



Technical Information

East Grinstead House
East Grinstead, West Sussex RH19 1UA
Telephone: 01342 326944
Fax: 01342 410258
www.caravanclub.co.uk

ADDITIONAL 12 VOLT WIRING IN TRAILER CARAVANS

This leaflet is prepared by The Caravan Club as part of its service to members. The contents are believed correct at the date of publication but the current position may be checked with the Club's Information Office.

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Contents

1. Scope	1
2. WARNING.....	2
3. Lighting Circuits.....	2
4. Battery Choice and Use.....	3
5. Battery Installation.....	4
6. Wiring.....	5
7. Interference Suppression.....	6
8. Schematic Diagrams.....	6

1. Scope

This leaflet describes the battery and additional circuits to operate 12V equipment in a caravan. The circuits in the caravan which enable its battery to be charged from the towing vehicle are included but not those related to a mains driven charger. These are described in the leaflet '*Mains Electrical Installations (Nominal Voltage 230V + 10% - 6% Volts AC) in Trailer Caravans and Motorcaravans*'. For many years UK caravans were built to British Standard 6765 Part 3, which includes a specification for 12V wiring. 1999 model year caravans (built from the latter part of 1998 onwards) are wired in accordance with European Standard BS EN 1648-1. Many aspects of these standards are similar, but where significant differences occur, these notes reflect the latest recommendations in the newer standard. Note that some caravan manufacturers may have begun to adopt aspects of the European Standard during 1997-8.

While the leaflet is written in context of a caravan installations, the arrangement of circuits and many of the issues discussed are similar in most motor caravans, with the obvious exception that the 'car' half of the system (covered in the leaflet 'Towbar Wiring') is also integrated into the same vehicle. Motor caravan owners may find some of the content of this leaflet of use, therefore, subject to a degree of interpretation.

2. WARNING

While there is no danger of electrocution from a 12V circuit, the type of battery used for storing power for 12V equipment can provide, for a short period of time, a power output of several kilowatts, more than the equivalent of that provided by a large electric fire. In the event of accidental misconnection between positive and negative conductors this power heats the wiring and can cause a serious fire hazard, and risk of personal injury. In the event of a momentary connection, an arc can be struck which could ignite adjacent material or petrol fumes, and cause risk of personal injury

3. Lighting Circuits

The mandatory road lights (rear, stop, turn indicators, etc) are powered from the towing vehicle via a 7-pin '12N' plug and socket or a 13-pin plug and socket. Reversing lights, which are not currently mandatory, but are invariably fitted on all modern caravans are powered via a 7-pin '12S' plug and socket or the same 13-pin plug and socket. Several variants of this system have been used over time - make sure you know which system your caravan uses, and that your car is wired in a compatible way. The information leaflet '*Towbar Wiring*' contains full details of these connections. See our website, or contact The Club's Technical Advice & Information Department and ask for a copy.

Many road lighting circuit faults are due to poor joints in the "earth return" connections. If the lights misbehave, for example if the intensity of other lights varies as the direction indicators operate, make a thorough check of all earth return connections before taking any other action. Include pin 3 of the 12N or 13-pin plug.

In older caravans, wires carrying lighting currents to the rear of the caravan were frequently run beneath the floor, where there is an increased risk of damage and general wear and tear. If a wire is found to be damaged, or if wires are found to be open-circuited, the cable should be replaced by one of a similar, or better specification. This should be fastened in place using plastic cable clips, spaced at not more than 250mm (10 inches) apart.

Difficulties may be found where wires disappear into the entrails of the caravan, as it may not be easy to pull the new wires through to their final destinations. The usual method is to use the old wire to pull the new, but care must be taken to check that there is no possible snagging point where the joint will snap, as broken ends are then bound to be unreachable!

It may be necessary to make a joint between a new cable and part of an old one. Such joints, if external to the caravan, should be enclosed to provide waterproofing and protection from physical damage. One crude but effective protection method is a thick coating of builders type silicone rubber sealant. Do not use coloured 'bath sealants' etc as the coloured fillers used in them may not be good insulators; nor should you use plastic bags which can encourage condensation.

Where lamp or plug wiring is replaced, take care to ensure that joints are properly made and will withstand vibration, and that there is no possibility of accidental short-circuits.

If replacement of any lamps is necessary the correct replacement should be used. If this is not obtainable care must be taken to ensure that the new unit complies with the legal requirements for vehicle lighting. Note that rear lights must generally form a matched pair.

4. Battery Choice and Use

Available batteries fall into two types, automotive and leisure. Both types are available in a number of sizes.

The automotive type of battery is designed to supply a high current, sometimes 200A or more, for a short time (frequently only a few seconds) in order to start the car engine. For the remaining time it is either at rest or being charged by the vehicle alternator. It is not designed to supply a few amperes for a period of hours, which is the kind of duty which arises in a caravan. Unless the caravan is going to be used with a mains supply and has an adequate charger which will be used for over 90% of the time that the caravan is in use, the purchase of an automotive battery will be false economy, despite the lower cost.

Leisure batteries are designed to supply currents of a few amps for longer periods and to be discharged and recharged many times. They are generally to be preferred in a caravan, therefore. However, battery life is enhanced if it is kept well-charged, so the use of a suitable charger is advisable if a mains hook-up is available.

After a period of discharge, the battery should be recharged as soon as practicable, as being left in a discharged state will reduce its life. During prolonged periods of idleness, eg in winter, it should be given a top-up charge every 6-8 weeks. In order to ensure that it is properly charged, but not over-charged, an 'automatic' or 'voltage controlled' battery charger should be used. Some battery chargers have circuits specifically designed for leisure batteries and these are to be preferred. While not in use, it may be desirable to disconnect the battery from the caravan, unless it is required to power a security device, as many modern caravans contain devices which may draw a small but appreciable amount of power even in an apparently idle state, and which will over time flatten the battery. It is not advisable to leave a battery connected to a charger for long periods over the winter, unless the charger is specifically design with a 'trickle charge' facility.

The battery should be examined at least twice a year. The terminals should be kept lightly greased with petroleum jelly (Vaseline). If any green deposits (verdigris) appear on them these should be cleaned off with a rag. The terminals should then be wiped over with a solution of household ammonia and fresh Vaseline applied.

Battery capacity is quoted in ampere-hours (Ah). This is roughly the result of multiplying the current being taken from the battery and the time for which the battery will supply the current before it must be recharged. The size of battery needed can be estimated from a combination of the length of time that the caravan will be in use between chargings, the amount of equipment in use and the length of time that equipment is switched on. This is not an exact calculation and it also depends on the age and condition of the battery and the rate of discharge, but it is a good guide. The current taken by any piece of equipment can be worked out by dividing its wattage by the nominal voltage (12V). For example a 13W fluorescent light will take $13/12A$, ie just over 1A whereas a spot light with a 5W bulb will take only $5/12A$, ie just over 0.4A. A water pump may take several amps, but it is usually only working for a few seconds at a time. A colour television also takes several amps, so a tele-addict on a CL without a mains hook-up needs a larger battery. Remember that many lights switched on mean more amps. Also, while in mid-summer lights are only needed for one or two hours perhaps, in winter they may be needed for five or six hours. The following table gives specimen figures for the consumption of typical appliances found in a caravan. While this is only one possible example, and your usage may vary significantly from this, it

does suggest that a battery of 60Ah capacity is the minimum size which will be acceptable in a well equipped caravan.

APPLIANCE	Watts	Amps	No	Use Hours	Ah
Fluorescent Light	13	1.1	3	4.0	13.2
Spot Light	5	0.4	2	2.0	1.6
Awning Light	10	0.8	1	0.5	0.4
Pump		7.0	1	1.0	7.0
Toilet Pump		5.0	1	0.5	2.5
Water Heater	1.2	0.1	1	12.0	1.2
Space Heater Fan		1.0	1	9.0	9.0
TV Black/White		3.0	1	3.0	9.0
TV Colour		8.0	1	3.0	24.0
TOTAL (TV B/W)					43.9
TOTAL (TV Colour)					58.9

Battery size and weight increases with capacity, with a 70Ah size weighing typically about 19kg. Since this must be included as part of the caravan's payload, a compromise between capacity and weight may be necessary. Look for a battery with a good power-to-weight ratio.

Battery capacity quoted in sales literature is not always achieved in practice, particularly as the battery gets older. Be sure to make the calculations on the side of caution and buy the most capacity you can afford, if the weight is acceptable.

5. Battery Installation

A battery contains acid and may give off acid fumes. While charging, a small amount of gas may be given off. In addition, should it be overcharged it could give off an explosive mixture of hydrogen and oxygen. It should therefore be mounted in an acid-resistant box which is adequately ventilated to the exterior of the caravan.

Many batteries are now 'sealed' (ie they cannot be topped up with acid, and will not spill if overturned. However, such batteries still allow for the release of gases, and hence still require suitable installation. Often, they are designed for use with a 'ventilation kit', which is a length of plastic tubing that plugs into a vent point on the battery. This tube should be directed to a suitable ventilation point, allowing any gases released to leave the caravan. For some battery compartments, the tube may need to be fitted between the access door and the edge of the compartment, and this must be done in such a way that the tube is not squashed flat. There may be a path provided through the sealing of the compartment door to allow for this.

Normally, a purpose-built battery compartment should be available in any remotely modern caravan. For caravans built since 1998, European Standards require that the battery is secured in a separate compartment. Old caravans may have the battery positioned on the floor in a cupboard or bed locker, without any sealed separation from the habitation area, or a portable battery box may be used. Such installations are less safe than modern sealed ones, and owners might consider having a separate battery locker installed to improve them.

The battery must be located in a secure manner (held by clamps, or located in a box which prevents it moving around), so as to withstand severe bumps, vibration and the effect of emergency braking.

On no account should the battery be mounted in a position adjacent to LPG cylinders, as a spark during connection or disconnection could ignite any gas which has leaked from them. Some imported caravans have had this arrangement which, while not illegal, is in The Club's opinion most unwise. Such installations should be relocated, preferably to a dedicated battery box.

Crocodile clips are not recommended in any location as sparks are formed during connection or disconnection.

Overcurrent protection devices (fuses, circuit breakers) must not be installed in the battery compartment (nor in the gas bottle locker).

6. Wiring

In general, the most convenient type of wire to use is the insulated stranded type which can be obtained from automobile and caravan accessory suppliers in a variety of colours.

There is a colour code convention for wiring to the 12N/12S or 13-pin plug, but general wiring throughout the body of the caravan may follow individual manufacturer's own conventions, or none at all!

Reels of wire usually carry a label giving an amperage rating which is the maximum current that the wire is designed to carry. It must not be used to carry a higher current. As power loss in a wire increases with length, the length of the wire must also be taken into account. The correct size for any length of wire can be chosen by the use of the following table, which gives the maximum current for which lengths of wire of various sizes should be used. Note that in this table, 'circuit length' refers to the sum of the lengths of the supply and return cables for the circuit.

WIRE SIZE	MAXIMUM CURRENT (IN AMPS) PERMITTED FOR A CIRCUIT LENGTH OF UP TO:			
	4m	8m	12m	16m
1.0mm ²	9.4	4.7	3.1	2.3
1.5mm ²	14.1	7.0	4.7	3.5
2.5mm ²	23.5	11.7	7.8	5.9
4.0mm ²	37.6	18.8	12.5	9.4

The above values are calculated to give safe operation, and also to ensure that the voltage drop between power supply & appliance is no more than 0.8V. This limit on voltage drop minimises the risk of voltage-sensitive equipment (eg TVs) failing to function correctly.

Note that the values quoted are maximums, and assume a high quality installation using modern cabling with effective insulation. It is not necessary to specify the thinnest

allowable cable, and it may be more cost effective to buy a single reel of heavier cable, rather than a number of lengths of different gauges.

When installing wires, it is strongly recommended that they be protected from physical damage by the use of plastic conduit or trunking. Where this is not done they should be held by plastic clips spaced at not more than 250mm (10 inches) for horizontal runs or 400mm (16 inches) for vertical runs. They should be positioned so that damage by the impact of sharp objects, eg the edges of awning poles, cannot occur.

Wires should not be run through a compartment containing gas cylinders unless absolutely unavoidable. If such a run is necessary, the cable must be enclosed in a continuous gas-tight conduit or duct, capable of resisting impact. The cable must be positioned at least 500mm above the base of the gas cylinders.

Fuses and/or miniature circuit breakers must be used in each circuit to provide protection against overload or short circuit. The rating of the fuse or circuit breaker must not be more than the maximum permissible current rating of the cable used in the circuit.

All fuses must be enclosed to prevent accidental damage.

No fuse and circuit breaker should be located in a compartment used for gas cylinder storage, auxiliary battery storage, or other fuel storage. The main fuse or circuit breaker for the auxiliary battery supply should be positioned at the end of the battery cable away from the battery, but before the rest of the caravan circuits. It too should not be in the battery compartment.

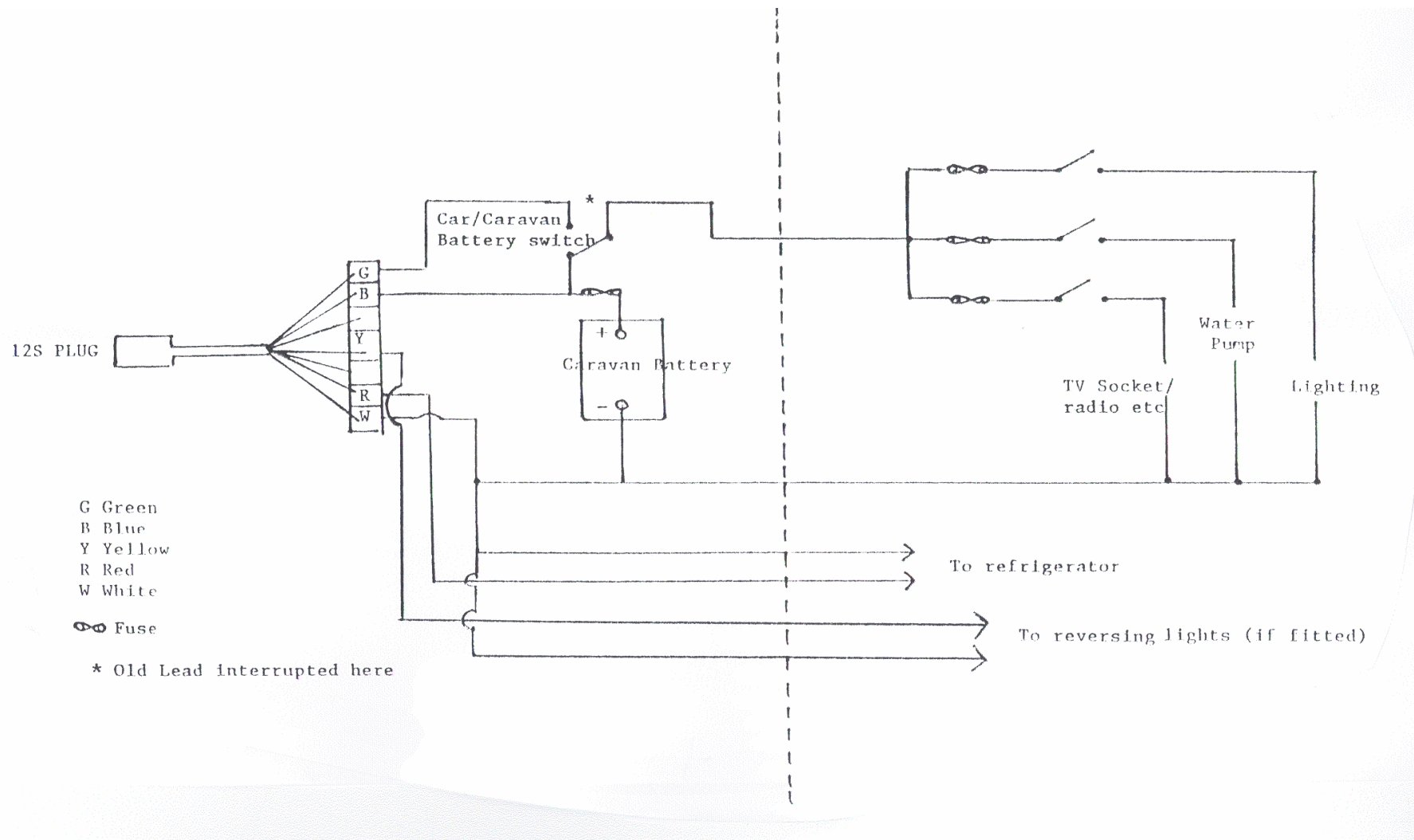
7. Interference Suppression

Interference on radio and TV can be caused by water pumps, fans and the transistor circuits used to feed fluorescent lights. The elimination of this type of interference is a complex subject. If you have trouble it is best to consult a competent radio/TV technician and follow his advice. Specialists in the installation of in-car entertainment systems are often able to help. Tighter European rules should make this less of a problem on more recent caravans.

8. Schematic Diagrams

The two diagrams on the following pages show an overview of the circuit arrangements likely to be found in typical caravans. The circuitry in a specific caravan may well differ, but these are intended to illustrate the general principles. Caravan handbooks sometimes include a wiring diagram, but experience suggests caution before assuming that these accurately represent the actual installation!

12S WIRING : CONNECTIONS FOR MOST UK-BUILT CARAVANS UP TO THE LATER PART OF 1998



12S WIRING : CONNECTIONS FOR ALL UK-BUILT CARAVANS FROM 1999 MODEL-YEAR ONWARD (IE LATE 1998 ONWARD), & SOME UK CARAVANS BUILT FROM 1997 ONWARD

