STN11xx

PowerSave Functionality

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1.0 PowerSave Functionality

STN11xx features a sophisticated power management system (PowerSave™) that can be used to put the device in low power mode. The primary purpose of PowerSave is to prevent the vehicle's battery from being drained when the device is left plugged in for extended periods of time (e.g., permanent in-vehicle installations).

The concept of a **trigger** is key to understanding the operation of PowerSave. A *trigger* is an event or a condition that causes the device to either go to sleep, or wake up from sleep. "Go to sleep after 5 minutes of UART inactivity" and "wake up when vehicle system voltage goes above 12.8 volts" are examples of triggers. Each trigger can be independently enabled or disabled.

The following sections describe the PowerSave functionality, while section 2.0 describes the commands and parameters used to configure and control the power management system. You can use the STSLCS command to print a summary of the active PowerSave configuration settings.

1.1 Control Modes

There are **two control modes** for the PowerSave functionality: **native** and **ELM327**. Use bit 7 ("master enable") of the programmable parameter 0E (**PP 0E**) to switch between the modes. See the description of the AT PP command for more information about PP 0E.

By default, STN11xx is operating in the native PowerSave control mode.

1.1.1 Native PowerSave Mode

When the "master enable" bit of PP 0E is cleared, or PP 0E is off, STN11xx is in the **native** PowerSave control mode.

In this mode, the rest of the 0E programmable parameter bits are ignored and the PowerSave is controlled exclusively via STSL commands. In native mode, the ATLP command is unavailable. Also, the ELM327 "ACT ALERT" and "LP ALERT" messages are not displayed.

1.1.2 ELM327 Low Power Mode

Note: *this mode had been implemented for compatibility with software written for the ELM327. The native PowerSave mode has a number of important advantages over the ELM327 Low Power mode, including greater flexibility, more straightforward configuration, and default settings that had been optimized for more reliable performance.*

When the "master enable" bit of the 0E programmable parameter is set and PP 0E is on, STN11xx is in the **ELM327 control mode.**

In this mode, most PowerSave settings are overridden by the PP 0E. However, the following settings that do not have a PP 0E equivalent can still be adjusted via their corresponding STSL commands:

- **UART wakeup pulse timing** (SLUWP)
- **External SLEEP input polarity** (SLXP)
- **Voltage based triggers** (SLVL, SLVLS, SLVLW, SLVG, SLVGW)

By default, instead of the fixed ELM327 minimum UART Rx wakeup pulse requirement of 128 µs, STN11xx pulse width is set to 0 (20 ns). This is done to allow the user to wake up the device by sending characters, even at highest supported UART baud rate.

In the ELM327 PowerSave control mode, STSLCS command will report the actual active configuration that is set via the 0E programmable parameter.

STN11xx external SLEEP input functions as the ELM327 IgnMon input.

1.2 Sleep Triggers

Device can be put to sleep using one of the four sleep triggers:

- **Sleep commands** (STSLEEP and ATLP)
- **UART inactivity** (SLU)
- **External SLEEP input** (SLX)
- **Voltage level** (SLVL)

Multiple sleep triggers can be enabled at the same time. The first trigger that gets activated will put the device to sleep.

By default, all sleep triggers are off.

Warning: *before you enable a sleep trigger or issue the STSLEEP command, make sure that the wakeup triggers are enabled and properly configured. The only other means of bringing the device out of the sleep state is to initiate a hardware reset, either via the* $\overline{RESET}$ *input, or by cycling the power.*

1.2.1 STSLEEP and ATLP commands

The device will go to sleep when it receives the ATLP or STSLEEP command. The ATLP command is available only in the ELM327 Low Power Mode.

The STSLEEP command has an optional *delay* parameter. The purpose of the delay is to prevent the device from going to sleep prematurely: some hosts

randomly toggle the UART communication lines and can unintentionally wake up the device as they are shutting down or entering the standby mode.

1.2.2 UART Inactivity

The STN11xx can be configured to go to sleep automatically after a period of UART inactivity.

UART inactivity sleep trigger is turned on/off using the STSLU command (it is off by default). Use the STSLUIT command to set the **UART inactivity sleep timeout.**

Warning: *STN11xx UART inactivity sleep trigger is disabled while any command is executing. In other words, STN11xx must print the command prompt before it will act on a sleep trigger. Therefore, commands which require UART activity to terminate their execution (e.g., ATMA, STMT, etc) will keep the device awake indefinitely. A continuous stream of incoming messages may also prevent the device from going to sleep. This may occur, for example, if message filters are set up to accept bus traffic intended for other nodes.*

1.2.3 External SLEEP Input

Another automatic sleep trigger is the **external SLEEP input.** This trigger is off by default. When enabled (using the STSLX command), it allows the external circuitry to control the sleep state.

When STN11xx senses a logic low on the SLEEP pin, it immediately aborts any OBD reception in progress, or monitoring command that is active at the time, and prints the command prompt. It then monitors the SLEEP input and enters the PowerSave mode if the minimum low time (specified by the STSLXST command) is satisfied.

Note: *STN1110 and microOBD 200 (STN1120) allow the polarity of the external SLEEP input to be inverted, via the STSLXP command.*

The following are some of the possible uses of this trigger:

- **"Host present" detect** – sleep/wakeup when the host disconnects/connects or starts up/shuts down (goes into standby)
- **Ignition key detect** – sleep/wakeup depending on the ignition key position
- **Direct sleep control** via host microcontroller

The logic state of the SLEEP input state can be polled using the STSLXS and ATIGN commands.

See section 1.6 for device-specific implementation details.

1.2.4 Voltage Level Sleep

The STN11xx can also enter sleep mode based on the voltage on the ANALOG_IN input. This trigger can be configured in the variety of ways. The settings specify voltage threshold, whether the trigger is active above or below the threshold setting, and the amount of time the voltage must stay below or above the threshold for the device to enter sleep mode.

The voltage level sleep trigger can be used to put the device into the low power mode when the engine shuts down and the alternator stops generating power. The delay is designed to prevent the device from entering sleep when the system voltage dips below the specified threshold due to momentary load changes. The default settings should work for most vehicles with 12 volt lead-acid batteries.

Use the STSLCS command to verify that the trigger was properly configured. An exclamation point ('!') in front of the voltage setting means that the trigger setting is invalid, and the trigger will never activate. Refer to section 1.4 "Voltage Trigger Considerations" for more information.

Note: *In order for the voltage level sleep trigger to operate properly on STN1110 IC or the microOBD 200 module (STN1120), the voltage measurement must be calibrated using the ATCV or STVCAL commands. The calibration is not necessary for the OBDLink scan tools, since it is done at the factory.*

1.3 Wakeup Triggers

There are four wakeup triggers:

- **UART Rx pulse** (SLU)
- **External SLEEP input** (SLX)
- **Voltage level** (SLVL)
- **Voltage change** (SLVG)

After any wakeup trigger timing requirements are satisfied, the STN11xx will wake up and perform an ATWS reset. The wakeup takes several milliseconds, therefore the host must wait for the command prompt before issuing any commands.

The STSLLT command can be used to determine which trigger caused the device to wake up.

By default, UART Rx pulse and external SLEEP input wakeup triggers are on, and voltage triggers are off.

1.3.1 UART Rx Pulse Wakeup

STN11xx can be configured to wake up on an active pulse detected on the UART Rx input. The host can generate the pulse by holding the Rx line in a logic low state, transmitting an RS232 “break” signal, or sending a character on UART whose bit pattern produces a pulse of the required duration.

The wakeup pulse has **minimum** and **maximum timing** requirements, which are set using the STSLUWP command, and are accurate to within approximately 5 µs. By default, the **minimum wakeup pulse width** is set to 0, which translates to an absolute minimum pulse width requirement of 20 ns. It can be increased to improve noise rejection; however, increasing the minimum pulse width will limit the maximum baud rate that the host must use to transmit the wake-up character. Due to the implementation limitations, setting the minimum wakeup pulse width to any value below 15 µs will cause it to be rounded down to 0 (20 ns).

The purpose of the **maximum wakeup pulse width** requirement is to avoid unintentional wakeups. Some PC hosts (especially ones using the RS232 connection) cause the UART Rx line to go low or generate a slow (200 ms or longer) pulse as the host is shutting down or entering standby. The default setting is 30 ms, which allows the device to wake up on a character transmitted over UART at baud rates as low as 300 baud. To disable the maximum pulse requirement and have STN11xx wake up on the high to low UART Rx transition (instead of a pulse), set the maximum pulse timing setting to 0.

1.3.2 External SLEEP Input Wakeup

STN11xx can be configured to wake up when it senses logic high on the external SLEEP control input.

The STXWT commands sets the minimum time the SLEEP input must remain high in order to bring the device out of the sleep state. The setting of 0 will result in a minimum time requirement of 15 µs.

Note: *STN1110 and microOBD 200 (STN1120) allow the polarity of the external SLEEP input to be inverted, via the STSLXP command.*

Section 1.2.3 lists possible applications for the external SLEEP input.

1.3.3 Voltage Level Wakeup

The STN11xx can also wake up based on the voltage on the ANALOG_IN input. This trigger can be configured in a variety of ways. The settings specify voltage threshold, whether the trigger is active above or below the threshold setting, and the minimum amount of time the voltage must stay below or above the threshold for the device to wake up.

The voltage level wakeup trigger can be used to wake up the device when the engine starts up and the alternator causes the system voltage to increase. The default settings should work for most vehicles with lead-acid batteries.

Use the STSLCS command to verify that the trigger was properly configured. An exclamation point (‘!’) in front of the voltage setting means that the trigger setting is invalid, and the trigger will never activate. Refer to section 1.4 “Voltage Trigger Considerations” for more information.

Note: *In order for the voltage level wakeup trigger to operate properly on STN1110 IC or microOBD 200 module (STN1120), the voltage measurement must be calibrated using the ATCV or STVCAL commands. The calibration is not necessary for the OBDLink scan tools, since it is done at the factory.*

1.3.4 Voltage Change Wakeup

The STN11xx can be configured to wake up when the *difference* between two consecutive voltage samples taken at the ANALOG_IN input exceeds a predefined threshold. The settings specify polarity of the change (rising, falling, or either), the change in volts or ADC steps, and the time between the samples.

The voltage level wakeup trigger can be used to wake up the device when the starter motor is cranking the engine (battery voltage dips) or when the engine starts up (voltage rises due to alternator running). This wakeup trigger can be more reliable than the voltage level wakeup trigger, since it does not rely on a specific voltage level which can vary between vehicles, but instead detects voltage change, which happens every time engine starts no matter what the battery level or the alternator voltage is.

Use the STSLCS command to verify that the trigger was properly configured. An exclamation point (‘!’) in front of the voltage setting means that the trigger setting is invalid, and the trigger will never activate. Refer to section 1.4 “Voltage Trigger Considerations” for more information.

Note: *If a non-default voltage scaling is used for the STN1110 IC or the microOBD 200 module (STN1120), the voltage measurement must be calibrated using the ATCV or STVCAL commands, for the voltage change wakeup trigger to operate properly.*

1.4 Voltage Trigger Considerations

Analog voltage that STN11xx “sees” on the ANALOG_IN pin is represented internally by a 12-bit integer. The conversion is done by an internal Analog

to Digital Converter (ADC for short). The voltage represented by a single bit is called an “ADC step”, and is measured in volts per bit (V/bit).

Since the maximum voltage that can be directly measured by the ANALOG_IN pin is very low (about 3V), the pin is normally connected to the voltage source to be measured via an external voltage divider. As its name implies, the voltage divider outputs a voltage that is a fraction of the actual input voltage. For example, a 1:10 voltage divider would output 1.2V for an input voltage of 12V.

Parameters to the voltage based triggers can be specified either in volts, or as raw ADC values.

When a parameter is specified in volts, STN11xx internally converts it to a corresponding ADC value. The size of the ADC step depends on the ratio of the voltage divider. By default, it is calibrated for a voltage divider with a ratio of 1:7.2. Keeping in mind that the maximum voltage on the ANALOG_IN pin is approximately equal to V_{DD} (typically, 3.3V), the maximum voltage that can be measured by the ADC using default calibration is about 24V:

3.3V ÷ 7.2 = 23.76V

To use voltage triggers with a voltage divider that has a different ratio, and to account for parts tolerances, the device must be calibrated using the ATCV or STVCAL commands.

When a parameter is specified as a raw ADC value, calibration must be done in the host software. To get the size of the ADC step, divide the actual measured voltage by the ADC value reported by the STVRX command. For example, if the actual measured voltage is 12V, and the STVRX command returns 0x7FF, the size of the ADC step is:

12V ÷ 0x7FF = 0.00586V/bit

To convert voltage to ADC steps, divide it by the ADC step size. For example, using the values above, 8V is equal to 0x554 steps:

8V ÷ 0.00586 = 0x554

Using ADC values instead of volts eliminates the need to convert ASCII to floating point and vice versa, greatly reducing the load on the host processor.

When setting up the voltage triggers, take special care to make sure that the parameters fall within a valid range of values. For example, the maximum voltage that can be represented by an ADC using default calibration is about 24V. If a parameter is set to a higher value – say, 25V – it falls outside the valid range of values.

A calibration change may put a previously valid value outside of the valid range. For example, if the calibration reduces the maximum voltage from 24V to 14V, a trigger set at 15V will no longer be inside the valid range.

Additional examples of invalid settings are a voltage level trigger specified as ‘below 0V’, and voltage change trigger parameter set to a value less than one ADC step size.

Whenever a parameter value falls outside the valid range, the STSLCS command will display a ‘!’ in front of the voltage setting to indicate that it is invalid, and the trigger will never activate.

1.5 External Power Control Output

The **PWR_CTRL output** can be used to put external circuitry into a low power mode. This pin outputs a logic “high” while the device is awake, and a “low” when STN11xx enters sleep mode.

STN1110 stand-alone IC allows the polarity of the PWR_CTRL to be changed via the STSLPCP command or bit 6 of the 0E programmable parameter (ELM327 LP mode only). The polarity is fixed for all other STN11xx ICs.

1.6 Device Specific Details

This section describes device-specific PowerSave implementation details for the different STN11xx-based ScanTool.net devices.

1.6.1 OBDLink Hardware Rev 1.x

OBDLink devices with hardware revision 1.x have the following limitations:

- In sleep mode, current consumption is about 37 mA (54 mA if the USB cable is plugged in and the virtual COM port is closed).
- External SLEEP control input is not enabled (ATIGN always returns “ON”, and STSLXS always returns “WAKE”).
- The “STATUS” LED is not controlled by the STN1100, and remains on during sleep.

1.6.2 OBDLink Hardware Rev 2.0 – 2.4

On OBDLink devices with hardware revisions 2.0-2.4, the SLEEP input detects voltage on the USB connector.

When enabled, the SLEEP input trigger can put the device to sleep when the chip detects that the host is no longer present. This can happen when the PC shuts down or hibernates, or when the user unplugs the USB cable.

Likewise, the SLEEP input can be configured to wake up the device when the chip detects an active host.

The STN1100 turns off the “STATUS” LED during sleep.

Note 1: *In sleep mode about 15 mA of current will be drawn from the USB socket if the host is active. To maximize power savings, USB must be unplugged or the host must be shut down or put into standby mode.*

Note 2: *Wireless add-on modules (Bluetooth, WiFi) are unpowered in sleep mode. Therefore, it is not possible to wake up the device over a wireless link; use one of the voltage-based wakeup triggers instead.*

1.6.3 OBDLink Hardware Rev 2.5 and Above

OBDLink devices with hardware revision 2.5 and above operate identically to the devices with hardware revisions 2.0 – 2.4 with one exception: SLEEP input in revisions 2.0 – 2.4 only detects unplugged USB cable and host shut down or in hibernate mode. Hardware revision 2.5 and above devices will also detect when the host PC is in standby or sleep mode.

Note: *Wireless add-on modules (Bluetooth, WiFi) are unpowered in sleep mode. Therefore, it is not possible to wake up the device over a wireless link; use one of the voltage-based wakeup triggers instead.*

1.6.4 OBDLink S

In OBDLink S devices, the SLEEP control input is implemented as “host present”. It is wired to sense whether a valid RS232 voltage is present on the RS232 Rx pin (pin 3 of the OBDLink S RS232 DB9 connector).

When enabled, the SLEEP input trigger can put the device to sleep when the chip detects that the host is no longer present. This can happen when the PC shuts down, enters standby, or when the user unplugs the serial cable.

Likewise, the SLEEP input can be configured to wake up the device when the chip detects an active host.

The STN1101 turns off the “STATUS” LED during sleep.

Note 1: *Some non-compliant USB to RS232 converters do not generate valid RS232 voltage levels. The SLEEP input sleep/wakeup triggers should not be used with such converters. Use the UART Rx pulse wakeup trigger (see section 1.3.1) instead. A lower than normal baud rate may be necessary to wake up reliably, due to the wakeup requirements of the RS232 transceiver IC.*

Note 2: *In sleep mode, the RS232 transceiver remains active if there is a valid voltage on the RS232 Rx pin. The transmitter can draw up to several mA of current, depending on the resistance of the load on the RS232 Tx line. For maximum power savings, disable the RS232 transceiver on the host side, shut down the host, or unplug the serial cable.*

1.6.5 microOBD 200

microOBD 200 has all of the STN1120 PowerSave I/O exposed for user implementation.

PWR_CTRL output has its polarity fixed to be active low (sleep = low). It is connected to the $\overline{\text{LP\_OUT}}$ module pin.

In order for the voltage-based sleep/wakeup triggers to operate properly, voltage measurement must be calibrated using the ATCV or STVCAL commands.

1.6.6 STN1110

In order for the voltage-based sleep/wakeup triggers to operate properly, voltage measurement must be calibrated using the ATCV or STVCAL commands.

1.7 Trigger Summary

Sleep Triggers	
Trigger	**Default state**
ATLP	User initiated. This trigger is available only in ELM327 Low Power mode
STSLEEP	User initiated, always available
UART inactivity	Off
External SLEEP input	Off
Voltage level	Off
Wakeup Triggers	
Trigger	**Default state**
UART Rx pulse	On
External SLEEP input	On
Voltage level	Off
Voltage change	Off

2.0 PowerSave ST Commands

The following sections describe the PowerSave ST commands. For brevity, the "ST" prefix is dropped in the command summary, and throughout the text. However, the STN11xx only accepts the full command, including the ST prefix. For example, the SLCS command must be entered as STSLCS.

2.1 Command Summary

Command	Description
SLCS	Print active PowerSave configuration summary
SLEEP *[delay]*	Enter sleep mode with optional delay
SLLT	Report last sleep/wakeup triggers
SLPCP 0|1	Set PWR_CTRL output polarity
SLU *sleep*, *wakeup*	UART sleep/wakeup triggers on/off
SLUIT *sec*	Set UART inactivity timeout
SLUWP *min*, *max*	Set UART wakeup pulse timing
SLVG on|off	Voltage change wakeup trigger on/off
SLVGW [+|-]*volts*, *ms*	Set configuration of the voltage change wakeup trigger
SLVL *sleep*, *wakeup*	Voltage level sleep/wakeup triggers on/off
SLVLS <|> *volts*|*0xhhh*, *sec*	Set configuration of the voltage level sleep trigger
SLVLW <|> *volts*|*0xhhh*, *sec*	Set configuration of the voltage level wakeup trigger
SLX *sleep*, *wakeup*	External sleep trigger on/off
SLXP 0|1	Set polarity of the external sleep control input
SLXS	Print external SLEEP input status
SLXST *ms*	Set minimum active time for external sleep trigger before entering sleep
SLXWT *ms*	Set minimum inactive time for external sleep trigger before wakeup

2.2 Command Descriptions

SLCS

Print active PowerSave configuration summary. This command prints only the currently active configuration. Therefore, to see the native configuration settings, ELM327 control mode must be turned off by clearing the "master enable" bit of PP 0E or turning off the PP 0E parameter. The device must be reset for any PowerSave configuration changes to take effect.

The configuration is printed in the following format:

```
CTRL MODE:   <NATIVE/ELM327>
PWR_CTRL:    LOW PWR = <LOW/HIGH>
UART SLEEP:  <ON/OFF>, <timeout> s
UART WAKE:   <ON/OFF>, <pulse min>-<pulse max> us
EXT INPUT:   <LOW/HIGH> = SLEEP
EXT SLEEP:   <ON/OFF>, <LOW/HIGH> FOR <time> ms
EXT WAKE:    <ON/OFF>, <LOW/HIGH> FOR <time> ms
VL SLEEP:    <ON/OFF>, <</>>[!]<level> FOR <time> s
VL WAKE:     <ON/OFF>, <</>>[!]<level> FOR <time> s
VCHG WAKE:   <ON/OFF>, [+/-][!]<change> IN <time> ms
```

See Table 1 for the detailed line-by-line description of the configuration summary. The "Sec." column of Table 1 contains a reference to the relevant section of this document.

Example:

```
CTRL MODE:  NATIVE
PWR_CTRL:   LOW PWR = LOW
UART SLEEP: OFF, 1200 s
UART WAKE:  ON,  0-30000 us
EXT INPUT:  LOW = SLEEP
EXT SLEEP:  OFF, LOW FOR 3000 ms
EXT WAKE:   ON,  HIGH FOR 2000 ms
VL SLEEP:   OFF, <13.00V FOR 600 s
VL WAKE:    OFF, >13.20V FOR 1 s
VCHG WAKE:  OFF, 0.20V IN 1000 ms
```

or

```
VL SLEEP:   OFF, <0x8C1 FOR 600 s
VL WAKE:    OFF, >0x8E3 FOR 1 s
VCHG WAKE:  OFF, 0x022 IN 1000 ms
```

Table 1 – PowerSave Configuration Summary Detail

Configuration Summary Line	Sec.	Description
CTRL MODE: <NATIVE/ELM327>	1.1	**PowerSave control mode.** Reports whether PowerSave module is operating in a *native PowerSave* control mode, where all settings are configured via the ST commands, or an *ELM327 Low Power* compatibility mode, where some settings are overridden via the ELM327 programmable parameter 0E.
PWR_CTRL: LOW PWR = <LOW/HIGH>	1.5	**PWR_CTRL output pin polarity**. Specifies whether the pin outputs a logic *LOW* or *HIGH* in low power mode.
UART SLEEP: <ON/OFF>, <timeout> s	1.2.2	**UART inactivity sleep** trigger: **<***ON/OFF***>** trigger on/off **<***timeout***>** inactivity timeout setting in milliseconds
UART WAKE: <ON/OFF>, <pulse min>-<pulse max> us	1.3.1	**UART Rx pulse wakeup** trigger: **<***ON/OFF***>** trigger on/off **<***pulse min***>** minimum UART Rx pulse width in microseconds **<***pulse max***>** maximum UART Rx pulse width in microseconds (0 = no maximum)
EXT INPUT: <LOW/HIGH> = SLEEP	1.2.3	**SLEEP input polarity.** Specifies whether it takes a *LOW* or a *HIGH* on the SLEEP pin to put the device to sleep.
EXT SLEEP: <ON/OFF>, <LOW/HIGH> FOR <time> ms	1.2.3	**External SLEEP input sleep** trigger: **<***ON/OFF***>** trigger on/off **<***LOW/HIGH***>** specifies the active logic level **<***time***>** specifies how long the SLEEP input must be held in the active ("sleep") state to put the device to sleep.
EXT WAKE: <ON/OFF>, <LOW/HIGH> FOR <time> ms	1.3.2	**External SLEEP input wakeup** trigger: **<***ON/OFF***>** trigger on/off **<***LOW/HIGH***>** specifies the active logic level **<***time***>** specifies how long the SLEEP input must be held in the inactive ("wake") state to wake the device from sleep.
VL SLEEP: <ON/OFF>, <</>>[!]<level> FOR <time> s	1.2.4	**Voltage level sleep** trigger: **<***ON/OFF***>** trigger on/off **<</>>** specifies whether the trigger region is below (<) or above (>) the <*level*> threshold setting ***[!]*** this designator indicates that the trigger voltage setting is invalid, i.e. cannot be achieved with the current voltage calibration

		<level> voltage threshold in volts ([d]d.ddV) or raw ADC steps (0xhhh) ***<time>*** number of consecutive seconds the voltage must remain above or below the threshold value for the trigger to activate
VL WAKE: <ON/OFF>, <</>>[!]<level> FOR <time> s	1.3.3	**Voltage level wakeup** trigger. Same format as the voltage level sleep trigger.
VCHG WAKE: <ON/OFF>, [+/-][!]<change> IN <time> ms	1.3.4	**Voltage change wakeup** trigger: ***<ON/OFF>*** trigger on/off ***[+/-]*** specifies whether the trigger detects only rising voltage (+), only falling voltage (-), or a voltage change in any direction (no sign) ***[!]*** this designator indicates that the voltage change setting is invalid, i.e. cannot be achieved with the current voltage calibration ***<change>*** voltage change in volts ([d]d.ddV) or raw ADC steps (0xhhh) ***<time>*** number of milliseconds between voltage samples

SLEEP *[delay]*

Enter sleep mode. Takes optional *delay* parameter in seconds. When the delay is specified, the command prints "OK", and returns to the command prompt. The sleep mode will be entered after the specified delay time. When the parameter is empty or 0 seconds delay is specified, the command will print "OK<CR>" and immediately put the device to sleep.

SLLT

Report last sleep/wakeup triggers, in this format:

SLEEP: <sleep trigger>
WAKE: <wakeup trigger>

Sleep trigger can be one of the following:

Trigger	Description
NONE	Device did not enter sleep mode since last reset
CMD	STSLEEP or ATLP command
UART	UART inactivity timeout
EXT	External sleep control input
VL	Voltage level

Wakeup trigger can be one of the following:

Trigger	Description
NONE	Device did not wake up from sleep since last reset
UART	UART Rx pulse
EXT	External sleep control input
VL	Voltage level
VCHG	Voltage change

Example:
```
SLEEP: CMD
WAKE:  UART
```

SLPCP 0|1

Set polarity of the PWR_CTRL output.

0: Normal power = HIGH, Low power mode = LOW
1: Normal power = LOW, Low power mode = HIGH

The default setting is 0.

Note: *This command is available only for STN1110 stand-alone IC.*

SLU *sleep*, *wakeup*

UART sleep/wakeup triggers on/off. Each of the two parameters can be independently configured as “on” or “off”. The first parameter specifies sleep trigger (UART inactivity timeout) setting, and the second one specifies wakeup trigger (low pulse on UART Rx input) setting. The defaults are sleep = off, wakeup = on.

Example: `STSLU off, on`

SLUIT *sec*

Set UART inactivity timeout. The parameter is specified in seconds (decimal). The default is 1200 (20 minutes).

SLUWP *min*, *max*

Set UART wakeup pulse timing. The parameters are specified in microseconds. The defaults are min = 0, max = 30000 (30 milliseconds).

SLVG on|off

Voltage change wakeup trigger on/off. The default is off.

SLVGW [+|-]*volts*, *ms*

Configure voltage change wakeup trigger. The first parameter specifies voltage difference between two samples. The optional ‘+’ or ‘-’ sign, preceding the voltage, specifies whether the trigger detects only rising voltage (+), only falling voltage (-), or a voltage change in any direction (no sign). The second parameter specifies the time between the samples in milliseconds. The value specified will be rounded to the nearest multiple of 250 ms, with any value below 250 being rounded up to the minimum setting of 250 ms. The default setting is 0.2, 1000 (voltage changing by 0.2V in any direction, with one second between the samples).

Example: `STSLVGW +0.15, 750`

SLVL *sleep*, *wakeup*

Turn voltage level sleep/wakeup triggers on/off. Each of the two parameters can be specified as “on” or “off”. The first parameter specifies the sleep trigger setting, and the second parameter specifies the wakeup trigger setting. The defaults are sleep = off, wakeup = off.

SLVLS <|> *volts|0xhhh*, *sec*

Configure voltage level sleep trigger. The “<” or “>” character specifies whether the trigger region is above or below the threshold voltage: “<” = below, “>” = above. The threshold voltage can be specified in volts with the maximum precision of two decimal places. It can also be specified in raw ADC steps by prefixing the value with ‘0x’. The *sec* parameter specifies how long the voltage must remain above or below the threshold before the device will enter sleep mode. The default is <13.00, 600 (below 13V for 600 seconds).

Examples:
```
STSLVLS <12.85, 60
STSLVLS >0x8ab, 0
```

SLVLW <|> *volts|0xhhh*, *sec*

Configure voltage level sleep trigger. The “<” or “>” character specifies whether the trigger region is above or below the threshold voltage: “<” = below, “>” = above. The threshold voltage can be specified in volts with the maximum precision of two decimal places. It can also be specified in raw ADC steps by prefixing the value with ‘0x’. The *sec* parameter specifies how long the voltage must remain above or below the threshold before the device will wake up from sleep. The default is >13.20, 1 (above 13.2V for 1 second).

Examples:
```
STSLVLW >13.15, 0
STSLVLW <0x8cd, 5
```

SLX *sleep*, *wakeup*

Enable or disable sleep/wakeup triggers associated with the external sleep control input (SLEEP pin). Each of the two parameters can be specified as “on” or “off”. The defaults are sleep = off, wakeup = on.

SLXP 0|1

Configure polarity of the SLEEP input.

0: LOW = sleep, HIGH = wake up
1: LOW = wake up, HIGH = sleep

The default setting is 0.

Note: *This command is available only for STN1110 stand-alone IC and microOBD 200 (STN1120).*

SLXS

Print the status of the external SLEEP input. Responds with “WAKE” or “SLEEP”.

SLXST *ms*

Specifies how long the SLEEP input must be held in the active (“sleep”) state to put the device to sleep. The *ms* parameter is the minimum time in milliseconds. The default is 3000 (3 seconds).

SLXWT *ms*

Specifies how long the SLEEP input must be held in the inactive (“wake”) state to wake the device from sleep. The *ms* parameter is the minimum time in milliseconds. The default is 2000 (2 seconds).