



SAW Shift At Will

Full control over your automatic transmission!

INSTRUCTION MANUAL

Thank you for purchasing this product. We hope that it will enhance your driving experience by giving you more control.

Please read this instruction manual carefully, to ensure proper use of this product.

Product Name: SAW System

Product Code: SAW300ZX

Software Version: V1.10

Vehicle Applications: Nissan 300ZX, Z32



TABLE OF CONTENTS

<u>INSTRUCTION MANUAL</u>	2
1. System Overview	3
1.1. Key features	3
1.2. System components and controls	3
1.2.1. Control Unit	3
1.2.2. Paddle Shifters	3
1.2.3. SAW Gauge	4
1.3. Basic handling	5
1.3.1. Driving in manual mode	5
1.3.2. Switching between the Auto and Manual Mode	5
1.3.3. Automatic mode of operation	6
2. Additional functions	8
2.1. Oil temperature monitoring	8
2.2. Shift alert and oil cooler fan control	8
2.3. Forced Lock-up operation	8
2.4. Upgrading the software	9
3. Tuning the system	10
3.1. Main display	10
3.2. Main menu	11
3.3. Oil temperature alarm and additional output function settings	11
3.4. Set miscellaneous function parameters	12
3.5. Line pressure setting	13
3.6. Down shift limits	13
3.7. Calibration	13
3.8. Torque converter lock-up setting	14
3.9. Downloading new shift maps	14
4. Warranty and terms of use	15



1. System Overview



1.1. Key features

- Completely replaces the original AT control unit
- Gives manual control over gear shifting
- Custom paddle shifters made to fit perfectly in the Nissan 300ZX
- Automatic shift-mode
- Two automatic shift-maps fully customizable by the user
- All parameters accessible for tuning via a PC-interface
- Monitoring of the transmission oil temperature
- Full control over the line pressure and lock-up operation
- Blue LED digital standard 2 1/16" gauge
- Shift alert output
- Any future software upgrades will be downloadable by the user

1.2. System components and controls

1.2.1. Control Unit

The SAW Control Unit replaces the OEM Automatic Transmission Control Unit. It connects to the vehicle-harness via screw-terminal sockets. Most of the connections are made by cutting the original harness and inserting the wires into the screw terminals. See the Installation Manual for the full installation information.

The Control Unit is equipped with a serial computer interface that is compatible with a VT100 terminal (you can e.g. use the Hyper Terminal program included in Windows to communicate with it).

The control unit can also be powered "on the bench" via any AC or DC power source of maximum 15V. This is to enable connecting to a PC away from the vehicle, in case that no laptop is available to the user.

1.2.2. Paddle Shifters

The paddle shifters are made to fit the 300ZX non-airbag steering wheel. They are using the cruise control wires to communicate with the Control Unit. The cruise control functionality is not

affected when driving in automatic mode. Keep the cruise control switched off while driving in manual mode.

1.2.3. SAW Gauge

The SAW Gauge is an AutoMeter blue LED digital gauge.

The information shown by the gauge includes:

- current gear
- auto/manual mode indication
- temperature alarm (blinking H)
- lock-up state



The gear display is equipped with a 3m cable that plugs in to the Control Unit. The gauge brightness is controllable through the menu (see chapter 3.4).



1.3. Basic handling

1.3.1. Driving in manual mode

Select the D-position with the shift lever when driving.

The manual mode gives you full control over the gear shifting and lock-up operation. Press momentarily on the paddle marked with “+” to up-shift and on the one marked with “-“ to down-shift. The lock-up is engaged and disengaged by pressing the +-paddle while in 4th gear.

The OD-button (and the hold button on Jap-spec) has no function when using SAW.

WARNING: The lock-up is originally designed for cruising situations and should therefore not be abused. Engage the lock-up when low on throttle. If you need to accelerate fast, disengage the lock-up first (this will also let the turbos spool up faster).

Always release the lockup when planning to stop. If the lock-up is not released then it will be automatically disengaged when the engine RPM drops below 1200RPM. It is though recommended to connect the brake lights to the brake switch input for an automatic lock-up release, as soon as the brake pedal is pressed (see the Installation Manual for details).

Down-shifting with the lock-up engaged is also possible. This will automatically release the lock-up and down shift to 3rd gear.

The engine brake is automatically applied by SAW when below a specified throttle level (see parameter tuning chapter 3). The engine brake is only available in 2nd and 3rd gear due to the mechanical design of the transmission.

There is a safety feature included in SAW that will block a down-shift if the speed is too high. The down shift speed thresholds are adjustable by the user (see chapter 3.6).

When coming to a stop, an automatic down-shift to 1st gear will occur in manual mode. This function can be disabled through the menu (see chapter 3.4).

1.3.2. Switching between the Auto and Manual Mode

The mode switching is done by holding the cruise control “Cancel”-button depressed for 2s. (It can also be done by holding both the Up-Shift and Down-Shift buttons depressed for 2s but this can result in an initial up or down shift.)

An optional mode switch input is also available, which allows for connecting a dedicated switch for setting the mode of operation.

Switching between the both modes can be done at any time, even while driving.

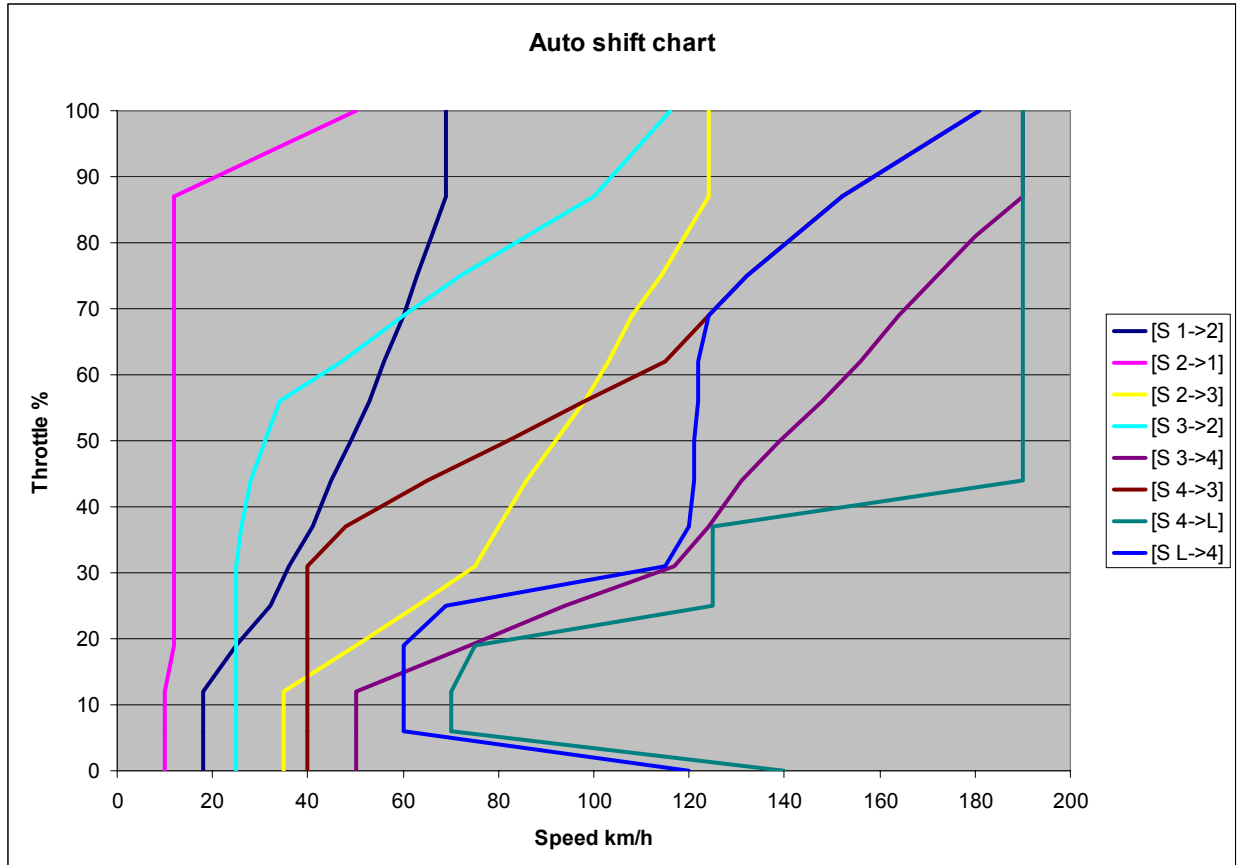
The default gear shift mode is automatic. It can be also set to manual, last used or switch controlled. See chapter 3.4 for more information.



1.3.3. Automatic mode of operation

In the automatic mode the SAW takes care of the gear shifts and the lock-up operation according to 2 shift maps (Sport and Comfort) that are programmable by the user. The map selection can be done by connecting a switch to the SAW Control Unit (see Installation Manual). When no switch is connected, the Sport Map is chosen by default. Both maps are identical at delivery and it is up to the user to tailor them to his/her needs.

The default shift map is shown below:



The shift maps can be edited in an Excel-sheet or directly in a text file. The Excel-sheet is available for download (one for mph entry and one for km/h entry).



The shift map text file format is as follows:

```
"[S 1->2] 18 18 18 25 32 36 41 45 49 53 56 60 63 66 69 69"  
"[S 2->1] 10 10 10 12 12 12 12 12 12 12 12 12 12 12 50"  
"[S 2->3] 35 35 35 50 63 75 80 86 92 98 103 108 114 119 124 124"  
"[S 3->2] 25 25 25 25 25 25 26 28 31 34 47 60 72 86 100 116"  
"[S 3->4] 50 50 50 74 94 117 124 131 139 148 156 164 172 180 190 190"  
"[S 4->3] 40 40 40 40 40 40 48 65 82 98 115 124 132 142 152 181"  
"[S 4->L] 140 70 70 75 125 125 125 190 190 190 190 190 190 190 190 190"  
"[S L->4] 120 60 60 60 69 115 120 121 121 122 122 124 132 142 152 181"  
"[C 1->2] 18 18 18 25 32 36 41 45 49 53 56 60 63 66 69 69"  
"[C 2->1] 10 10 10 12 12 12 12 12 12 12 12 12 12 12 50"  
"[C 2->3] 35 35 35 50 63 75 80 86 92 98 103 108 114 119 124 124"  
"[C 3->2] 25 25 25 25 25 25 26 28 31 34 47 60 72 86 100 116"  
"[C 3->4] 50 50 50 74 94 117 124 131 139 148 156 164 172 180 190 190"  
"[C 4->3] 40 40 40 40 40 40 48 65 82 98 115 124 132 142 152 181"  
"[C 4->L] 140 70 70 75 125 125 125 190 190 190 190 190 190 190 190 190"  
"[C L->4] 120 60 60 60 69 115 120 121 121 122 122 124 132 142 152 181"  
"[END]"
```

The texts within brackets are “tags”. The letter S signifies the Sport Map and C the Comfort Map.

Tag naming explanation:

- 1->2** = Shift from 1st gear to 2nd
- 2->1** = Shift from 2nd gear to 1st
- 2->3** = Shift from 2nd gear to 3rd
- 3->2** = Shift from 3rd gear to 2nd
- 3->4** = Shift from 3rd gear to 4th
- 4->3** = Shift from 4th gear to 3rd
- 4->L** = Activate torque converter lock-up
- L->4** = Deactivate torque converter lock-up

Each of the 16 numbers following a tag is a speed (in km/h) at which the shift action is to be triggered.

The speed values are ordered from the lowest throttle opening to the highest.

The throttle opening levels in percent are:

0, 6, 12, 19, 25, 31, 37, 44, 50, 56, 62, 69, 75, 81, 87, 100

The 100% throttle opening column is only used when the kick-down switch is activated.

The map file can be sent to SAW Control Unit using a terminal emulator program (see chapter 3.9)



2. Additional functions

2.1. Oil temperature monitoring

The oil temperature is an important factor when it comes to the transmission longevity. This is especially important when using your car on a race track when excessive amounts of heat are generated in the transmission and the torque converter in particular.

SAW allows for generating a visual warning when a specified oil temperature is exceeded. This temperature is set to 100°C (212°F) by default. See also chapter 3.3 for setting the temperature threshold.

2.2. Shift alert and oil cooler fan control

The Control Unit is equipped with an additional output function that can either control an oil cooler fan or be used as a LED/buzzer control for shift alert.

The shift alert will light/sound when a specified RPM threshold has been exceeded. It is meant to be used as a shift reminder in manual mode. See chapter 3.3 for more information on setting the RPM threshold.

The oil cooler fan control is meant to be used to control an electrical fan, mounted on the transmission oil cooler. The fan will be engaged at a preset temperature and disengaged automatically when the temperature drops 5 degrees Celsius. See chapter 3.3 for more information on setting the fan engagement temperature threshold.

2.3. Forced Lock-up operation

SAW allows for forcing the engagement/disengagement of the lock-up in any gear by connecting a dedicated switch to the Control Unit. This feature can be explored by the users but is not recommended to be used for transmission longevity reasons.

NOTE: The automatic lock-up disengagement below a specified RPM level operates regardless of the position of the force lock-up switch.



2.4. Upgrading the software

A SAW software upgrade is possible to be made by the end user. Any software updates will be made available on our home page.

The software is downloaded to the SAW Control Unit using a PC-program available on our home page.

The software update procedure is as follows:

- Download the new software
- Download the update tool program
- Connect the SAW to the PC's COM-port
- Press the SW update button (indicated on the Control Unit lid)
- Power up the Control Unit
- Release the SW update button
- Run the update tool as described below

Run the update tool from the command line. In Windows go to the start menu and click on "Run...". Type "cmd" in the window that popped up and click OK. This will bring up the DOS window. Be sure to either go to the directory where you downloaded the SAW update files or put the files in "My Documents" folder, where the DOS window will be executing by default.

The update tool command line to enter is:

```
saw_update filename -COMx
```

The "filename" is the name of the software file downloaded. The COM-port needs to be specified if using other COM-port number than COM1.

The update will take a couple of minutes, which is normal. Progress is shown on screen in percent. Make sure your Laptop does not go to suspend/sleep mode during the update, as this will disturb the software update procedure.



3. Tuning the system

The SAW system is delivered with a default configuration that in most cases does not need to be modified. The subsequent chapters bring an explanation to all the parameters available, for those who like to fine tune the system

You will need a terminal emulator program for connecting to the SAW menu system. The Hyper Terminal program included in Windows will do just fine. There are also other free terminal emulators available on the internet e.g. Tera Term.

The connection settings should be as follows:

Bits per second: 9600

Data bits: 8

Parity: None

Stop bits: 1

Flow control: None

The terminal emulation is VT100 and should be automatically detected by the terminal emulator.

3.1. Main display

```
ESS Racing * Shift At will * v1.10
Speed (kmph/mph): 182/113      RPM: 4500
Throttle (%): 0                Gear: 4
Oil temp (C): 25              TC-lock sw: UNLOCK
Up-shift: OFF                 Down-shift: OFF
Mode switch: MANUAL           Auto-mode: SPORT
Kick sw: OFF                  Break sw: OFF
```

Press M to enter menu, any other key to redraw screen.

The main display shows the current values on all SAW inputs. This is a first thing to check after installation.

The values shown are updated twice a second. The redraw screen feature is needed if the screen gets corrupted for some reason. Refreshing the screen is also needed when connecting to the SAW while it is running (normally only the values on the main display are updated, not the text).

Pressing M will enter the menu.

The current software version is presented in the upper right corner (“V1.10”).



3.2. Main menu

1. Set oil temp. alarm and additional output function
2. Set function parameters
3. Set max line pressure throttle threshold
4. Set down shift limits
5. Calibration
6. TC lock-up settings
7. Download auto shift map

Enter menu number: _

(any other key to exit)

NOTE: All parameter changes take effect after next power-up!

This is the main menu with a number of sub-menus to be chosen from.

Parameter changes should be done while the vehicle is stationary. All changes take effect at next ignition off-on transition.

3.3. Oil temperature alarm and additional output function settings

1. Set oil temp. alarm and additional output function

Activate alarm above (degrees C):100 max:110

Set additional output function (+ to change):SHIFT ALERT

Activate shift alert above (RPM):6500

Activate oil cooler fan at (degrees C):95

Set new value and press enter to accept.

Press any other key to exit.

This menu allows setting the oil temperature alarm threshold in degrees Celsius. The default value is set to 100°C (212°F).

Additional output function is also controlled through this menu.

There are two functions to choose from: shift alert and fan control.

For the shift alert function, the RPM threshold can be set.

For the oil cooler fan control, the fan activation temperature can be set. The fan is automatically deactivated when the temperature drops 5 degrees Celsius below the ON-threshold set.



3.4. Set miscellaneous function parameters

2. Set function parameters

Set default shift mode (press + to change):AUTO
Auto downshift to 1st when stopped:ENABLED
Set gauge dimmer bright level (% of max):65
Set gauge dimmer dim level (% of max):18
Activate overrun clutch below throttle level(%):25

Set new value and press enter to accept.
Use + key to change textual parameters.
NOTE: Gauge dimmer changes take effect immediately.
Press any other key to exit.

Miscellaneous function parameters are controlled through this menu.

The default shift mode can be preset to: automatic, manual, last used or switch controlled. Press the + key to change the value (accept with enter key).

Default shift mode is the mode chosen after turning the ignition on. The “last used” mode remembers the mode used when turning the ignition off. When using the “switch controlled” mode, an additional mode switch has to be fitted (see Installation Manual).

There are two gauge brightness levels that can be set through this menu. One is the bright level and the other is the dim level. Switching between the bright and dim levels is done by means of connecting the white wire in the gauge connector to the driving light circuit (see Installation Manual for more information).

The overrun solenoid is the one controlling the engine brake. It is activated below a certain throttle level in all gears except the 4th. In 1st gear even though operating, it has no effect on engine brake due to the mechanical design of the transmission.



3.5. Line pressure setting

3. Set max line pressure throttle threshold

Maximum line pressure above throttle level(%):25 max:100

Set new value and press enter to accept.
Press any other key to exit.

The line pressure is the transmission oil pressure level. The pressure level is controlled proportional to the throttle opening (load). Here you can set the throttle level above which the line pressure will be set to its maximum level. Note that setting this level to 0% will cause the maximum line pressure to be applied regardless of the throttle level. This will affect the engine brake, as it needs the pressure to be low while braking. With the line pressure at maximum level the gear shifts will be jerky as well.

3.6. Down shift limits

4. Set down shift limits

Down shift to 3rd gear (km/h):180 max:300
Down shift to 2nd gear (km/h):120 max:300
Down shift to 1st gear (km/h):80 max:300

Use the Tab key to choose the value to be changed.
Set new value and press enter to accept.
Press any other key to exit.

These are the down shift limits that control the blocking of a down-shift depending on speed.

3.7. Calibration

5. Calibration

Speed input (km/h at 100Hz):278 max:999
RPM input (RPM at 1Hz):20 max:255
Throttle input at 100% (mV):4301 max:5000
Throttle input at 0% (mV):400 max:5000
Oil temp. sensor resistance at 100C(Ohm):201 max:4281
Oil temp. sensor resistance at 80C(Ohm):298 max:4281
Oil temp. sensor resistance at 20C(Ohm):2100 max:4281

Use the Tab key to choose the value to be changed.
Set new value and press enter to accept.
Press any other key to exit.
NOTE: Some parameters entered are rounded off.

This menu is aimed for fine tuning the SAW inputs.

The speed input characteristics is defined as the speed detected when the input signal frequency is equal to 100Hz. This value may need tuning when mounting after market wheels with a different



diameter than the original. This value can be fine tuned by using a GPS receiver with velocity display and checking it against the speed shown on the main display.

The RPM input does not need tuning when the SAW is used on a Nissan 300ZX.

The throttle 0% and 100% thresholds fine-tune the throttle opening detection.

The oil temperature sensor resistance is non-linear and is defined at 3 temperature levels. These values can be fine-tuned for a more accurate temperature reading.

3.8. Torque converter lock-up setting

6. TC lock-up settings

Shut off level (RPM):1200 max:8000

Use the Tab key to choose the value to be changed.
Set new value and press enter to accept.
Press any other key to exit.

The torque converter emergency lock-up release RPM level can be set here.

3.9. Downloading new shift maps

7. Download auto shift map

Ready to receive shift map file.
Send map file using send text file command.

WARNING: Do not download new shift maps while driving!
Press Esc key to cancel download.

New shift maps can be downloaded to the Control Unit using this menu.

If using the Hyper Terminal program, go to the Transfer menu and select the Send Text File menu item. Choose the map file to send and wait for confirmation. The download menu will return to the main menu upon completion of the map recording.

Remember to cycle the ignition for the changes to take effect!

WARNING: Be cautious when modifying the shift-maps. The SAW unit does not check for map suitability and correctness. Do not define overlapping gears as this will result in shifting back and forth between them. If you detect any strange behavior while driving with a new map, switch immediately to manual mode.



4. Warranty and terms of use

This product is covered by a 1-year warranty from the time of purchase. The warranty covers any component or material faults. The warranty is not valid in case of tampering with the product or improper installation.

ESS Racing can not be held responsible for any damage caused to the automatic transmission. The SAW System controls the transmission in the same way as the original Nissan ATCU (Automatic Transmission Control Unit) does, however it gives the user a possibility to increase the mechanical load on the transmission e.g. when using it in a racing competition. The user should be aware that using the transmission outside of the recommended operating temperature of 80-90C (176-194F) will shorten its mechanical lifetime. It is recommended to install an additional oil cooler when using the transmission under high load.

Accidental, incidental or consequential damage, such as: loss of use of the vehicle, inconvenience, any and all labor costs or commercial losses are not covered by the warranty. In no event will ESS Racing's liability ever exceed the purchase price.