



# SAW Shift At Will

*Full control over your automatic transmission!*

## **INSTALLATION MANUAL**

This manual provides the user with detailed installation instructions, to ensure a problem-free set up of the Shift At Will System.

Please read this installation manual carefully, prior to installation of this product.

Product Name: SAW System

Product Code: SAW300ZX

Software version: V1.10

Vehicle Applications: Nissan 300ZX, Z32



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## 1. General

### 1.1. Tools and materials required

- screwdriver
- side cutter
- scalpel or a knife
- soldering iron and solder
- electrical insulation tape
- electrical wire (approx. AWG24 or 0,5mm in diameter)

### 1.2. Short description of items to install

The installation of the SAW System is divided in 3 steps as described in the following chapters.

#### 1.2.1. Automatic Transmission Control Unit (ATCU)

Control Unit installation consists of locating a number of wires in the original ATCU harness, splicing into or cutting them and connecting them to the SAW connector. The original ATCU has to be removed (it will be replaced by the SAW unit). A handful of connections have to be made to the ECU and Cruise Control Module harness as well.

See chapter 2 for the full description of the installation.

#### 1.2.2. Paddle Shifters

The paddle shifters fit the non-airbag steering wheel of the 300ZX. Installation includes removing the steering wheel and making an opening in the back plastic cover to enable the paddle mount to protrude through it.

See chapter 2.6 for the full description of the installation.

#### 1.2.3. SAW Gauge

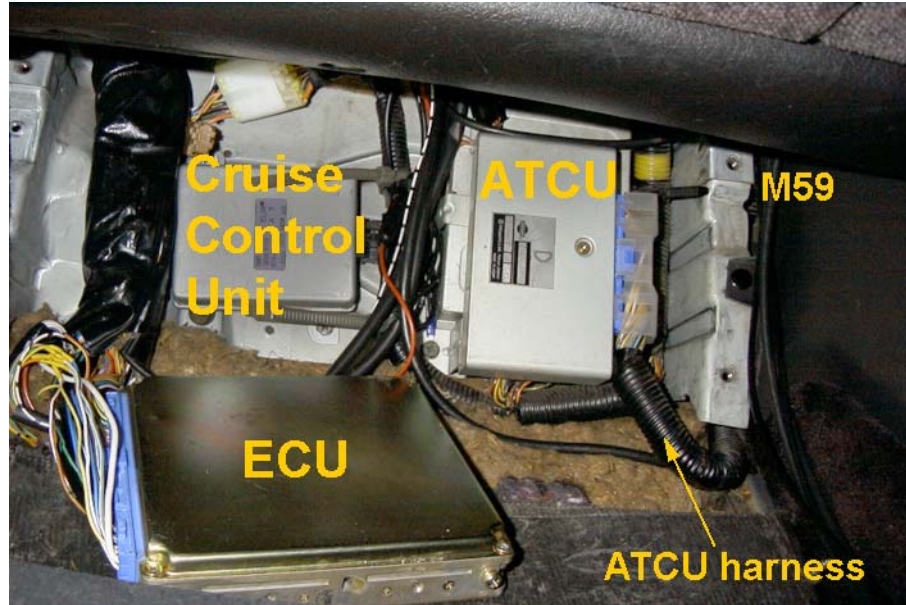
The SAW Gauge plugs in to the Control Unit, so there are no particular difficulties associated with its installation except for finding a suitable place to install this standard 2 1/16" (52,4mm) round gauge in.

See chapter 2.6 for the full description of the installation.

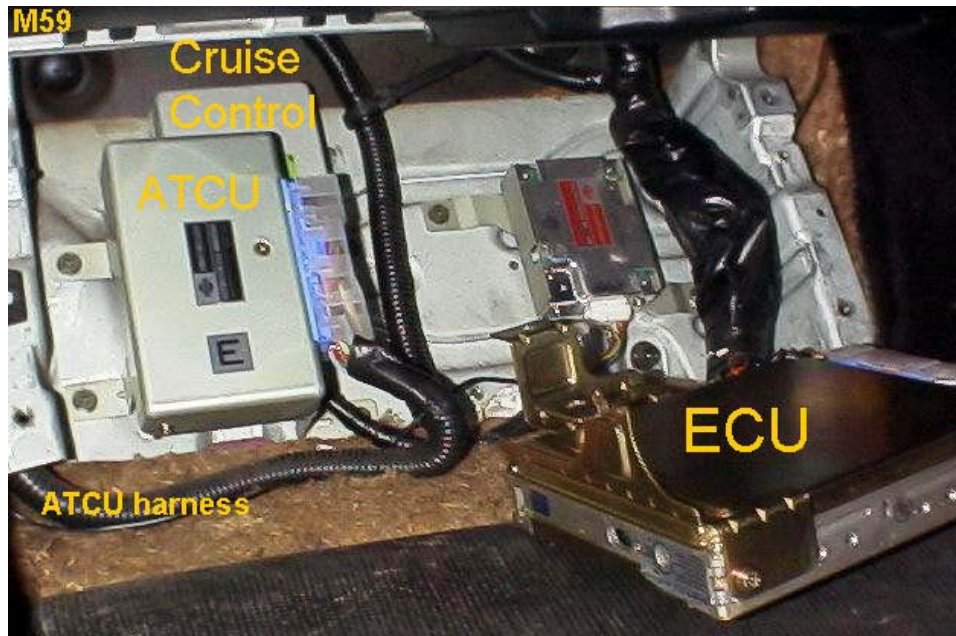
## 1.3. Location of parts

All the main electronic boxes are located in the passenger foot well.

The picture below shows the location of the ECU, ATCU and Cruise Control Module on an LHD car. Note that the ECU is already moved from its original location, over the Cruise Control Module.



The picture below shows the location of parts on an RHD car. Note that the Cruise Control Module is located under the ATCU.



Access to the harness of the above parts will be needed during the installation of the SAW system.

## 2. Control Unit installation

### 2.1. Mechanical preparations

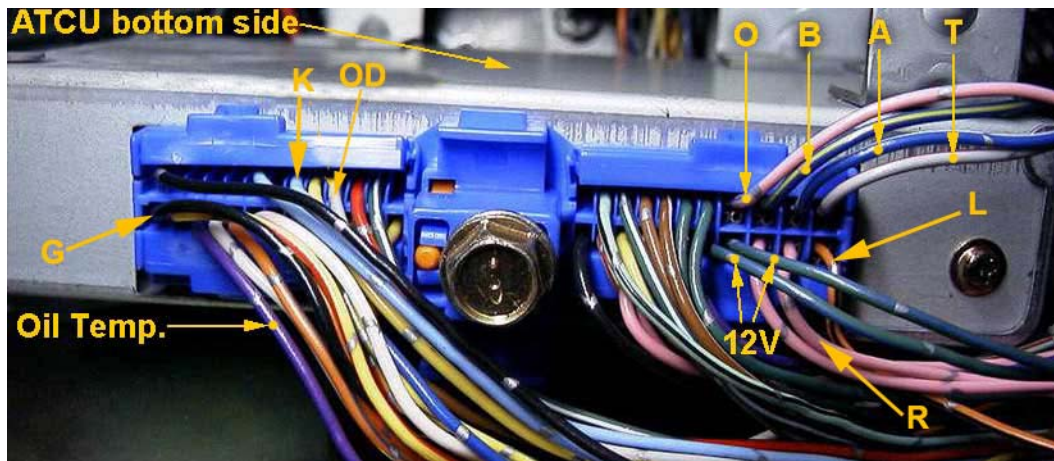
Disconnect the battery.

Remove the wooden plate in the passenger foot well to gain access to the ATCU.

Disconnect and remove the original ATCU.

### 2.2. Connecting to the ATCU harness

Locate the necessary wires as depicted in the picture below.



The pin numbering is arranged as follows (facing the connector from the harness side).

Bottom of the ATCU																								
48	X	X	X	X	43	X	41	40	39	38	37	X	⊕	X	21	20	19	18	17	16	8	7	6	5
35	34	33	32	31	30	29	28	27	X	25	24	23	⊕	15	14	13	12	11	10	9	4	3	2	1
Top of the ATCU																								

Pin no.	Color	Function
1	Orange-Black	Line pressure solenoid ('L' in the picture)
2	Pink	Line pressure solenoid resistor ('R' in the picture)
5	Grey-Red	TC Lock-up solenoid ('T' in the picture)
8	Pink-Blue	Overrun clutch solenoid ('O' in the picture)
6	Blue-White	A, Shift Solenoid A
7	Blue-Yellow	B, Shift Solenoid B
4	Green-Blue	12V power supply
9	Green-Blue	12V power supply
33	Purple	Oil temperature sensor
35	Black	Ground (be sure to use this ground and not chassis ground)
39	Gray	OD-switch – Map switch ('OD' in the picture above)
41	Sky Blue	Kick-down switch ('K' in the picture above)



All the ATCU harness wires, except the kick-down and map-switch, connect to the SAW Harness Connector 1. Its pin out is described in the table below.

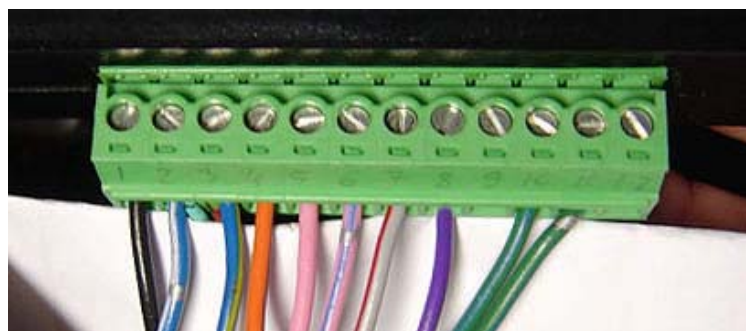
Pin no.	Description (color and location on ATCU)
1	GND – Ground (black, pin 35 on ATCU)
2	A-solenoid (Blue-White, pin 6 on ATCU)
3	B-solenoid (Blue-Yellow, pin 7 on ATCU)
4	LPR-solenoid (Orange-Black, pin 1 on ATCU)
5	LPR-solenoid resistor (Pink, pin 2 on ATCU)
6	Overrun solenoid (Pink-Blue, pin 8 on ATCU)
7	TC Lock-up solenoid (Grey-Red, pin 5 on ATCU)
8	Oil temp. sensor (Purple, pin 33 on ATCU)
9	Auto/Manual mode switch. Ground this terminal for auto-mode.
10	+12V (Green-Blue, pin 4 on ATCU)
11	+12V (Green-Blue, pin 9 on ATCU)
12	Not used

The kick-down switch wire has to be connected to SAW Harness Connector 2, terminal no. 5. For the map-switch connection description see chapter 2.5.3.

Connecting the harness to the SAW can be made in two ways. Either splicing in new wires into the ATCU harness and connecting them to SAW or cutting the original harness and using it to connect directly to SAW.

The first method is recommended because it leaves the original harness intact and the Nissan ATCU can be reconnected at any time e.g. when leaving the car at a garage for service or when selling the car. Never leave both the SAW Unit and original ATCU connected to the harness at the same time!

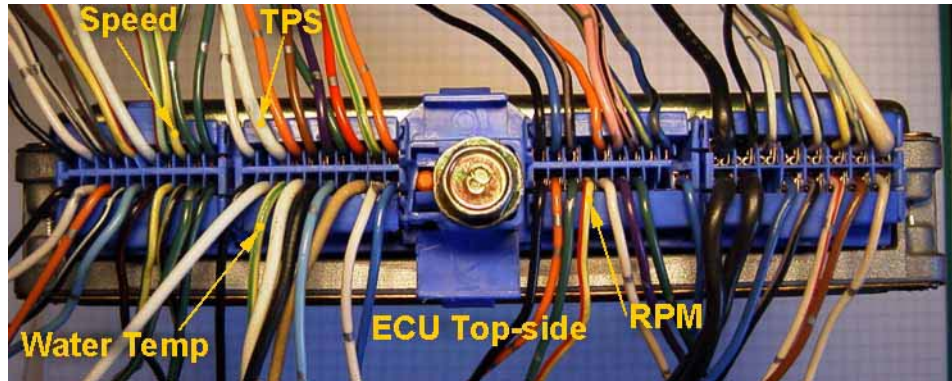
When using the second method, cut the wires at an equal distance from the ATCU to enable them to fit firmly in the SAW harness connectors. The picture below shows the SAW socket with all the ATCU harness wires connected. Note that the socket terminals are numbered from left to right (as shown on the Control Unit lid).



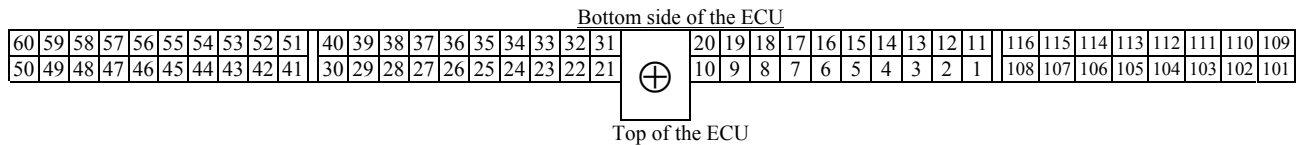


## 2.3. Connecting to the ECU harness

There are 3 wires that have to be located and connected to in the ECU harness. These are the speed, TPS and RPM wires. You will find them in the picture below.



The ECU top-side is the side that faces up when mounted (where the Nissan label is situated). The picture below shows the ECU connector outline as viewed from the harness side.



The ECU connector pin numbering is arranged as follows.

Pin no.	Color	Description
7	Yellow-Red	RPM, engine revolution
38	White	TPS, Throttle Position Sensor
53	Yellow-Green	Speed signal

You will need to splice into the ECU harness, without cutting it.

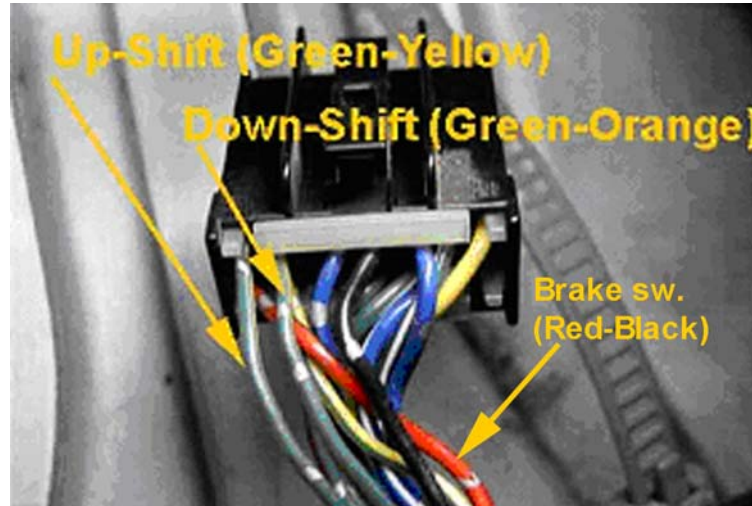
Use a scalpel or a knife to strip a bit of the isolation on the ECU harness wires and solder in suitable wires that will connect to the SAW Harness Connector 2. Use an insulating tape to cover the solder point.

Connect the wires to the Harness Connector 2 according to the table below. The voltage values in parentheses are important to be noted when using SAW on other vehicles than the 300ZX.

Pin no.	Description
1	TPS – Throttle position sensor (max. 5V)
2	RPM – Engine revolution signal (max. 10V)
4	Speed – Vehicle speed signal (max 10V)

## 2.4. Cruise Control harness connections

There are 3 wires that have to be located in the Cruise Control harness. One for the brake switch and two for the paddle switches. Refer to the picture below for wire location in the Cruise control connector.



The three wires are to be connected to SAW Harness Connector 2 as follows.

Wire color	SAW Harness Conn. terminal no.	Description
Green-Yellow	Harness Conn.2, terminal 7	Up-shift switch
Green-Orange	Harness Conn.2, terminal 8	Down-shift switch
Red-Black	Harness Conn.2, terminal 3	Brake Switch

### 2.4.1. Brake Switch Circuit description

The brake switch acts as an emergency release of the torque converter lock-up. It is recommended to be used for safety reasons. It will release the lock-up as soon as the brake pedal is pressed, enabling a more efficient braking.

NOTE: The torque converter lock-up is also automatically released when the engine revolution drops below 1200RPM (default setting), as not to stall the engine when stopping.

The brake switch terminal accepts **max. 15V** and releases the lock-up when the voltage changes from 0V to battery voltage.

### 2.4.2. Up-shift and Down-shift Switch Circuit description

Up-shift and Down-shift switches are normally connected to the shift paddles according to the description in chapter 2.4.

The user can fit additional shift switches for convenience. The switch inputs accept **max. 15V** (battery voltage). The up/down shift will be triggered when the input changes from 0V to battery voltage. The up-shift input also controls the lock-up while in 4<sup>th</sup> gear (see Instruction Manual).





## 2.5. Connecting Optional Switches

There are a number of additional switches that can be connected to the SAW Control Unit to control additional features, which are optional to use. Those switch-inputs are described in the chapters that follow.

### 2.5.1. Mode Switch

The mode switch selects the gear shift mode. The default mode is manual. When this terminal is grounded, the mode selected is automatic. Switching between auto and manual modes can also be made by using the shift paddles or the Cancel button (see the User Manual for more information).

This terminal should only be **grounded** when active. Do not connect any voltage to it!

### 2.5.2. Lock-up Switch

The lock up switch forces the activation and deactivation of the torque converter lock-up. It should be used with caution. The lock-up is originally designed to be used in 4<sup>th</sup> gear and low load only (while cruising). The lock-up can also be engaged/disengaged using the up-shift paddle while in 4<sup>th</sup> gear.

Grounding this terminal will force the torque converter to lock-up (if the engine RPM is below the defined shut off value). Releasing the grounding will release the lock-up.

This terminal should only be **grounded** when active. Do not connect any voltage to it!

**WARNING:** Locking the torque converter under high load can damage the lock-up clutch!

### 2.5.3. Map Switch

This input selects one of the two shift maps loaded in the SAW unit.

There are two SAW hardware variants released.

1.

For the variant where the map switch input is marked with "Map sw. 12V", this input can be connected directly to the OD-switch wire in the ATCU harness (see chapter 2.2). When the OD-switch is ON (the dash light is out) then the Sport map is chosen. When the OD-switch is in the OFF position then the Comfort map is chosen.

2.

For the variant where the map switch input is marked with "Map sw.", this input can only be operated by a new dedicated switch.

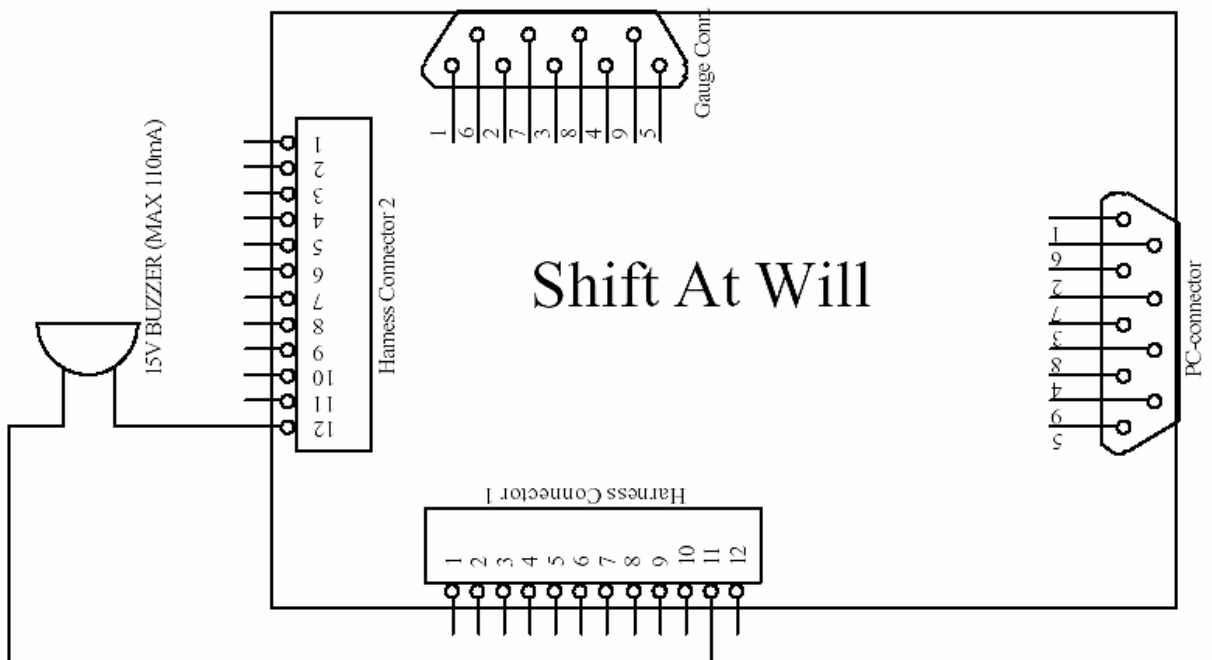
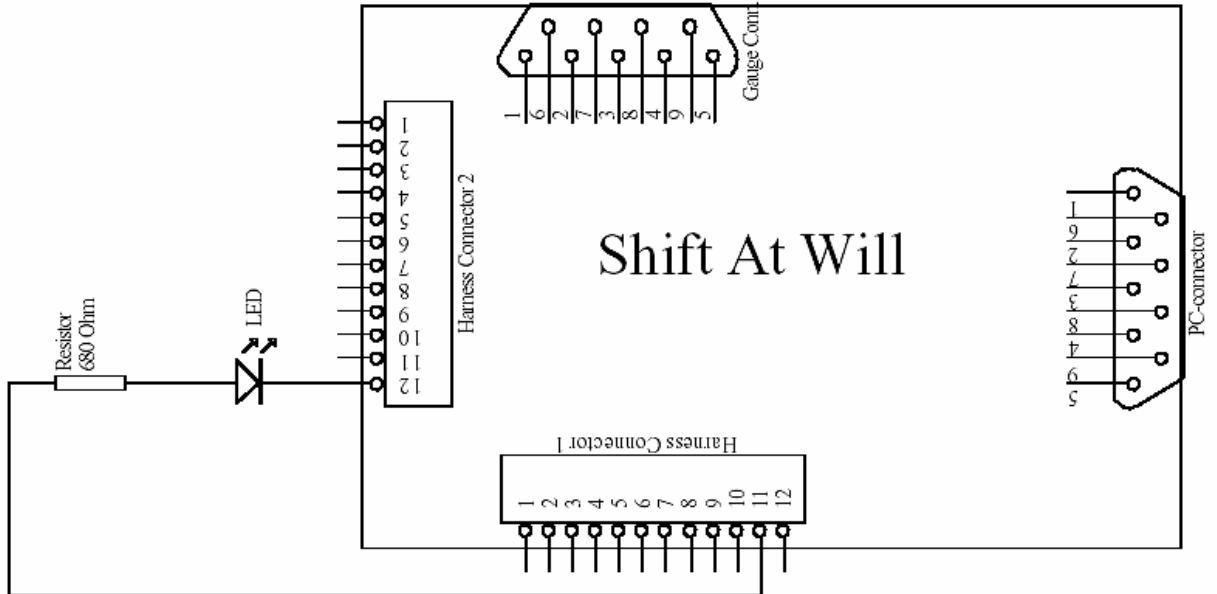
Grounding this input will select the "Comfort Map". Disconnecting the ground will select the "Sport Map".

Thus for variant 2, this terminal should only be **grounded** when active. Do not connect any voltage to it!

## 2.6. Using the Additional Output port

### 2.6.1. Shift Light/Buzzer connection

Connect the shift LED or buzzer according to the schematic below. Connecting a buzzer with a higher current consumption than 110mA may damage the additional output circuit of the SAW control unit!



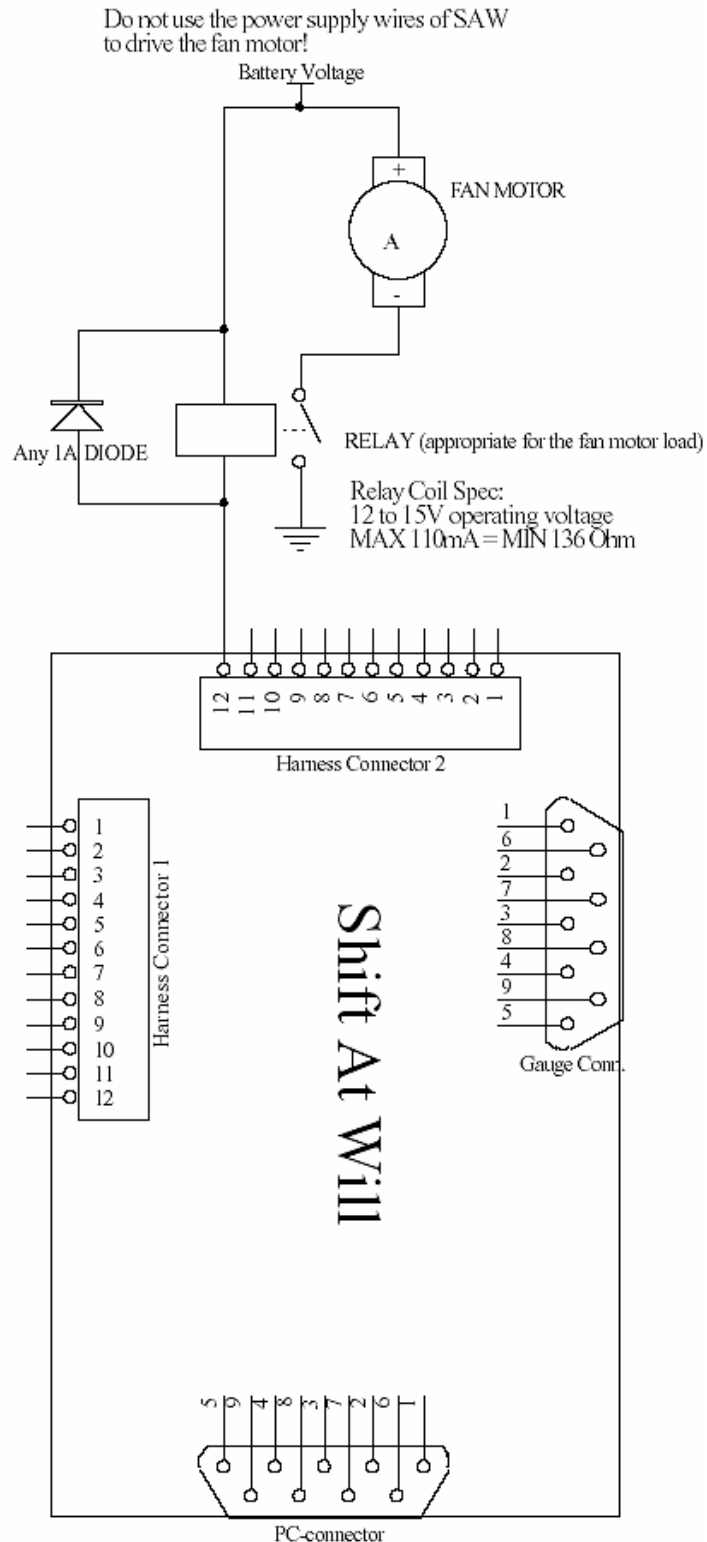
## 2.6.2. Radiator fan control

The additional output can also be used to drive a relay that controls a transmission oil cooler radiator.

The battery voltage driving the fan motor has to be taken from a fused battery voltage line that is controlled by the ignition key.

The discharge diode mounted in parallel with the relay is compulsory.

Any deviations from the connection diagram shown below may cause damage to the SAW control unit.



## 3. Shift Paddle installation

### 3.1. Mechanical installation of the paddles

Shift paddle installation includes removing the steering wheel.

To remove the steering wheel front cover:

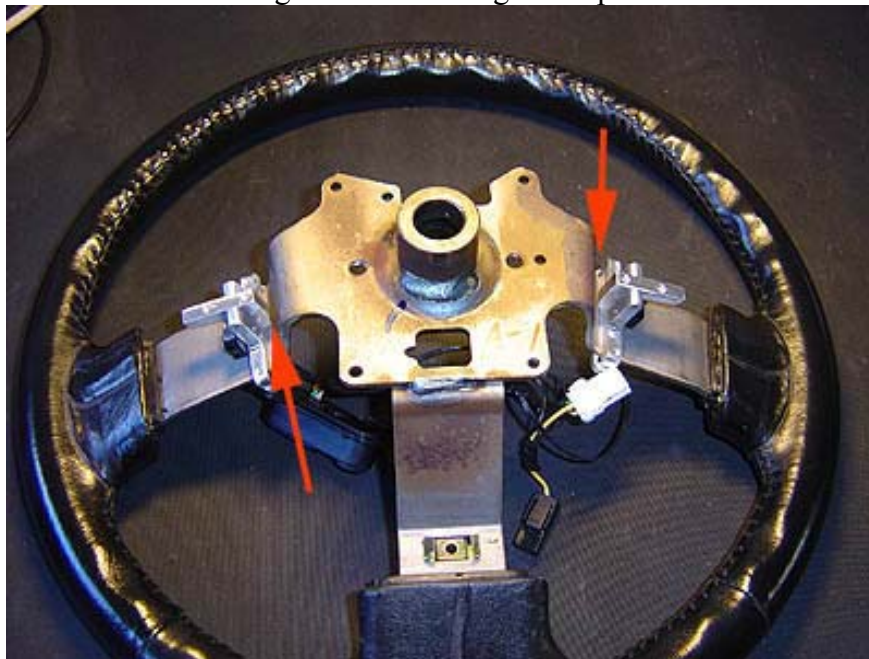
- undo a screw behind the steering wheel, that secures the center piece in place
- pull on the center piece from below (it has a couple of snap on fasteners)

Unplug the connector behind the center cover.

Detach the steering wheel from the steering column by removing the nut in the center.

Remove the back cover from the steering wheel.

Fix the paddle mounts on the steering wheel according to the picture below.

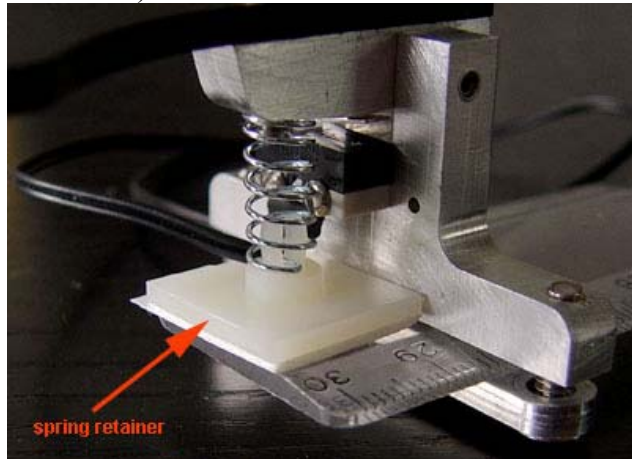


Be sure to adjust the mounting position so that the paddle-lever will rest on the steering wheel frame when the paddle is fully depressed (this is pointed out by the arrows in the picture above). This is as not to damage the switch by pressing the paddle to hard.

The next step is to drill one opening on each side of the back-cover for the paddle mounts to protrude through. The picture below shows the back cover in place.



Install also the return spring before the back cover is fit in place. The spring has to rest on the spring retainer supplied, as not to slip away. The upper end of the spring is retained by the paddle mounting screw (see picture below).



Mount the paddles on the paddle levers (usually the up-shift paddle, marked with a +, on your right side).



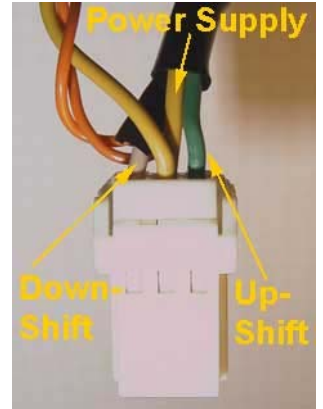


## 3.2. Electrical installation

The paddle shifters are electrically connected using the cruise control harness. This limits the use of cruise control when running the SAW system in manual mode. The “Set Coast” button wire serves as the Up-Shift control and the “Resume Accel” as Down-Shift.

When running in Auto-mode, the cruise control function is not affected.

Connect one wire from each paddle switch to the power supply wire of the steering wheel cover connector as illustrated in this picture. Then connect the second wire of each switch to either the up-shift or the down-shift cable as pointed out in the picture.



This completes the electrical installation at the steering wheel.

The next step is to connect the cruise control wires at the cruise control module to the SAW unit. See chapter 2.4 for the description.



#### 4. SAW Gauge installation

The SAW Gauge is a standard 2 1/16" (52,4mm) round gauge that can be fit into e.g. an A-pillar mount. It plugs directly into the SAW Control Unit. If the supplied connecting cable is too short, it can be extended with a standard serial port extension cable (9-pin DSUB).

The gauge supports a **dimmer function** that is controlled by the separate white wire in the gauge harness. Connect this wire to the car's instrument illumination to make it dim when driving with the lights on at night.

#### 5. First use after installation

These are the recommended steps to follow after the installation has been completed.

Connect a laptop computer to the SAW computer interface as described in the "Tuning the system" chapter of the Instruction Manual). After starting and setting up a terminal emulator program (e.g. Hyper Terminal in Windows), switch on the ignition.

Check that the SAW input values reported in the main display are correct (press the space bar to redraw the screen). Switch all the connected switches and see that their status on the main display changes.

Switch to manual mode and 1<sup>st</sup> gear. Start the engine and check that the RPM reading is correct (the OEM RPM gauge is inaccurate and is usually showing a slightly higher reading).

Begin driving in manual mode and check that all gears are shifting correctly.

Check the lock-up operation in 4<sup>th</sup> gear.

Check the speed reading for correctness.

If all the above tests are successful then you're ready to test the automatic shifting mode.

Stop the vehicle and switch to auto mode. Begin driving carefully to check if the gear switching is correct.

Now everything is tested and the fun begins!

#### 6. Additional notes on ignition timing

After installing Shift At Will, the ECU will use 25 degree timing when idling, even when the shift lever is placed in "N" position. With the original ATCU, the ECU changes the timing to 15 degrees when the shift lever is put in "N" or "P" position. There are no drawbacks to this except when adjusting the ignition timing. The ECU is only assuming that the lever is always in the "D" position, where it normally is placed while driving anyway.

Adjusting the ignition timing can be done either after reconnecting the original ATCU and disconnecting SAW from the harness or by using a Cozult, Techtom MDM or other diagnostic equipment to read the timing used by the ECU. Using a diagnostic equipment to read the ignition timing used by the ECU is always recommended due to several factors affecting the timing even when not using Shift At Will.