

CX-9 Automatic Door-lock/Unlock

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1. Introduction

When we bought a Mazda CX-9 in 2007, we were surprised to find that there is NO automatic door-lock. I have searched Internet and many people had the same surprise. It was confirmed by Mazda that the CX9 does not have automatic door-lock either. Time for action !

As the door-mechanism is NOT designed to open the door and unlock the door at the same time, I looked for a way for automatic lock AND unlock to prevent having to press unlock first before exiting the car (call me lazy). If you don't want automatic unlock however a small modification is described in alternative chapter 3 in the document.

I wanted to keep the design simple, easy to build for people with little electronic knowledge, easy to diagnose in case of issues and low cost. As a result I have designed it with relays and it can be built in 1

hour, tested in 1 hour and installing into the car will take you 2 hours. However it could also take up to 14 days, depending how much experience you have 😊

Ideally lock/unlock should happen when you switch from PARK to automated/manual gear, but that would mean a lot of work to take the dashboard out. Remember: one of the design principles was keeping it EASY. I decided that the parking-brake was a great way to activate door-lock/unlock

Below is very detailed information, however if a less technical person wants to understand this:

1. You start the car as normal
2. Release the parking-brake before you start driving as normal, HOWEVER as by a miracle the doors lock automatically 😊
3. Drive as normal
4. Park the car as normal
5. Put the parking-brake on as normal, HOWEVER as by a miracle the doors now UNLOCK automatically 😊
6. Switch of the engine.

WOW.... who would NOT understand and like that..... (No Emails with names please!)

For the more technical & lucky people that will built and install; I wish you a TON of pleasure with the descriptions below. I tried to be complete and as helpful as possible. Take time to read the document maybe 2 times before you start. It can save you a lot of time. An in-house test is proposed. You do that BEFORE you install it in the car. I mention it here as many people believe you don't have to read a manual before and find themselves in trouble later on.

The building and install requires a basic knowledge of electronics and as well as standard set of the tools when dealing with basic electronics. If after reading below you find it too difficult or don't have the tools, contact a friend or a friend of a friend to help out.

Last but not least, if you decide to build and install, it is all at **your own risk and cost**. I only share advice around I have done it, what worked for me and added information to try to help you. However any issues/damage or cost is at your own risk.

I expect however you will be happy, so happy you want to donate money. Please do so, but not to me, but think about the people that are less fortunate in the world and support them. Remember that any Dollar or Euro (or whatever) counts for them. Thank you and happy reading!

Paul

2. The Circuit explanation (Detailed diagram in Appendix-A)

Power-up reset

As soon as 12V power is supplied, independent of parking brake-switch, relay-C is activated. Contact-A is moving from Normally Closed (NC) to Normally Opened (NO) and is preventing that a door-lock signal can be passed on. Capacitor C1 is getting charged and at a certain moment Relay-C will drop off. Contact-A is returning to NC and a door-lock signal to be passed on (depending on Pulse relay).

Activator

The parking brake-switch is the causing the activation. When pressed (e.g. parking brake is on) the parking brake-switch will connect to ground. Through D1, relay-A is activated with a little delay caused by R1 & C3. This is necessary to give relay-C at power-on/off just a little head start (~10ms) to make sure Relay-C is activated JUST before relay-A. As relay-A is a double contact relay BOTH contact-C and contact-D will move from NC to NO at the same time. This condition will stay until the parking brake is released (e.g. parking brake is off), relay-A will drop off and contact-C and contact-D will return to NC.

A diode over the relay-A is to prevent spikes to the capacitor C3. Don't be a wise guy and a put a diode over the relay-B and relay-C; the circuit will not work.

Pulse

When contact-C closes (e.g. relay-A is on because the parking-brake is on), relay-B will activate and close contact-B, allowing signal for door-lock to be passed on. Capacitor C2 starts charging and at a certain moment relay-B will drop off. Contact-B is returning to NC, stopping a door-lock signal.

The timing for relay-C (reset) is twice the time for relay-B (Pulse). The current values will give about ~3 seconds reset and ~1.5 seconds pulse.

Step-by-step how it works

1A: When power is applied first time, relay-C will be activated for ~3 seconds power-on, contact-A is open and thus NO a door-lock signal can be passed on.

1B: When the parking brake is pressed (on) at the time power is applied, it will activate relay-A with a little delay (~10ms) to allow step 1A to start happening JUST a little tiny bit earlier. Relay-B will be activated, by contact-C. Contact-B will close, however as contact-A is open (see step 1A) no door-lock signal is passed on. Capacitor C2 is getting charge and relay-B will drop off after 1.5 second and then relay-C will drop-off, because capacitor C1 is now charged.

1C: When the parking brake is now released (off), relay-A will drop off after a tiny small delay and contact-C and contact-D will return to NC, connecting to relay-B to ground.

Now the charged capacitor C2 will be discharged and relay-B will activate. Contact-B is closed and a door-lock signal is sent to the contact-D. Contact-D is in NC and the ground signal is sent through a 1K resistor to the car computer. This indicates a lock signal and the doors will lock. After ~1.5 seconds the capacitor C2 will have been discharged, relay-B is dropping off and contact-B is returning to NC, stopping the door-lock signal.

During driving NONE of the relays is activated:

- Relay-A is only activated when the parking brake is pressed (on)
- Relay-B is only activated for 1.5 seconds to give a pulse (C2 is discharged)
- Relay-C was activated for 3 seconds for power-up (C1 is charged)

1D: When parking brake is pressed again (e.g. on), the parking brake-switch will connect to ground again. It will activate relay-A with a little delay. Contact-C will activate relay-B by connecting to +12V. Contact-B is closed and a door-lock signal is sent to the contact-D. Contact-D is in NO and the ground signal is sent directly to the car computer. This indicates an unlock signal and the doors will unlock.

After ~1.5 seconds the capacitor C2 will have been charged, relay-B is dropping off and Contact-B is returning to NC, stopping the door-lock signal.

During standstill / parking brake is ON / contact ON only Relay-A is activated:

- Relay-A is activated as the parking brake is pressed (ON)
- Relay-B is only activated for 1.5 seconds to give a pulse (C2 is charged)
- Relay-C was activated for 3 seconds for power-up (C1 is charged)

1E: if the parking break is released again (e.g. off) the process repeats starting with step 1C.

Some people, no names mentioned, forget to put a car on the parking brake. If at the time of power-on the parking brake was released (e.g. off), the normal power-up reset will happen (step 1A), however relay-A and relay-B will not have been activated. If after ~3 seconds (the reset time) AND before driving the parking brake is pressed (on) , process 1D will happen and an unlock signal will be sent to the car. This is normal behavior. What is NOT normal behavior is NOT using the parking-brake ☺.

Power-off reset

When the contact is switched off, power is removed from the circuit. Assuming the parking brake is pressed (ON) and as such we are at the end of step 1D.

When the power is removed for the circuit, relay-A will stay activate for little time (~36ms) because of charge in C3, this will allow Relay-C to get activated before Relay-A drops off. A change in relay-A state will trigger relay-B to provide a pulse. As such the delay will prevent false door-lock signal (locking the doors while you are still in)

The charged Capacitor C1 will be discharged and relay-C will activate. Contact-A is set to NO, preventing a door-lock signal to be sent to the contact-D.

When relay-A is dropping off, it will activate relay-B through contact-C. Relay-B will activate because of the charged Capacitor C2. Contact-B is closed but no door-lock signal is sent because of contact-A being in NO state.

After ~1.5 seconds relay-B will de-activate and after ~3 seconds relay-C will.

If at the time of contact switching off the parking brake was NOT pressed (e.g. off), we are at the end of stage 1C. Relay-A was not activated and C2 was NOT charged thus relay-B will NOT activate.

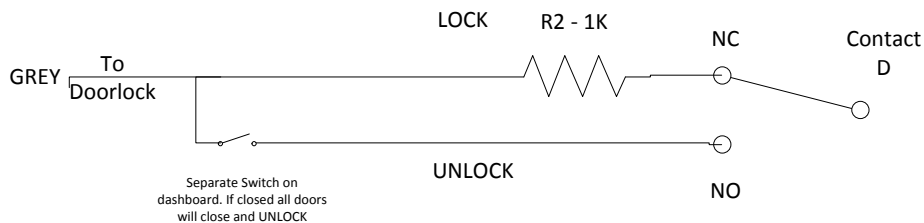
At the end of power-off all relays and capacitors are back in rest, waiting for a new opportunity to shine and perform their same tricks at the next occasion.

3. Alternatives/modifications

No Unlock wanted

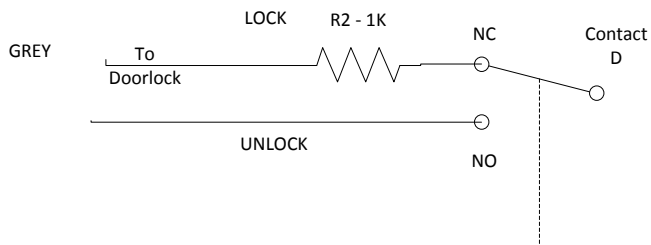
If you want the doors to only automatically lock but NOT to automatically unlock, don't connect a wire to the NO contact-D. You will have to manually unlock. Because of the mechanism in CX-9, this requires to first press unlock on the door before you can open the door with the door handle.

- If you would consider this, you don't need a Relay-A with double contact either, you only need a SPDT, instead of DPDT. (see Appendix-B shopping list). A tiny bit less cost but a **massive** amount less comfort. Trust me... you will love automatic unlock once it is installed and wonder how you could have lived without it.
- In case you want unlock sometimes, but not all of the time, you can consider an extra switch on the dashboard to allow unlock when you want it. (I have not tried this, but I am sure it works)



Unlock only on driver site

If you only want to UNLOCK the door on the driver side when the parking-brake is pressed (on), then do not connect the grey wire to contact-D, NO. Connect a separate wire to contact-D, NO and the other side of the wire to White/Black wire on 0940-01E: PIN 5K. This is the connector UNDER the 6 pin connector on the BCM (see appendix-C). I have not tried this, but I expect this works.



4. Building

I have built the circuit directly on and around the relays. I first glued the relays together (super glue / 10 seconds glue) in a way that it still would fit in the plastic box.

I applied red wire for 12V, black for MIN/ground around the relays. Grey for the all the door-lock signals and white for all the parking-brake signals. This makes it easier to diagnose later instead of or wires having one color and when you connect wires of a different color on the same contact.....get concerned.

With a little bit of patience and good looking & checking it was an easy job in 1 hour and performed the in-house test (chapter 5). I used a battery charger for the 12V.

I have drilled a hole in the plastic box to let the wires out and put the relays in the box, while pulling the 4 wires through the hole & put a wire tie around the wires to as stop to prevent them being pulled completely.

I secured the relays in the box with thick paper on top and aside. I did not glue as I might need to remove them from the plastic box to troubleshoot more later on (which I had to....)

Before closing the box I included a copy of circuit (printed Appendix- A) for future reference. That is a good habit in case of problems in the future and you can't find THIS document.

5. In-house test

Actually before you install in the car, do a test on your table with a 12V supply. It can save you a lot of trouble, not only because you will have to try to fix the problem sitting in an uncomfortable positioning next to the car while it is cold or raining, but also make sure the basics are working and not blowing up fuses in the car. Let alone it will save you the “supporting” remarks from your significant other and that by itself is worth more than anything else.

Connect the black-wire to the MIN. Hold grey and white wire separate. Connect the red-wire to the +12V. Don't expect fireworks.... it is only 12V and if you see sparks.... get a rest or check the circuit.

click-clack

Hurray ... The relays have come alive! That is good news. No click-clack.... no 12 volt....fix it first!

First check: Relay-C should pulse for ~3 seconds (Don't buy a stopwatch.. it is aboutish)

- Make sure the Black wire is still connected to the MIN
- Take the Red wire from the +12V and hold to MIN (to discharge Capacitors C1)
- Locate Relay-C and make sure you can see it well.
- Reconnect Red-wire to +12V and watch relay-C. It should activate and... de-activate.. in ~3 seconds
- If it did, you are good and you are on your way, if NOT, don't worry (yet)
 - Check carefully the wires and connection.
 - Check your circuit (Maybe capacitor C1 is defect or wrongly connected (watch the polarization of the capacitors!))

Second check: Relay-A should activate.

- Make sure Black wire is connected to MIN
- The Red wire is connected to + 12V
- Locate Relay-A make sure you can see it well.
- Hold the white wire against the MIN (simulating the parking-brake switch)
- Relay-A should activate as long as you have the white wire against the MIN. To see it well, remove the white wire from the MIN, it should de-activate and repeat it again.
- If it did activate, you are great if not you are still good..
 - Check the circuit. Did you put the diode D1 correct? Is the capacitor correct connected? Is D2 correctly connected (remember the stripe on the diode should point to +12V)
 - Do you still have 12V (do you hear click-clack when connecting 12V)?

Third check: Relay-B should pulse.

- Make sure Black wire is connected to MIN
- The Red wire is connected to + 12V
- Locate Relay-B make sure you can see it well.
- Hold the white wire against the MIN (simulating the parking-brake switch)
- Relay-B should activate and after 1.5 seconds de-activate. If you now remove the white from the MIN, Relay-B should activate and after 1.5 seconds de-activate again.
- Repeat it a couple of times. Every time you hold /remove the white wire, you will hear every time 2 relays: A and B. Concentrate on relay-B
- If Relay-B did activate and de-activate, you are fantastic if NOT.. oh well.. you are still great
 - Check the circuit. Are the wires on the right contact points on contact-C
 - Is the capacitor correctly connected (with the – connected to the MIN)?
 - Do you still have 12V?

Fourth and last check: Making sure that Relay-C is LONGER activated than Relay-B at power-on.

This requires 2 pair of eyes and you only have 1 pair, but it can still be done. NORMALLY if the capacitor C1 (2200uF) is two times the capacitor C2 (1000uF), this should not be a problem, but if you have old capacitors, they tend to dry out and lose their power.

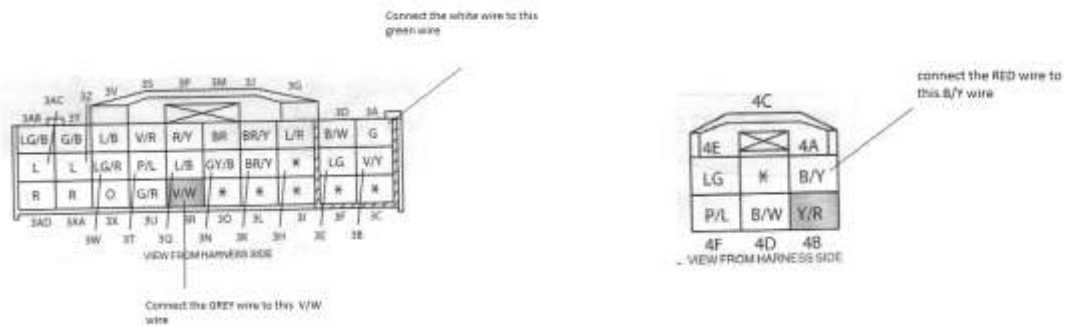
- Make sure black wire is connected to MIN
- Make sure the white wire is also connect to MIN (simulating the parking-brake switch)
- Locate Relay-B and Relay-C. Make sure you can see them.
- Hold the red wire against the +12V (simulating power-on)
 - Relay-B should activate and after 1.5 seconds DE-activate.
 - Relay-C should have activated at the same time as Relay-B BUT will de-activate later (if it is quite you may be able to hear the click)
- OK.. now remove the red wire from the +12V and hold the red wire against the MIN (de-charge C1 and C2). Relay-B and Relay-C will activate and de-activate and against Relay-C should take longer.
- ARE U SURE.. ??? NO.. repeat by holding the red-wire against the +12V and repeat the whole test
- If relay-B and relay-C activate and relay-B de-activates before relay-C, you are gigantic and you should consider starting your own business if not.. keep your day-job and
 - Check the circuit. After the wires on the right contact points.
 - Is the capacitor correctly connected (with the – connected to the MIN)?
 - Didn't you switch capacitor C1 and C2
 - Are this new capacitors, if not they might have dried out and lost their power

6. Install in the CX-9

There are some good descriptions, coming from Mazda to directly on how to remove the necessary panels as well as locate the cable connections. I have included a copy of the information in Appendix-C that is coming from these instructions. I hope it will not get me in copyright trouble for including instead of referencing, but the information is coming from Internet, I use source reference and I am sure Mazda wants happy drivers. Thank you Mazda!

Steps

- Disconnect the battery (as precaution) - See Appendix-C
 - a. Disconnection with clear radio-channels and seat-memory.
- Remove the panels - See Appendix-C
- Appendix-C shows the Body Control Module (BCM). It is located at the front, behind the kick-panel at the driver side:
 - a. The white 30-pin connector at the top
 - b. The white 6-pin connector underneath



- **Locate the right wires with the right colors and connect the wires from the circuit using the wire-taps as follows:**
 - Grey wire: connect to Violet/White (v/w) wire on 30 pin connector; PIN 3R
 - White wire: connect to Green (G) wire on 30 pin connector; PIN 1A
 - Red wire: connect to Black/Yellow (B/Y) wire on 6 pin connector; Pin 4A
 - Black wire: connect to ground/chassis connection on the car
- After connection the wires, Connect the Battery - See Appendix -C

7. Testing in the car

This is to be performed after it is installed, but do it **before** you have the relay plastic box well secured and all the cable perfectly bundled with tire-wraps/tie wires. Trust me..... I have been there...

Get in the car and close the doors as they can't be locked with an open door. Make sure your car is on flat ground and does not roll away when releasing the parking brake. Also make sure your panels are in a save location and the car is not rolling over it or you sitting on it.

Put the ignition switch in the ON. That is one step beyond ACC and the lights on the dashboard will go on. You can also start the engine and after you release it; that is ON position.

- A. Door-locks should NOT have activated so far. If that did happen however go to chapter 9: diagnose step 1.
- B. Press and release the parking brake (off) to remove the parking brake. The doors should lock. If that does not happen go to chapter 9: diagnose step 2.
- C. Press the parking brake (on), the doors should go to unlock. If that does not happen go to chapter 9: diagnose step 2.
- D. You should be able to repeat step B and C, but don't try to get your doors go wild 😊
- E. Before you switch off the contact make sure that parking brake is pressed (on). The doors should be unlocked. When switching off, door-locks should not activate. If that does happen go to chapter 9: diagnose step 1.
- F. Same as E, but then with parking brake is released (off). The doors should be locked. When switching off, door locks should not activate. If that does happen however go to chapter 9: diagnose step 1. You will have to unlock manual in any case.

If all above steps pass you are ready to finalize the installation following the steps in chapter 8.

8. Finalizing the installation

There are some good descriptions, coming from Mazda to directly on how to remove the necessary panels as well as locate the cable connections. I have included a copy of the information in Appendix-C that is coming from these instructions. I hope it will not get me in copyright trouble for including instead of referencing, but the information is coming from Internet, I use source reference and I am sure Mazda wants happy drivers. Thank you Mazda!

Steps

- Fasten the relay box with relays on a secure place with tie wires under the dashboard. You will find a good place high up under the dashboard. Also use tire wraps/tie wire to make sure that the wires are secured and not in the way.
- Replace the panels - Appendix-D
- Last but not least...
 - Put the tools back in the tool-box
 - Clean the car, vacuum the floor
 - Final check and then give a demonstration!

Even better if you have an significant other (Probably the less technical person), ask him/her to act as "normal" with the car. I bet one of two things will happen:

1. Automatic door lock/unlock is not noticed (actually that is VERY good news)
2. Parking brake is not used as it should (that is bad)

So much for a fine demo and credit for all the hours of hard work. Well the good news is that you stayed out of trouble and YOU know you have achieved. What is more important? ☺

Time to celebrate... the job is done!

9. Diagnose errors

Step 1: If door-locks are activated either during power-on or power-off, it means that relay-A is activating or de-activating before Relay-C can prevent a door-lock signal to be sent.

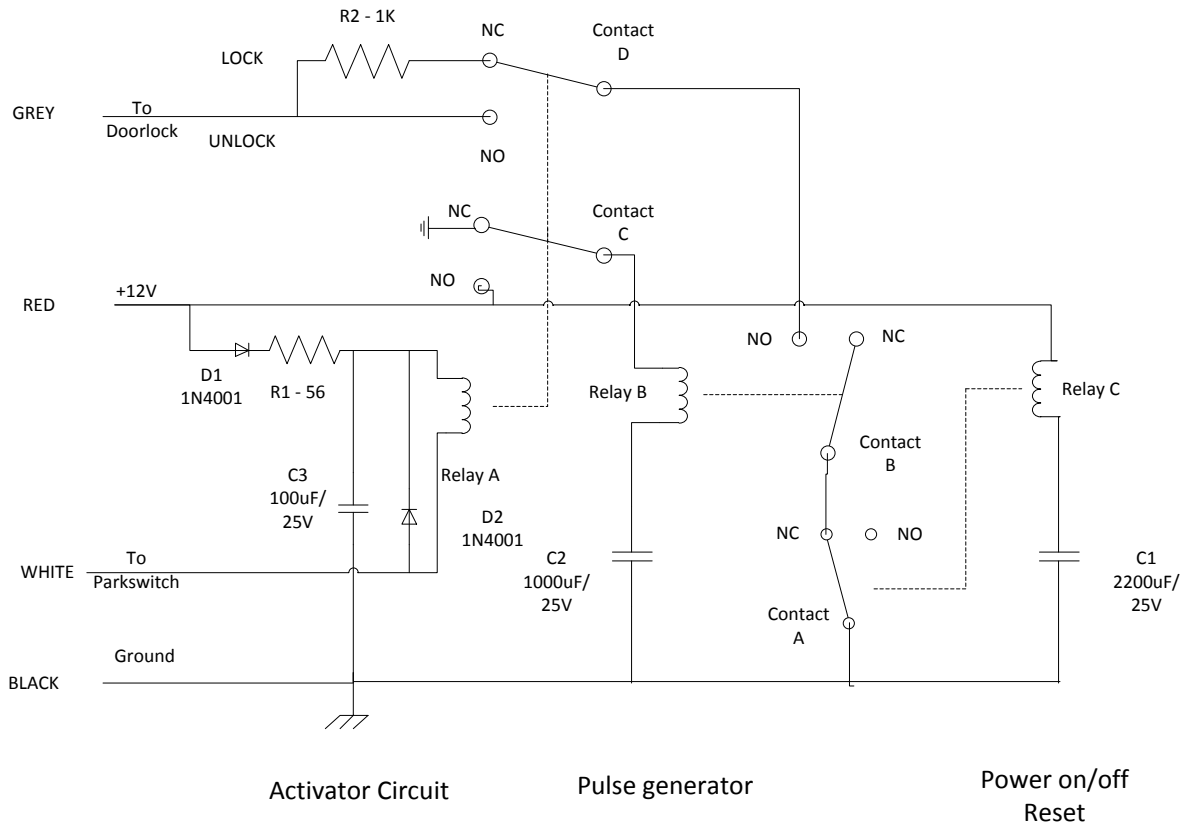
- a. Check that relay-C is activated and de-activated after ~3 seconds at power-on or Power-off. If NOT.
 - i. Check the components are correct and correctly connected.
 - ii. Check your circuit (Maybe capacitor C1 is defect or wrongly connected (watch the polarization of the capacitors!))
- b. If Relay-C does activate and de-activate (as check in step 1.a),
 - i. Check that contact-A is correctly connected with contact-B to prevent door-lock signal at power-on/off.
 - ii. Check that the circuit around Relay- , especially C3 is correctly connected
 - iii. Otherwise try to increase the C3 value, e.g. double to 200uF. This will increase the time for activation/de-activation of Relay-A. The relay-C might be slow. C3 should NOT be more than half the value of C2. (this is unusual action to take as the change is less than 0.001% that this is the cause, but you never know)

Step 2: The doors won't lock or unlock:

1. If you **don't hear** a clicking sound from the door-locks when move the parking-brake between pressed and released;
 - Check that the doors lock/unlock with the manually. If NOT :
 - Check the fuse D/L : 25A in the engine area is not broken (see owner's manual)
 - Check that you have 12V power on the relay circuit with a meter. If no power :
 - Make sure the ignition switch is in the correct position (ON)
 - Check the red and black wire connections
 - Check fuse 4 (Meter 10A) in the glove fuse box is not broken. (see owner's manual)
 - Check that parking brake-switch activator is correctly working:
 - With the ignition switch in ON the red brake-light on the dashboard should switch on/off with the parking brake between released and pressed. Make sure it is fully released and pressed!
 - Check that the white wire is correctly connection to the green
 - Check that the white wire is connecting to ground (with an ohm-meter) when the parking brake is pressed (on)
 - Check that the door-lock signal is correctly working :

- Check that the grey wire is correctly connected to black/violet wire
 - When you connect the grey wire to ground with a test wire, the doors should lock.
- 2. If you hear the door-locks do make a clicking sound when move the parking-brake between pressed and released, it could mean they are activated but either:
 - Check whether you can lock/unlock manual. If **NOT**:
 - One of the doors is still open. Check the doors and your internal lights; if they are on, a door is still open.
 - Pulse Relay-B might be in constant on. Check whether Relay-B is only one during the pulse for ~1.5 seconds.
 - Disconnect grey wire and see whether manual switch now works, if so:
 - Check your circuit (Maybe capacitor C2 is defect or wrongly connected (watch the polarization of the capacitors !))
 - Maybe the door-locks try to unlock, instead of lock, or opposite.
 - To check whether the door-locks try to LOCK instead of Unlock, unlock the doors manual and repeat the test step B. If the doors now lock, you have reversed the resistor R2 connection on the relay. (we are only human)
 - Don't hold the UNLOCK door switch pressed at the same time as pressing and releasing the parking-brake. It would harm, but it does not help either.
 - Test whether grey wire is correctly connected.
 - With a test wire connect grey wire to ground. Door should UNLOCK.
 - With a test wire connect grey wire to resistor of 1K (1000 Ohm) and connect other side of resistor to ground. Door should LOCK.
 - Disconnect grey wire from V/W wire and with an ohm meter check that the grey wire is NOT making connection constant to ground. With the ignition key in ON, wait 3 seconds, press and release parking brake couple of times. You should see the meter do a short **detection** before showing open circuit again (detection is the right word, the needle will move only shortly)
 - If either is not working remove the circuit (e.g. disconnect grey wire from V/W wire and double check you component connections.
 - The pulse time is too short. Increase the value of capacitor C2, but don't make it more than three-quarter the value of C1. If longer time is needed increase C1 value accordingly. (This step is very unusual to be needed, but MAYBE you are unlucky...)

Appendix-A: Circuit details



The circuit has 3 major parts, build around 3 separate relays:

1. **Activator:** Triggered by the parking brake-switch.
2. **Pulse generator:** When triggered by the activator it creates the pulses for door lock/unlock.
3. **Power on/off reset:** Makes sure NO lock/unlock pulse is sent during the instable power-up and power-down period of the circuit.

Appendix-B: Shopping list

Resistor (normal ¼ watt)

R1 56 Ω /Ohm
R2 1000 Ω /ohm (1K)

Diode (1A)

D1 1N4001
D2 1N4001

Capacitor (Don't go for 16V, unless you can't get different)

C1 2200 μ F/ 25V
C2 1000 μ F/ 25V
C3 100 μ F/ 25V

Relay (many relay can have range which is good as well e.g. 6V – 30V)

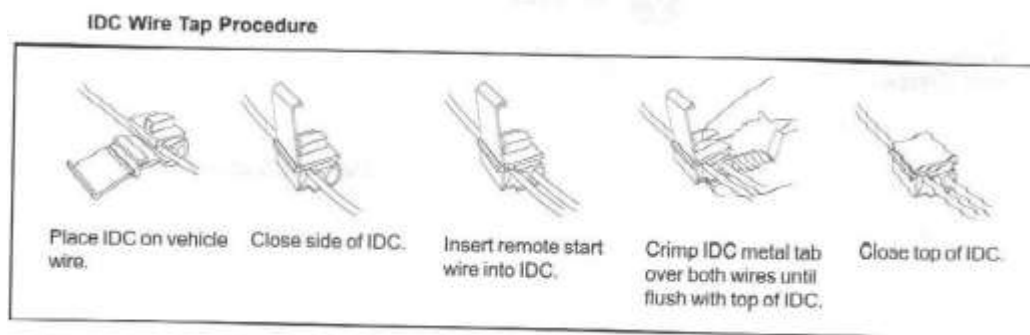
A 12V – DPDT Relay (Double Pole, Double Throw relay)
B 12V – SPDT Relay (Single Pole, Double Throw relay)
C 12V – SPDT Relay (Single Pole, Double Throw relay)

Wire (0.75 mm² / 18 Gauge) – Available in any good auto shop

Red 50cm/ 20 Inch
White 50cm/ 20 Inch
Grey 50cm/ 20 Inch
Black 50cm/ 20 inch

1 x plastic box large enough to hold the circuit

4 x IDC wire-tap or also called quick splice – Available at any good auto shop



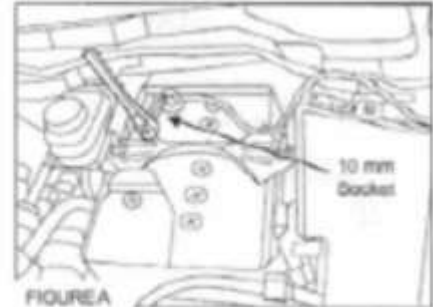
Try to see whether they also sell one box of patience.... You might need it ☺

Appendix-C: Remove panels and (dis)connect battery

VEHICLE PREPARATION

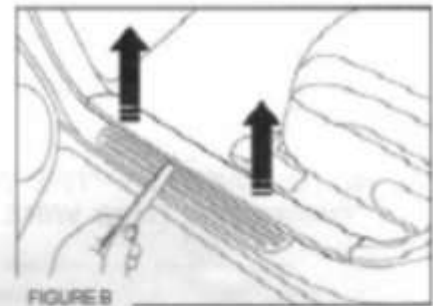
Disconnect and Remove Battery

- Disconnect and isolate the negative and positive battery terminals. (FIGURE A)
- Remove battery hold-down bracket assembly by loosening both 10 mm nuts and pivoting lower retainers toward vehicle dashwall. (FIGURE A)
- Carefully remove the battery from vehicle.

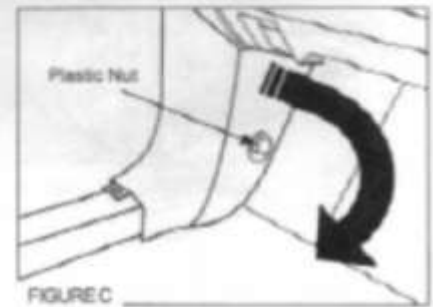


Remove the following components:

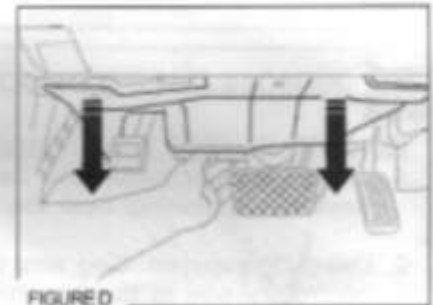
- Using a fiber stick, remove the driver's side scuff plate. The scuff plate is held by 3 clips. (FIGURE B)



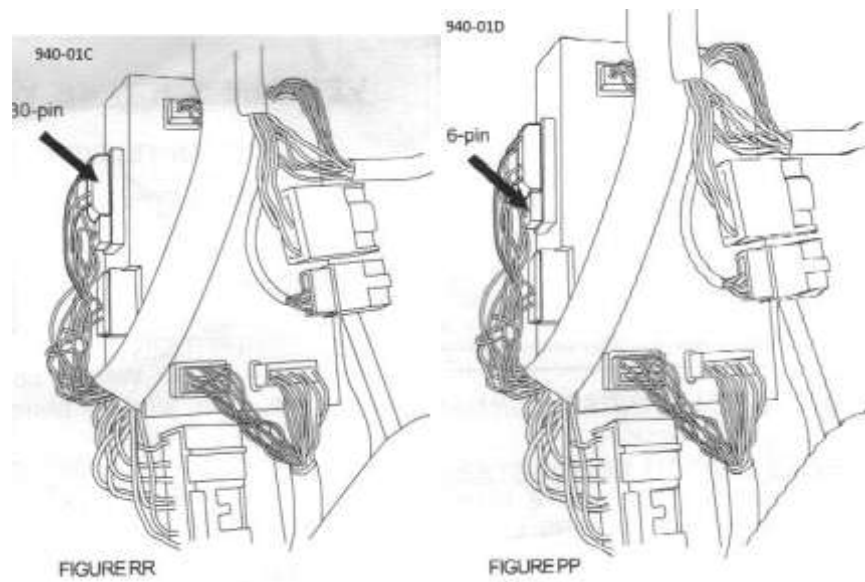
- Remove the driver's side kick panel by removing the plastic nut. (FIGURE C) Partially peel back the rubber weatherstrip away from the kick panel. Insert a fiber stick between the body and kick panel to disengage the retaining clip. Gently pull the kick panel toward the passenger's side of the vehicle to remove.



- Remove the black, lower dash panel by using a fiber stick to pull the plastic center button of both plastic fasteners out to disengage. Use a fiber stick to disengage the single clip located at the front, center of the panel and remove. (FIGURE D)

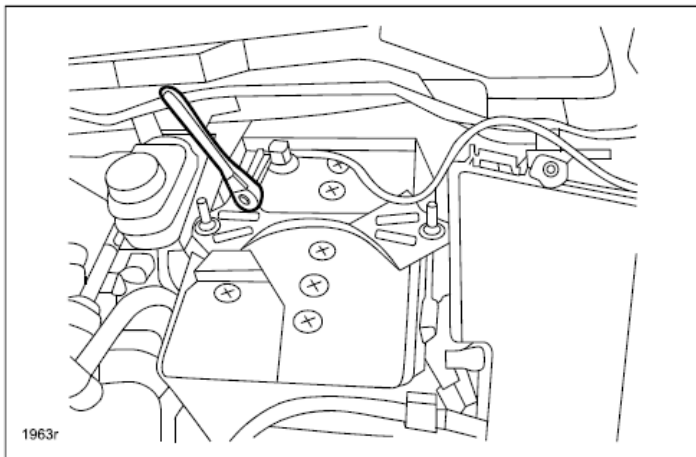


BCM



Reconnect the battery

- Verify that all connections are secure.
- Turn the ignition switch to RUN position



- Reconnect the negative battery cable.
- Turn the ignition switch to the OFF position.

Appendix-D: Re-installing panels

⚠ CAUTION: Do not pierce the remote start wiring with the steering column cover halves or phillips head screws during reassembly.

- c. Replace the ignition knob by pushing toward the ignition switch until it snaps in place. (Smart-Key equipped vehicles only)
- d. Re-install the black, lower dash panel by engaging the single clip located at the front, center of the panel. Re-install both plastic fasteners and push the plastic center button down until flush with fastener to engage. (FIGURE XX)
- e. Re-install the driver's side kick panel by engaging the retaining clip on the panel. Re-install the plastic nut and rubber weatherstrip on the kick panel. (FIGURE YY)
- f. Re-install the driver's side scuff plate by engaging all three clips. (FIGURE ZZ)

