POWER LOCKING KITS FOR CARS

If your car doesn't have built-in power door locking and unlocking, you may well want to add this feature — either for the convenience, or because you're adding a burglar alarm or immobiliser and you want the additional security. Once you have power door locking installed it can be interconnected with an alarm or immobiliser so that the doors are locked or unlocked automatically when you arm or disarm the security system, and the system can also lock all doors when it detects an intrusion.

It's probably easier than you might think to add power door locking, because complete 'aftermarket' kits are available (as well as many of the specialised components) from suppliers like Electus Distribution.

By the way although these kits and components are mainly designed as and sold for power locking systems in cars, they're really quite suitable for any application where a mechanism needs to be operated in linear push-pull fashion, by pulses of low voltage (12V nominal) DC.

In this data sheet we'll explain how add-on power door locking systems actually work, and also the basics of installing them. Most of them are built up using only three different types of component. There are *master lock actuators* for the doors you still wish to be able to lock and unlock with a conventional key, *slave lock actuators* for the remaining doors and a *lock control relay unit* to make it all work. We'll now look at these components in turn.

Master actuators

A master actuator is really two things in one. It's a linear actuator — an electromechanical device which can operate a door lock mechanism when pulsed with electric current — plus a set of monitoring contacts which are used to sense whether the actuator (and hence the lock mechanism) is in the 'locked' or 'unlocked' state.

By the way master actuators are sometimes called 'master solenoids', because some early units were in fact based on solenoid coils and moving magnets. However most modern actuators are based on a small DC motor, driving an armature rod back and forth in linear fashion via a gearbox and rack-and-pinion system.

Fig.1 shows the basic idea. A small pinion gear on the end of the motor shaft meshes with a larger gear on the layshaft, which also has another small pinion to engage the rack along the side of the armature rod. So when a pulse of current is passed through the motor in one direction, the armature rod is propelled out from the actuator. Conversely when a pulse is passed through the motor in the opposite direction, the armature rod is pulled back into the actuator.

The armature rod only moves about 20mm between the two extremes, but this is quite enough to operate most car locking mechanisms. Especially when the motor and gearing can typically exert about 2.8kg of thrust on the armature rod, in either direction.

As you can see the master actuator also has a changeover (SPDT) contact set, operated by a linear cam or 'bump' on the side of the armature rod. As a result the state of the contacts depends on the position of the rod. The moving centre spring contacts one fixed spring when the rod is anywhere in the 'inner' 50% of its travel, but contacts the other fixed spring when the rod is in the 'outer' 50% of its travel.

Note that the state of the contacts depends purely on the position of the armature rod — not on how it is moved. It makes no difference whether the rod has been moved by the actuator motor or you moving it manually, as part of locking or unlocking the door with a key.

As you can see the armature rod has a hole in the outer end, so you can couple it to the lock mechanism via a metal rod. It generally comes with a suitable rod, which can be cut to size, plus a small clamp block which allows the far end to be clamped to a suitable lever in the door lock mechanism.

The body of the actuator (generally fibreglass-reinforced plastic) is provided with moulded mounting spigots, which can be used to mount the actuator onto suitable metalwork inside the car door, from either side. Often a small strip of slotted metal is supplied with it, to make mounting easier.

The actuator is also fitted with a telescopic rubber 'boot' which covers the sliding joint between the armature rod and the actuator's body, to keep water out and make the actuator reasonably weatherproof. (Water can find its way inside most car doors, especially during heavy rain.)

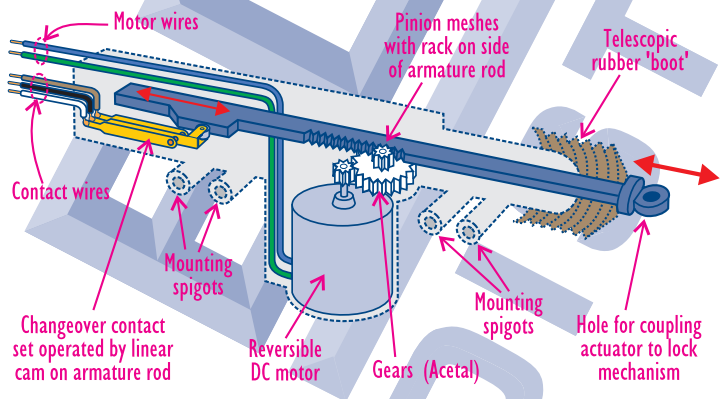

Fig.1: What's inside a master actuator. A slave actuator is virtually identical except that it lacks the set of contacts used to monitor the position of the armature rod.

Slave actuators

You probably won't be surprised to learn that a slave actuator is very similar to a master actuator. In fact they're almost identical. The slave actuator has exactly the same motor, gearing and armature rod system, and the armature rod is therefore able to be moved in or out in response to pulses of current fed through the motor in one direction or the other.

The actuator body is essentially the same too, and it's provided with the same set of coupling and mounting hardware. The only real difference is that there's no contact set in the slave actuator, to sense the position of its armature rod.

That's because slave actuators are used purely to operate lock mechanisms, and not to respond when their lock mechanism is operated manually. That's because they're

used to control the locks of rear doors and passenger-side front doors where there's no normal key mechanism.

The lock control unit

The current pulses that make all of the actuators work are supplied from the car's battery, of course, but under the control of the lock control unit. These are sometimes called 'lock control relays', but they're more complicated than a relay. In fact they usually have two relays, controlled by some electronic circuitry — see Fig.2.

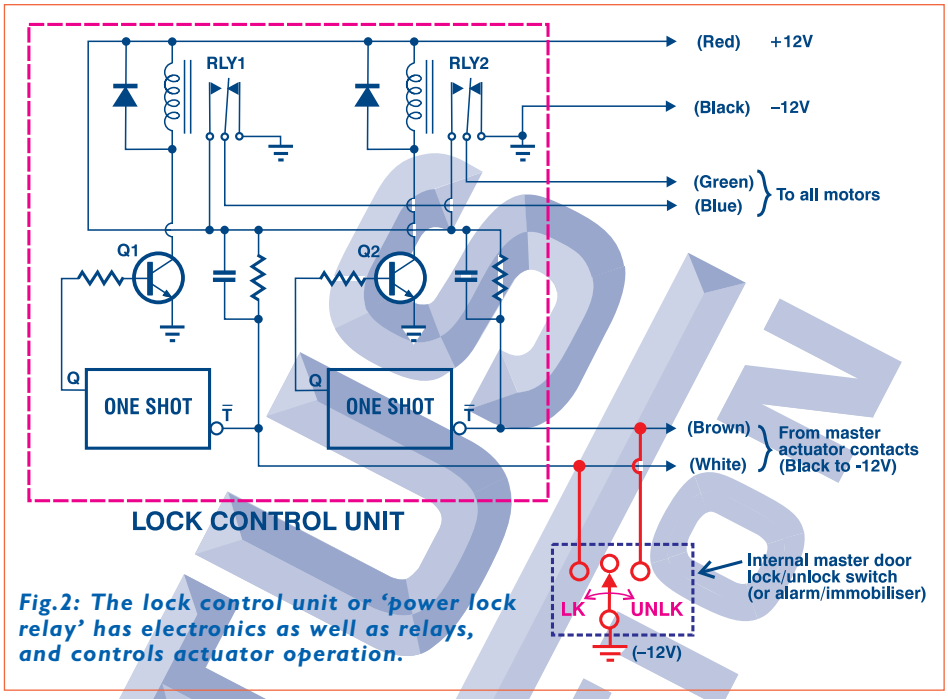

Fig.2: The lock control unit or 'power lock relay' has electronics as well as relays, and controls actuator operation.

The way it all works is quite ingenious. All of the actuator motors are connected in parallel, with both connections brought back to the control unit (green and blue wires). As you can see each side is connected to the moving contact of an SPDT relay, and as both relays are normally de-energised this means that both sides of the motors are connected to -12V (i.e., the car's frame).

However each relay coil is driven by a switching transistor, and each transistor is driven in turn by a 'one-shot' or monostable multivibrator. Both one-shots are designed to produce an output pulse of about 200 - 250ms (milliseconds), or between a fifth and a quarter of a second.

So when one of the one-shots is triggered, one of the relays is energised for this short time, connecting that side of the motors to the +12V (battery positive). Since the other side is still connected to -12V by the other relay (the two are never energised at the same time), a pulse of current therefore flows through all of the actuator motors, in one direction.

On the other hand if the *other* one-shot is triggered, the second relay is energised instead, resulting in the motors all getting a pulse of current in the opposite direction.

This means that all of the actuators can be pulsed 'in' or 'out' simply by triggering one or the other one-shot inside the control unit. And both one-shots are designed for *negative triggering*, so that either can be triggered simply by connecting its input connection (brown or white wires) briefly to -12V (black wire).

As you can see, that's exactly what those changeover contacts in the master actuators are used for. So if you turn your key in the door lock of one of doors fitted with a master actuator, this will move its armature rod and operate the contact set — triggering the correct one-shot in the control unit to make all of the other actuators copy the movement. If you unlock that door, they'll all unlock; if you lock it, they'll all lock. It's very simple, but quite ingenious.

Because the one-shots in the control unit are independent, there can be more than one master actuator. Additional masters simply have their contact sets connected in parallel with the first, so that any set of contacts can trigger the one-shot which will reverse all actuator rod positions.

Even better, brief short connections of either one-shot trigger input to -12V can also operate all of the actuator motors, and this is how a 'master door control' switch inside the car works. It's also how a burglar alarm or immobiliser can control the door locking system, simply by using relay contacts to connect either one-shot input to -12V briefly.

As Fig.2 shows, any additional master actuator, master control switch or alarm/immobiliser contacts are simply connected so that they too can connect either the white or brown wires to the black -12V wire. Many alarm and immobiliser units are already provided with colour-coded wires for this purpose.

Hopefully this explanation has given you a good understanding of the way power locking systems work. As you can see they're really quite straightforward electrically. Most of the hassle involved in fitting them to a vehicle is on the mechanical side, because you have to remove interior door panels and mount each actuator in position to operate that door's lock mechanism.

Then, once you've mounted each actuator and adjusted its coupling rod to move the lock mechanism correctly for locking and unlocking, there's some more fiddling around to run the leads from each back into the car body through protective 'loom tubing' near the hinges, and back to the control unit — which is usually mounted under the dash somewhere. So there are usually some internal body lining panels to remove and replace, too.

In short, there can be a fair bit of work in actually fitting a power locking system, either by itself or as part of an alarm/immobiliser system. But the time and effort are worth it, for the added security and convenience.

How about it? You'll find everything you need at your nearest Electus Distribution supplier — master and slave actuators, power control units, wire and cable, key switches, inline fuses, and also complete kits for two-door and four-door locking systems. Plus alarm and immobiliser kits, if you're really feeling adventurous! If you're fitting one, it makes a lot of sense to fit the other while you have those panels off...