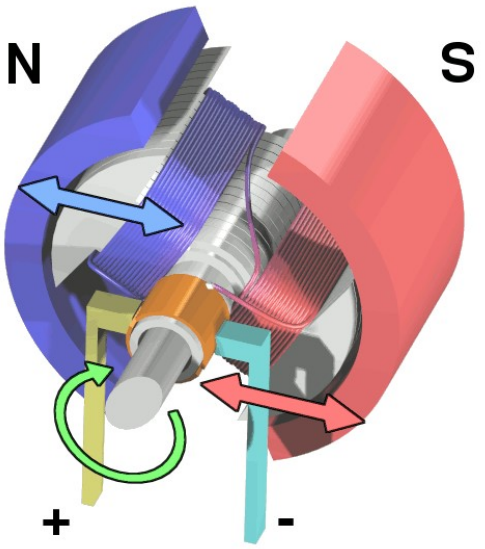
User's guide for DT-C001

DC Motors

EXOTEST® EDUCATION

Document No. 00308589-V1

Direct current model



1. RESOURCES FILE

Principle of operation of a direct current (d.c.) motor

When a coil carrying a current (supplied by brushes and a commutator) is placed in a magnetic field, a force couple (or pair of forces) is generated. This force couple creates a rotational torque which rotates the coil through about 90 degrees. Since the direction of current flow in the coil does not change, then as the coil rotates the rotational torque gradually reduces to zero once the coil has rotated through about 90 degrees (in this neutral zone, the coil is perpendicular to the field produced by the permanent magnets).

By winding a large number of similar coils around the armature (or rotor) the motor can rotate smoothly. These coils are distributed evenly around the periphery of the armature so that torque is generated irrespectively of the angle of rotation. Once the coils have reached the zone of neutral torque, the direction of current flow must be reversed simultaneously in every coil of wire.

The direction of current flow is reversed by a commutator which, together with the brushes, transmits current from the stationary part of the motor to the rotating part.

The main advantage offered by d.c. motors is their compatibility with the means used to regulate or vary their speed, torque and direction of rotation: variable speed drives variateurs de vitesse. Another advantage is that they can be connected directly to energy sources: lead-acid batteries, lithium-ion batteries, etc.

The main drawback of d.c. machines is wear of the rotating brush/commutator assembly. It is a complex assembly to produce, and consumes energy. Another problem can arise with wound-rotor motors when they are operated at high speed. Over time, the high centrifugal forces can break down the banding which secures the coils to the rotor.

Some of these drawbacks have been partially overcome by producing motors with no iron in the rotor, such as “disk” motors or low-inertia “coreless” motors, which are nonetheless always fitted with brushes. The above drawbacks have been eliminated by the introduction of brushless motor technology moteurs *brushless*, also known as “brushless d.c. motors” or brushless motors.

1.1 Reminder

Laplace’s law

A current-carrying conductor in a magnetic field experiences a force, the direction of which can be determined using the “Laplace’s right-hand rule” (a variant on Fleming’s **left**-hand rule).

F = B * I * L

F	**Force in newtons**
B	**Magnetic induction in teslas**
I	**Current in the conductor in amps**
L	**Length of the conductor in metres**

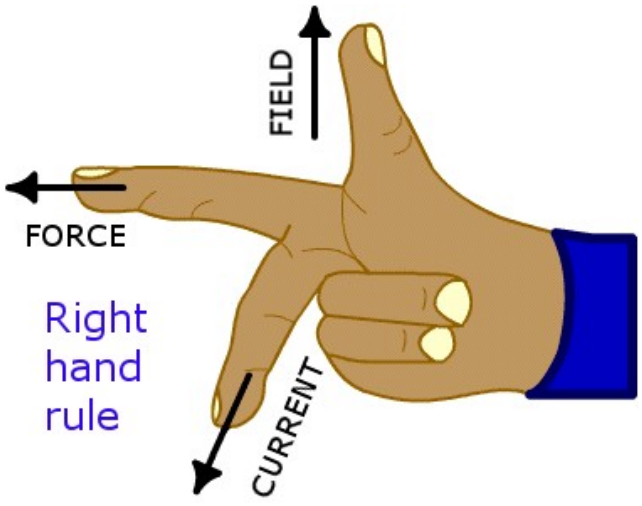
The right-hand rule

To determine the direction of the force, point your thumb, index finger and middle finger in directions perpendicular to each other, as shown.

The thumb points in the direction of the field (the direction of the lines of induction always run from N to S when outside a magnet, and from S to N when inside).

The middle finger points in the direction of the current (and always in accordance with the convention for current direction, i.e. from +ve to -ve).

The index finger then indicates the direction of the force.



Make sure that you use your right hand and not your left hand. In fact, the left hand is used for another rule.

1.2 Composition

STATOR (field magnet)
The stator stator generates a *longitudinal* and steady magnetic flux flux magnétique either due to current flowing through coils wound around the stator or as a result of the stator being a permanent magnet aimants. It is thus also known as the “field magnet” since it generates the magnetic field within the machine. It is secured to the motor housing.

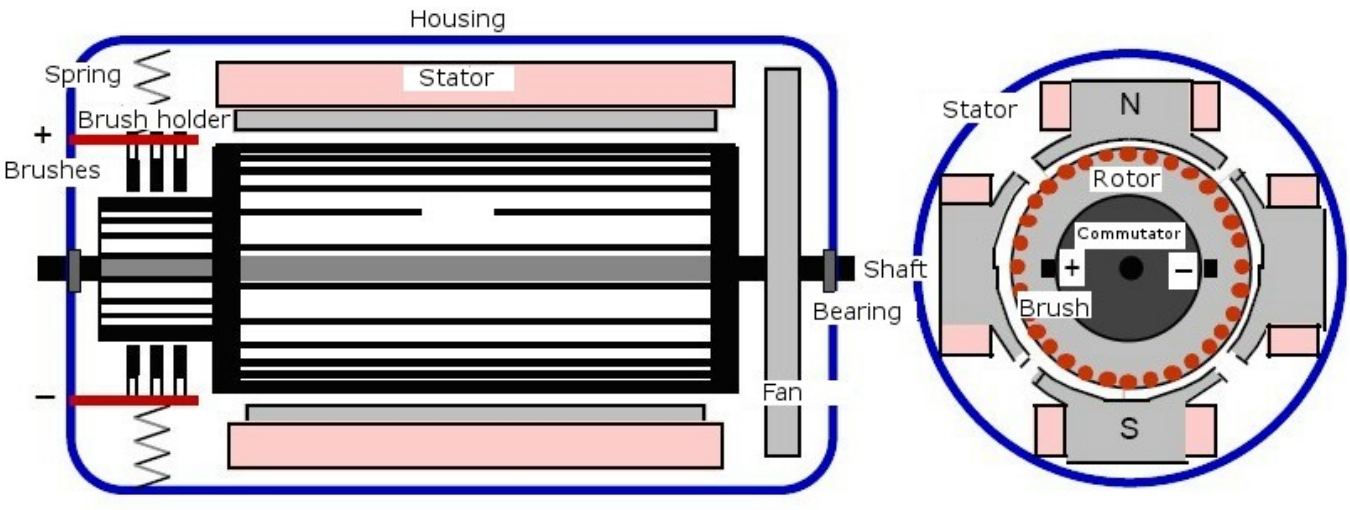
Brushes
The brushes distribute electricity to the rotor

Magnets
The magnets create the magnetic field They are made from an assembly or lamination of strips of electrical steel, (+ 0.5 mm) thick, insulated from each other by natural oxidation. An alternative is the use of pole magnets.

ROTOR (armature)
The wound rotor rotor connected to a rotating commutator collecteur rotatif reverses the polarity polarité in each rotor winding at least once per rotation, so as to create a transverse magnetic flux in quadrature to the flux generated by the stator. The rotor windings are also known as armature windings.
The rotation of the armature provides the useful motion generated by the motor.

Commutator
This component receives the electrical current from the brushes.

Wound components
These components are produced by winding insulated copper wire (insulating varnish) around a pole body so as to produce an electromagnet.



2 USER FILE

USER AND INSTRUCTION MANUAL

Installing and starting up benchtop learning module DT-C001

Connect the module to the power supply provided.
Wire up the d.c. motors to operate the system as indicated in the user manual supplied with module DT-C001.
There are moving components on module DT-C001.

Environment

Module DT-C001 is designed for benchtop use. It must be installed in a dry place away from dust, steam and combustion fumes.
The module requires approximately 400–500 lux of light
The module must be placed in a practical exercise room. Its operating noise level does not exceed 70 decibels.
The benchtop learning module is protected against potential user error.

Calibrating and maintaining benchtop learning module DT-C001

Calibrating: set in the factory.
Maintenance frequency: none.
Cleaning: use a clean and very soft cloth and a window-cleaning product.

Number of work stations and position of user

Module DT-C001 is considered to be a single work station.
The module user will remain seated throughout the practical exercise.

Lockout/Tagout procedure

Switch off the power supply by setting the switch to 0.
Unplug the 230 V connector.
Check that there is no current by actuating the d.c. motor control switches, and check the bi-coloured LEDs – if nothing happens and the LED are off, then there is no current in the module.
Store module DT-C001 in a secure room while out of use.

Residual risk

For the entire duration of the practical session, the trainee shall work on the front of the learning module.

Transporting module DT-C001

The benchtop learning module must be switched off and disconnected before transport.

The module should only be opened by certified and authorised persons

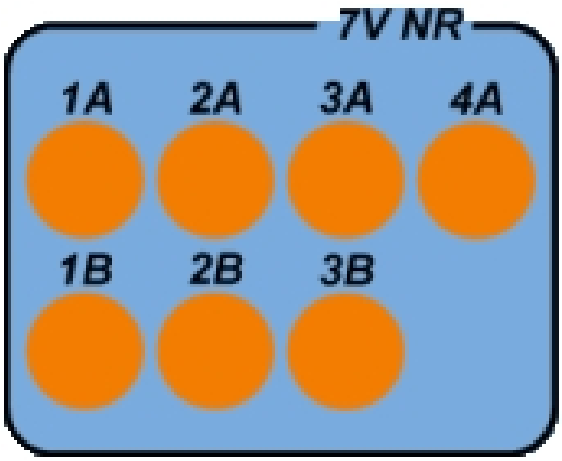
Module DT-C0001 comprises two dc. motors – one which operates an electric window and one which adjusts the wing mirror position. The controls for the electric window and wing mirrors are located in the centre of the module.

Protective features incorporated into the module ensure that the user cannot damage the module by inadvertently reversing a polarity or applying an over-voltage.

Part equivalence table

Product name	Device number Ref.	PSA Ref.
Electric window motor	6040	9223 52
Wing mirror motor	6415	6602 38
Control unit	6036	6552 WP

Terminal allocation for the 7V Black connector block

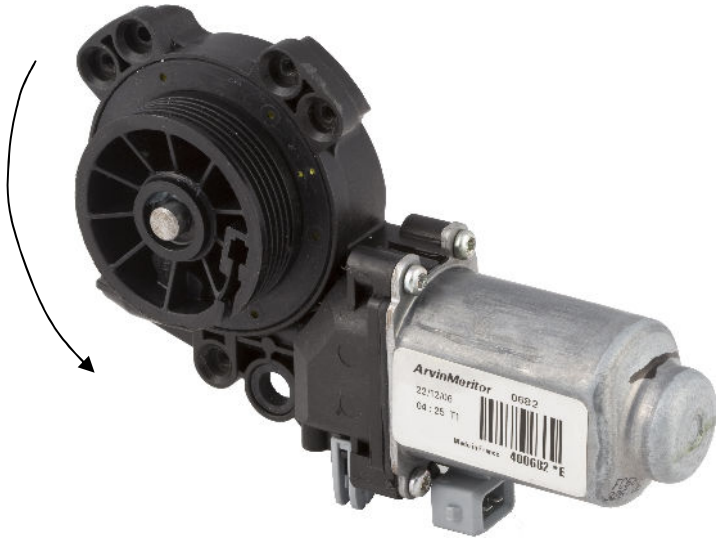


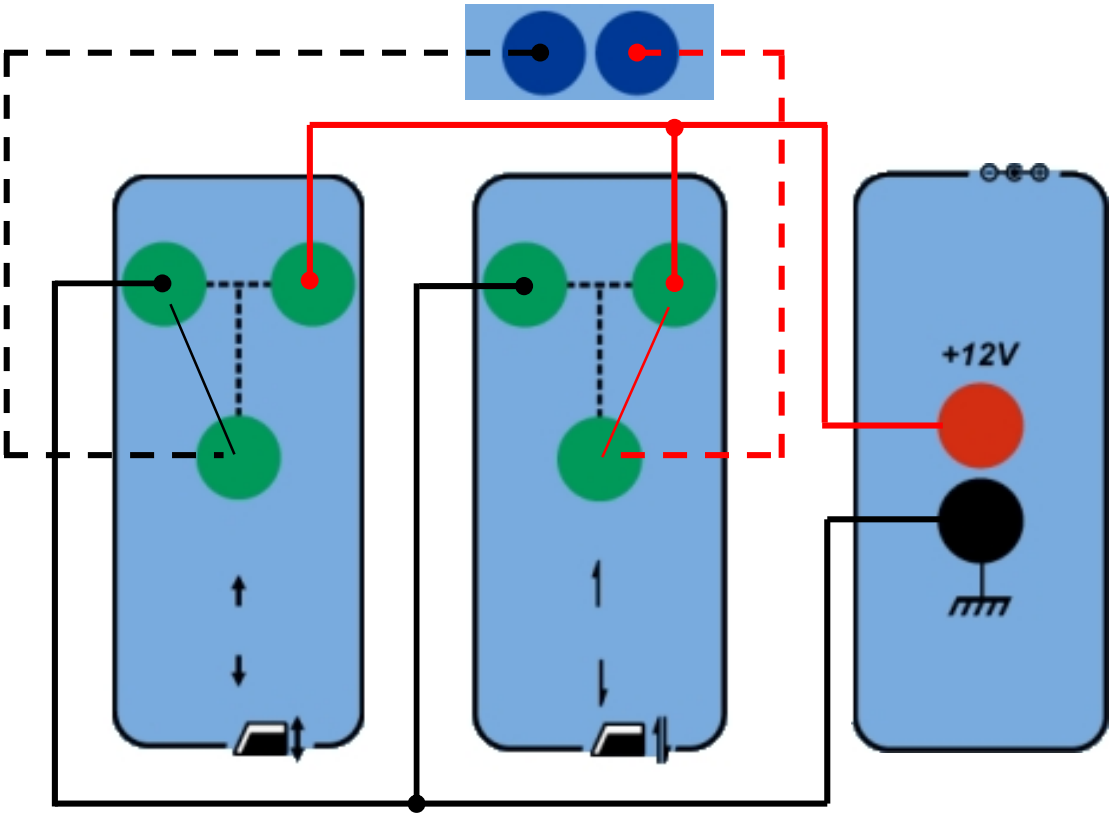
7 CHANNELS Black

1A = Ground
2A = Spare
3A = +12 V
4A = Motor control
1B = Spare
2B = Spare
3B = Motor control

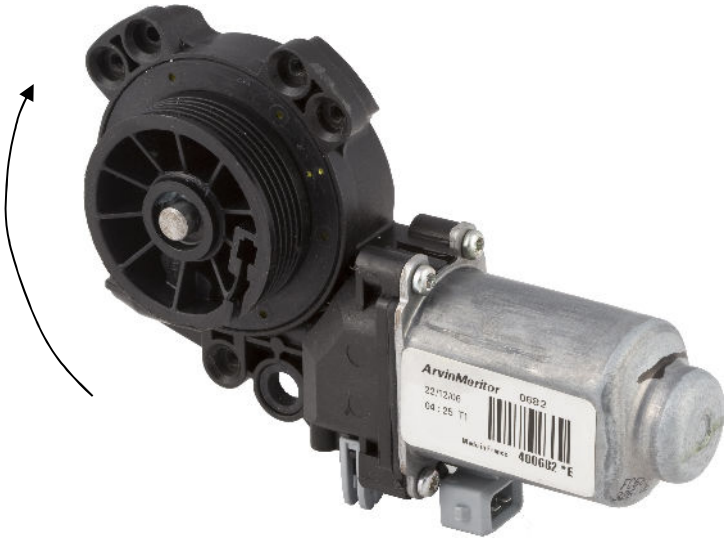
2.1 Study of the electric window d.c. motor

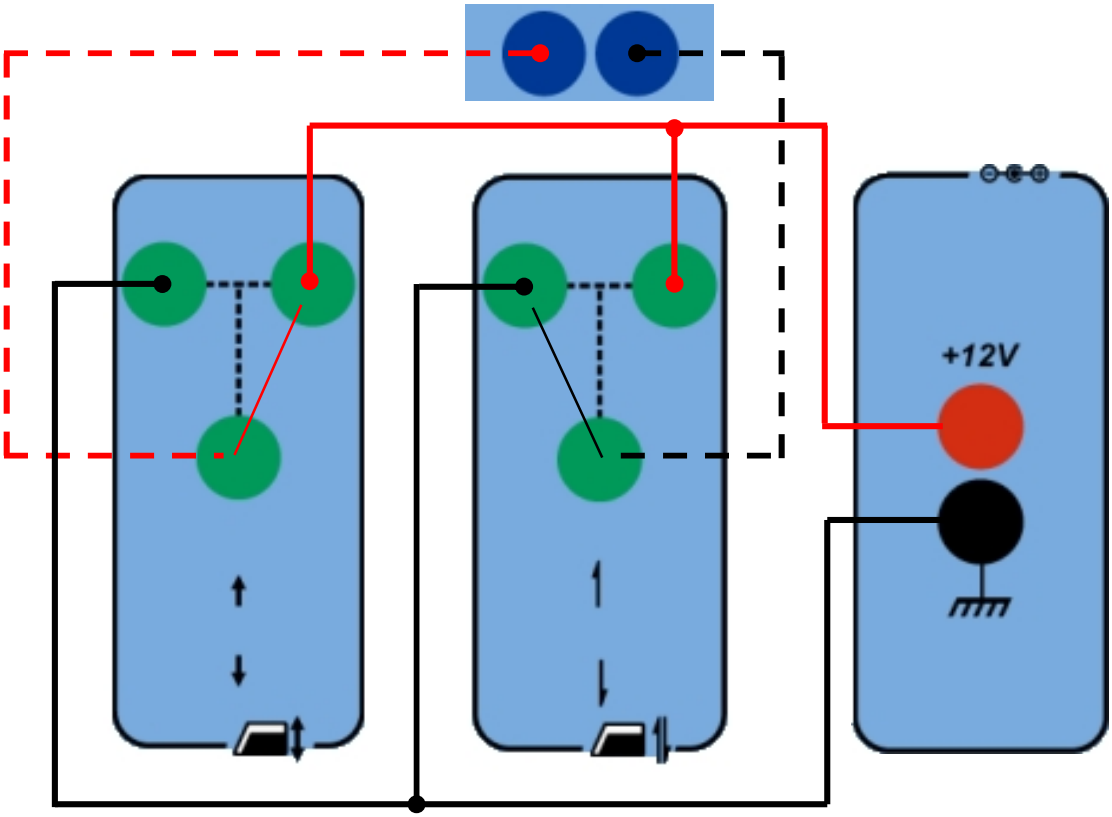
Wiring



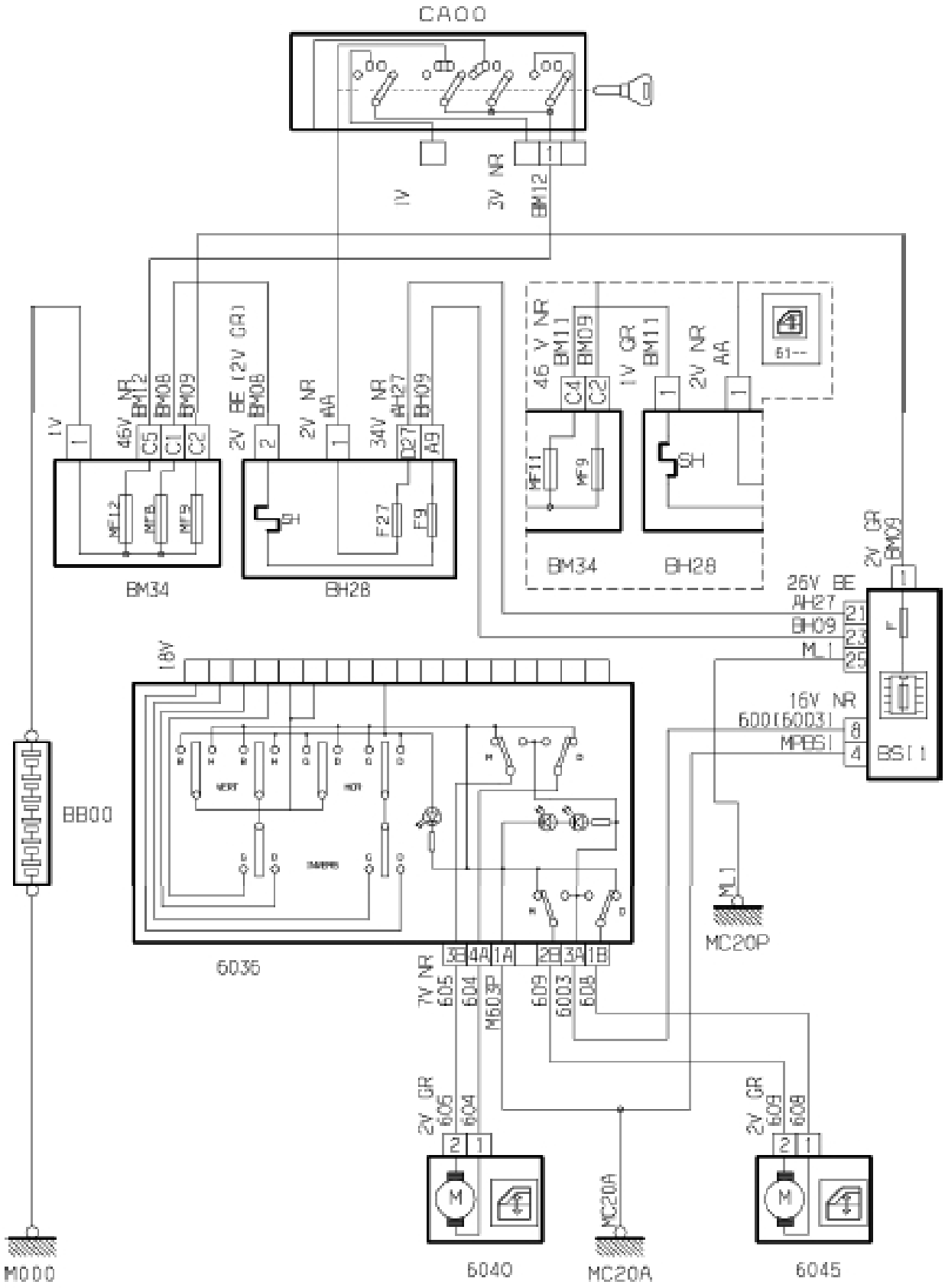


Reversing the direction of rotation.





Wiring diagram

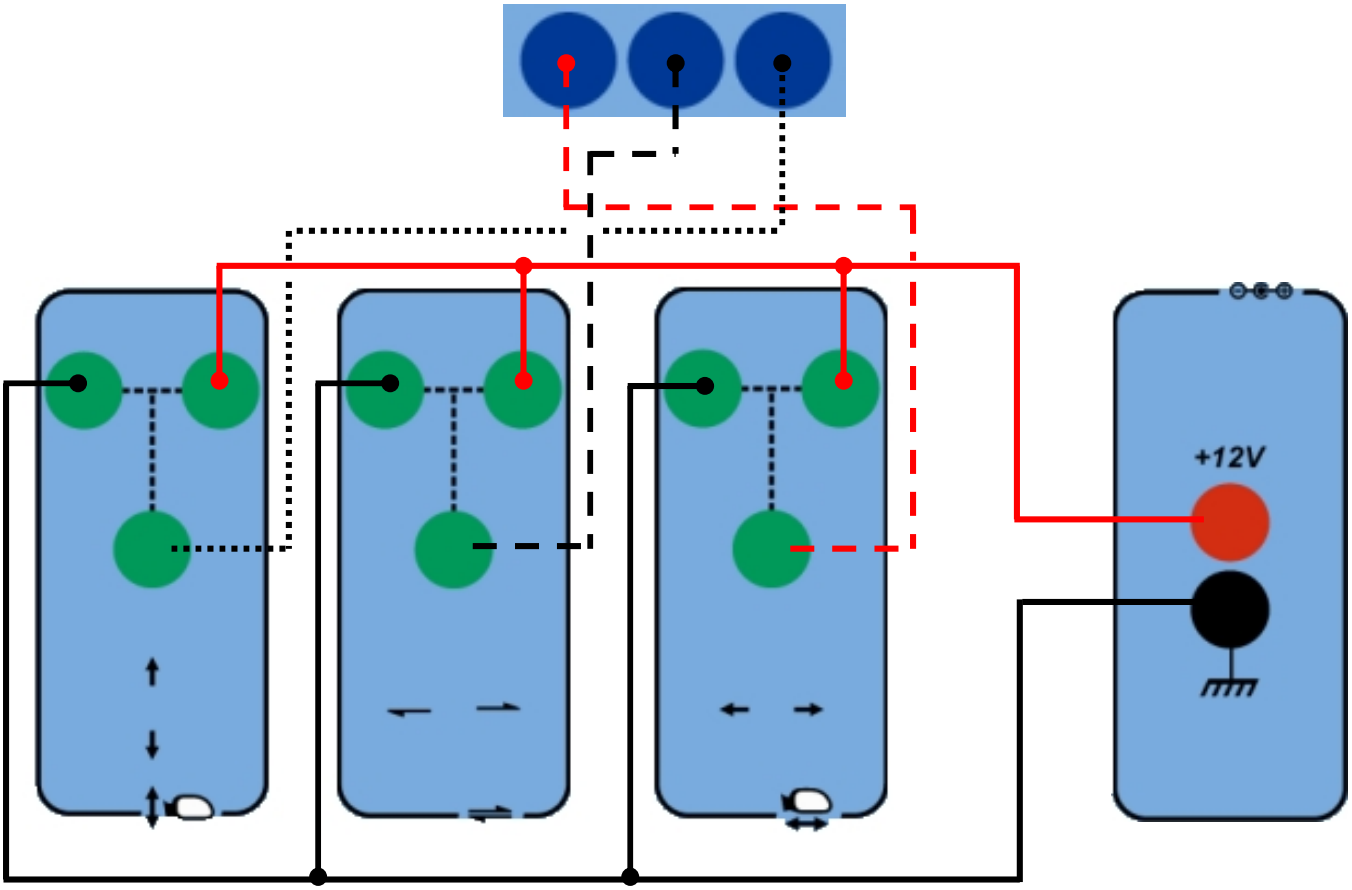


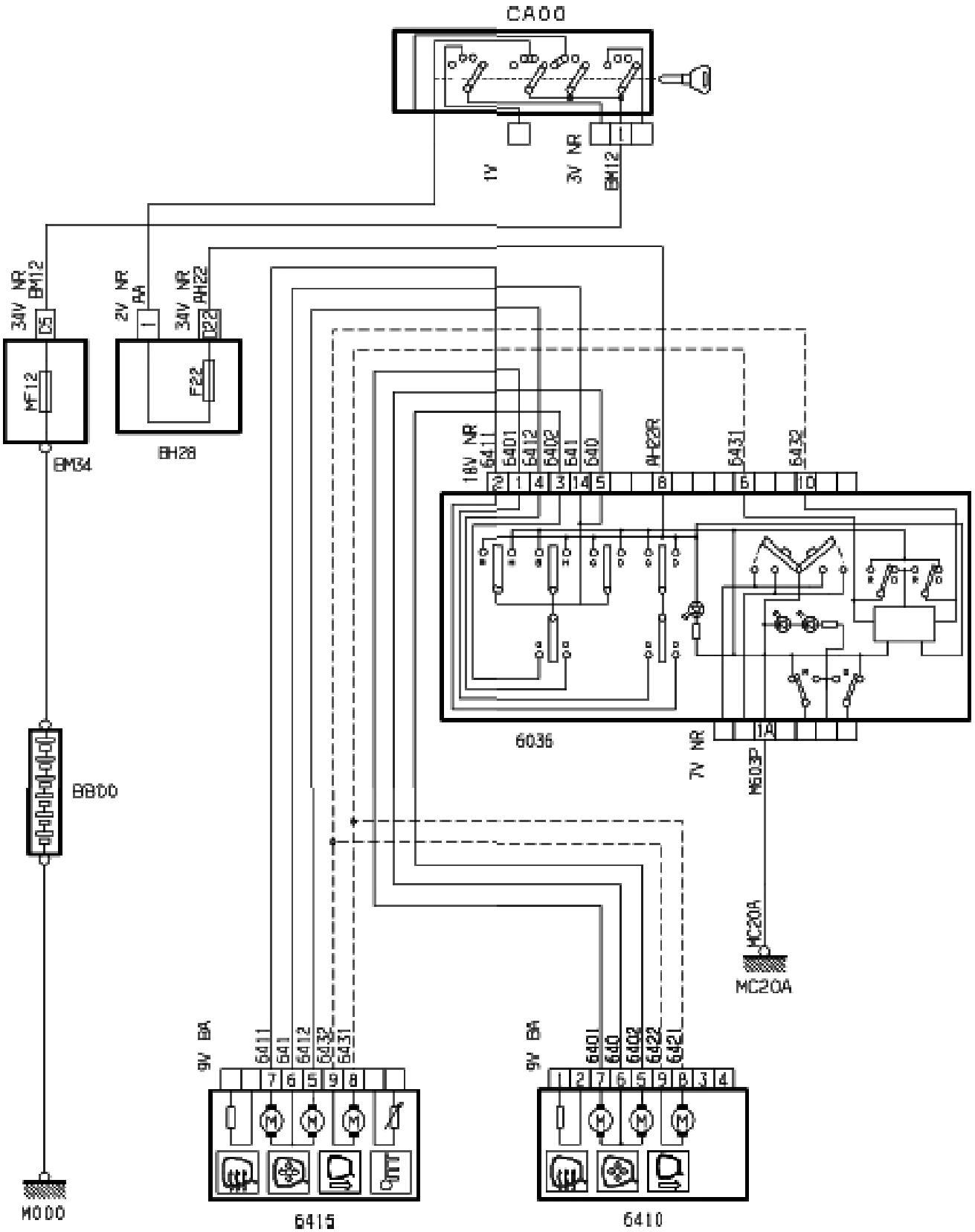
2.2 Study of the wing mirror d.c. motor

Wiring

2

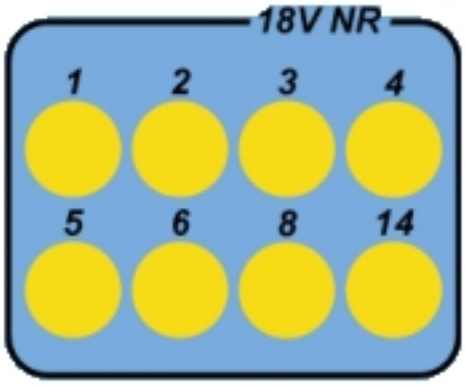
Wiring example for Up/right movement





Wiring diagram

Terminal allocation for the 18V Black connector block



18 CHANNELS Black

1 = Not connected
2 = Right/Left Wing Mirror Motor control
3 = Not connected
4 = Up/Down Wing Mirror Motor control
5 = Not connected
6 = Not connected
8 = +12 V
14 =Common

3 Practical exercises

To reverse the direction of rotation of a separately-excited d.c. motor, you must: (there may be more than one solution):

X • Reverse the polarity at the armature terminals
• Reverse the polarity at the field magnet terminals
• Reverse the polarities at the terminals of both the armature and field magnet

According to Laplace's right-hand rule, the thumb, index finger and middle finger relate respectively to:

X • Field, force, current
• Force, field, current
• Force, current, field
• Field, current, force

The part of the motor which moves is called the: (there may be more than one solution):

X • Rotor
• Inductor
X • Armature
• Stator

The stationary part of the motor is called the: (there may be more than one solution):

• Rotor
X • Stator
• Commutator
X • Field magnet

In a d.c. shunt motor, which of these windings has the lowest resistance?

• Armature winding
X • Field magnet winding

What do you do to increase the speed of a separately-excited d.c. motor?

• Reduce the armature voltage
• Increase the field magnet voltage
X • Increase the armature voltage

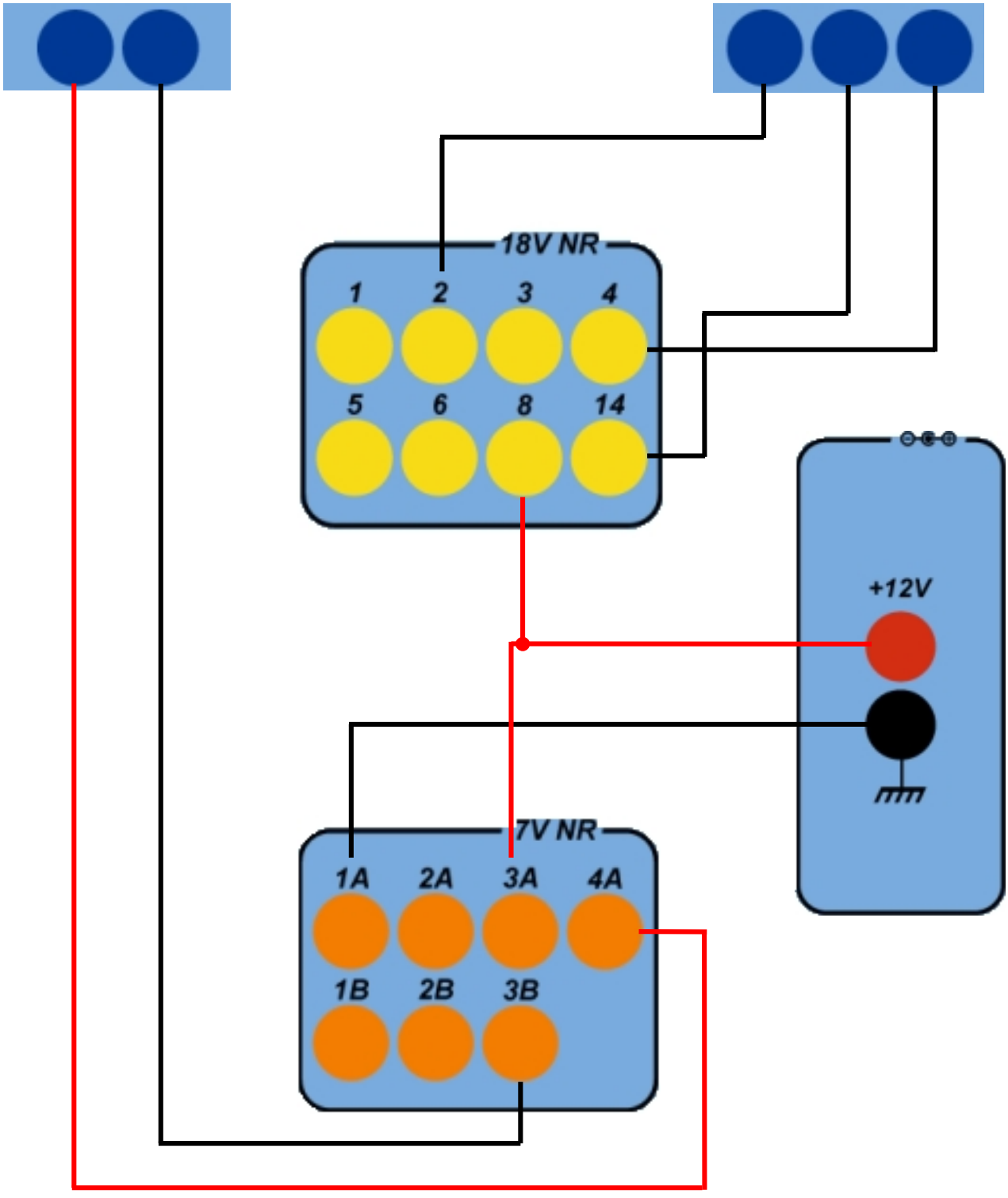
The resisting torque for a separately-excited motor is increased slightly. What happens to the current in the armature winding?

X • It increases
• It stays the same
• It reduces

3.1 Wire up the unit which controls the electric window and wing mirror motors.

If you're not sure, refer to the wiring diagrams on pages 11 and 13.

Wiring setup as per the manufacturer's wiring diagram



CE DECLARATION OF CONFORMITY

Via this declaration of conformity with the requirements stated in directive 2004/108/EC relating to electromagnetic compatibility, the company:

S.A.S. ANNECY ELECTRONIQUE
Parc Altaïs – 1, rue Callisto
F74650 CHAVANOD

Declares that the product indicated below:

Make	Model	Product name
EXXOTEST	**DT-C001**	**BENCHTOP LEARNING MODULE: Study of the d.c. motor**

I - has been manufactured in accordance with the requirements of European directives:

- Low Voltage Directive 2006/95/EC of 12 December 2006
- Machinery Directive 98/37/EC of 22 June 1998
- Electromagnetic Compatibility Directive 2004/108/EC of 15 December 2004

and meets the requirements of the following standard:

- NF EN 61326-1 of 07/1997 +A1 of 10/1998 +A2 of 09/2001
  Electrical equipment for measurement, control and laboratory use. EMC requirements.

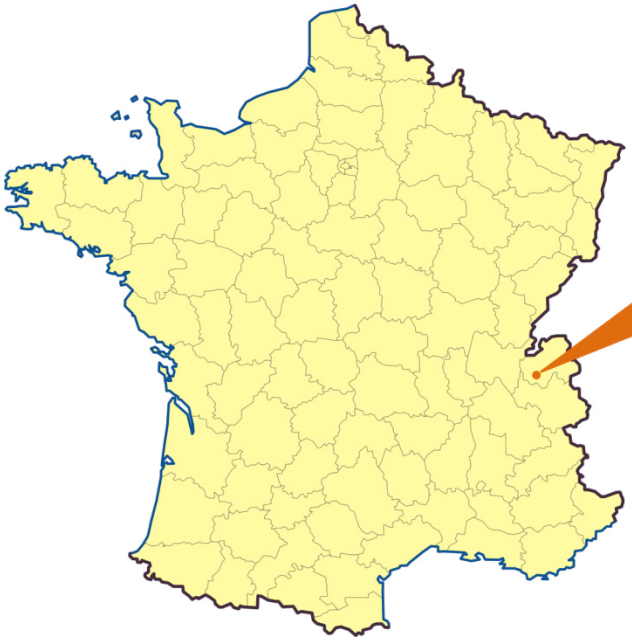
II – has been manufactured in compliance with the requirements of European directives relating to the design of Electrical & Electronic Equipment (EEE) and the management of Waste Electrical & Electronic Equipment (WEEE) in the EU:

- Directive 2002/96/EC of 27 January 2003 on waste electrical & electronic equipment
- Directive 2011/65/EC of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (ROHS).

Signed in Chavanod, France, on 2 June 2009

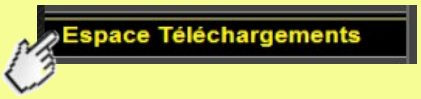
Stéphane Sorlin, Chairman

Latitude: 45° 53' 49'' / Longitude: 6° 4' 57''



Visit our website www.exxotest.com

This document is available in the Download Area.



Sign in!

Original manual

Document n° 00308589-V1

ANNECY ELECTRONIQUE, créateur et fabricant de matériel : Exxotest et Navylec.
Parc Altaïs - 1 rue Callisto - F 74650 CHAVANOD - Tel : 33 (0)4 50 02 34 34 - Fax : 33 (0)4 50 68 58 93
S.A.S. au Capital de 345 000€ - RC ANNECY 80 B 243 - SIRET 320 140 619 00042 - APE 2651B - N° TVA FR 37 320 140 619
ISO 9001 : 2008 N° FQA 4000142 par L.R.Q.A.