Understanding Caravan and Tow Car Electrics

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Introduction

This is a simple guide that hopefully will give you an insight into your caravan and tow car electrical systems. It was written in response to a number of questions asked on the **Caravantalk.co.uk** forums.

It describes the electrical systems on a typical caravan and how they work. However, as caravans have evolved to the demands of the modern caravanner, these systems have become more complex, but a basic understanding of a simple system will help you diagnose faults even on complex systems in a modern caravan and help to maintain your caravan over the coming years. I have assumed you have no knowledge of caravan electrics, so I've started at the beginning and with a bit of history. Apologies to those reading that have some knowledge and find the early part a little simplistic.

I have described a generic car and caravan wiring system, it will not be identical to your car or caravan. Each caravan manufacturer will have adapted a basic system to allow for more features and to take into account more complex requirements from its customers.

The Caravan

A modern caravan has basically three electrical systems on board. Two of these systems are 12 volt Direct Current (DC) just like your car and the third is 240 volt Alternating Current (AC) just like your house.

The first system is to provide the lights that replicate the road lights on your car. The second system is designed to allow 12 volt lights and accessories to be run from a battery in your caravan and finally the third system is designed to allow you to plug in to a 240 volt socket on a caravan site and allow the use of the same equipment you would normally just plug in to a socket at home. This is commonly known as EHU... short for Electrical Hook Up.

In the beginning....

The first and oldest electrical system on caravans, that was installed way back when most caravan's were no more than small garden sheds on wheels were the rear lights that replicated the rear lights of the towing vehicle, usually no more than two side lights and two brake lights.

Illumination for inside the caravan was provided by gas lights fed from a small gas cylinder usually clamped to the "A" frame of the caravan. It wasn't long before the lighting system needed to be upgraded, as direction indicators became mandatory on cars, additional wiring was needed to replicate indicators on the rear of the caravan. Skip forward a few years and a rear fog light became mandatory, so a further upgrade was made to the lighting electrical system to allow the rear fog light to be installed. The wiring for these lights was connected through a 7 pin plug to the car that is commonly known as a "12N" connection.

Sometime in between the indicators and rear fog light

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changes, people decided they wanted to replace the gas lights inside the caravan with 12 volt lights that could be run from the car battery.
People often used old car spotlights or other 12 volt lights that were found in cars of the time as interior lights and these soon drained the car battery, so an "upgrade" was to install a second battery in the caravan that could be used to provide power for lighting. These were usually old car batteries. It would be another few years before the dedicated "leisure battery" came along. Originally, you would have to take this battery out of the caravan and charge it at home using a standard car battery charger. Again, in a continual developing process, someone came up with the idea of being able to charge the second battery in the caravan from the tow car while driving along the road, or when on site, being able to run the engine of the car and using a long lead be able to plug the caravan into the car to charge the battery for the next nights use of the lights.

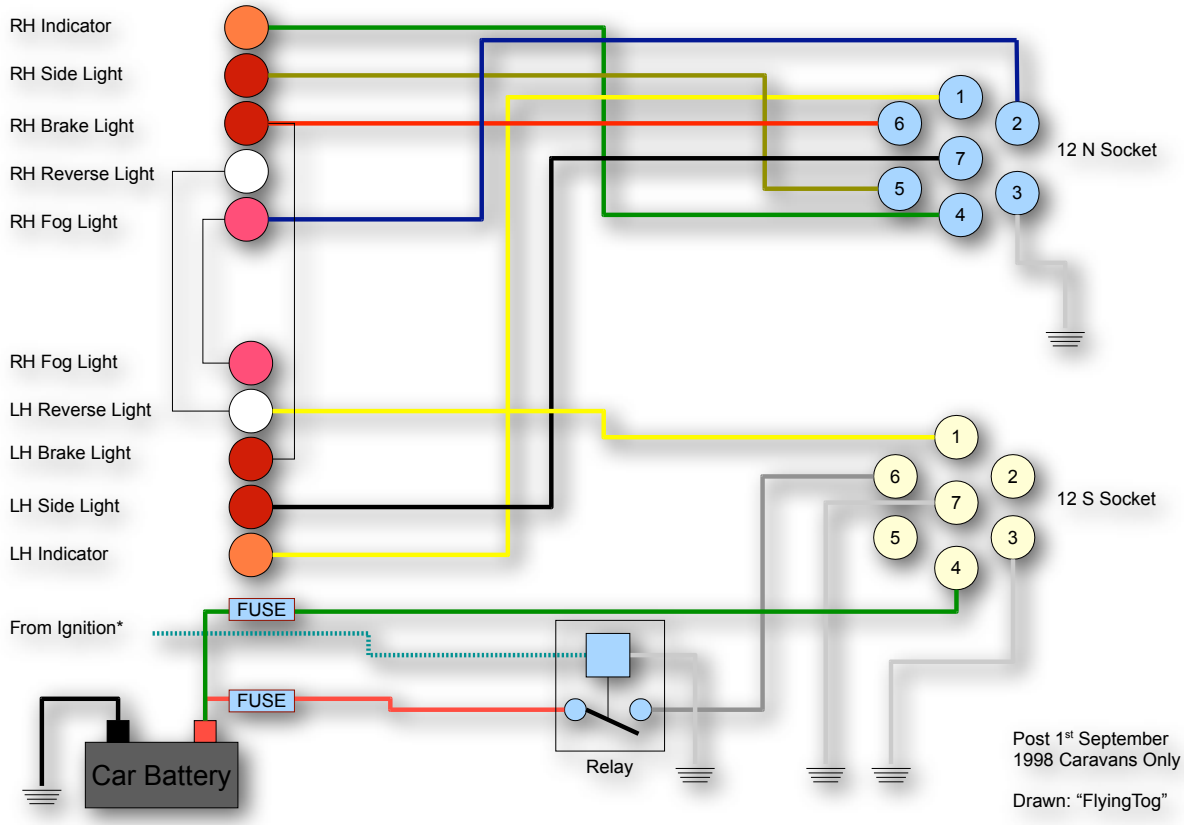
So a second "supplimental" electrical system was born and the "12S" (S for supplemental as to differentiate it from the 12N or Normal) connection came into being.

The 12 Volt systems

The 12 volt systems are split into two. The first, and as we have seen, the oldest is the caravan road lights, that is to say the lights that are required by law to have on all trailers. These lights consist of "tail" or "rear" lights - rear side lights (red), brake lights (red), direction indicator lights (orange), reversing lights (white) and fog lights (red). Due to the size of a caravan front marker lights (white) are required and from 2013 side marker lights (orange) on longer caravans.

These lights are connected to the car via a 7 pin "12N" type plug or by a more modern "continental" style 13 pin plug. The road lights are usually a complete system with all the supply and earth connections being separate from any other electrical system on the caravan. One of the most common faults with road lights is problems associated with the earth lead, but more of that later.

The only road lights that are not connected via the 12N connection are the caravan's reversing lights. The original 7 pin socket when it was developed



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was thought to have enough connections for everything anyone could ever want. Unfortunately as the years progressed, the number of "spare" connection on this plug diminished, to the point where there was no spare connection for the reversing lights. However, with the advent of the 12S, this was taken care of.

The second 12 volt system is the supplemental system. This is designed so that when towing, you can charge the caravan's leisure battery, power the fridge and in some cases power an electrical brake system. The design of the supplemental system has to take into account a number of things:-

- It must be able to charge the caravan's leisure battery only when the car battery is fully charged and the engine is running.
- It must be able to power the caravan's fridge - but not allow the fridge to flatten the car battery if the engine is not running.
- It must be able to power the internal 12 volt electrical system of the caravan, but turn everything off when the engine is running.
- It must not interfere with the correct operation of the road lights of the caravan or towing vehicle.

OK, so lets look at the first one -

"It must be able to charge the caravan's leisure battery only when the car battery is fully charged and the engine is running"

A simple connection from the car battery to the leisure battery in the caravan achieves this, but there are problems with this type of connection. If the car battery is flat and you try to start the car, a heavy current will be drawn from the caravan's leisure battery and would cause the caravan wiring to over heat and possibly cause a fire. It would also damage the plug and socket connecting the caravan's wiring to the car, as they are not designed to take the high currents involved in starting a car engine. So how can we do this safely?

The charging circuit from the car is connected to the caravan's leisure battery via a relay installed in the caravan. This relay is a voltage sensing relay and only turns "ON" when it detects a voltage greater than 13.8 volts (or there abouts - each manufacturer has its own preference). So when you start the car, you turn the ignition key (or press the button) and the starter motor is engaged, this drops the car's battery voltage to below the setting of the voltage sensing relay in the caravan and so it disconnects the leisure battery. Once the engine has started, the cars alternator starts to charge the car battery to replace the energy used in starting the car. As the charge in the battery is replaced, the voltage of the car's electrical system rises until it is at a level that the voltage sensing relay in the caravan turns back on and allows the cars electrical system to start charging the leisure battery.

Please Note: Some cars have a voltage sensing relay fitted in the electrical system when the tow bar was installed, it has the same effect as described above. Alternatively, some cars control this relay by signals from the cars ECU... the ECU it detects when the car's battery is fully charged and turns the relay on. Caravan manufacturers recognise there are different systems and in order to make their caravan compatible with all the differing systems, most install a voltage sensing relay of some description. To be sure everything remains safe, and large currents can't be drawn from the leisure battery damaging the caravans wiring to try and start the car, they install a fuse between the leisure battery and the charging circuit.

Top Tip *- If your leisure battery doesn't work when you arrive on site - check this fuse first. If everything was OK when you last hitched up to the caravan and then started your car's engine and now the leisure battery doesn't work.... you might have blown the fuse starting the car and it might be a sign that everything is not well with the charging circuit.*

Now let's look at the second one -

"It must be able to power the caravan's fridge - but not allow the fridge to flatten the car battery if the engine is not running".

How do we do this? Actually its quite simple. A separate lead from the car battery to the 12S socket (or 13 pin socket) has a relay connected in line with it. The relay is controlled by the ignition switch, so that only when the car's ignition switch is on and energising the relay, is the voltage from the car battery "turned on" to the relevant pin in the 12S (or 13 pin) socket. The cable that connects this circuit MUST be 2.5 mm diameter as it will carry a relatively large current. The earth path for this circuit is kept separate within the caravan and

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only earthed within the car. This is to ensure that the circuit is not connected to other circuits and to make sure the higher current required cannot be fed through other devices if a fault should develop. You will find out shortly why each caravan 12 volt system has a separate earth cable only earthed when it is connected to the car.
So, lets look at the third one -

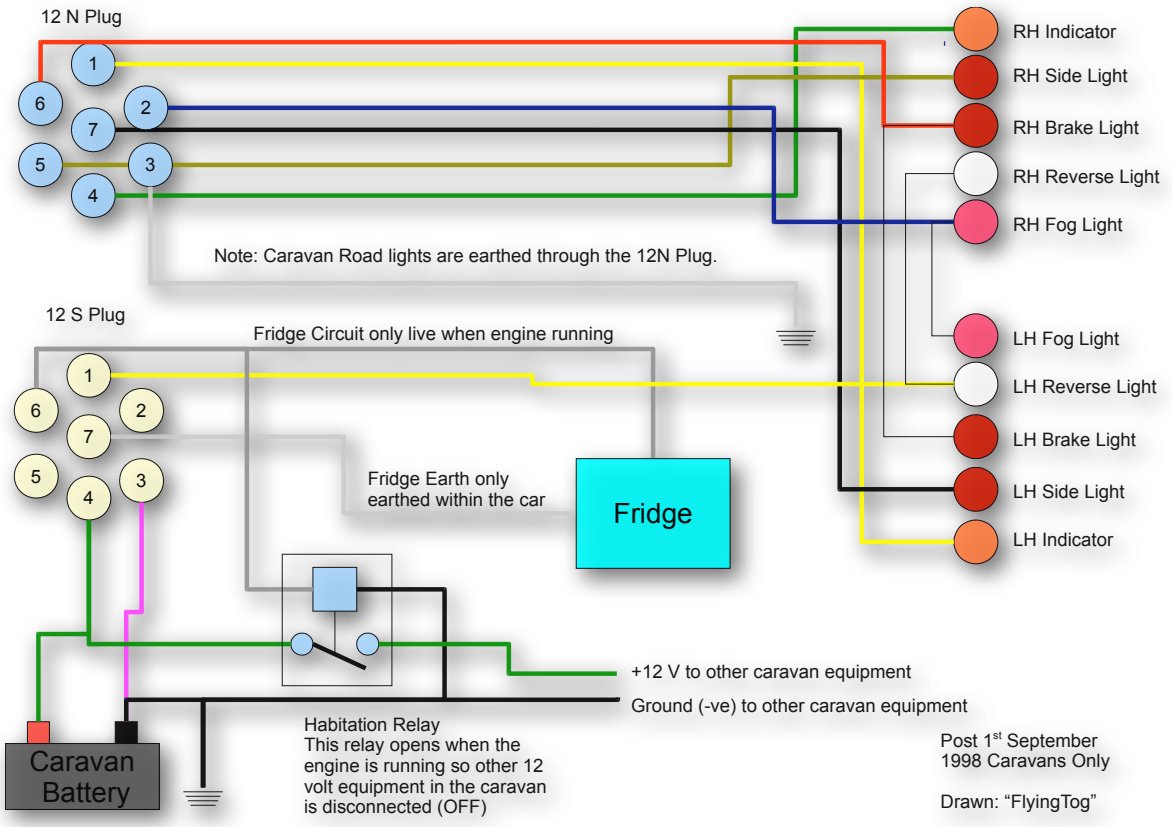
"It must be able to power the internal 12 volt electrical system of the caravan, but turn everything off when the engine is running"

This is achieved by another relay, this time installed in the caravan. It is often called "the habitation relay". With the engine off, the relay allows electrical current from the car battery to power the caravan's 12 volt internal services... the interior lights, 12 volt sockets etc. The incoming feed from the car goes to a relay. This relay is controlled by sensing the voltage on the circuit that powers the fridge. Remember we said that we only want to power the fridge when the engine is running so we would not flatten the car battery when the engine isn't running so we switched the fridge circuit "on" with the ignition... well in the caravan, the habitation relay senses the fridge circuit being turned "on" and when it detects this, it turns "off" so turning off the power to the internal 12 volt services. Why should we want to do this? Well, there are good reasons. With the increasing complexity of car electrical systems and the fact that modern cars are now controlled by computers, especially things like ABS, Engine ECU's, Traction Control and Airbags in order to make sure these systems are not compromised by anything electrical in the caravan, the habitation relay turn all the caravan's systems off with the exception of the fridge circuit and the caravan's road lights. This is why the earth's for these circuits are kept separate.

Finally, lets look at the last one -

"It must not interfere with the correct operation of the road lights of the caravan or towing vehicle".

The lighting system on modern cars has grown more complex over time. We now have sensors that can detect when a bulb is not working and some cars have a system called "CANBUS" which uses digital signals to turn lights on and off when the car's ECU or "brain" detects things... like you applying the brakes for example. To make sure caravan road lights can work with all cars, a simple standard is adopted so that you can plug virtually any caravan into any car and all the road lights will work. In order to make sure this can happen, the road light system on a caravan is kept completely separate form the other 12 volt systems, including having its own earth return path.



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The 240 Volt System

The 240 volt system is exactly the same as your house wiring. It allows you to use the same appliances you do in your home and works in the same way. The 240 volt system is not connected directly to any of the 12 volt systems in the caravan. I'll explain a bit more about that shortly.

How do you get 240 volts in your caravan? Well you use a EHU or Electrical Hook Up lead. These leads are different to the ones you have in your house in so far as they use different connectors. The connectors are blue in colour and have a 16 Amp rating, one end will have a plug with three pins on it to plug into the EHU socket on the caravan pitch and the other will have a "line" socket or trailing socket that plugs into a connector fitted into an outside locker or in some cases under a special weatherproof flap installed on the outside of the caravan.

When connected, this lead provides a 240 volt supply of up to 16 Amps. In the UK some caravan sites are limited to 10 Amps, and on the continent, this can be limited to 6 Amps or even lower. Note that in Europe, the connectors mat be different, not all have adopted the standard blue 16 Amp connections yet.

When you connect up to the site electrics - sometimes referred to as "shore power" (from boating) or "ground power" (from aviation) you need some form of protection from faults. This is usually achieved by a device called a ELCB or Earth Leakage Circuit Breaker. Simply this is a special switch that looks at the current on the incoming wire (live) and returning down the neutral wire. If it detects a difference or it detects that some of the incoming current is "leaking" to the earth connection, it then switches off the supply. It can do this very fast... were talking milliseconds here which is far quicker than a fuse takes to 'blow'. You can test the ELCB by pressing the little test button on the device. It should cause the switch to turn off when pressed. If is doesn't **TURN OFF THE ELCB MANUALLY, UNPLUG THE EHU CABLE AND DO NOT TURN THE ELCB ON AGAIN BUT GET A QUALIFIED ELECTRICIAN TO CHECK EVERYTHING IMMEDIATELY.**

From the ELCB, the supply is taken to several other little devices called MCB's or Miniature Circuit Breakers. These are the modern equivalent of fuses. In fact the whole ELCB and MCB set up in your caravan is almost identical to the 'consumer unit' (fuse box) that is in your house, only on a smaller scale.

Each of these MCB's will supply either a number of sockets, the leisure battery charger, water heater, caravan heater etc.

The only way the 240 volt or mains system is connected to any other electrical system in your caravan is via the caravan's on board charger. This device is sometimes built into a box along with the ELCB and MCB's... sometimes its a standalone box usually located near the battery. This charger is a bit more complex than the cheap car battery chargers that you can buy from your local car parts shop. It has to do several things - firstly, it has to be capable of charging the leisure battery, second, it has to be capable of supplying enough current to allow you to use all the 12 volt appliances in the caravan... your water pump, interior lights etc. Some of the appliances that can be set to run on gas (dual fuel)....the water heater for example, still need a 12 volt supply for its operation. This is the same for your fridge and space heater when operating on gas.

Remember, most caravan electrical systems are designed so the fridge will not run off the leisure battery... but requires that the leisure battery (or small 12 volt supply) is present to be able to operate of gas.

The inbuilt charger also has to be capable of running all the 12 volt systems even if there isn't a leisure battery connected.

For electrical safety, the caravan's chassis is connected to the 240 volt system earth. This means when you are plugged in to the EHU on your pitch, the caravan is safely connected to Earth, so should any fault develop it will trip the ELCB and you will be safe... even if standing on wet grass touching the metal frame of the caravan. This is one of the reasons the 12 volt neutral (sometimes called "earth" or "return") is kept completely separate.

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Altering Caravan Wiring

Lets look at the 12 Volt systems first. Anyone with basic DIY skills can alter or adapt the 12 volt wiring on a caravan. Before you start any work, draw out on paper the existing cabling you want to alter and identify on the drawing the basic parts, including cable colours, positive wires and neutral wires. Take pictures as well so you can easily put things back if you get stuck. Next, draw what you want to do and where you are going to connect the wires. Study the route of any new cables - is it possible to get the cables where you want them? Are the cables going to get trapped or damaged when the caravan is moving? If you are adding additional 12 Volt outlets (Cigar lighter or accessory type sockets) is the cable you are joining into of sufficient size to carry the additional load?

Once you have decided what you want to do, write down a shopping list of things you will need. Wire - what length, rating and colour? Do you need any special connectors?

Connecting 12 Volt Cable

Don't ever consider using "scotchlok's" (sometimes referred to as "IDC" or Insulation Displacement Contact) to splice into existing cables or lengthen cables. These connectors are unreliable as they rely on a metal blade cutting through the insulation and nipping the conductor inside the cable. They cannot be reliably installed and cannot handle more than one or two amps.

A better way would be to solder the cables then cover the soldered joint with heat shrink sleeving, although, better than scotchlok's, its still not the best way. Soldering takes a bit of practice and the transition point between soldered and unsoldered cable is a weak point. Soldered connections also suffer from oxidisation.

The best way of splicing or lengthening cables is to use crimped connections. You can buy a good ratchet crimp tool for £10 to £20 and will provide a lifetime of use. For the actual crimp fittings, you can buy through crimps for various sizes of cable (usually coloured Yellow, Blue & Red) that come with a heat shrink sleeve as part of the connector. The other thing you will need is a good pair of cable insulation strippers. All these tools and crimps can be found at places like Maplins. If you haven't already got a simple digital multimeter, now is a good time to get one. It doesn't have to be a 'sooper dooper' one, a simple one can be bought for under £10. (One of mine cost £4.99 from Maplins!) To learn how to make good crimp connections, there are lots of instructional videos on "YouTube"... just do a search on Google.

USEFUL INFORMATION

Pin Connections - Post 1st September 1998 Caravans

12N

Pin 1	Left Hand Indicator
Pin 2	Rear Fog Light
Pin 3	Neutral (Earth or Ground) for all Road lights
Pin 4	Right Hand Indicator
Pin 5	Right Hand Side Lights (rear, side marker lights, front position lights)
Pin 6	Brake Lights
Pin 7	Left Hand Side Lights (rear, side marker lights, front position lights)

12S

Pin 1	Reversing Lights (these are "earthed" via pin 3 on the 12N connection)
Pin 2	Not Connected
Pin 3	Earth Return for Pin 4 (Charging circuit)
Pin 4	Permanently Live (direct from car battery)
Pin 5	Not Connected
Pin 6	Positive When Ignition On (Fridge Supply)
Pin 7	Earth Return for Pin 6

13 Pin "Continental"

Pin 1	Left Hand Indicator
Pin 2	Rear Fog Light
Pin 3	Neutral (Earth or Ground) for all Road lights
Pin 4	Right Hand Indicator
Pin 5	Right Hand Side Lights (rear, side marker lights, front position lights)
Pin 6	Brake Lights
Pin 7	Left Hand Side Lights (rear, side marker lights, front position lights)
Pin 8	Reversing Lights (these are "earthed" via pin 3 only)
Pin 9	Permanently Live (direct from car battery)
Pin 10	Positive When Ignition On (Fridge Supply)
Pin 11	Earth Return for Pin 10 (Fridge)
Pin 12	Not Connected (designated signaling connection)
Pin 13	Earth Return for Pin 9

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If you are installing a new outlet, remember to include a fuse into the circuit. Generally, you always install the fuse as close to the battery or connection where you are picking up the positive supply from. The fuse is there to protect the cable from overload in the event of damage so its no use having it near the outlet if it gets damaged near the connection to the positive supply.
Just because you are working on 12 Volts it doesn't mean you can leave the battery connected! Leisure batteries store energy... that is what they are designed to do. Releasing this energy in a short burst if you get the wiring wrong will be spectacular, quick and dangerous! Batteries can and do explode, wiring can and will become red hot and you could loose your caravan. **ALWAYS DISCONNECT THE BATTERY**.... you have been warned!

240 Volt Wiring

Well, you may have basic DIY skills and have already altered your caravans 12 Volt wiring, but unless you are familiar with electrical wiring and by that I mean more than just putting a 13 Amp plug on to the toaster, I would suggest you get a qualified electrician in. As most caravans are fairly simple, it will not cost too much to get the expert in. You can help keep the cost down by knowing exactly what you want to do, knowing where you think the cables could run and most of all, move anything from cupboards or lockers that would delay the electrician. Remember, If it took you 30 minutes to empty a locker so a cable could be run, you would have been paying the electrician to do that!

One final word -

DO NOT INSTALL ANY ELECTRICAL DEVICE, SWITCH, LIGHT OR OUTLET IN THE GAS LOCKER!

It doesn't matter if its 240 Volt or 12 Volt. **DONT DO IT.** That goes for joining cables as well, don't join them in the gas locker. If you need to route a cable through the gas locker, make sure that it is well secured and cannot be damaged by the gas bottles and the terminations are well away from the locker. With a bit of thought, another route can usually be found that doesn't involve routing through the locker.

Calculating the load on your EHU supply.

Most, but not all caravan sites have a rating of 16 Amps for their hook up point. So what's the maximum load that you can use on a 240 volt 16 Amp EHU?

We want to find out the maximum load in watts that we can have plugged in to the caravan. We know the voltage - 240 and we know the maximum current - 16 A, so if we use the following formula:-

V x I = P

240 x 16 = 3840 Watts.

What can we plug in then?

To work out what you can plug in, look at the data plate on the equipment and it should tell you the power rating.... a small toaster for example might have a rating of 800 Watts.

So add up all the electrical devices that you want to have switched on and as long as the total comes to less than 3840 Watts, you are OK.

But don't forget that your caravan's leisure battery charger will have a rating, so will the electric

FORMULAS FOR WORKING WITH ELECTRICS

If you want to know how to work out things like power (measured in watts) or resistance (measured in ohms) here's how...

Power (W) is expressed in "Watts"
Potential (V) is measured in "Volts"
Resistance (Ω) is measured in "Ohms"
Current (I) is measured in "Amps"

So.....

Voltage x Current = Power.... V x I = P
Power / Voltage = Current.... P / V = I
Power / Current = Voltage.... P / I = V
Voltage / Resistance = Current....V / R = C
Voltage / Current = Resistance.... V / I = R
Resistance x Current = Voltage.... R x I = V

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water heater and your caravan space heater, so if you have these on, you have to take these into account. To find out these ratings, look in the caravan's handbook or check the manufacturers plate on each device.

Now before you go switching on everything you own in the van, it is worth checking that the site supply is indeed 16 Amps. Some sites in the UK are only 10 Amps, in which case your total load can only be 2400 Watts. Continental sites can have a supply rating down as low as 6 Amps in which case your total load can only be 1320 Watts (remember, European supply voltage is usually 220 Volts... so you will need to take this into account when working out the maximum load).

Calculating volt drop in cables.

In order to calculate the voltage drop in a given length of cable, we need to know the resistance, current in the cable and volt drop for a known length of cable for each different the different sizes (cross sectional area given in mm^2 for each cable used. Here is a simple table for the most common type of single PVC cable used and its size.

Cable Cross Sectional Area (mm^2)	Max Current Capacity (A)	Volt Drop (mV/A/m)
1.0	14.0	38.0
1.5	18.0	25.0
2.5	25.0	15.0

How to work out the voltage drop.

Voltage drop is expressed as milli volts per amp per metre. So lets look at that.

Think of the brake lights on your caravan. We have a 1.0 mm^2 cable connected to a battery that is 12 metres long that needs to supply two light bulbs that have a total load of 50 watts at 12 volts, how do we work out the voltage drop?

First we need to work out the current required, so we use P / V = I or 50 watts / 12 volts = 4.1 Amps

Now we can use the following formula... Volt Drop x Current x length of cable and divide by 1000 (to convert mV (millivolts) into Volts).

So in our example:-
38 mA/A/m x 4.1 Amps x 12 volts = 1869.6 mV divided by 1000 = 1.86 Volts.

Now to complete our simple circuit, we also have a neutral cable (earth or ground) and have to calculate the voltage drop for this as well. As it is exactly the same cable and length, we also have a 1.86 volt drop.

So when our brake lights work, they are working not at 12 volts, but at 8.28 volts (12 volts minus 3.72 volts).

Maybe 1.0 mm^2 cable is too small for this application then, so lets try it with 1.5 mm^2 cable.....

(25 x 4.1 x 12)/1000 = 1.23 volts

so this time, the brake lights will operate with a voltage of 9.54 volts. This is a little better than before.

OK, so its still not too good and your brake lights will be a little dimmer than intended. We can still improve things. If you remember, the earth cable for the road lights was on pin 3 of the 12N and the 13 Pin connection, and as it has to provide a return path for other road lights as well, it is usually a larger size - 2.5 mm^2

So lets check that out.....

(15 x 4.1 x 12)/1000 = 0.73 Volts

OK, thats getting better.... now we have a 0.73 volt drop on the neutral cable, a 1.23 volt drop on the positive cable.... so now our brake lights are working at 10.04 volts - definitely brighter!

"Why do my brake lights fluctuate between dim and bright when the indicators are on?"

OK, this is easy. We have seen how we calculate the voltage drop in a given length of cable for a given load. Well, when the indicator lights are on, the calculation for the neutral cable changes. This

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time, we have to take into account the change in voltage drop for a higher load in the neutral cable. So, if the indicator bulb is 15 watts, and we do the calculation for the volt drop:-

We find the current in the cable:

15 Watts / 12 volts = 1.25 Amps

Now calculate the voltage drop:

(15 x 1.25 x 12)/1000 = 0.225 volts

So each time the indicator lights up, the voltage drop on the return cable increases by 0.225 volts causing the voltage at the brake lights to drop from 10.04 volts to 9.81 volts, enough to cause a drop in brightness noticeable with the naked eye.

Although this is a simplistic view of volt drop, it can be seen that the wrong size of cable can have consequences, and sometimes things don't always work as they should as the voltage drop is too much. It is important therefore when altering any wiring on your caravan or car, you should always choose the correct size. If in doubt, always go a size larger.

At this point, I have to throw a few other things into the pot. The connection between the caravan and car will also have some resistance and therefore a voltage drop, the earth point in the car may be slightly corroded, not noticeable in the operation of the car lights, but when you add up the voltage drop for the cable, the connection and the corroded earth point, you can now understand why your caravan lights may not be shining as brightly as they could or should be.

How can we improve this situation? Well installing a 2.5 mm^2 cable direct from the battery to the earth terminal in rear of the car where the trailer lights are connected to will definitely help. This is especially important if the charging circuit and fridge circuit also share the same earthing point. It may be worth going up to a 4 mm^2 cable if you can. Making sure the earthing point is clean and not corroded will make a difference as well.

One other thing to consider is changing the rear light bulbs to the LED type. LED bulbs manufactured for use in automobiles have a wider operating voltage from around 8 volts to 18 volts and will always be a full brightness between these voltages. A word of caution though. Any LED bulb used in a car or trailers road lights MUST have an EC marking on it. Some LED bulbs are only designed for show purposes and are not road legal. The reason behind this is some reflector designs rely on enough light being emitted in all directions in order to reflect off the interior of the light fitting. One of the requirements for vehicle lighting is not only the brightness of the displayed light but the surface area that is illuminated. Some LED Bulbs only emit light in one direction and nothing is reflected off the interior of the fitting.

On the upside, to offset some of the voltage drop loss, when the engine is running, a cars electrical system usually operates around 13.5 to 13.8 volts and can be as high as 15.2 volts.

Measuring the charge in your leisure battery

To enable you to do this, you will need a digital multimeter. These are not expensive and small simple multimeters can usually be found for around £10 in electronic shops or big DIY stores.

Set the multimeter scale to read 30 volts DC. With the caravan 12 volt electrical system turned off, place the red lead on the positive terminal (+ve)

STATE OF CHARGE FOR LEISURE BATTERIES

No Load voltage reading	% Charge
12.73	100%
12.62	90%
12.50	80%
12.37	70%
12.24	60%
12.10	50%
11.96	40%
11.81	30%
11.66	20%
11.51	10%
10.50	0%

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and the black lead on the negative terminal (-ve). Read the voltage displayed on the multimeter.

To maximise the life of the battery, it is advised you never let the charge drop below 50%.

Leisure batteries with a voltage of below 11.81 should only be charged with a 4 stage charger otherwise damage to the plates may occur. For the best charging performance when the leisure battery is not in use (over winter) look for a charger that offers a 4 stage charging process (Bulk - Absorption - Equalisation - Float).

For the most accurate results using this method of measuring the state of charge (SOC) the battery should have been rested for at least 6 hours - i.e not been charged or any load put on it.

Using Generators

The use of petrol generators on most caravan sights is frowned on, mainly because of the noise. There are petrol generators that are coming on to the market that are extremely quiet, but a generator, no matter how quiet will quickly annoy you neighbours on a summers evening when all the windows are open and people are sat outside or in their awnings.

However, at some events, the use of generators is increasing and at others, motor sport events for example, you will find nearly every team caravan has a generator running away in the background.

A couple of important things to keep in mind when choosing and using a generator. If you are looking to buy one for the first time, always go for a 4 stroke engine, they are always much quieter. Also, always go for "Inverter Technology" generators, unfortunately they are usually two or three times the cost of a conventional generator, but you can plug almost any device into them and they will run your caravan 240 volt electrics without any problems. Cheaper conventional generators have very poor voltage regulation and could damage your caravans charging system or other components. When operating your caravan on a generator, you may get the reverse polarity light illuminating. This is because the generator "earth" is usually floating and the circuit that detects reverse polarity sees this and thinks that there is a problem. Always check your caravans handbook for advice about using a generator.

A typical generator can only provide a fraction of the electrical power that you would have if you were on a EHU supply. Most Generators are around 2Kva or about 2000 Watts, which is equivalent to just over 8 Amps, so you will be limited to what you can plug in. Remember that your caravan's leisure battery charger will take between 3 and 4 amps.

If you are taking a generator with you, take it in the car boot. These are heavy bits of equipment and not really suitable for carrying in your caravan.

Glossary

ECU -
Electronic Control Unit, another name for a computer that controls circuits or a cars engine.

EHU -
Electrical Hook Up. A term for connecting your caravan to the campsite 240 volt supply. Can be used in various ways - "EHU Lead" "EHU point" etc.

Relay -
A relay is quite a simple device. Its a switch, but it is a switch with a difference. It can be turned on or off remotely by a different electrical circuit. So it allows the switching of a high powered circuit by a low powered circuit.

12N Plug (or Socket)
The connection point between car and caravan or trailer. The 12N connection is for the road lights only. A 12N plug or socket is usually black in colour.

12S Plug (or Socket)
The connection point between car and caravan or trailer. The 12S connection is for the supplemental services required on caravans. The only road lights that are connected using this connection are the reversing lights. The earth return for the reversing lights are via the 12N connection. A 12S plug is usually light grey in colour and the 12S socket usually has a light grey or white lift up cover.

13 Pin Plug (or Socket)
This is sometimes called a "continental" plug or socket. It was adopted in Europe a few years before it became fitted as standard in the UK by caravan manufacturers. As its name suggests, it has 13 pins or connections and is generally considered superior in current carrying capacity and reliability. It also has the advantage of being only one connection between the tow car and caravan and is more robust in construction. Beware of cheap versions though which have a reputation of not being durable.

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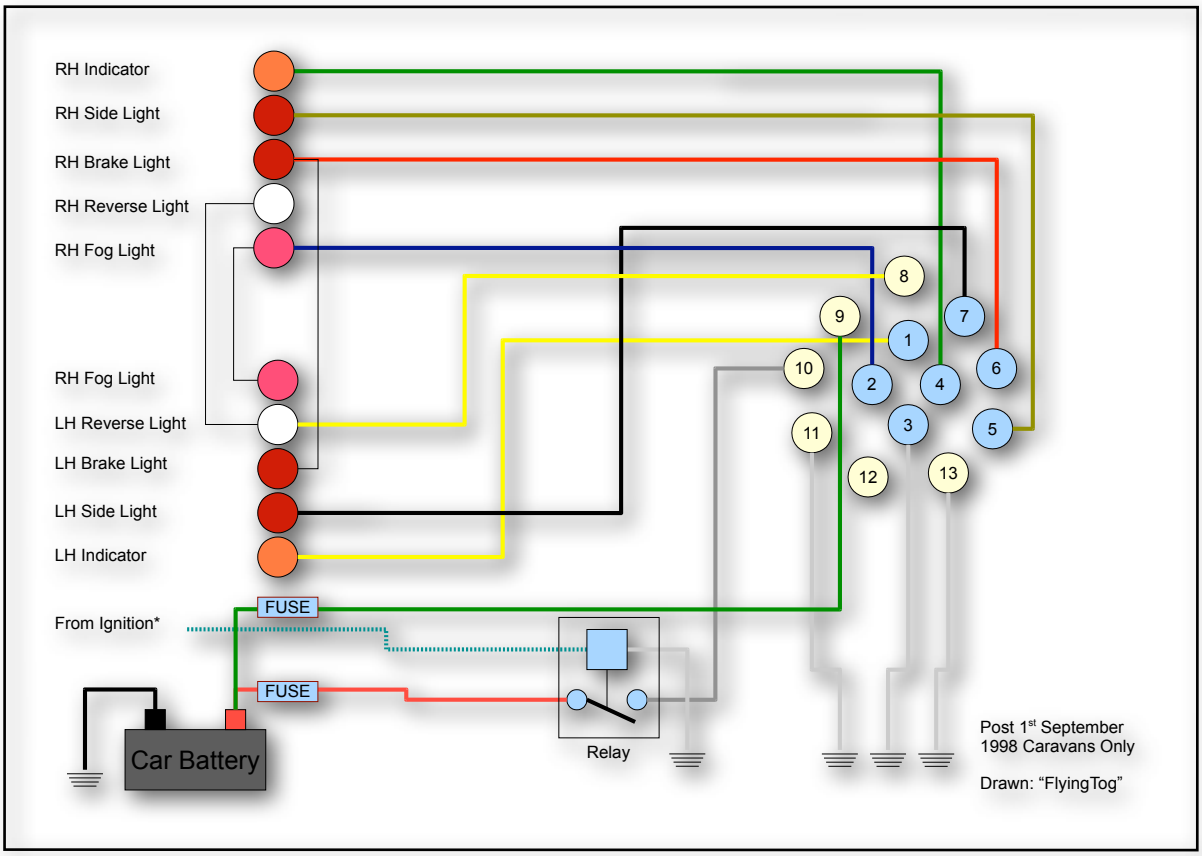
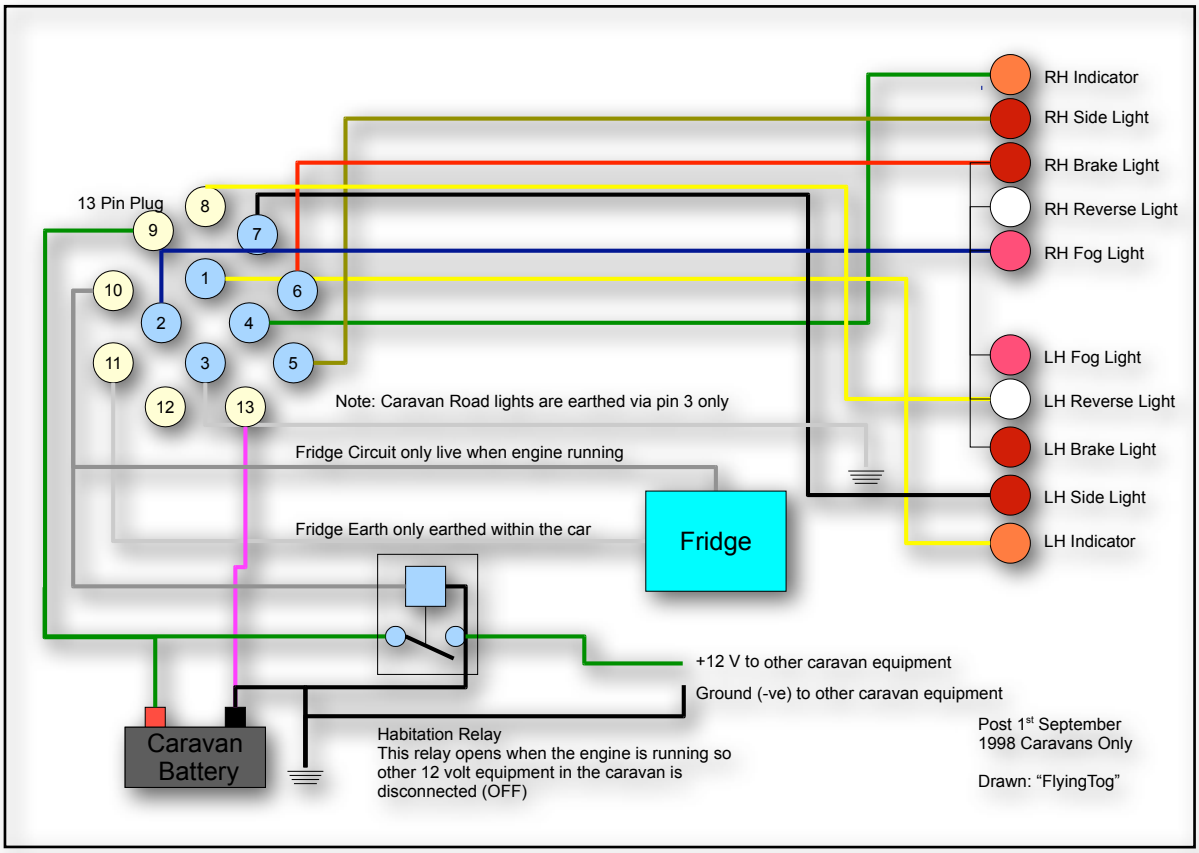
Understanding Caravan and Tow Car Electrics



Typical schematic of 13 pin socket connected to a car



Typical schematic of 13 pin system on a caravan

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Understanding Caravan and Tow Car Electrics

A useful guide to the pin numbers and what circuits they connect.

Please remember, these pin connections are for POST 1st September 1998 Caravans

13 Pin Socket	Description	Colour	12N Pin Number	12 S Pin Number	
1	Left Hand Indicator	Yellow	1		
2	Rear Fog Light	Blue	2		
3	Earth Contacts for 1 to 8	White	3		
4	Right Hand Indicator	Green	4		
5	Right Hand Side Lights, Marker Lights & NP Lights	Brown	5		
6	Brake Lights	Red	6		
7	Left Hand Side Lights, Marker Lights & NP Lights	Black	7		
8	Reversing Lights	Pink		1	
9	Positive Direct From Battery	Orange		4	
10	Positive On Ignition (fridge)	Grey		6	
11	Earth Return for 10	White/Black		7	
12	Signaling Connection for Trailer	White Blue		NC	
13	Earth Return for 9	White Red		3	

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