

Installing the RT-50A Rain Tracker on a Toyota Prius 2010 (v3 – European model)

Introduction

This document describes how to install and customize the RT-50A Rain Tracker <http://www.raintracker.com> on a Toyota Prius 2010 (v3) not provided of automatic wipers.

RT-50A, produced by Hydreon/Xenso <http://www.hydreon.com>, is a hands-free rain and light sensing retrofit cruise control, automatically driving windshield wipers and headlights. Installing it on a Prius provides both automatic wipers and automatic headlights within a single control module.

How the RT50A Rain Tracker works

The RT50 Rain Tracker system is composed of three elements:

- An intelligent optical sensor snapped into a coupler that bonds permanently to the windshield.
- A relay interface unit.
- Wiring components.

The intelligent optical sensor coupled on the inside surface of windshield includes two pairs of infrared light emitters/detectors and a PIC microcontroller based logical unit; it is responsible of:

- discerning sunlight from night time,
- determining rain,
- driving intermittence of wipers at slow speed and switching wipers to high speed.

The sensor cable connects the relay interface unit through three wires:

- +12V power supply to the B+ car ignition (a 5V linear voltage regulator is included inside the sensor)
- output
- ground

The output pin carries discrete analogical voltages; values are the following:

- 0 V (constant value) = no rain, sunlight
- 1 V (constant value) = no rain, night time
- 1 V / 2 V intermittent pulses with variable frequency = slow drizzle
- 2 V (constant value) = slow rain
- 4 V (constant value) = fast rain

The relay interface unit is an analog device including four separate elements:

- The fast mode relay (pins 9 and 10), driven by a 4V comparator (and powered by the MODE READER pin 3).
- The slow mode relay (pins 6, 7 and 8), driven by a 2V comparator (and also powered by the MODE READER pin 3).
- The cam feedback, which drives the slow mode relay through a +12V positive input (the brown wire) in parallel with the slow mode rain element.
- The headlamp relay (yellow and green/yellow wires), driven by a 1V comparator powered by the B+ (+12V ignition).

By consequence of this, when the fast mode relay is active, also the slow mode relay is switched on. Besides, when fast mode or slow mode wipers are active, also the headlamp relay is switched on.

Notice also that the headlamp control is always active, even when the MODE input is not connected. This means that it can be independently managed by a separate activation switch.

Connections in summary

The diagram that can be found at http://www.raintracker.com/compatibility/toyota_prius_05-07_rt-50a.htm is a valid reference for the installation. This means that information valid for a TOYOTA PRIUS 04 – 08 can be generally extended to the Prius 2010 (that is not directly reported on Rain Tracker's site at the moment).

In summary:

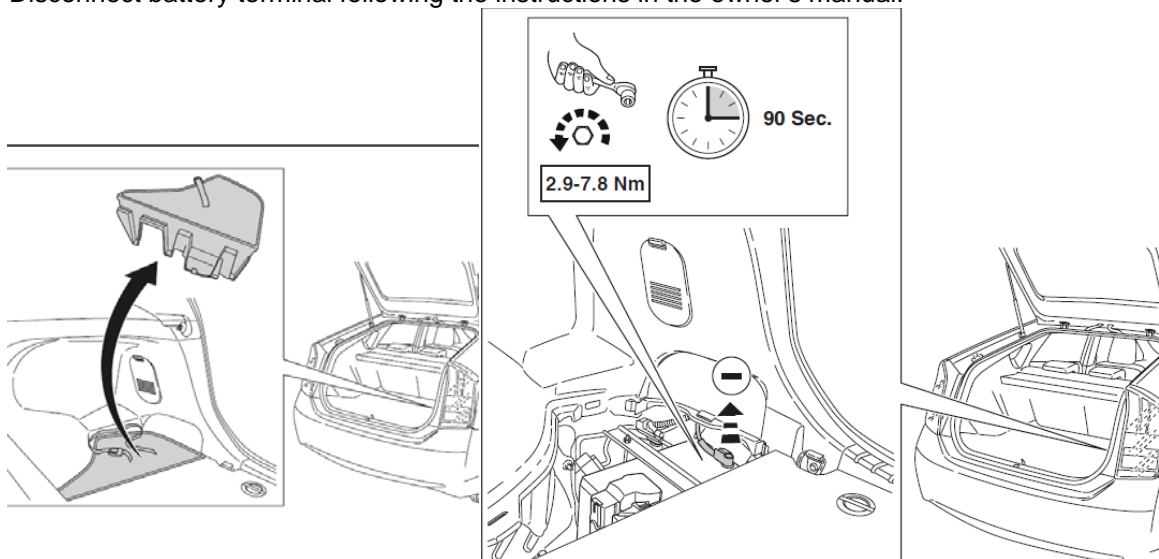
- The Rain Tracker wiper cruise control works in parallel with the existing wiper system, so the existing manual control modes are not affected.
- Wire colors of the wipers stalk switch in the steering column are red for slow, white for fast, white/black for ground, brown for +12V ignition; notice that the Rain Tracker documentation reports light green for +12V ignition; maybe that refers to previous Prius modes; Prius v3 2010 has a brown wire.
- The red wire related to the slow mode winding needs to be cut inside the steering column as described in Rain Tracker documentation.
- Diode WHT/YEL (pins 5-4) is needed.
- Cam feedback is not needed.

The headlamps control perfectly works and is very easy to install. It does not need any external relay, because the Prius headlights stalk switch already controls the headlight relay through its electronic control unit. Switching on parking lights and headlights can be simply obtained by grounding pin 20 – blue – of the stalk switch connector on the steering column. As this is a gate control, a very limited current flows.

Detailed mounting

To remove the bottom portion of the steering wheel column cover, perform the following actions.

- Disconnect battery terminal following the instructions in the owner's manual.



- Check the following pictures to open the steering wheel column cover: push the right side of the lower housing in to disengage the two claws.
- Do the same for the left side.



- Rotate the steering wheel so that the top of the wheel is facing the drivers side door. You will see a small rectangular hole in the front of the lower housing. Find something that fits in it.
- Pull the cover towards the driver side while pushing inward the hole to release the claw: without pulling the cover, the disengaging operation will result difficult.
- Spin the wheel 180 degrees clockwise and repeat the claw disengagement for the right side.
- The cover will come right off, exposing the headlight wire harness and the wiper wire harness.
- These harnesses for ease of access can be removed by pushing on the little release lever on the plugs.
- Note that the wiper harness is actually constituted by two separate plugs.

The connector on the left side of the steering column, below the left stalk switch (lights) is L47; useful pins are:

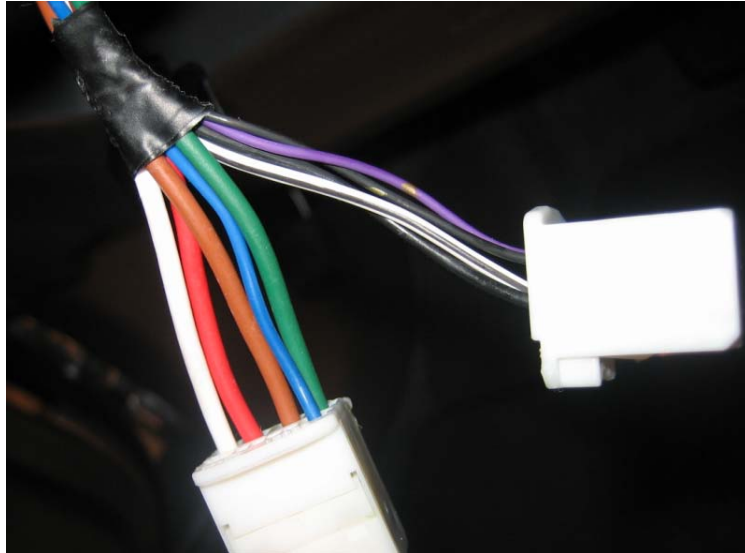
- Pin 20 (thin blue 24AWG): when connected to ground, it turns on tail lights + parking lights + headlights
- Pin 12 (thin green 24AWG): ground

Notice that, with the Prius European model, by connecting pin 20 to pin 12, headlights come always on, regardless the vehicle is powered on or off. Current flowing between these two pins is very limited (few hundreds microamperes).

The larger white connector on the right side of the steering column, below the right stalk switch (wipers) has the following useful pins:

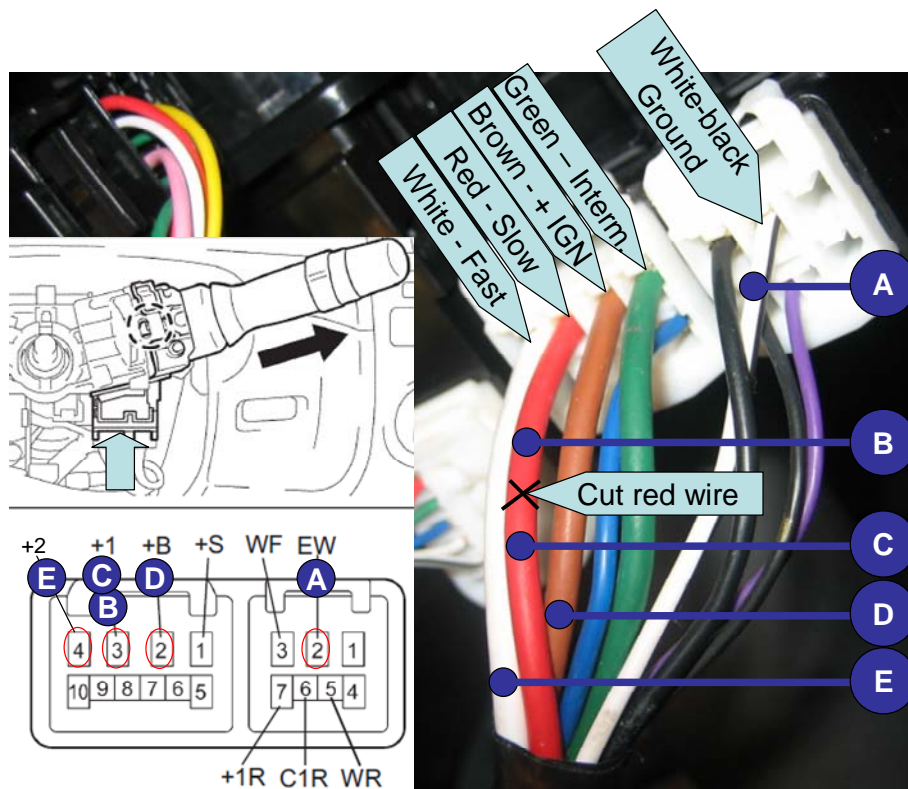
- Thick 16AWG brown: 12V+ ignition
- Thick 16AWG red: slow wiping speed; this wire is grounded by the cam when the stalk switch is in its default position
- Thick 16AWG white: fast wiping speed

Notice: do not short the red wire to the brown one when the wipers stalk switch is in its default position.



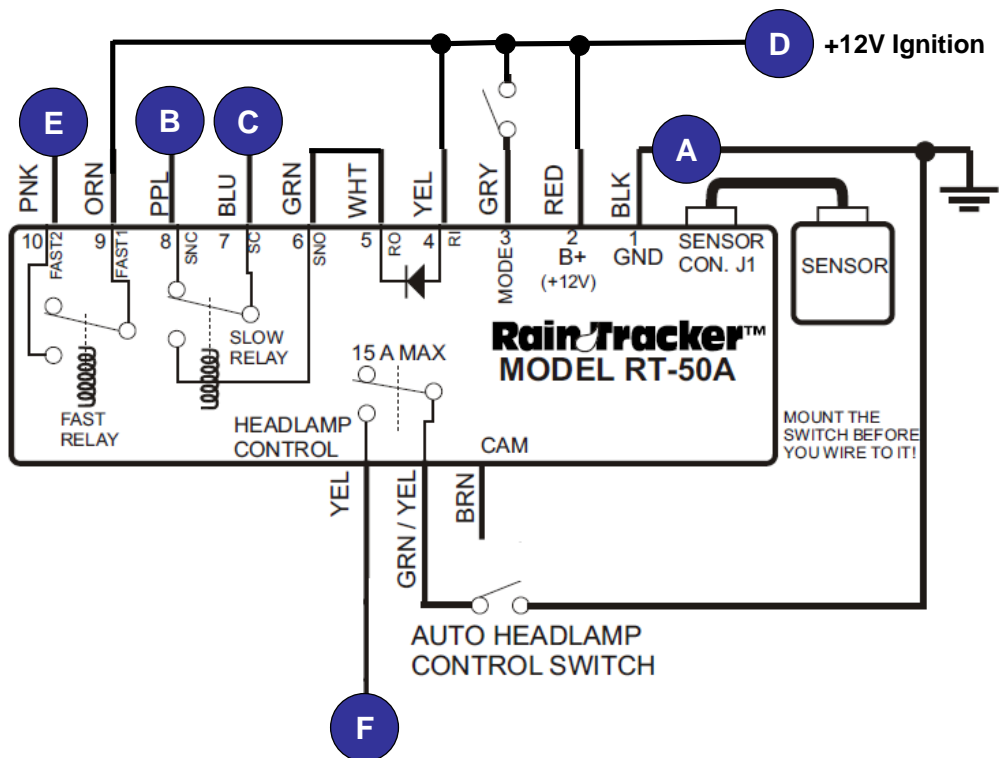
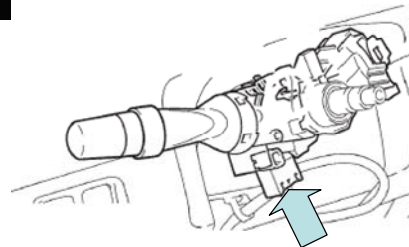
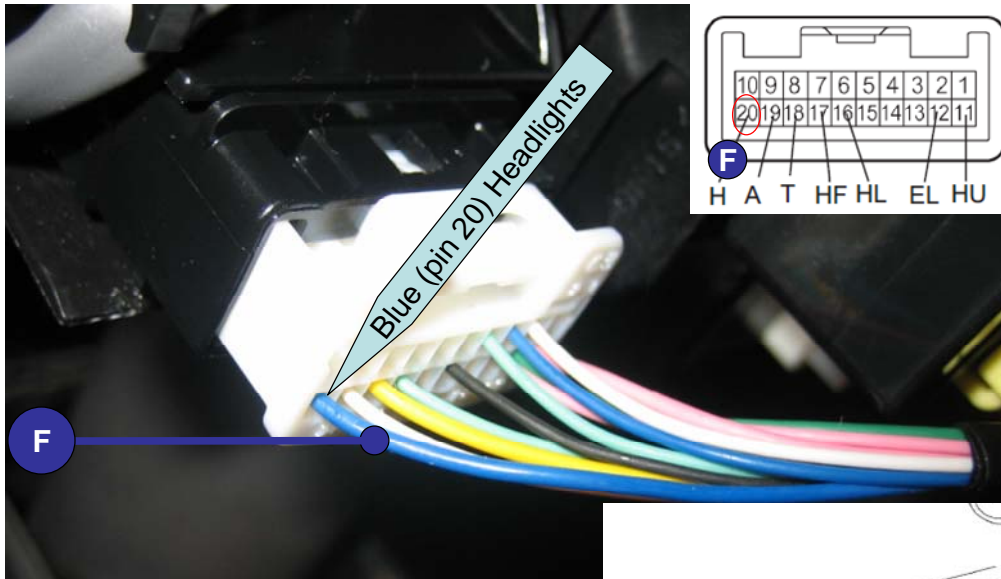
The other connector below the right stalk switch (wipers) has a white/black wire, which is an alternative ground than pin 12 of L47. The wires of the two wiper connectors can be better managed by removing the black tape joining them.

The following picture shows the impacted connectors with related labels A, B, C, D and E.



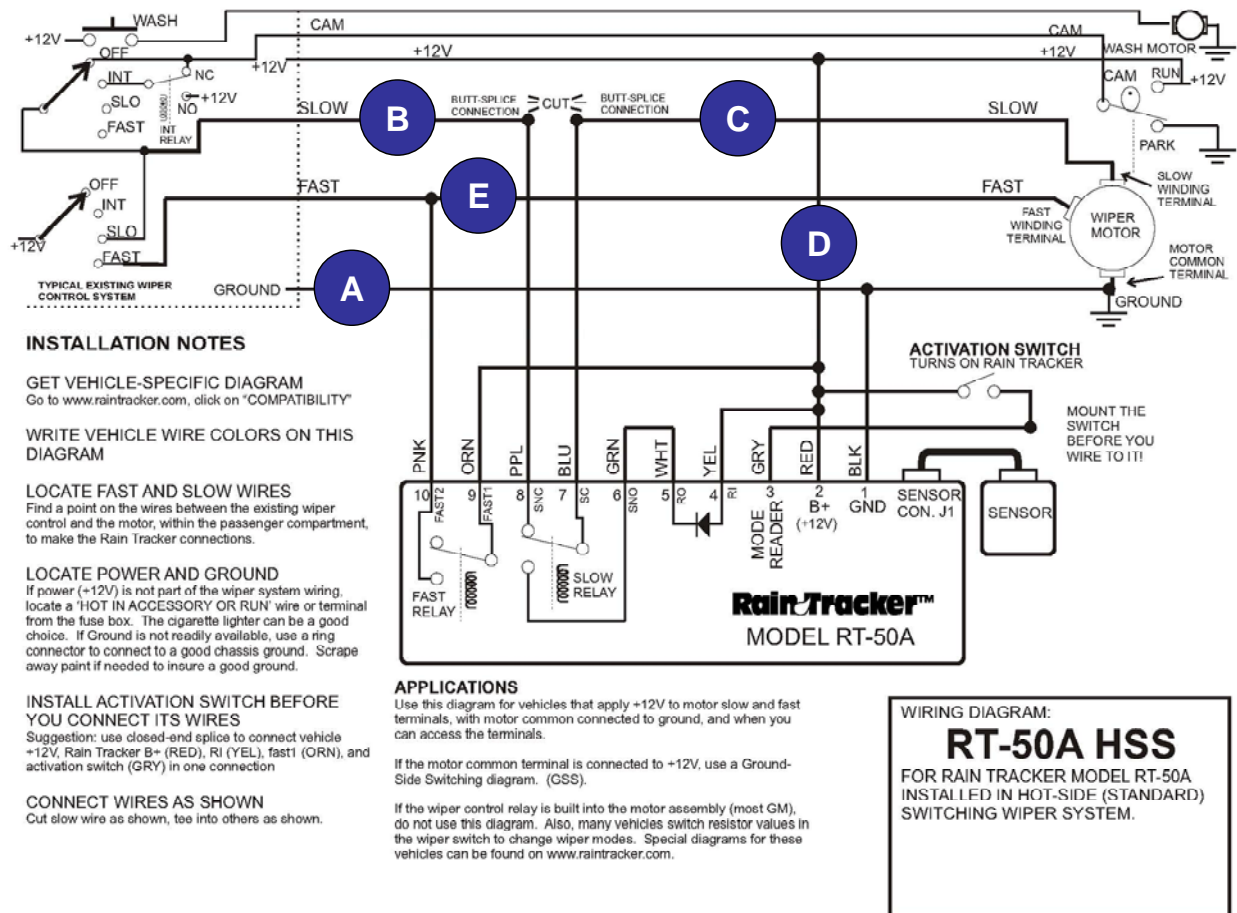
Connector labeled F is the blue one below the light stalk switch (see the following picture).

Subsequently, the schematic diagram for interconnecting the RT-50A to the Prius 2010 v3 is reported. It is based on a two-key keyboard (only one key is included in the kit). A possible modification described afterwards introduces an additional key to enable the headlights come on automatically when the vehicle is on, regardless the rain or light mode.

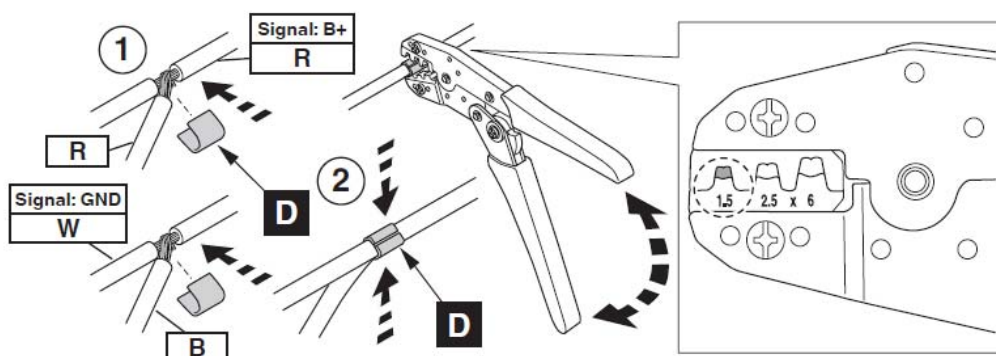


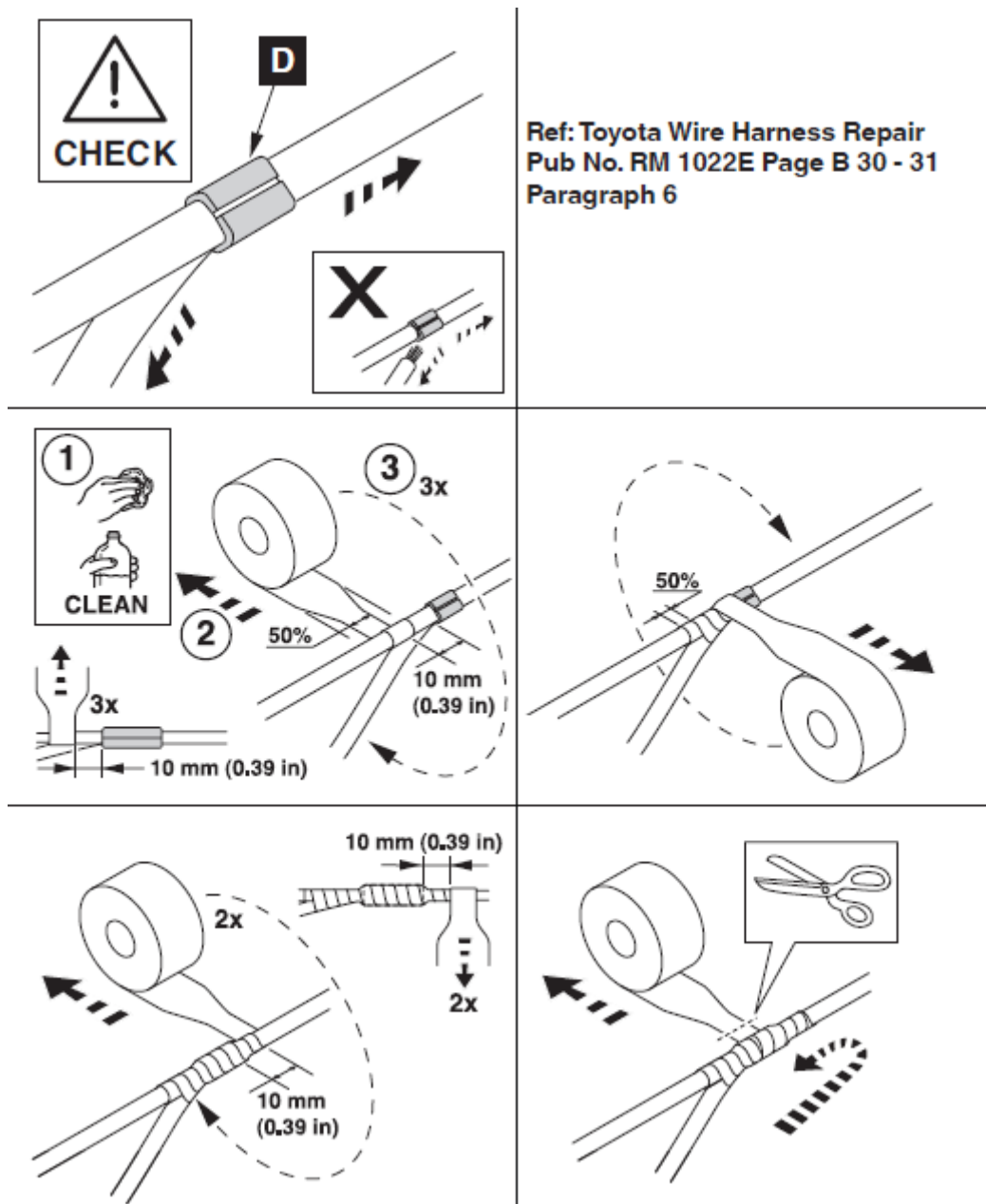
Label	Wire of RT-50A	Wire of wipers connector	Wire of headlamp connector
A	Black	White-Black	
B	Purple	Red (connector side)	
C	Blue	Red (harness side)	
D	Red, Yellow, Orange (and switch cable)	Brown	
E	Pink	White	
F	Yellow		Blue (pin 20)

For the sake of clarity, the used labels are also reported in the standard RT-50A wiring diagram.



To perform tee connections to existing power wires, Toyota suggest the following.





Toyota uses single coated adhesive foam tape (not included in the kit). Pay attention to select an electrical tape resisting to high temperature.

I used the following:

- two-screw terminal strips (chocolate blocks, not included in the kit) for E and D connections; all have been covered with heat-shrink tubing.



- Single screw terminals (not included in the kit) to wire together red, gray, yellow and orange cables to the one connected with the ignition wire through a two-screw terminal through a short thick cable.



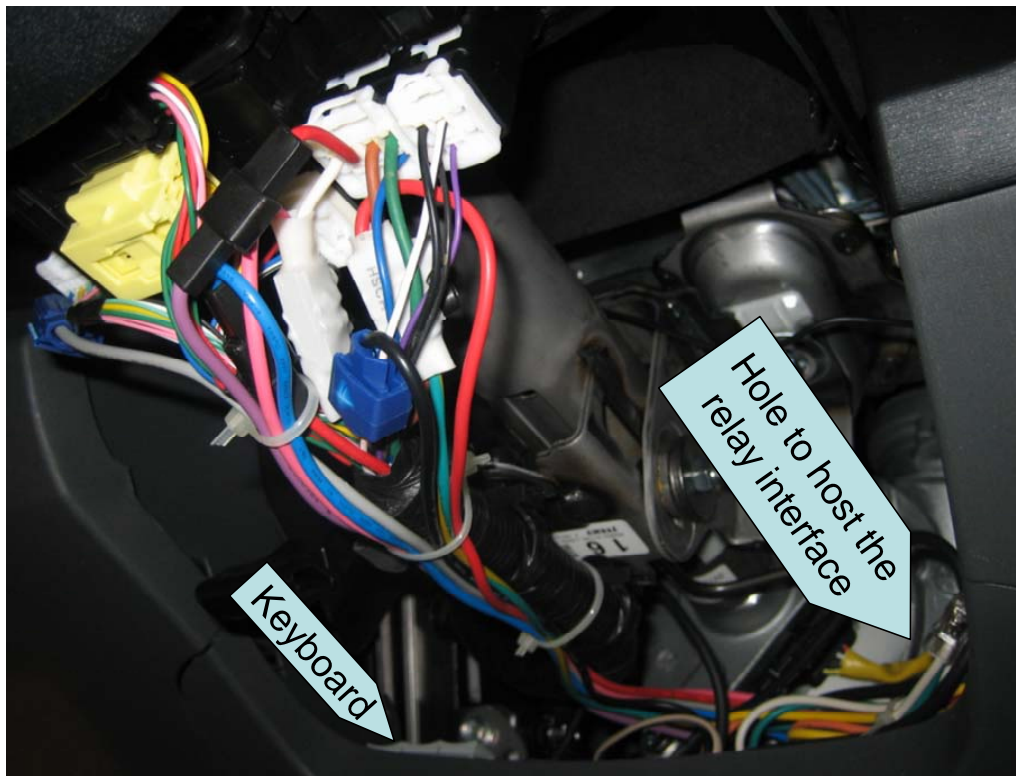
- No-strip tee splices for A and F connections



- Big lock-in crimp 'Lucar' terminals (male/female) with full insulation shields (connectors and related insulators not included in the kit) for B and C connections



The following picture shows the performed connections.



On the right side of the internal space below the steering wheel there is a deep hole where the control unit can be fastened in oblique position. Notice not to leave the small socket unconnected in case it is not used, as its pins can cause shorts.



Sensor and coupler can be installed as explained in the instructions. Please, follow the installation notes very carefully, cleaning the glass.



The sensor can be installed just below the rear view mirror, within the area swept by the wipers, and out of the shadeband.



When calculating the space between sensor and mirror, consider also the length of the sensor socket. In the following picture, the sensor socket had to be twisted due to lack of space. It would be better to avoid this operation, even if not influencing at all the electric connections and not compromising so much its mechanical performance.



Ignition based headlamps: a possible further mod

If the driver wants to always keep the headlights on, regardless rain and light, a useful modification can be implemented, effective with European Prius models not equipped with stalk switch AUTO position, where the parking lights will not turn off automatically when powering off a car.

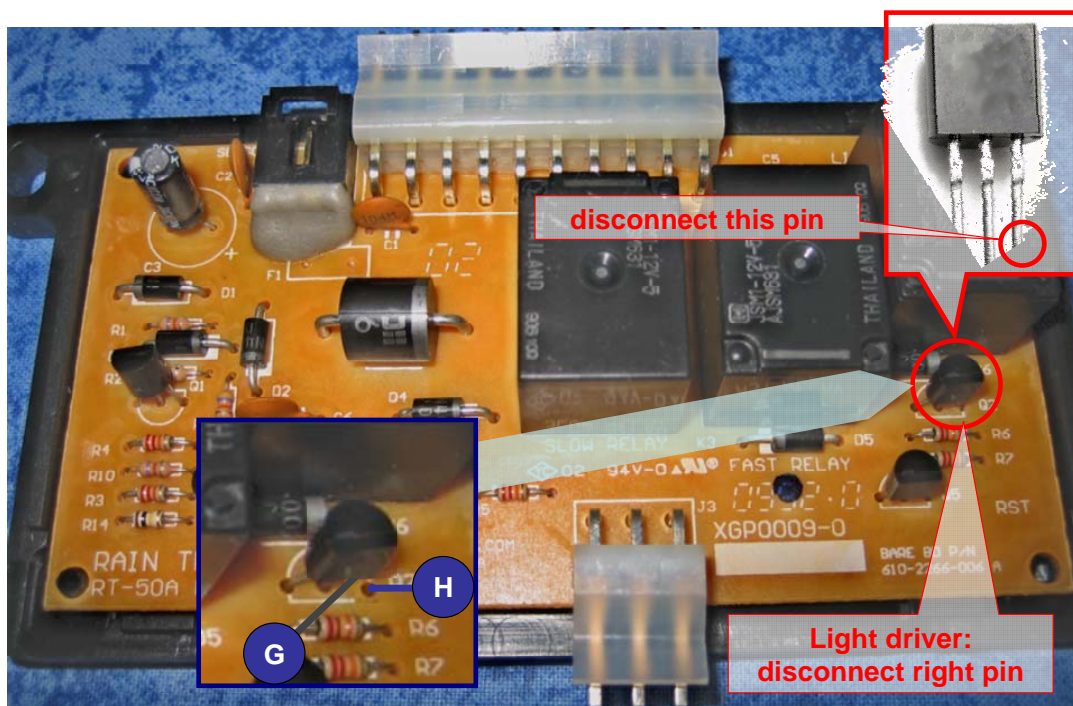
More precisely on these versions, after turning the stalk switch to the headlights position, if the car is started and then switched off, the tail lights and the parking lights remain switched on while the headlights come automatically off (besides, when opening the door, a buzzer warns to release the stalk switch to its off position before exiting). With this vehicle setting, it is not possible to turn on the headlights and leave the stalk switch always on.

In this case, a modification is suggested to allow the RT-50A internal light relay to automatically switch the headlights basing on ignition other than on rain. There are two optional versions to implement the modification; in the first version, simply disconnect the transistor driver from the internal headlight relay and expose both endings (transistor and coil) to an external two position switch, so that user can select to set automatic headlights based on ignition or set automatic headlights based on rain. A three position switch can be used so that there is also the possibility to fully disable automatic headlights through a single command unit.

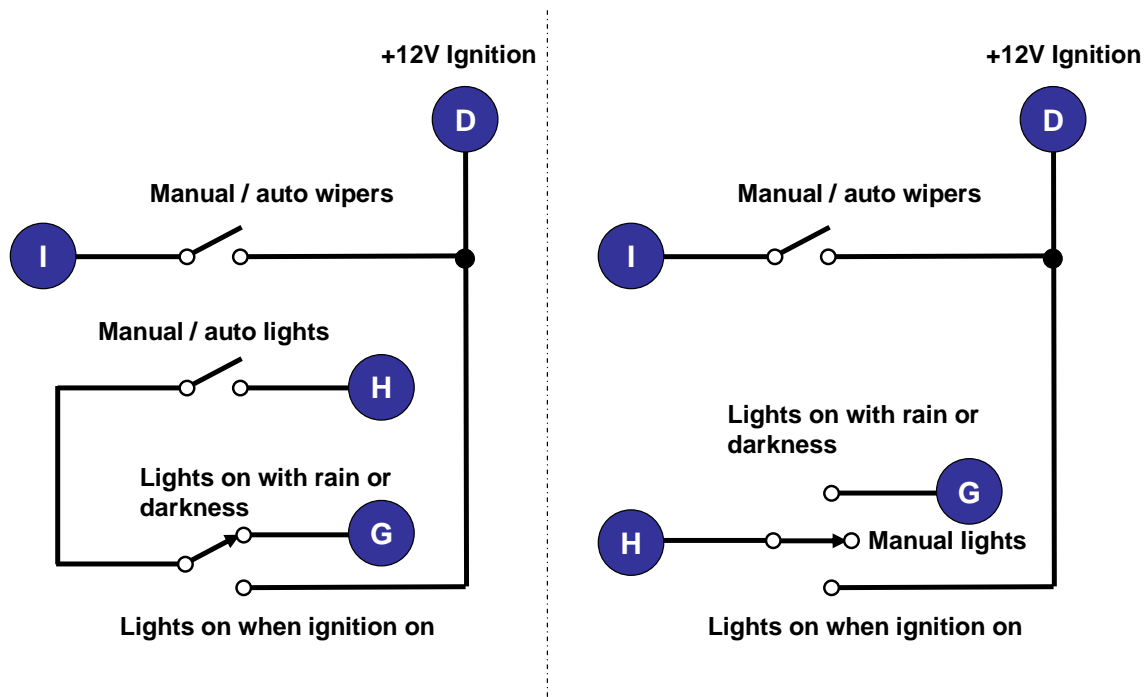
The relay interface has to be opened by screwing off the two screws in the following picture.



The following picture reports the previously described modification (subsequently, an alternative modification is proposed).

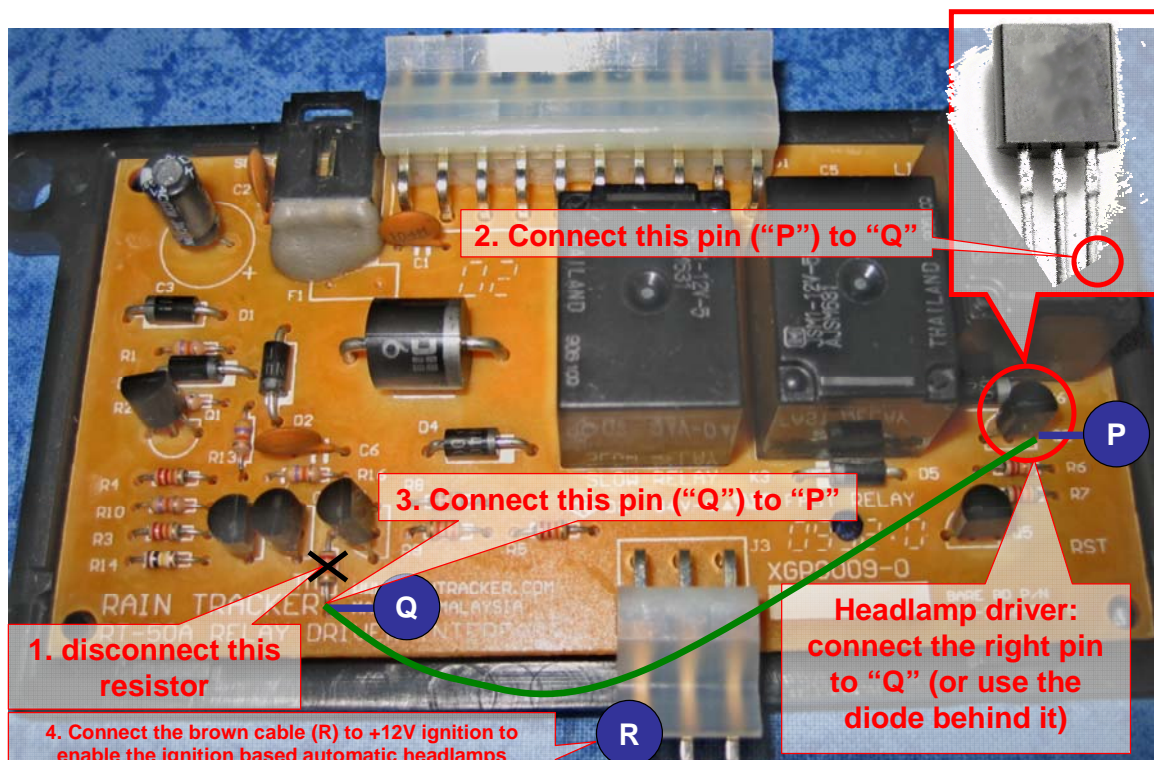


The following picture reports the three-key external keyboard required with this modification (using two keys and one switch or one key and one switch).

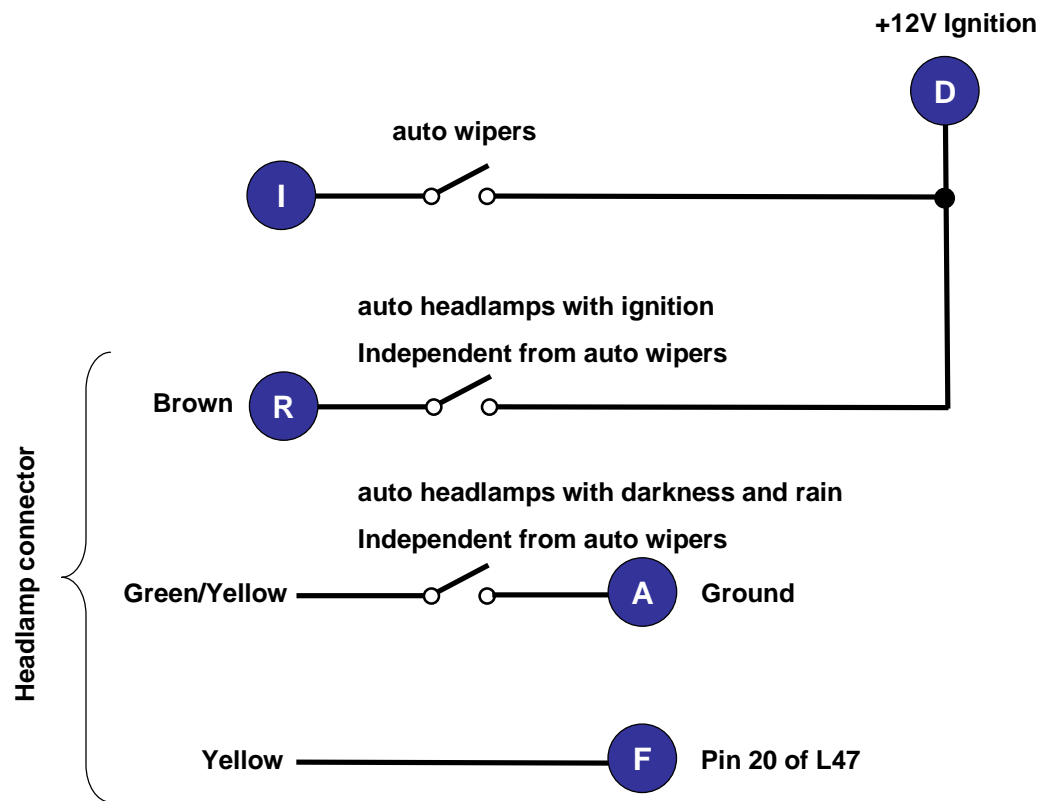


With this modification, the green/yellow wire can be directly connected to ground (A) without the switch shown in the schematic diagram and the yellow wire of the headlamp socket can be connected to pin 20 of L47 (F).

A more practical alternative is to directly connect a switch to the headlamp relay in parallel to the transistor driver. Considering that the cam feedback is not used, the related resistor can be disconnected with a solderer. The hole close to the last "R" of the "RAIN TRACKER" serigraphy can be used to connect a wire to the headlamp relay coil positive connector (e.g., the transistor right pin or the diode right pin).

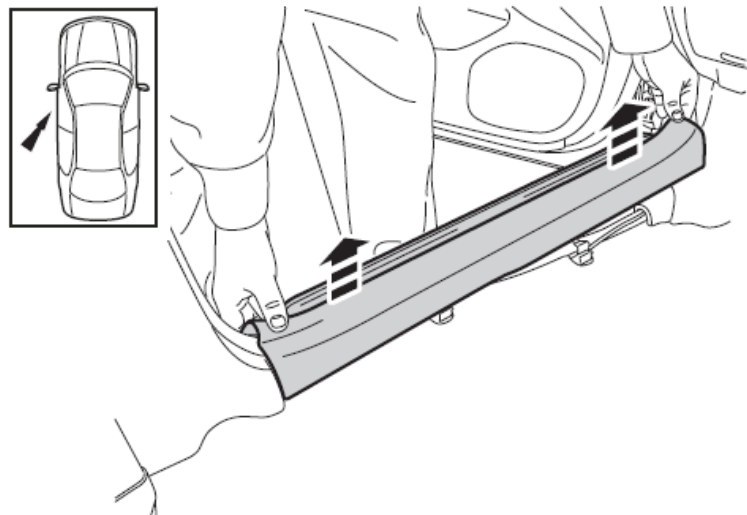


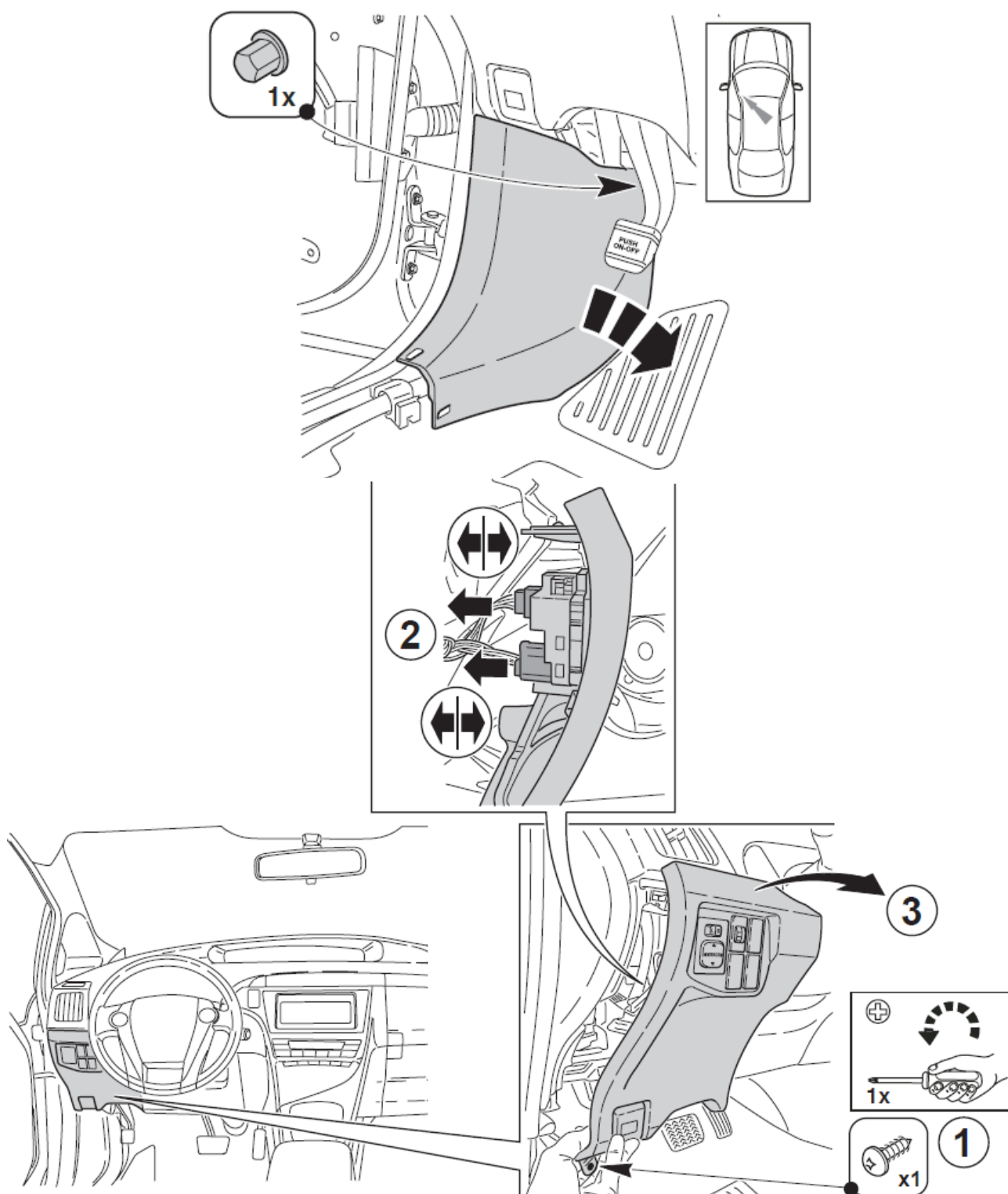
The following picture reports the three-key external keyboard required with this alternative modification.



The keyboard

I implemented a small three-key keyboard as shown in a previous picture. An alternative method is using the apposite free key covers in the left side of the dashboard. Here are the disassembly instructions.





At the end, a possible issue

The headlights control is perfect and the described optional modification provides an additional useful functionality. The sensitivity with few raindrops is effective and false wipes are actually rare. The wipers immediately start when raining (also with drizzle).

Anyway, when rain increases, the reaction of the RT50A unit might not be enough and can require the driver to manually operate the wiper stalk switch to slow continuous or to fast modes, especially in the darkness and at high car speed.

To reduce this issue, the sensitivity regulation has to be adjusted by turning the small trimmer potentiometer of the sensor clockwise close to the maximum position with the aid of a tiny screwdriver (avoid setting the trimmer to the limit).