The remote control transmitter in use.

Velleman K6706A/K6707 CODELOCK REMOTE CONTROL TRANSMITTER/RECEIVER

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We live in the era of remote control – a by-product of the labour-saving (and not just in political terms) don't-leave-your-armchair age of user convenience. In other words, If it hasn't got a handset, then it isn't hip'. We all know about TVs, VCRs and Hi-Fi systems, but there are also – apparently – curtain openers, infra-red computer joysticks, light dimmers and motorised swimming-pool covers. It will probably be toasters, telephones and trees before too long. . . .

But then again, there is plenty of stuff that isn't remote controllable, and probably never will be (particularly if it's something that you already own). Yet, there's a good case for the opposite. Everybody associates the remote control with the couch potato – but what about the elderly? What about the disabled? What about the bed-ridden? Life for such individuals would be made considerably easier through remote control. Wouldn't it be a boon if they could turn a light out from the comfort of their bed simply by pressing a button on a keyfob!

A pair of Velleman kits could come to their rescue, and help many others. The K6706A is a tiny keyfob remote transmitter that's rather like the ones supplied with car alarms (indeed, the device is also used in a Velleman vehicle alarm project). It features a pair of buttons that could be used to activate various functions, such as the switching off or on of lights. The companion K6707 kit receives the signal from the transmitter, and uses it to drive a relay. This isolated switched output, which is rated at 10A, can be used for all kinds of interesting things.

The system, unlike VCRs and TV sets, doesn't use infra-red signalling. Instead, it uses ultra low-power radio, at a UHF frequency of 433·92MHz. The advantage of this is a better range – you can operate the remote from a completely different room in the house. Velleman claims that a 30m range is possible. The low-power 433·92MHz telemetry band is, out of interest, deregulated – it's possible to use it, without licence, in the UK and continental Europe. Note, however, that in the UK, the frequency should only be used for automotive applications (such as alarms and central door locks) – any other uses are at your own risk. Our European readers can, however, use it for more general applications.

To give your transmitter/receiver combination a high degree of addressability, a coded transmission system is used. Indeed, you have a choice of nearly 9,000 combinations to play with. As a result, there is only the remotest of remote chances that your neighbour will be using the same code, and so it's unlikely that remotely switching your kettle on will trigger his car alarm. Velleman claim that a range of 30m is attainable.

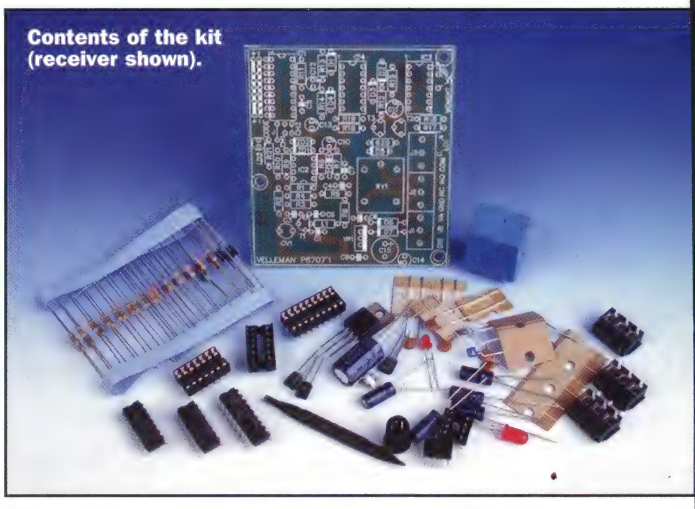
A single keyfob can be used t operate two receivers, which ca be set to respond to a keypress from SW1 (Channel 1), and SW (Channel 2). One channel coul for example, open a garage doo while the other could turn on the light. If the garage door is metal, the receivers might have to be mounted outside in a weatherproof box – unfortunate the aerial is on the receiver PCB and a metal garage door might do a good job of shielding the transmitter's signals, thus affecting the range of the syster

How Does it Work

In both transmitter and receiver kits is an encoder/decoder (or ·codelock') IC, the CMOS-fabricated UM3758-120A from UMC. Whenever one of the buttons on the transmitter (see Figure 1) is pressed, this chip yields a serial 12-bit code (see Figure 2). This code is used to modulate an 433·92MHz oscillator, based around T1 and X1 (the latter is a SAW resonator). The code is set via 1 pins on the chip. They can be left floating, or tied to the supply voltage or ground – in other words, it's tri-state.

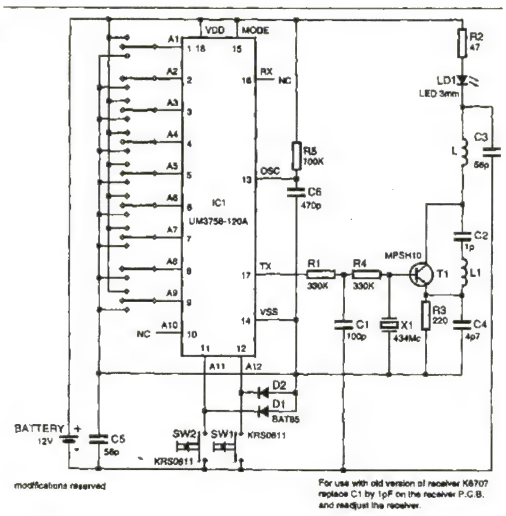
As a result, there are a possibl 531,441 code combinations (312 to choose from. Unfortunately, these Velleman kits don't give you access to all such codes. On code-setting pin is left unconnected, while others are wired so that they can operate in only two of the possible three states. There's nothing to stop you from carrying out modifications to the PCBs if you really do need more choice.

On both transmitter and receiver, seven of the 12 code pins (A1, A3 to A7, and A9) are accessible and ·tri-stateable'. The



Contents of the kit (receiver shown).

igure 1. ransmitter ircuit iagram.



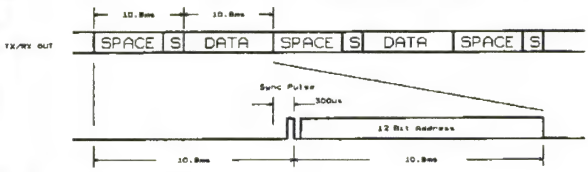


Figure 2. Format of transmitted code.

B has a series of tin-plated cks and holes that will accept e jumpers for such a purpose. cause of the way the circuit ard has been designed – ere's no hole in the PCB at the propriate point – a further two de-setting pins (A2 and A8) n be only be grounded or left ating. In other words, the tion of a third state (supply ltage) has been deliberately minated. Exactly why Velleman s done this is a mystery. rhaps it's been done to ensure mpatiblity with other kits in eir range.

Two more of the code pins 11, A12) are wired to the yfob's pair of push-buttons W2 & SW1, respectively), and as such, are capable of working in two states (ground or floating). Since the push-buttons are momentary-action, these pins will be floating most of the time. Grounding them operates the transmitter and sends the code; interestingly, a pair of diodes (D1 & D2) ensure that the UM3758's clock oscillator only operates when one of the two buttons are pressed, thus conserving power (note that the chip is permanently connected to the tiny 12V battery). The final available code-setting pin, A10, is also left floating. The upshot of all this is that you have a total of 8,748 combinations to play with. Nevertheless, it's still enough for most applications.

The same type of chip is employed by the receiver, the circuit of which can be found in Figure 3. To make the circuit designer's life easier, the UMC3758 can operate in either encode or decode mode, depending on the voltage applied to one of the pins. No prizes for guessing how it's wired in the receiver! The signal is retrieved by an extremely simple TRF (Tuned Radio Frequency) radio receiver, and processed by op-amps A1 and A2 to ensure the correct logic levels.

Interestingly, the receiving aerial, shown as L2 on the circuit diagram, is formed by a PCB track. For this reason, the receiver circuit board should not be mounted in a metal box, as this would act as an effective Faraday cage and prevent pickup of the transmitter's signals. A plastic box (such as Maplin's LH21X) is, therefore, mandatory. L2 also forms part of the receiver's tuned circuit – which can be adjusted by parallel-connected trimmer CV1.

The processed signal is fed into the UMC3758 (IC1 in the circuit diagram). At this point, there's also an LED that blinks whenever a datastream from the keyfob is being received – a distinct help when setting up the receiver. On the receiver is a series of jumpers identical to those found on the transmitter. If the received code matches the one set through these jumpers, then a logic-level output is raised by the chip. A link, which corresponds to code-setting pins A11 and A12 and hence the transmitter's push buttons, can be set on the PCB. It is important to wire this link according to the push button that you would like to operate your equipment. Through this provision, two channels can be set up if a pair of receivers are employed.

The output from IC1 is active-low. It is then inverted by a Schmitt inverter (one of six in IC4), and fed into a circuit based around a pair of D-type flip-flops (both in IC3, a 4013). This part of the design is designed to provide the kit with even greater flexibility. You can choose whether you want the output to toggle – i.e., change state until the keyfob button is pressed again – or a momentary action, in which the output is active for as long as the button is pressed.

Another link on the receiver PCB determines which mode is selected; in my experience, the toggle' action is rather more useful.The logic-level output from the flip-flops drives the relay, via transistor T2. The relay is a single-pole changeover type, and all its contacts are brought out to a series of screw terminals on the receiver PCB. A final part of the circuit drives an LED that indicates the state of the relay. When the relay is energised, the light blinks (courtesy of spare Schmitt inverter N5 and associated components).

Construction Time Again

Building the two kits won't pose much of a problem to the seasoned constructor, and indeed, the entire job shouldn't take much longer than a couple of hours. The Velleman PCBs are of excellent quality, with nice clear legends. For ease of construction, Velleman has resisted the march towards surface-mount, although the transmitter would be a good candidate for its employment. For now, though, everything's through-hole. It's good to see IC sockets, although you should consider soldering the chips straight to the board if your project is to end up in a hostile

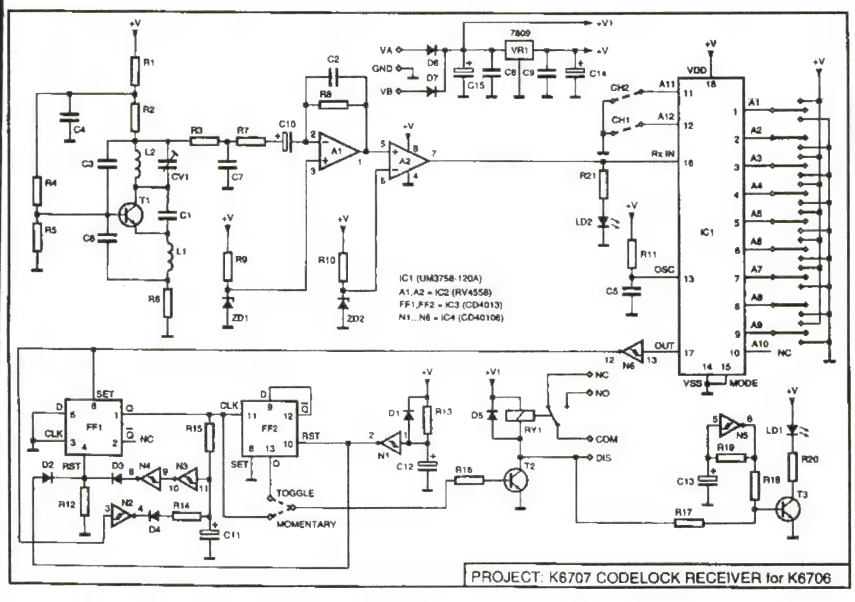


Figure 3. Circuit diagram of receiver.

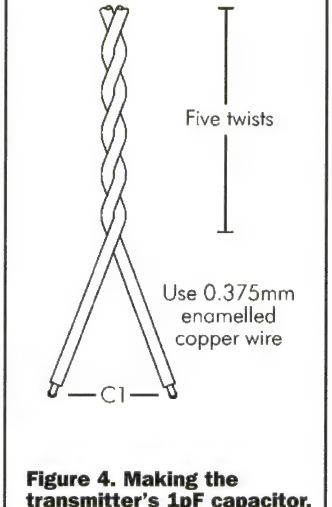
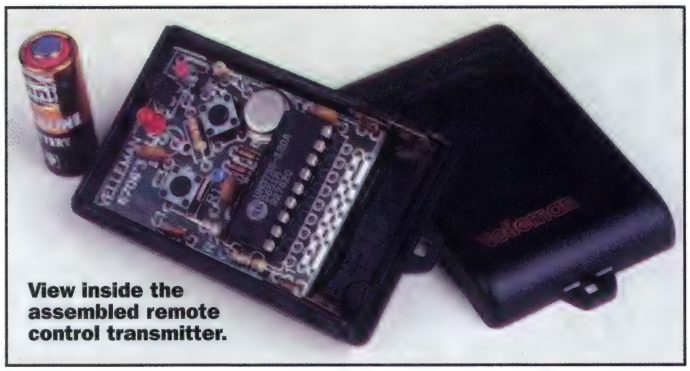
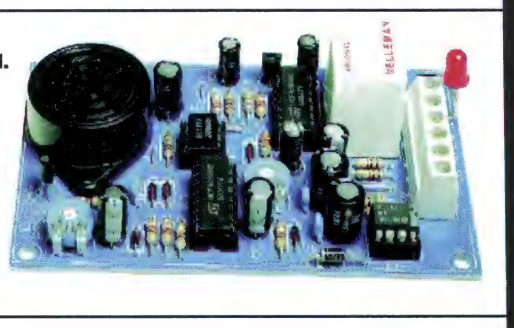


Figure 4. Making the transmitter's 1pF capacitor.



View inside the assembled remote control transmitter.



Assemled receiver board.

environment. Don't forget to set up the wire links that correspond to the code and receiver channel you want to use.

One of the ceramic capacitors supplied with the transmitter, C1, has a value of 100pF – and this is indeed the correct value if the transmitter is to be used with certain Velleman kits. For compatibility with the K6707 receiver, C1 has to be replaced by a 1pF capacitor – that's right, 1pF! Seeing as capacitors of so low a value aren't commercially available, you'll have to make your own. This can be done by twisting two pieces of enamelled copper wire together, as shown in Figure 4.

There are some caveats, however. For a start, there's an annoying need to make and fit the fiddly wire links that set codes on both transmitter and receiver. Velleman should have designed the PCB tracks so that solder bridges could be used instead – as it is, they're too far apart. The second point concerns the receiver's use of a section of PCB track as the aerial. An external aerial input would have been much better. The receiver could then be built into a screened enclosure and protected from unwanted noise and other nasties (such as stray capacitance, which could affect the receiver's tuned circuit). With an external aerial, the effective range of the system would be improved as well.

Once built and checked, it's time to set it all up. The transmitter is powered by a tiny GP23A 12V alkaline lighter battery, which mates with blades soldered to the circuit board and held in place by the snap-fit case. The receiver has rectification, smoothing and regulation on the circuit board, and can be powered by a 9V centre-tapped mains transformer (such as Maplin's YN15R). As an alternative, a DC power source capable of supplying between 12 and 16V at 100mA can be used.

To set up the receiver, the relevant button on the transmitter is held down while adjusting CV2 on the receiver – a plastic trim tool is supplied for the purpose. LED LD2 should begin to flash as the receiver goes into alignment. To maximise the range, fine tuning of CV2 is necessary – you might need to get somebody to help you here. There is an alternative, if the receiver is configured for toggle operation. You can try tweaking the trimmer slightly, moving away and activating the transmitter. If the LD1 has changed state, the transmitter has successfully talked to the transmitter. If it hasn't, try tweaking it the other way slightly. By repeating this procedure, and moving progressively further away from the receiver, adjustment for maximum range can be achieved.

What Can You Do With It?

An obvious use is a remote-controlled light switch. Most wall-mounting light switches are single-pole changeover types, and so substitution is an easy task. It is important to take the appropriate safety precautions when working with mains electricity, such as shutting off the power and removing the fuse that feeds the lighting circuit you're working with. It is also highly important to build the receiver into a well-insulated plastic case, and to hide any exposed mains wiring. If you're in any doubt as to what you're doing, consult a qualified electrician.

- Easy to build – no coils to be made!
- Two channels
- Fixed 433·92MHz transmitter frequency
- Operates in conjunction with the K6707 code lock receiver
- SAW resonator
- Approved design (report BLC/96-0452 according to I-ETS 300 220)
- 8,748 possible codes
- Range of the transmitter/ receiver: approximately 30m
- LED on/off and battery indication
- Key-chain housing
- Power supply: GP23A 12V lighter battery
- Dimensions (WHD): 35 × 15 × 57mm

Table 1. Transmitter specifications.

This project could also be used to switch other mains appliances – such as kettles, TV sets, outdoor lighting, garage door openers and the like. We would recommend that a double-pole relay, of contact rating appropriate to the current being switched. is used. This relay could be switched by the receiver's existing one – or you could replace the existing relay with another (note that your replacement must have a 12V coil). You would have to mount the relay on another circuit board, since the track pattern and through-holes on the receiver PCB won't accommodate a different type.

Not all of the fun centres around mains voltages, though. Older Hi-Fi, and the stuff pitched at the audiophile market, dispenses with gimmickry such as remote controls. But why should you suffer inconvenience for your music? The receiver module associated with a universal remote control device could interrupt the audio between pre-amp and power-amp, thus muting the audio when the phone starts ringing. I successfully tried this with my elderly integrated Pioneer amp (which has rear-mounted links to separate pre-amp and power amp). For stereo systems, however, a DPST relay is needed – remember that the device fitted to the receiver is a simple single-way (i.e., mono) changeover type.

Then, there's security. This project could be used to remotely-arm a car alarm. Shielding of the receiver by the car bodywork isn't as much of a problem as you would think, at least, at close-range. This is because at the low wavelengths involved, signals could propagate through gaps i the bodywork. A bigger disadvantage is the financial aspect – the combined price of the kits represents a significant chunk of a new car alarm's price. You could, however, implement a remote panic button for use with an existing domestic alarm system. Another security possibility is the remote door-lock, in which your old-fashioned key is replaced by an electronic version. Here, the receiver drives an electromechanical door-release, such as Maplin's 12V YU89V.

- Easy to build – no coils to be made!
- Operates in conjunction with the K6706 two channel codelock transmitter
- 8,748 possible codes
- Range of the transmitter/ receiver: approximately 30m
- LED on/off indication
- LED receiving level indicator
- Relay output: 10A, toggle or momentary contact
- Separate output to switch Velleman car alarm on or off
- Power supply: 2 × 9VAC, or 12-16VDC (100mA maximum)
- Dimensions: 76 × 84mm

Table 2. Receiver specifications.

Conclusion

These two kits work well, although I couldn't get the full 30m range – probably something to with the cluttered nature of my home. They are flexible, and can be put to a range of uses – at least, if you live in Europe. Unfortunately, legal use of the 433·92MHz band in the UK is restricted to automotive applications. But then again, the power levels involved are in the sub-milliwatt region, and the transmitter will be operated in short bursts. The risk of causing interference to other radio users, and attracting the interest of the DTI's Radio Investigation Service, is hence very low. Nevertheless if you, as a UK reader, choose to use these kits for anything that isn't vehicle-related, you do so at your own risk.

Ordering Information

K6706A 2 Channel Transmitter Kit. Order As: VF84F (£14.99)
K6707 2 Channel Receiver Kit. Order As: VF66W (£20.99)
MB2 Plastic Box. Order As: LH21X (£2.34)
250mA 9-0-9V Transformer. Order As: YN15R (£4.99)
Electric Door Lock. Order As: YU89W (£16.99)
GP23A Alkaline Battery. Order As: JG91Y (£0.99)
Spacers, screws and other hardware: As Required.