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1. COMPONENTS

1.1 GENERAL

Bulbs

Headlights	75/70 W
Parking light	5 W
Tail light	10 W
Rear fog light	21 W
Back-up light	21 W
Stop light	21 W
Direction indicator	21 W
Side light	3 W
Instrument panel lighting	2 W
Tachograph	2 W
Cab lighting	21 W
Bunk reading lamp	10 W
Warning lamps on instrument panel	1.2 W
Stepwell lighting	5 W
Marker light	5 W

REVOLUTION SENSOR

Air gap between tooth and sensor	0.3 - 0.7 mm

Max. current and wire cross sectional area (mm^2)				
Wire diameter	< 2 m	2 - 4 m	4 - 8 m	> 8 m
1	9	5	4	
1.5	22.5	13.5	7.5	6
2.5	37.5	22.5	12.5	10
4	60	36	20	16
6	90	54	30	24
10	150	90	50	40
16	240	144	80	64
25	375	225	125	100
35	525	315	175	140
50	750	450	250	200
70	1050	630	350	280
95	1425	855	475	380
120	1800	1080	600	480

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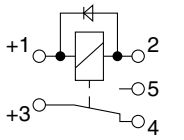
Microrelay

Maximum making current between points 3 and 5: 10A
Maximum breaking current between points 3 and 4: 5A



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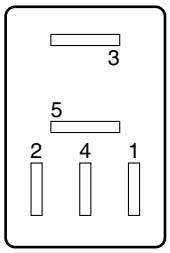

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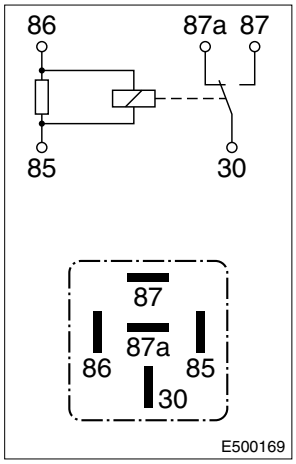
Minirelay

Maximum making current between points 30 and 87: 20A
Maximum breaking current between points 30 and 87a: 10A



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1. BATTERIES

1.1 FAULT-FINDING TABLE

FAULT: NEW BATTERY GETS QUITE HOT DURING CHARGING	
Possible cause	**Remedy**
Inadequate formation because of bad conservation or long-term (moist) storage	Allow battery to cool down Charge properly Check density

FAULT: ELECTROLYTE LEVEL TOO LOW	
Possible cause	**Remedy**
Leaking battery box	Replace battery
Excessive gas production caused by overcharging	Check/repair charger

FAULT: BATTERY ACID SPILLS FROM THE PLUG HOLES	
Possible cause	**Remedy**
Battery level exceeds capacity	Siphon off liquid
Overcharging	Check charger and repair, if necessary

FAULT: DENSITY IS TOO LOW (< 1,240) BAD STARTING	
Possible cause	**Remedy**
Power user left on	Charge battery
Insufficient charge	Check/repair charger
Short circuit in the charging circuit	Check charging circuit

FAULT: DENSITY IS TOO HIGH (< 1,290)	
Possible cause	**Remedy**
Topped up with acid instead of distilled water	Siphon off liquid and top up with distilled water If necessary, repeat after mixing (charging)

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FAULT: BAD STARTING BAD STARTING TEST POWER FAILS UNDER LOAD	
Possible cause	**Remedy**
- Discharged battery	Charge battery
- Worn battery (corroded plates)	Replace battery
- Defective battery (“dead cell”)	Replace battery
- Battery too small	Install battery with a larger capacity
- Sulphated battery (plates are hard)	Replace battery

FAULT: BURNT-IN BATTERY TERMINALS	
Possible cause	**Remedy**
- Wire clamps not securely fitted or bad contact	Have battery terminals repaired, securely fit wire clamps, and replace clamps, if necessary

FAULT: EXCESSIVE BUBBLING IN 1 OR 2 CELLS DURING HIGH LOADS (STARTING OR STARTING TEST)	
Possible cause	**Remedy**
- Defective cells	Replace battery
- Leaking partition	Replace battery

FAULT: BATTERY DISCHARGES QUICKLY (CANNOT CONTAIN ITS CHARGE)	
Possible cause	**Remedy**
- Insufficient charge	Check charge, is charging time (driving time) sufficient?
- Short circuit in the charging circuit	Check charging circuit
- Major self-discharging, e.g. because of contamination	Clean battery
- Battery sulphated (on inspection, plates prove hard and possibly have white appearance)	Replace battery

FAULT: SHORT BATTERY LIFE	
Possible cause	**Remedy**
- Wrong type of battery (e.g. in case of tailboards)	Install Super Heavy Duty or semi-traction battery
- Too many deep discharges	Intermediate additional charging with battery charger
- No recharging after deep discharge (white deposition)	Always recharge battery after deep discharge

FAULT: BATTERY GETS HOT DURING OPERATION AND USES A LOT OF WATER	
Possible cause	**Remedy**
- Overcharging or charging voltage too high	Check charger (voltage regulator)

FAULT: BATTERY HAS EXPLODED	
Possible cause	**Remedy**
- Fire or spark during or immediately after charging	Ensure proper ventilation and be careful with fire and sparks
- Short-circuiting tools	Be careful where you put tools
- Internal fault (loose connection)	Replace battery

FAULT: DEFECTIVE ALTERNATOR AND/OR DIODES (RADIO AND OTHER POLARITY-SENSITIVE EQUIPMENT DO NOT WORK)	
Possible cause	**Remedy**
- Reversed battery polarity or incorrect charging	Discharge battery and recharge in the proper direction Replace battery, if necessary

FAULT: BATTERY IS INACTIVE (NO VOLTAGE)	
Possible cause	**Remedy**
- Internal open circuit	Replace battery
- Battery extremely deeply discharged	Charge and test battery, replace if necessary

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2. TROUBLESHOOTING

The following test equipment and tools can be used to localise faults.

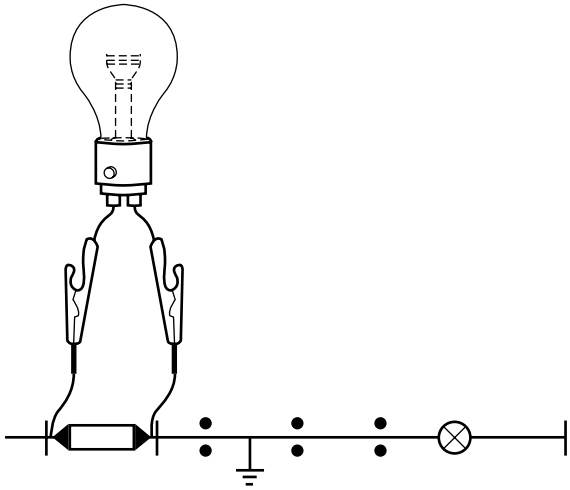
1. The best instrument for this purpose is a digital multimeter. This instrument enables voltages, currents and resistances to be measured without reading errors, and it can trace virtually all faults.
2. Many but not all faults can be traced in a simple way by using warning lamps. However, faults which are caused by a poor earth connection can in general not be traced via a warning lamp or a buzzer.

The most frequently occurring faults are:

a. short circuit
b. open circuit
c. earthing problems (poor earth connection caused by corrosion).

2.1 SHORT CIRCUITS

A short circuit is caused by a positive wire shorting somewhere to earth. In most cases this will cause a fuse to blow.
70W is then used to trace this fault. First check the diagram to see which consumers are protected by the fuse and then switch them all off.
Remove the fuse and replace it with a test lamp. Then, one by one, switch the consumers on and off. If the test lamp starts burning very brightly when a consumer is switched on, it is almost certain that the fault is in the wiring of that particular consumer. Check the diagram to see which connector is used to connect this consumer. Remove the first wiring connection (looking from the fuse).
If the test lamp continues to burn brightly, the fault is between the fuse and this wiring connection.



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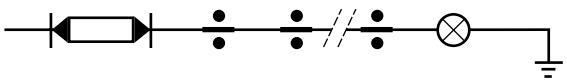
However, if the test lamp stops burning, the fault is somewhere further on in the wiring.
Restore the wiring connection and disconnect the next one. If the test lamp continues to burn brightly, the fault is between these two wiring connections.
However, if the lamp stops burning again, the fault tracing procedure must be continued.
In this way the faulty section of the wiring can be found.

2.2 OPEN CIRCUITS



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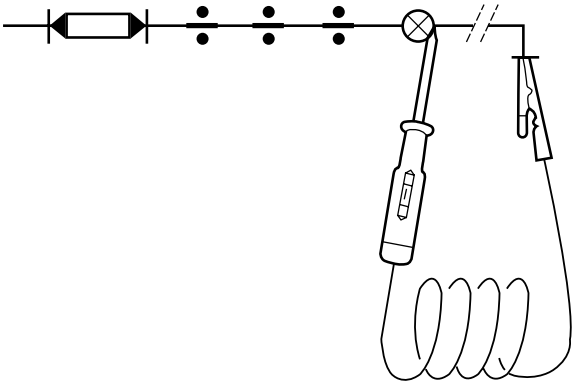
Suppose a consumer is not functioning. The fault may then be in the consumer itself, or the wiring may be interrupted.
First switch on the consumer and check for voltage with the test lamp. If no voltage is present, first check whether the fuse is still intact.
If there is voltage at the fuse, the wiring must be checked again from the fuse to the consumer. Every wiring connection must be checked.
If there is no voltage at one of these wiring connections, the interruption is between this connection and the connection checked second-last.
If voltage was found at the consumer, there is still the possibility of an interruption in the wiring from the negative terminal of the consumer to earth. This can be checked with a test lamp. Make sure the circuit concerned is connected up.
Connect one end of the test lamp to earth and the other end to the negative (-) terminal of the component to be checked.
If the test lamp starts burning, the earth connection of the component is interrupted. If the test lamp does **not** come on, the earth connection of the component will in most cases be in good order.
If the positive and negative connections are both in good order, the consumer is defective and must be replaced.



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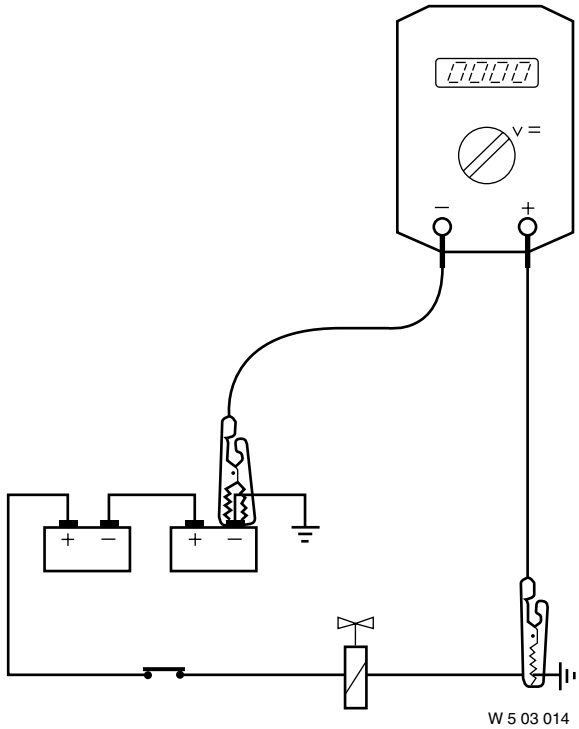
2.3 EARTHING PROBLEMS

Problems with the earth connections are mostly caused by corrosion on the contact surfaces of electrical connections.
Earthing problems can only be traced with a (preferably digital) multimeter. Digital, because this kind of problem usually involves only a few volts and the readings of an analog meter are not precise enough for this purpose.
To establish whether a certain earthing point has a good earth connection, measure with a voltmeter between the battery negative pole and the earthing point in question.
Now switch on as many consumers as possible.
If there is a correct earth connection, **no** voltage should be found.
In practice, however, a loss of approx. 0,5V will often be measured.
If the reading is higher, the earth connection must be checked carefully.
In this way the earth connections of all the consumers can be checked and measured.



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1. GENERAL

1.1 MULTIMETER

Multimeters are available in two different versions:
- analog meter
- digital meter

An analog meter has an indicating needle (pointer) which can move over a graduated scale.

A digital meter indicates the measured values by means of digits in a read-out window.

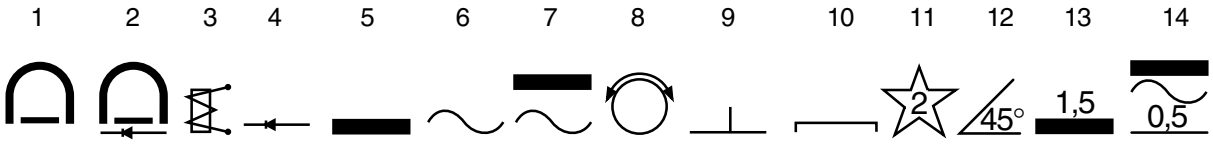
Analog meter
Disadvantages:
- Difficult to read due to the various graduated scales.
- Not capable of giving precision readings (depending on the scale arrangement/measuring range).
- If the meter is connected up incorrectly, there is a real risk of electrical defects in the meter.
- The indicating needle (pointer) is not resistant to powerful mechanical vibrations.
- The meter must usually be used in a certain position.

Advantages:
- Useful, for example, when measuring a potentiometer with a minor interruption.

Digital meter
Disadvantages:
- Meter is slow. With a fluctuating voltage all you can see are flashing digits.

Advantages:
- It indicates the correct value without the risk of misinterpretation.
- Gives more accurate readings.
- It is protected against faulty connection.
- It is resistant to powerful mechanical vibrations.
- It can be used in any position.

Key to the symbols on analog meters.
The following symbols may occur on an analog meter:



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1. Moving-coil meter with permanent magnet.
2. Moving-coil meter with rectifier cell.
3. Electromagnetic or soft-iron meter.
4. With rectifier cell.
5. Suitable for direct current.
6. Suitable for alternating current.
7. Suitable for direct current and alternating current.
8. Meter with zero adjustment.
9. Meter may only be used in the vertical position.
10. Meter may only be used in the horizontal position.
11. Test voltage is 2 kilovolts (without a digit it is 0.5 kilovolt).
12. Meter may only be used at the angle indicated.
13. Suitable for direct current, class 1.5 (inaccuracy 1.5% of full scale).
14. Suitable for direct current and alternating current, classes 1 and 0.5 (see item 13 for explanation).