



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: V1.20

Vehicle Applications: Nissan 300ZX, Z32



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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 splicing into 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 (COM-port) 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 (lit in auto mode)
- temperature alarm (blinking H)
- lock-up state by showing 'L' or a pseudo 5th gear
- shift map selection indication (lit in sport mode)
- additional output status indication (lit when active)
- shift light function



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 3.3).



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. Pressing the “-“ paddle while the lock-up is engaged in 4th gear, will cause the lock-up to disengage and the system will down shift to 3rd gear.

WARNING: The lock-up is originally designed for cruising situations and could be damaged if engaged at hard acceleration. Version 1.2 of the SAW software incorporates a lock-up protection function that will not allow lock-up engagement until the load decreases to an appropriate level (it will use the currently chosen shift map to evaluate that). The lock-up engagement will thus be pending (blinking ‘L’) until proper engagement conditions are met.

Always release the lockup when planning to stop. If the lock-up is not manually released then it will be automatically disengaged when brake pedal is pressed or the engine RPM drops below 1200RPM.

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 3.4).

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 3.3).

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 paddles 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.

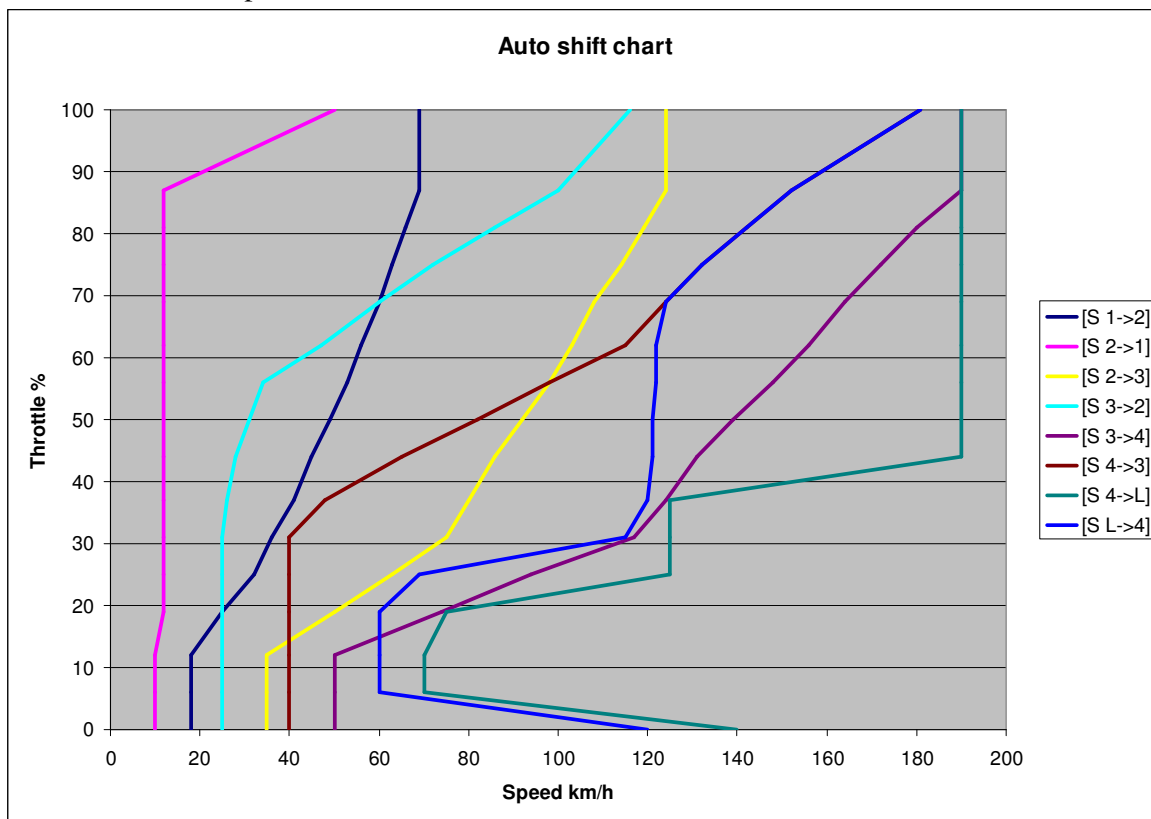
The default gear shift mode is automatic. It can be also set to manual, last used or switch controlled. See chapter 3.3 for more information.

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 the OD-button to the SAW Control Unit (see Installation Manual). When nothing is connected to the map switch input, 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 hold button found on Jap-spec vehicles has no function when using SAW.

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 Map Version]"
```

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 3.7)

A map version tag can be entered in the Excel-sheet and is shown in SAW map management menu.



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 3.5 for setting the temperature threshold.

2.2. Additional output: 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 3.5 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 below the preset threshold. See chapter 3.5 for more information on setting the fan engagement temperature threshold.

2.3. Shift light function

The shift alert can also (apart from being output by the additional output) be shown in the SAW gauge. When the preset RPM limit is reached then the gauge will be lit with its maximum brightness. All LED segments will be lit except for the middle digit that will still show the current gear.

2.4. 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 and at pressing the brake pedal operates regardless of the position of the force lock-up switch.

The OD-button, normally used to control the shift map chosen, can also be configured to be used as lock-up control instead.



2.5. 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 or enable/disable its features.

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 (it can be found under All Programs->Accessories->Communications). 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 * v1.20
Speed (kmph/mph): 182/113      RPM: 4500
Throttle (%): 0                Gear: 4 (AUTO)
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 (“V1.20”).



3.2. Main menu

1. Set function parameters
2. Set limits and thresholds
3. Set alarms and additional input/output functions
4. TC lock-up settings
5. Manage auto shift maps
6. Solenoid self test
7. Calibration

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. Set function parameters

1. 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

Pseudo 5th gear operation (press + to change):DISABLED

Set new value and press enter to accept.

Use the Tab key to choose the value to be changed.

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.



Pseudo 5th gear operation shows the lock-up status as the 5th gear. Down-shifting from the locked-up state will cause the lock up to disengage and the gear to remain in 4th. A pending lock-up will be shown as a blinking '5'.

3.4. Set limits and thresholds

2. Set limits and thresholds

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

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.

The down shift limits are used to control the blocking of a down-shift depending on speed.

3.5. Oil temperature alarm and additional output function settings

3. Set alarms and additional input/output functions

```
Activate oil temperature alarm above (degrees C):100  max:110
Set additional output function (+ to change):SHIFT ALERT
Activate oil cooler fan at (degrees C):95      max:110
Activate shift alert above (RPM):6000      max:8000
Shift alert in gauge (+ to change):ENABLED
Use map-switch input as lock-up switch (+ to change):DISABLED
```

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.

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 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.

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

The SAW gauge can be used as a shift light. This function can be enabled/disabled in this menu.

The map switch input can be set to act as the lock-up control instead. The OD-button is then set to control the lock-up, which can be handy on a dyno.



3.6. Torque converter lock-up setting

4. Torque converter lock-up settings

shut off level (RPM):1200 max:8000
Lock-up engagement load protection (+ to change):ENABLED

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.

Lock up engagement load protection can be enabled/disabled here.

3.7. Shift map management

5. Manage auto shift maps

Current shift map version: Original-TT

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.

Current shift map version is shown here. The SAW is delivered with original shift maps preloaded. Their version tag is: Original-TT for a Z equipped with a TT differential and Original-NA for a Z with a NA differential.

Downloading the shift maps with the Hyper Terminal program is accomplished as follows. 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. You can then go back to menu 5 to double check the map version.

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.



3.8.Solenoid self test

6. solenoid self test

```
A-shift-solenoid status: NOT TESTED
B-shift-solenoid status: NOT TESTED
  LPR-solenoid status: NOT TESTED
LPR series resistor status: NOT TESTED
  Overrun-solenoid status: NOT TESTED
  TCL-solenoid status: NOT TESTED
```

WARNING: This test can only be performed with the engine off!

Press the T key to perform the test or any other key to exit.

The transmission solenoid self test can be done here. It is recommended to be done to verify the installation and if any erroneous transmission behaviour is detected.

This test can only be performed with the engine off. Only the ignition should be on.

The possible test results include:

NOT TESTED – Not tested yet (the status upon entering the menu or when trying to test with engine on)

TEST OK! – Test passed (a solenoid is connected to SAW output. It can still be a wrong solenoid connected to the wrong output)

OPEN CIRCUIT – Nothing is connected to the SAW output

SHORT CIRCUIT – Serious problem that can damage the SAW in long term! Switch off the ignition and investigate immediately! The SAW output is short circuit to chassis ground.



3.9. 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 circumference 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.



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.