Quick guide in SG sensor setup
Understanding behavior of the SG sensor
and how to use the SCU

Quick guide in SG sensor setup

SG sensor basics

SCU

Polarity

Offset

Gain

Menu/Block diagram for SCU advanced functions.

Quick guide in SG sensor setup

When your sensor is glued in in the right position, time is up for optimize the sensor parameters

Following four scenarios are in speech for quick setup.

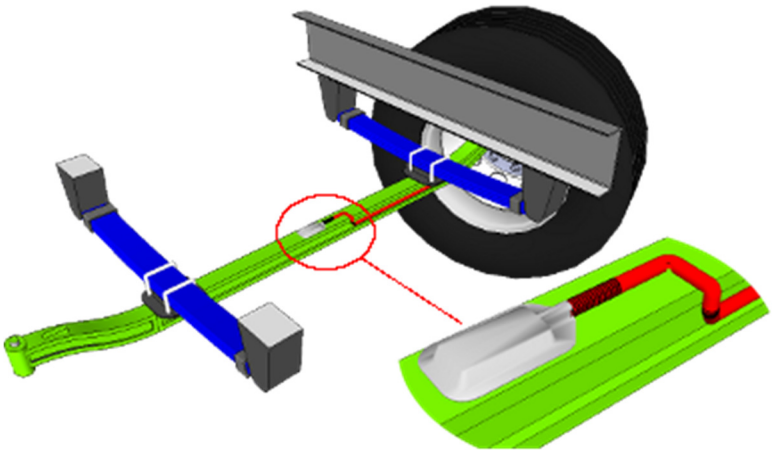
1. **SG sensor on steering front axle**
2. **SG sensor on topside of parabolic spring**
3. **SG sensor on bottom side of parabolic spring / bottom side of trapeze spring**
4. **SG sensor on top side of non-driven rear axle (typically axle on a mechanical suspended trailer)**

Above scenarios are based on a P/N 10203 SG sensor CL, this sensor is a part of following sensor kits:

- P/N 10208 SG sensor CL3, including 3 m long extension cable, connectors in both ends
- P/N 10209 SG sensor CL5, including 5 m long extension cable, connector one end, other end wires
- P/N 10210 SG sensor CL8, including 8 m long extension cable, connector one end, other end wires

For all other combination of spring types and sensors further details must be discussed and understood.

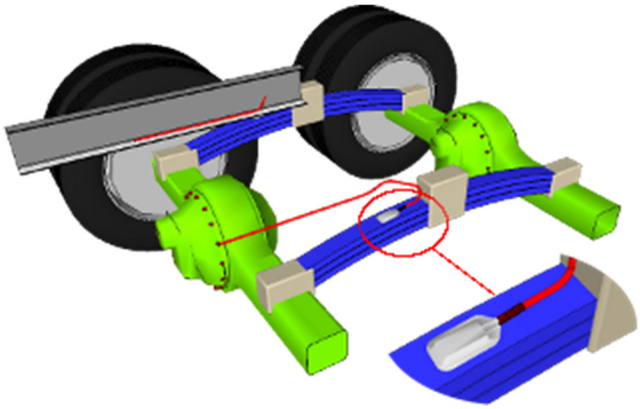
SG sensor on steering front axle



A. Connect the SCU to power Supply, it can be 12/24 V from vehicle battery or sourced by 12 V DC adapter connected to the main 120/230 V supply. SCU display reads SW version like 2.11 followed by "---". The "---" indicate no SG sensor connected to the SCU.
B. Connect the SG sensor glued onto the front axle in speech to the SCU, the SCU starts reading the "OAA" output from the SG sensor, this value is typically in range 5.00 to 20.0
C. Press the "+" button and the SCU reads AP6
D. Press the "S" button and SCU starts a one-minute long sequence setting up **Positive polarity**, **max gain** and adjusting the **offset** until OAA reading is 15,0 ± 0,5 [1] and your automatic SG sensor set up is finished.
E. You can verify the function of the SG sensor by entering the truck cabin while you are watching the reading of the SCU: OAA reading by SCU increase by approximately 2 from 15 to 17 when one person (100 kg) enter the cabin. SCU reading returns to 15 when you leave the cabin again.
F. Disconnect the SCU and connect the SG sensor to the Kimax wiring installed on the truck.

[1] 15,0 Is a standard factory setting, this value can be changed in advance settings under the "Set" menu

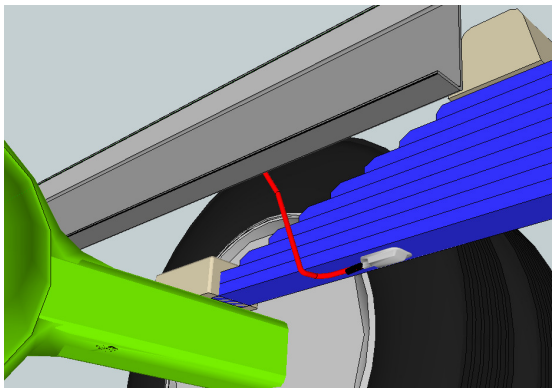
SG sensor on topside of parabolic spring



A. Connect the SCU to power Supply, it can be 12/24 V from vehicle battery or sourced by 12 V DC adapter connected to the main 120/230 V supply. SCU display reads SW version like 1.09 followed by "---". The "---" indicate no SG sensor connected to the SCU.
B. Connect one of the individual SG sensor glued onto the top of the parabolic spring in speech to the SCU, the SCU starts reading the "OAA" output from the SG sensor this value is typically in range 5.00 to 20.0
C. Press the "+" button and the SCU reads AP6
D. Press the "S" button and SCU starts a one-minute long sequence setting up **Positive polarity**, **max gain** and adjusting the **offset** until OAA reading is 15,0 ± 0,5 [2] and your automatic SG sensor set up is finished.
E. You can verify the function of the SG sensor by entering the truck above the spring while you are watching the reading of the SCU: OAA reading of SCU increase by approximately 0,5 from 15 to 15,5 by one person (100 kg) entering the chassis. SCU reading returns to 15 when you leave the chassis again.
F. Disconnect the SCU and connect the SG sensor to the Kimax wiring installed on the truck.
G. Both SG sensor on left side parabolic spring and SG sensor on right side parabolic spring must be set up individual.

[2] 15,0 Is a standard factory setting, this value can be changed in advance settings under the "Set" menu

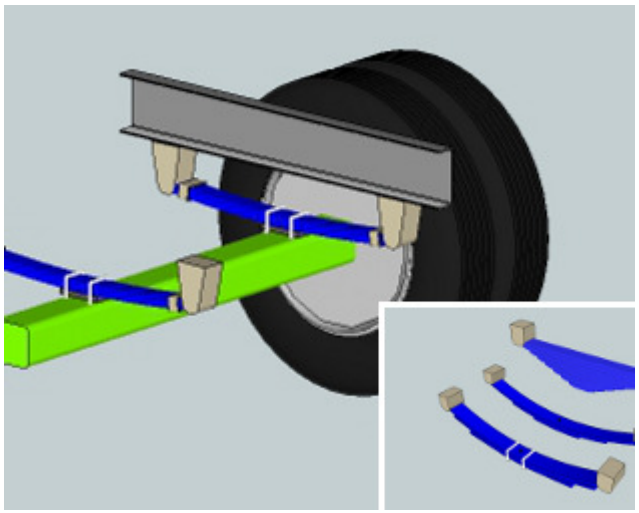
SG sensor on bottom side of parabolic spring / bottom side of trapeze spring



A. Connect the SCU to power Supply, it can be 12/24 V from vehicle battery or sourced by 12 V DC adapter connected to the main 120/230 V supply. SCU display reads SW version like 1.09 followed by "---". The "---" indicate no SG sensor connected to the SCU.
B. Connect one of the individual SG sensor glued onto the bottom of the parabolic spring/trapeze spring in speech to the SCU, the SCU starts reading the "OAA" output from the SG sensor, this value is typically in range 5.00 to 20.0
C. Press the "-" button and the SCU reads AN6
D. Press the "S" button and SCU starts a one-minute long sequence setting up **Negative polarity**, **max gain** and adjusting the offset until OAA reading is 15,0 ± 0,5 [3] and your automatic SG sensor set up is finished.
E. You can verify the function of the SG sensor by entering the truck above the spring while you are watching the reading of the SCU: OAA reading of SCU increase by approximately 0,5 from 15 to 15,5 by one person (100 kg) entering the chassis. SCU reading returns to 15 when you leave the chassis again.
F. Disconnect the SCU and connect the SG sensor to the wiring installed on the truck.
G. Both SG sensor on left side parabolic spring and SG sensor on right side parabolic spring must be set up individual.

[3] 15,0 Is a standard factory setting, this value can be changed in advance settings under the "Set" menu

SG sensor on top side of non-driven rear axle (typically axle on a mechanical suspended trailer)



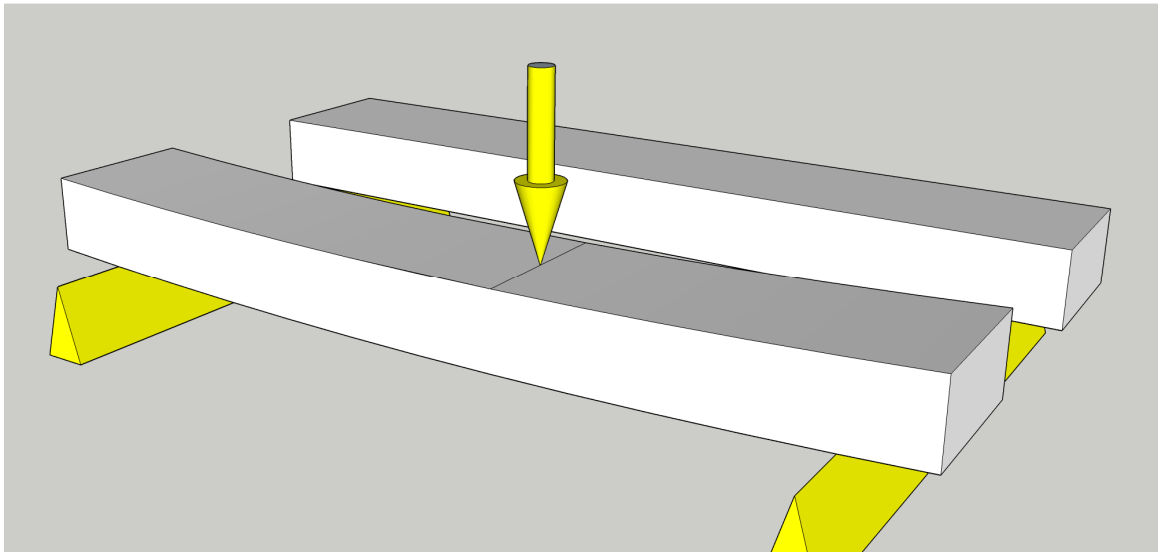
A. Connect the SCU to power Supply, it can be 12/24 V from vehicle battery or sourced by 12 V DC adapter connected to the main 120/230 V supply. SCU display reads SW version like 1.06 or 1.09 followed by "---". The "---" indicate no SG sensor connected to the SCU.
B. Connect the SG sensor glued onto the rear axle in speech to the SCU, the SCU starts reading the "OAA" output from the SG sensor, this value is typically in range 5.00 to 20.0
C. Press the "+" button and the SCU reads AP6
D. Press the "S" button and SCU starts a one-minute long sequence setting up **Positive polarity**, **max gain** and adjusting the **offset** until OAA reading is 15,0 ± 0,5 [4] and your SG sensor set up is finished.
E. You can verify the function of the SG sensor by entering the trailer above the actual axle while you are watching the reading of the SCU: OAA reading of SCU increase by approximately 0,5 from 15 to 15,5 by one person (100 kg) entering the trailer. SCU reading returns to 15 when you leave the trailer again.
F. Disconnect the SCU and connect the SG sensor to the wiring installed on the trailer.
G. In case of two or more axle in same group, you must run the automatic set up sequence on each individual axle.

[4] 15,0 Is a standard factory setting, this value can be changed in advance settings under the "Set" menu. I make sense to set the "Set" value to 8 in case more than two sensors from same axle group are connected to same input.

SG sensor basics

The SG sensor is a Strain Gauge based sensor able to measure one direction bending of a beam.

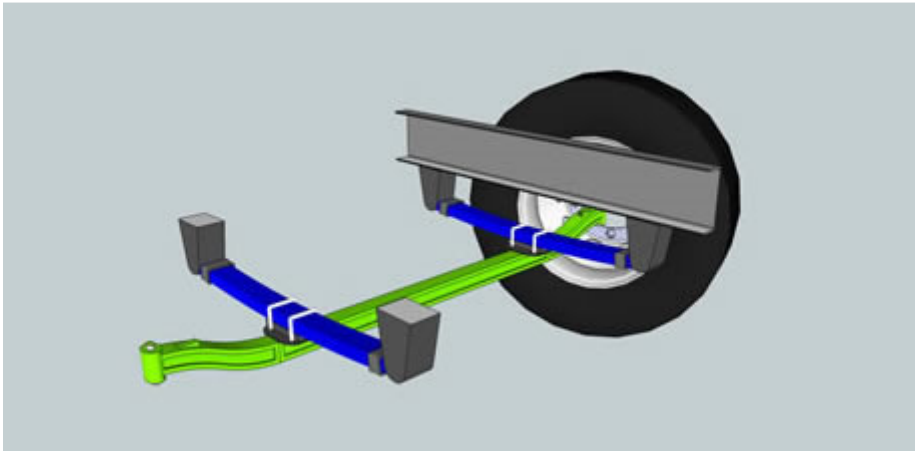
Loading a beam makes the beam bending independent dimension and type of material, only question is how much (or how little) the actual bending is !



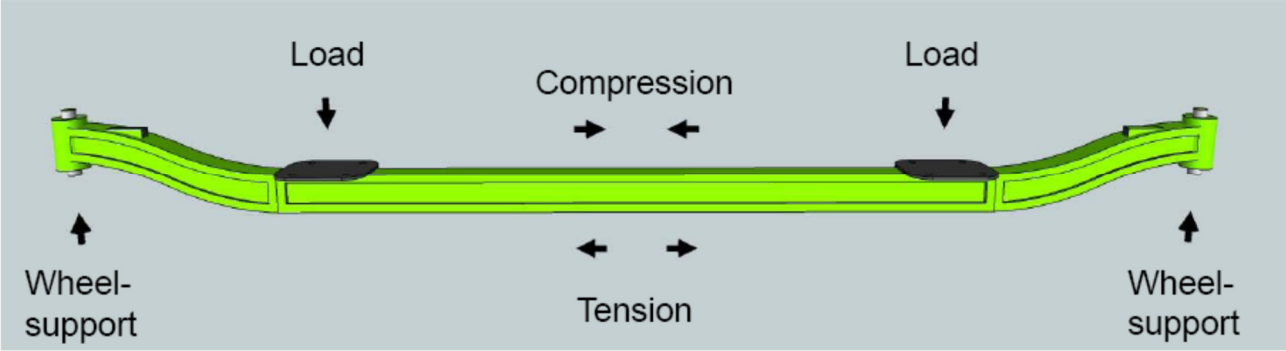
Even a rail from a railway track you can bend by pressing it by your tumb !

In the following discussion, we face the behavior of a steel front axle from a truck.

The front axle is supported by the wheels standing on the road surface, the load on the front axle is applied though the springs which carry the front end of chassis frame.

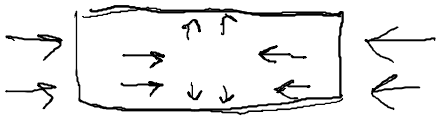


A typical front axle from a truck behave like this when you apply load on the truck:



The steel axle is compressed on the topside and a tension apply on the bottom side, even it is not visible by your eyes and you can't measure it with a standard ruler from your desk.

Understanding how compression forces act on a body, look at your eraser, when you apply a compression force to the eraser by your fingers (the eraser material (rubber) is typical much softer than steel), it behaves like steel, - one of the difference is the change in dimension is much easier to make visible.



Applying pressure on your eraser makes it shorter and wider. Same story happens when you apply pressure on a steel beam.

The ratio between change in length and width by compressing a body is commonly described as Poisson's ratio, which typical are in range 0,25 to 0,5 depending on material.

A typical value for steel could be 0,28, this means a 100 µm compression in length result in a 28 µm extension of the width of the body.

How big (small) is the real changes in length and with measured on a real front axle ?

Practical experience:
When we put two reference point onto the top of a front axle, placed on the centerline and around the middle of the axle in a distance of 50 mm between each other, the distance change to somehow 49,97 mm, by loading the axle with 8 ton. This means the top surface of the axle is compressed by 30 µm measured over a distance of 50 mm.

SCU

Main idea in using the SCU for adjusting settings in the SG sensor is for optimizing the dynamic range of an actual sensor installed on an axle.

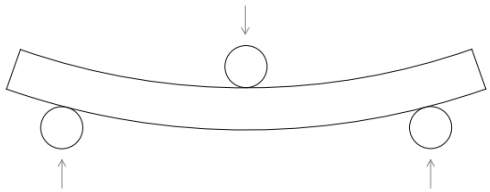
Basically, we talk about followings parameters to be adjusted:

1. Polarity of slope, positive or negative
2. Offset of the output signal from the SG sensor in unloaded conditions
3. Gain setting of the SG sensor

Polarity

Let us once again play with your eraser (rubber) on your desk, in order of understanding how to select between positive and negative polarity of the SG sensor setting.

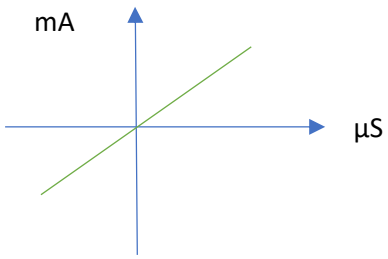
When you slightly bend the eraser rubber material by pressing the topside at center position and the bottom side is supported in two positions the rubber material on the bottom side extend while the top side is compressed.

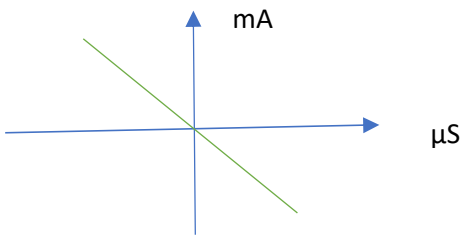


Imagine a standard set up SG sensor glued onto the topside of your eraser, cable goes out in length direction of the eraser. This example offers you an increasing output signal corresponding to the compression of the rubber material. This happens because of the SG sensor as standard have a positive slope according to a compression of material.

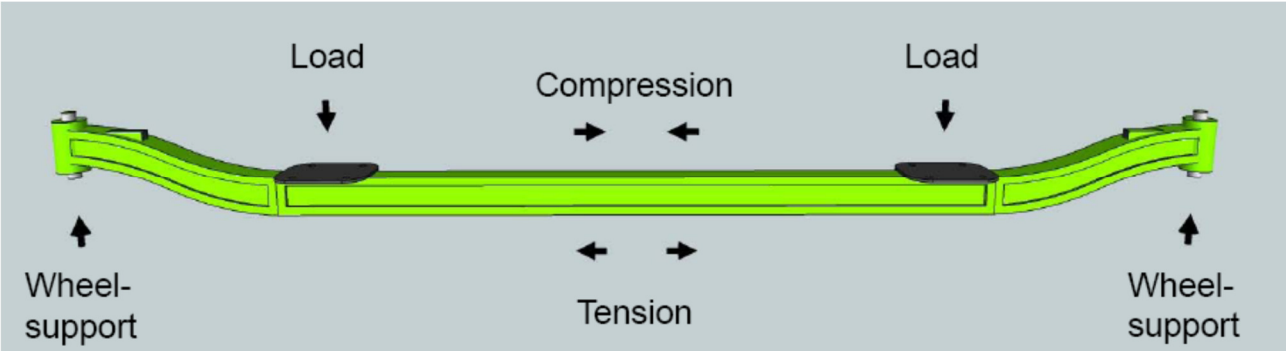
An equal SG sensor glued onto the bottom side of your eraser, cable goes out in length direction of eraser, offer you a decreasing output signal corresponding to the extension of the rubber material.

Changing the slope of the bottom side SG sensor from “positive” to “negative” reverse the output signal making an increasing output signal corresponding to the extension of the rubber material.





Same story happens by loading a front axle of a truck,



- a SG sensor glued onto the topside of the axle need to be set for a “positive” slope.
- a SG sensor glued onto the bottom side of the axle need to be set for a “negative” slope in order of offering you an increasing output signal vs increasing load.

When you place your SG sensor on top of the axle in position “compression” and cable out in length direction of the axle, you must configure it for what we call a positive slope like AP6 on the.

When you place your SG sensor on bottom side of the axle in position “Tension” and cable out in length direction of the axle, you must configure it for what we call a negative slope like AN6 on the SCU

In case you place the SG sensor perpendicular to the axle, you must use the AN6 in the compression mode and the AP6 in the Tension mode !

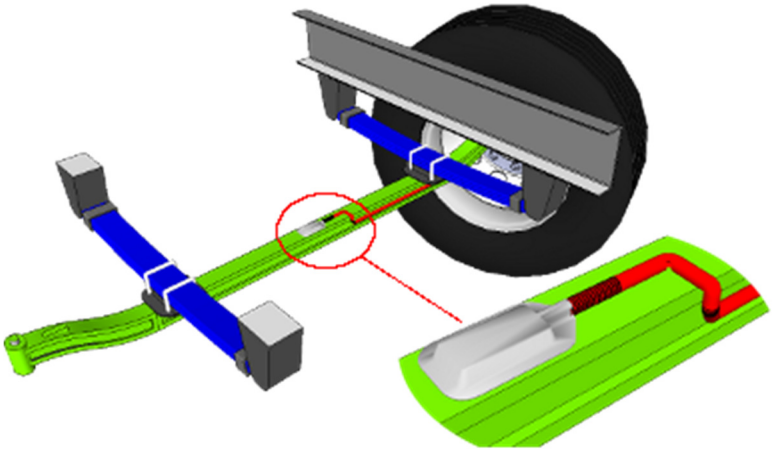
Offset- front axle sensor

More reasons for variation in the output signal, when a SG sensor is glued onto an axle.

- The SG sensors are set for an OAA output signal ≈ 15 during manufacture process. Storage and transport can afterwards affect the sensor and the output signal can vary.
- When you glue the sensor onto an axle the forces you apply to the sensor can affect the output signal from the sensor.
- The surface of the axle, where you glue the sensor, can be slightly uneven and affect the output signal from the sensor.

Most common application for the SG sensor is for axle load measurement on a front axle.

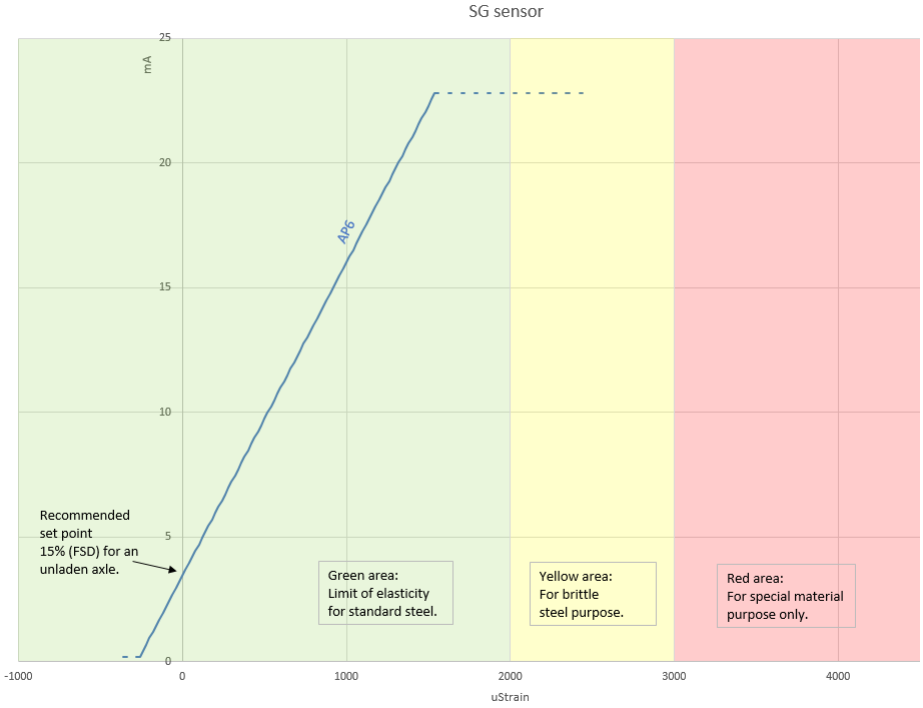
Front axles are most common equipped with a SG sensor located on top of the axle centered into the middle of the axle.



It makes sense to offset the output from the SG sensor into the dynamic range away from “zero” on an empty truck, because of the actual front axle load can decrease for some reasons like:

- Consuming fuel from your fuel tank reduce typically axle load on the front axle
- Heavy backload of your truck makes your front axle load lighter
- Dynamic impact on your front axle makes it heavier and lighter during driving

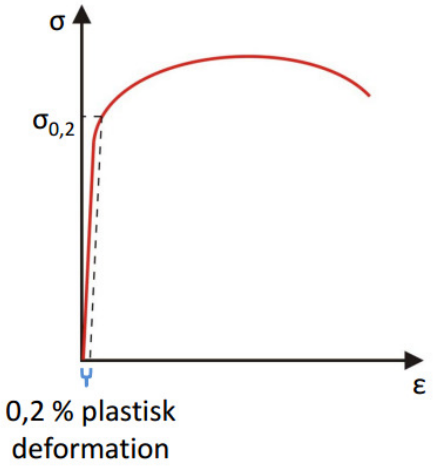
Practical experience indicates a 15 % offset ≈ 3,5 mA current out of the SG sensor makes sense on a non-driven front axle. This value leaves a good margin to the bottom limit and offer a great dynamic range up to the upper limit of the sensor output.



Above diagram showing offset set for OAA 15 ≈ 3,5 mA at 0 µS.

Diagram for trækstyrke

Typically, elastic range for steel is 0,2 % elongation or 2.000 µS, some type of steel, especially springs, have elastic region up to 0,3 % elongation.

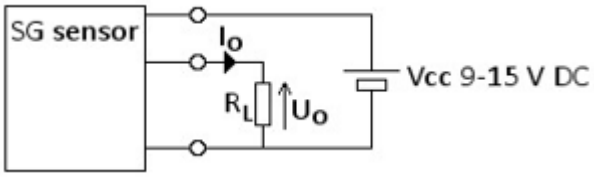


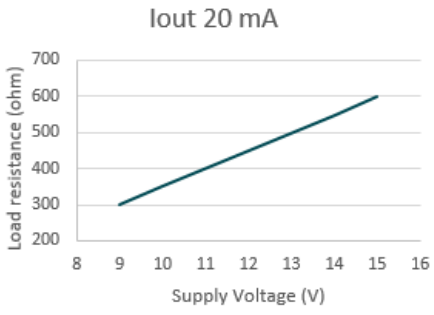
Output from SG sensor

The output signal from the SG sensor is basically a 0-20 mA current signal. In order of being able to compare and handle the SG sensor signal in same way as the air pressure signal from an air suspended axle, we usually talk about the OAA reading on an input. 0-20 mA from a SG sensor equals 0-100 OAA reading.

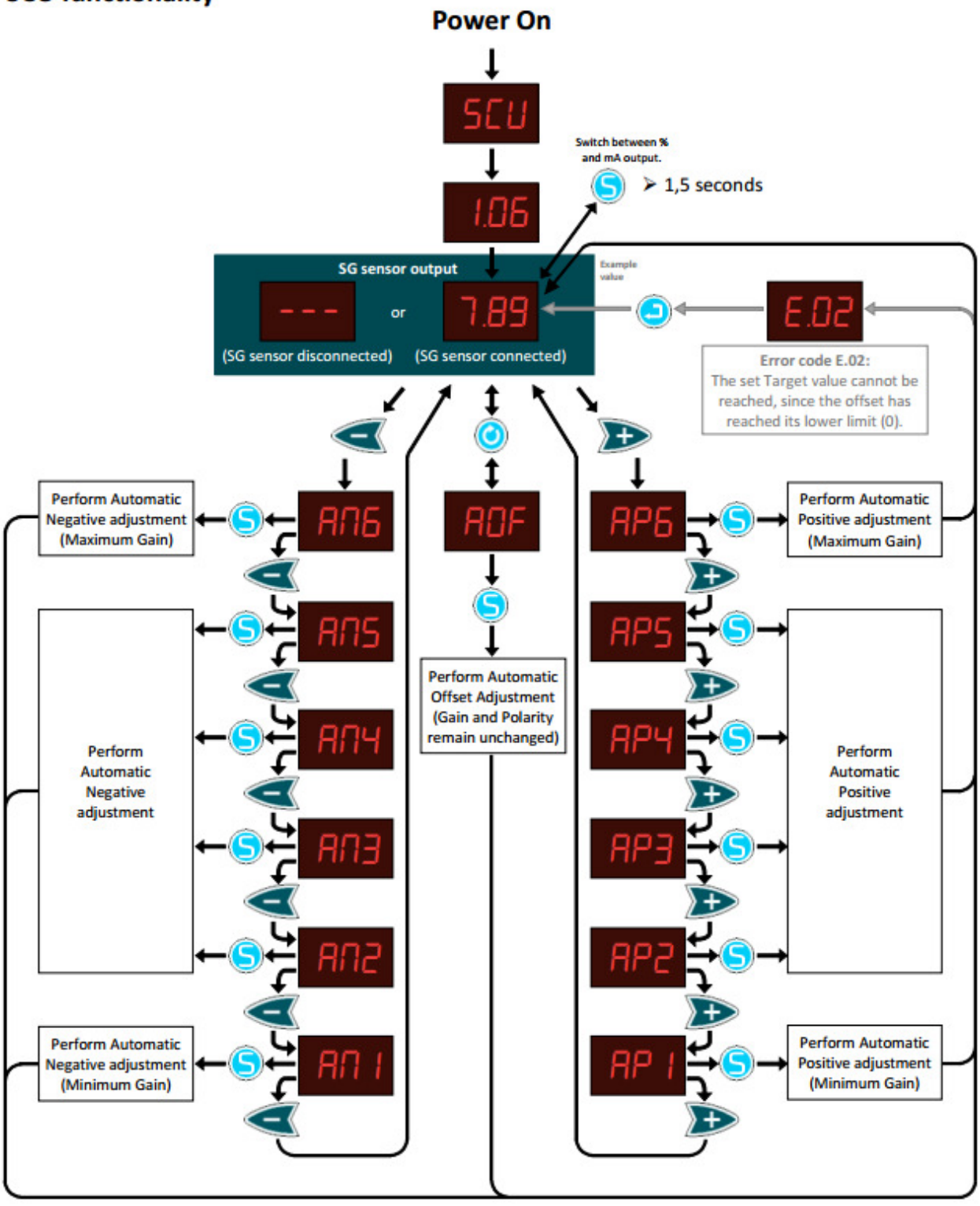
In same way 0-10 bar on an air input equals 0-100 OAA reading.

In other words, 0-100 OAA is the same as 0-100% input signal.

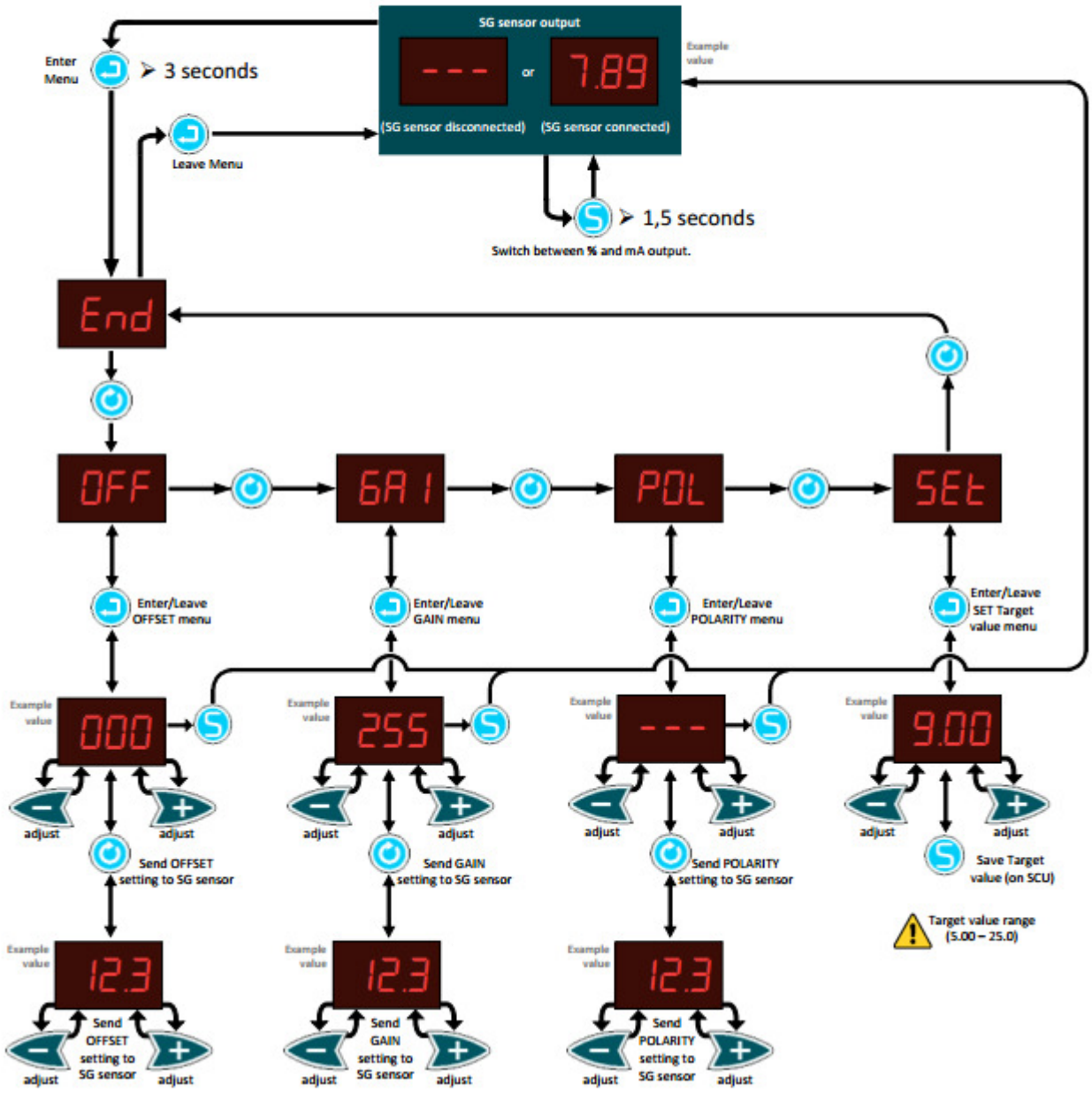




SCU functionality



Advanced Settings



AN6:	Automatic Negative adjustment	Gain: 255 Polarity: Positive Offset: Adjusted to produce an output as close as possible to the Target value
AN5:	Automatic Negative adjustment	Gain: 232 Polarity: Positive Offset: Adjusted to produce an output as close as possible to the Target value
AN4:	Automatic Negative adjustment	Gain: 202 Polarity: Positive Offset: Adjusted to produce an output as close as possible to the Target value
AN3:	Automatic Negative adjustment	Gain: 163 Polarity: Positive Offset: Adjusted to produce an output as close as possible to the Target value
AN2:	Automatic Negative adjustment	Gain: 103 Polarity: Positive Offset: Adjusted to produce an output as close as possible to the Target value
AN1:	Automatic Negative adjustment	Gain: 0 Polarity: Positive Offset: Adjusted to produce an output as close as possible to the Target value
AOF:	Automatic Offset adjustment	Gain: Not affected Polarity: Not affected Offset: Adjusted to produce an output as close as possible to the Target value
AP6:	Automatic Positive adjustment	Gain: 255 Polarity: Negative Offset: Adjusted to produce an output as close as possible to the Target value
AP5:	Automatic Positive adjustment	Gain: 232 Polarity: Negative Offset: Adjusted to produce an output as close as possible to the Target value
AP4:	Automatic Positive adjustment	Gain: 202 Polarity: Negative Offset: Adjusted to produce an output as close as possible to the Target value
AP3:	Automatic Positive adjustment	Gain: 163 Polarity: Negative Offset: Adjusted to produce an output as close as possible to the Target value
AP2:	Automatic Positive adjustment	Gain: 103 Polarity: Negative Offset: Adjusted to produce an output as close as possible to the Target value
AP1:	Automatic Positive adjustment	Gain: 0 Polarity: Negative Offset: Adjusted to produce an output as close as possible to the Target value
End:	End of menu	
OFF:	Offset	Minimum value: 000 Maximum value: 255 OFFSET unknown: ---
GAI:	Gain	Minimum value: 000 Maximum value: 255 GAIN unknown: ---
POL:	Polarity	Possible values: POS or NEG POLARITY unknown: ---
POS:	Positive	Intended for measuring Compression
NEG:	Negative	Intended for measuring Tension
SEt:	Set Target Value	All auto functions are adjusting the offset value to produce an output as close as possible to the Target value. Minimum value: 5,00 Maximum value: 25,0
---:	No Sensor connected or Unknown value	

E.01:	Error code 1	Trying to store a Target value outside the valid range (5,00 - 25,0).
E.02:	Error code 2	The set Target value cannot be reached, since the offset has reached its lower limit (0).
E.03:	Error code 3	The set Target value cannot be reached, since the offset has reached its higher limit (255).
E.04:	Error code 4	The sensor cannot be set close enough to the set Target value before time out is reached.
E.05:	Error code 5	The SCU cannot determine the type of the connected sensor.

When the auto functions results in an output within ±1,00 from the Target value, it's considered as OK.

Example:

Target value is set to 15,0.

A result within the range 14,0 – 16,0 is considered OK. However, the auto functions will try to get as close to the Target value (15,0) as possible.

A result outside the range 14,0 – 16,0 will produce an error (E.02, E.03 or E.04 (depending on the situation)). Press the enter button to acknowledge the error. The sensor now outputs the result that was found to be closest to the Target value.