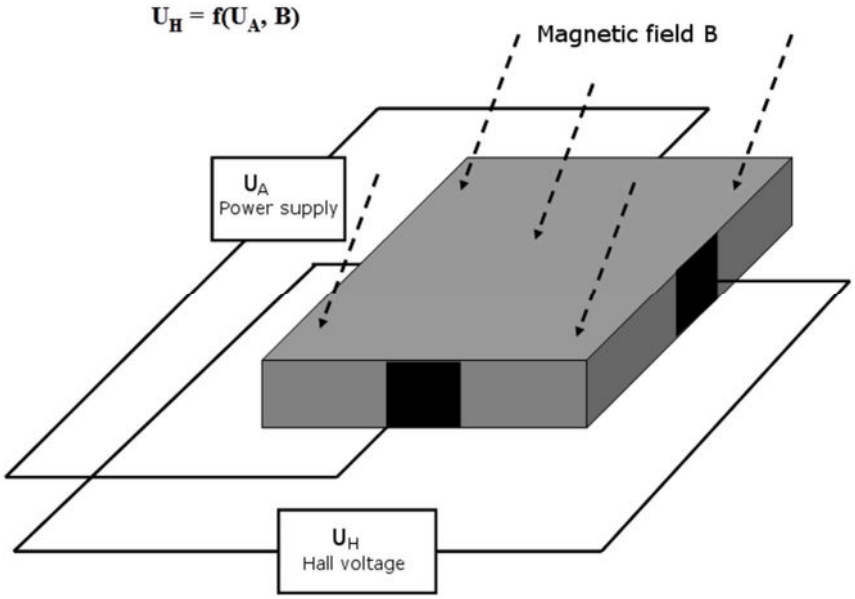
Characteristic curve



1.2. Hall Effect cylinder reference sensor

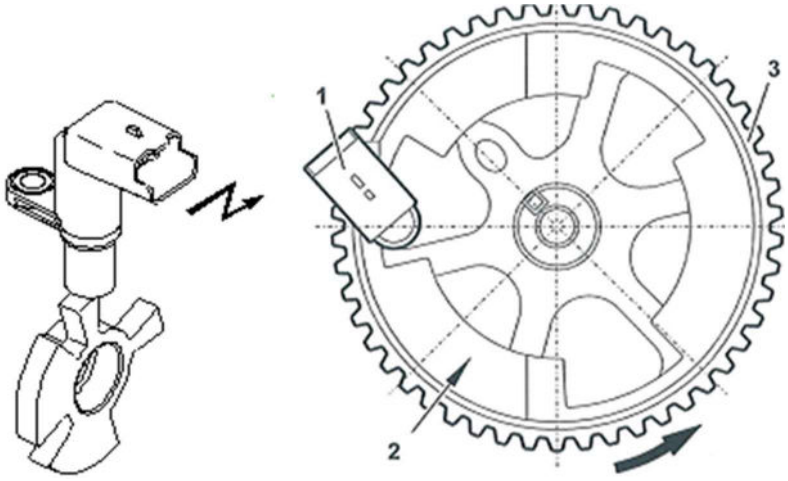
1.2.1. Principle of the Hall Effect

The Hall Effect is generated by means of a thin metal plate to which a supply voltage (UA) is applied.
When this plate is subjected to a magnetic field B, a part of the supply current is diverted, resulting in Hall voltage (UH).



1.2.2. Setup

The Hall Effect sensor is mounted facing a target integrated into the camshaft timing gear.
There are two types of mounting (see illustration).



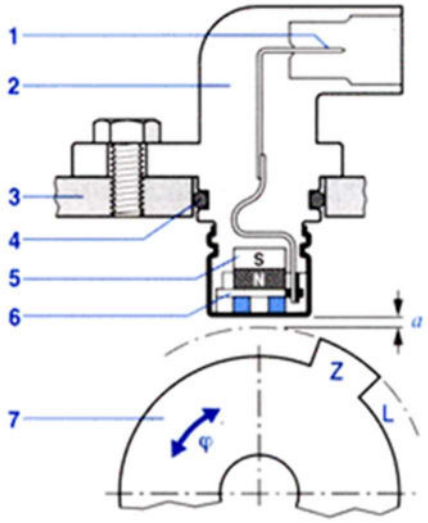
1.2.3. Role

The cylinder reference sensor informs the injection ECU of the TDC position on the compression stroke of each cylinder or helps differentiate the TDC of the exhaust stroke from the TDC of the compression stroke.
The injection ECU requires this information on starting to control the injectors in sequential mode (cylinder by cylinder in 1-3-4-2 order).

1.2.4. Description

This sensor is equipped with a Hall plate, an electronic circuit and a permanent magnet.
This plate, to which voltage is applied by the circuit, is traversed by the magnetic field in a perpendicular direction.
When a tooth appears before the plate, the electron flow is diverted by the variation in the magnetic field, creating a potential difference of the order of a few millivolts.
The circuit amplifies and converts this signal into a “square-wave” signal that can be directly processed by the ECU.
The amplitude of the output voltage is constant at all engine speeds. It can therefore work with low rotational speeds and is more precise than the inductive sensor.
Furthermore, it is more or less sensitive to interference.
This type of sensor generally requires a 5 V external power supply and therefore has a 3-wire connection.

Number	Description
1	Electrical connection
2	Sensor housing
3	Crankcase
4	Seal
5	Magnet
6	Hall printed circuit
7	Toothed wheel
A	Air gap
ϕ	Angle of rotation
Z	Tooth
L	Tooth gap

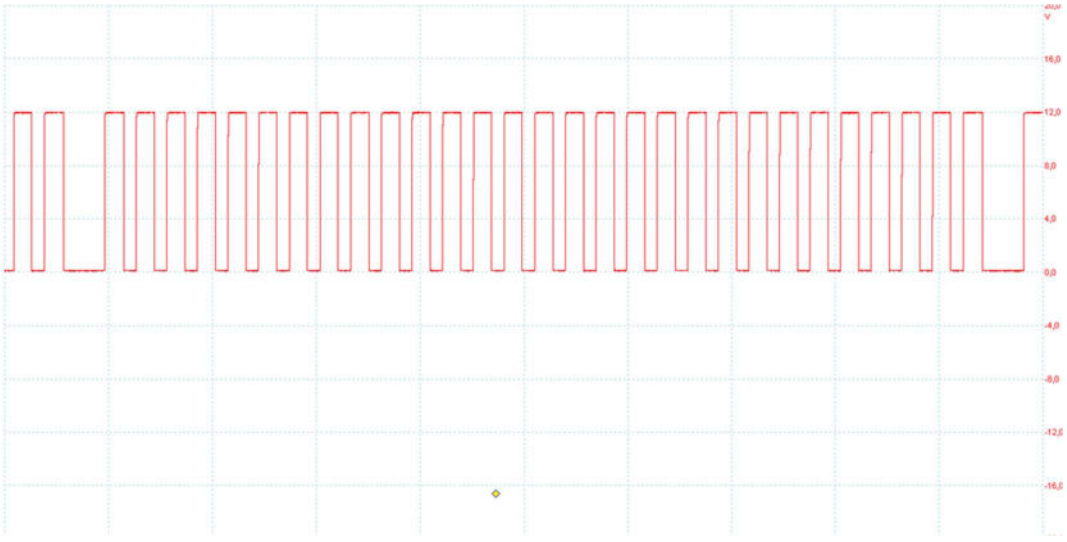


1.2.5. Electrical features

Connector channel allocation

Channel number	Signal
1	5 V.
2	Signal
3	Ground

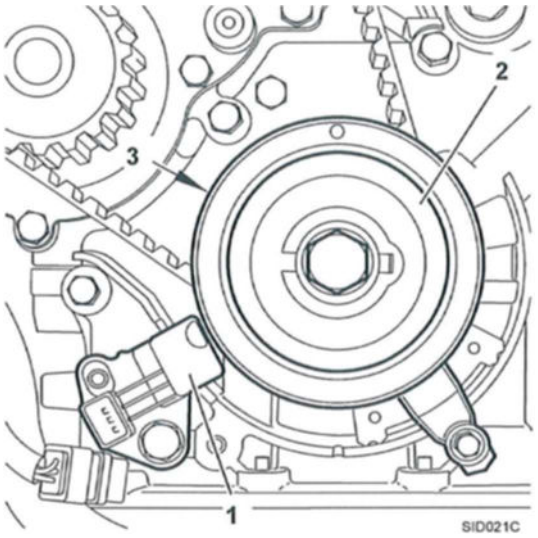
Characteristic curve



1.3. Hall effect engine speed sensor

1.3.1. Setup

This new engine speed sensor is mounted on the timing side of the engine block. The magnetic-pole target is fastened to the crankshaft gear.



1.3.2. Role

It is used to determine:

- ✓ Engine speed
- ✓ The position of the moving parts of the engine

1.3.3. Description

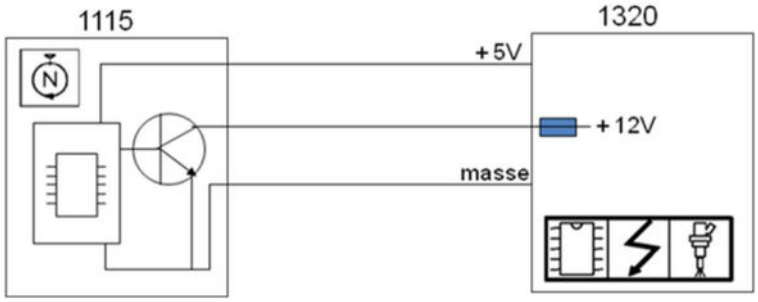
The particular feature of this sensor is that it operates like a magnetoresistive sensor, i.e. facing a magnetic-pole target.
The sensor (1) is attached to the oil pump body.
The target (3) is fastened to the crankshaft gear (2).
The target is made up of 60 (58 + 2) pairs of magnetic poles spread around the periphery. Two poles are missing to identify the top dead centre.
Beware: Do not place any parts containing magnets near the engine speed sensor target as there is a risk of demagnetising it.

1.3.4. Electrical features

Connector channel allocation

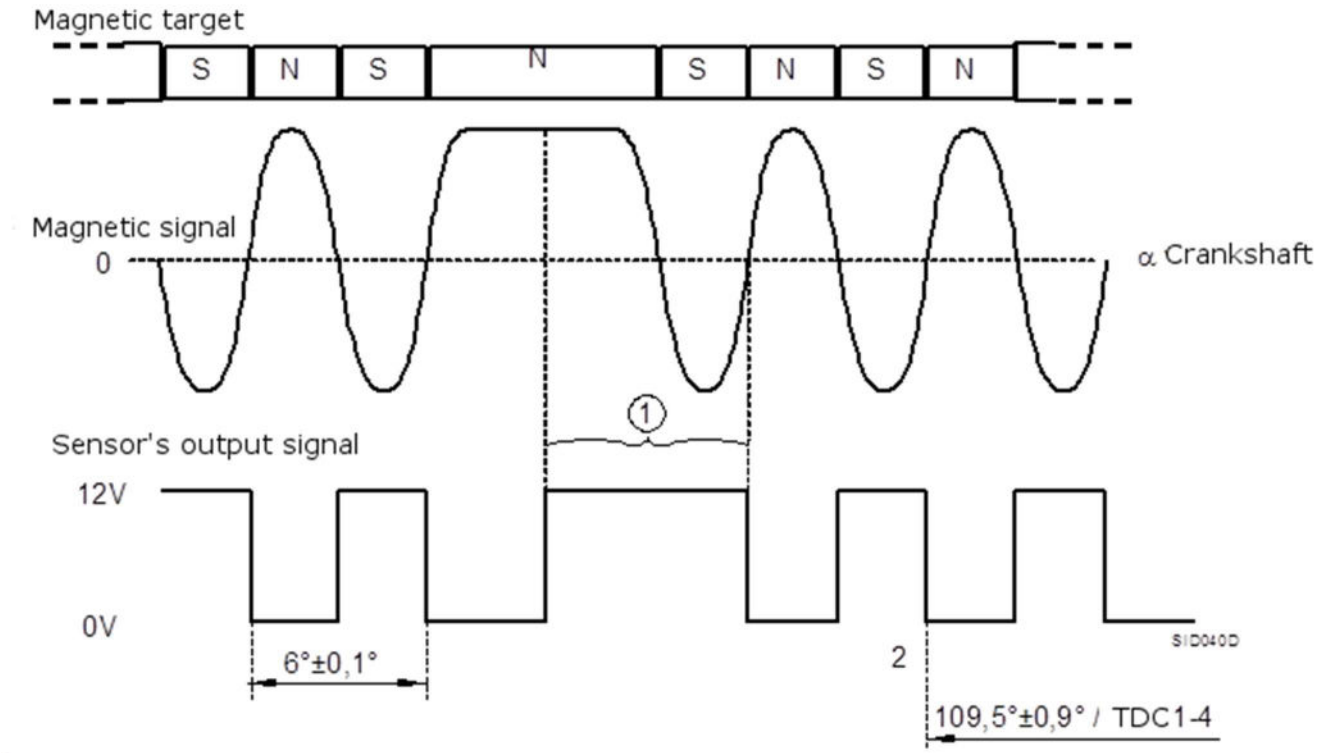
Channel number	Signal
1	5 V
2	Signal
3	Ground

Operating characteristics



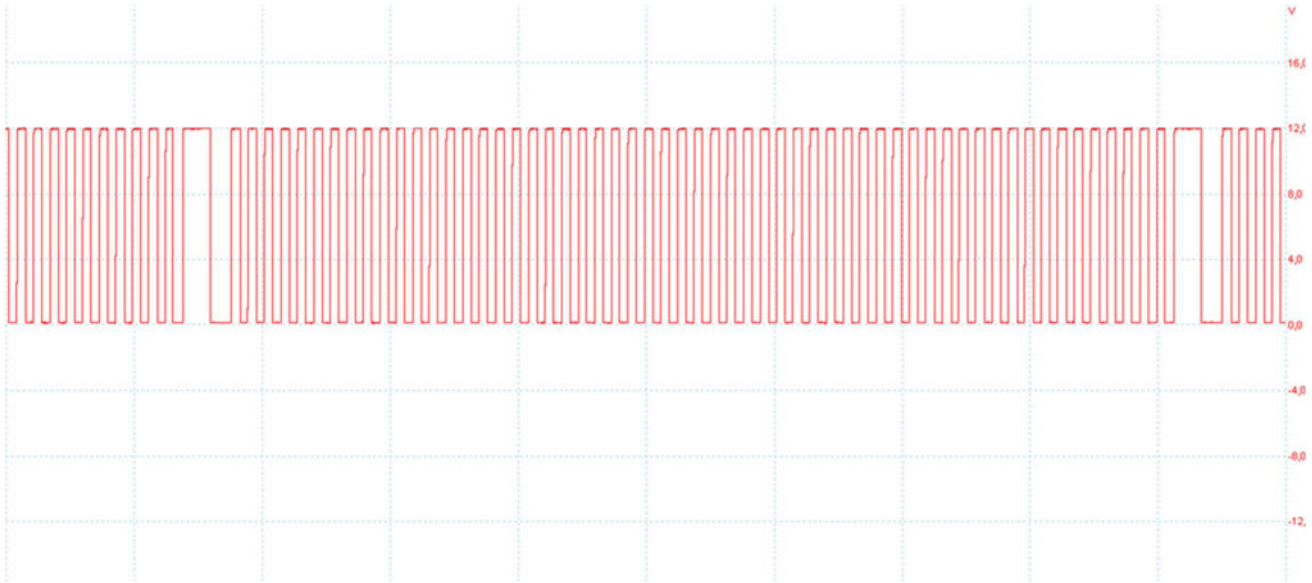
The Hall Effect sensor (1115) receives a +5 V power supply via the engine ECU (1320), but its signal is +12 V.
In fact, the actual voltage of the sensor signal is indeed +5 V but it is used to control the base of an internal transistor.
The collector of this transistor, also erroneously considered for the sensor signal output, does not transmit but receives +12 V.
This signal is therefore the image of the real signal but at +12V

Signal features



Number	Description
S	South pole
N	North pole
1	The engine speed sensor gives a high signal to ensure that the first passage of the south pole is detected after the “minus 2 teeth” section (this part of the target is disturbed).
2	Mark for the injection ECU to identify the crankshaft position (109.5°± 0.9° before TDC 1-4)

Characteristic curve



2. USER FILE

2.1. Installing and starting up module DT-M006

Use the 12 V – 3 A power supply unit provided (ALF290M).
Plug the power supply unit into the 230 V mains supply (check the position of the power supply switch on the rear of the power supply unit).
Connect the power supply + and ground outputs to module DT-M006 using the two one-metre cables provided.
Switch on the power supply. Then proceed with module wiring.
The moving components are the two targets.

Note: A protective device with a buzzer warns you if the supply voltage is over 12 V, or if the positive and negative are inverted.

2.2. Calibrating and maintaining module DT-M006

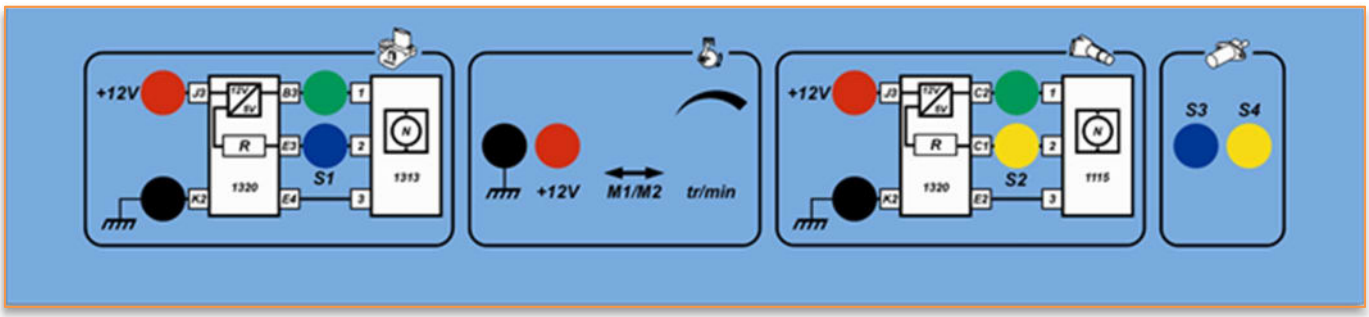
Calibration: factory setting.
Maintenance frequency: none.
Cleaning: use a very soft, clean cloth with a window cleaning product.

2.3. Putting out of operation

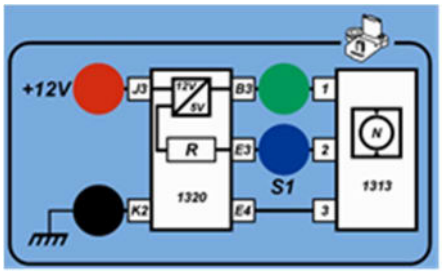
Switch off the fixed power supply by setting the switch to 0.
Unplug the 230 V connection from the mains.
Remove all the cables with banana plugs from the module.
Store module DT-M006 and its accessories in a secure room or cabinet while out of use.

The module should only be opened by certified and authorised persons.

2.4. Front panel description

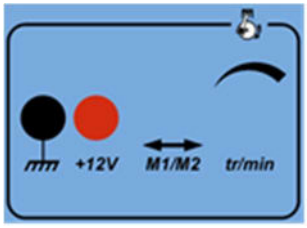


2.4.1. Magnetoresistive sensor



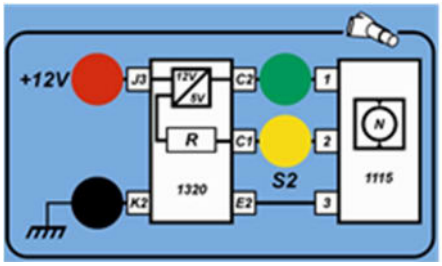
Number	Description
1320	Engine ECU
1313	Magnetoresistive sensor
J3	Engine ECU +12 V supply socket
K2	Engine ECU ground socket
B3 and 1	Sensor +5V power supply
E4 and 3	Sensor ground
E3, 2 and S1	Sensor signal

2.4.2. Target management



Number	Description
+12V Ground	Black and red engine power supply sockets
M1/M2	Target selector switch
tr/min	Engine speed (rpm) control potentiometer

2.4.3. Hall Effect sensor



Number	Description
1320	Engine ECU
1115	Hall Effect sensor
J3	Engine ECU +12V supply socket
K2	Engine ECU ground socket
C2 and 1	Sensor +5V power supply
E2 and 3	Sensor ground
C1, 2 and S2	Sensor signal

2.1.1. Inductive sensor

Number	Description
S3	Sensor signal
S4	Sensor signal

CE DECLARATION OF CONFORMITY

Manufacturer
Name: **ANNECY ELECTRONIQUE SAS**
Street: **1, rue Callisto - Parc Altaïs**
Town: **74650 CHAVANOD**
Country: **FRANCE**

Represented by the signatory below, declares that the following product:

Product reference	Description	Make
DT-M006	**Benchtop learning module: Measuring engine speed and crankshaft position**	EXXOTEST

complies with all requirements of European directives relating to the design of Electrical & Electronic Equipment (EEE) and the management of Waste Electrical & Electronic Equipment (WEEE) in the EU:

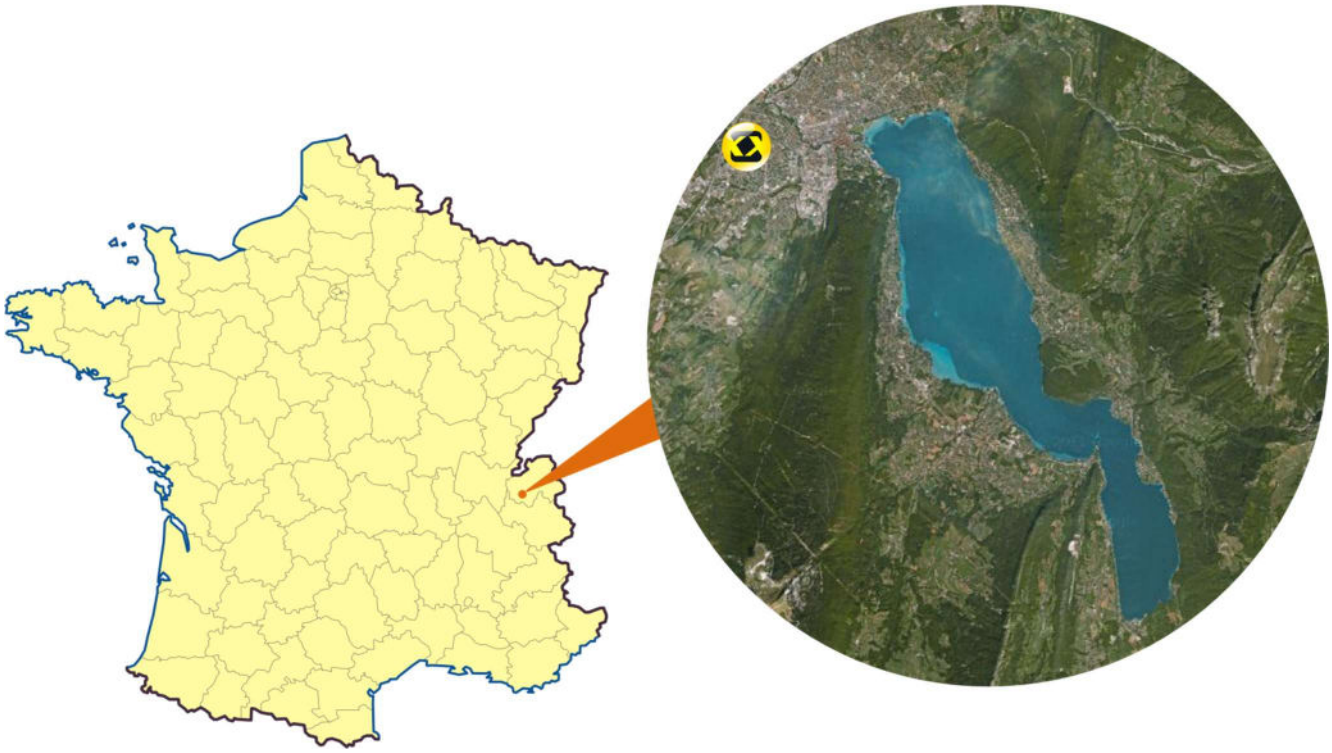
- Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE)
- Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (ROHS)
- Electromagnetic Compatibility Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004.

The product has been manufactured in accordance with the requirements of European directive:

- Directive 2006/95/EC of the European Parliament and of the Council of 12 December 2006 on the harmonisation of the laws of Member States relating to electrical equipment designed for use within certain voltage limits.

Signed in Chavanod on 20 July 2015

Stéphane Sorlin, Chairman



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