Mini-Line®
Grade and Slope Control System

HS301 User Manual

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Grade and Slope Control System

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TECHNOLOGIES
PAVING INNOVATION

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About HS301 User Manual

Content and structure

This user manual for Mini-Line® Grade and Slope Control System with HS301 has been developed to the operator to provide the necessary information to operate the Mini-Line® Grade and Slope Control System with the use of the handheld controller, HS301. The Danish version of this manual constitutes the original version, and can therefore be used as a reference in case of doubt regarding use or misuse of the system.

The user manual is a practical guide for set-up, mounting, operating and maintaining the Mini-Line® Grade and Slope Control System with the use of the HS301 handset. The user manual has been divided into colour-coded sections, enabling the user to easily look up the potential subjects of interest.

Safe use

Before Mini-Line® Grade and Slope Control System is operated, this user manual should be studied carefully to ensure correct and safe use of the system. Particularly the section Safety Instruction p. 57 should be read thoroughly before use.

Getting thoroughly acquainted with the manual furthermore ensures the operator the full value of the system, as the user manual contains a multitude of practical dos and donts, as well as useful guidance on maintenance and troubleshooting. The user manual should always be stored together with the system.

To ensure safe use of the Mini-Line® Grade and Slope Control System, the operator is advised to perform an individual risk assessment of the use of the system in combination the relevant asphalt paver.

All products in the Mini-Line® Grade and Slope Control System are CE-marked and comply with regulations for security and reliability.

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Mini-Line® Grade and Slope Control System

All products in the Mini-Line® Grade and Slope Control System contain a model number/name, serial number and part number, so that each unit is easily identified and traceable. All relevant numbers should be stated, when contacting TF-Technologies regarding your product:

Example
Model number/name: HS301
Serial number: TF-37126
Part number: S-50332

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User manual information

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Symbol overview

This user manual uses a range of symbols and warning notifications throughout the manual to make the operator aware of important safety measures or information regarding operation. The following symbols are used in this manual:

Warning!

Indicates important information the operator must be aware of to avoid dangerous situations which can result in death or serious personal injury

Caution!

Indicates important information the operator must be aware of to avoid dangerous situations which can result in material damages

Tip

Indicates information regarding efficient and failure-free operation of the Mini-Line® Grade and Slope Control System

Step-by-step instructions

Indicates a step-by-step instruction, where a particular order of actions is required or recommended

Introduction

Introduction to Mini-Line® Grade and Slope Control System

Grade and slope control

Mini-Line® is TF-Technologies' levelling series, ensuring correct grade and slope in asphalt work for both asphalt pavers and milling machines.

Mini-Line® Grade and Slope Control System consists of a range of controllers and sensors which are connected via electrical cables and can be used in various combinations depending on type of machine and asphalt job.

The controllers of the series adjust the height of the screed on the asphalt paver or the drum of the asphalt milling machine to obtain the desired grade and slope of the road. The controllers receive signals from the sensors and use these input to determine whether changes in grade and/or slope is required. Based on this, the controller makes the machine raise or lower the relevant tow point or drum to obtain the correct grade and/or slope.

The Mini-Line® Grade and Slope Control System provides the operator full control of the paving or milling job in each of the two sides of the asphalt machine that normally work independently of each other. The auto mode of the controllers eliminates the risk of overcompensation in manual operation, just as the need for manual supervision is significantly reduced.

Each controller is designed to a different situation and machine, for the optimal operation for the operator.

Controllers in the Mini-Line® Grade and Slope Control System

HS301

Simple and mobile asphalt paving

On paving jobs where it is easy for the operator to walk around both sides of the asphalt paver, the HS301 handset is a simple and handheld controller providing mobility around the asphalt paver.

PL2005

Asphalt paving with full control in both sides

With the PL2005 the operator has a full overview of all sensors and settings from one unit in both sides of the paver. Grade and slope sensors are synchronized with the PL2005, offering a quicker slope regulation.

LRL2000

Milling with full control close to the operator

The position of the operator can vary greatly from milling machine to milling machine. With LRL2000 the operator can obtain full control of all sensors and settings on up to six different controller units placed on the machine.

Versatile sensors

Several of the Mini-Line® sensors can be used across the different types of controllers, and the selection has been specifically adapted to the harsh conditions of asphalt paving and milling. The grade sensors can be used for ground sensing, curb sensing, stringline sensing and joint matching, and provide high precision measurements. The slope sensors are specifically designed to work under the high temperatures and vibration levels of asphalt machines without losing precision.

Flexible controllers that can be used on most machines

Asphalt machines from different manufacturers have different hydraulics and use different input and power supply. Therefore, the Mini-Line® controllers are designed to be flexible and easily adapted to different types of machines.

- **Can be connected to power supply between 10 to 30 VDC**
- **Can be connected to machines with ON/OFF or proportional valves**
- **Compatible with NPN or PNP driven valves**
- **Output pulse can be adjusted to the hydraulics of the individual machine so that the tow points work optimally**

Additionally, all Mini-Line® controllers have a range of adjustable control parameters, so that operation can be easily adjusted to a particular task or different user preferences. The regulation and communication of the controllers can be performed in inches as well as millimetres.

Simple design and operation

The controllers and sensors of the Mini-Line® Grade and Slope Control System automatically start up when power is applied, and are easily operated with a few push-buttons and simple settings.

The control parameters are adjusted the first time the controller is used on a machine, after which the controller remembers the chosen settings. Similarly, the selected grade and slope setpoint is remembered when the power is cut off and re-applied.

Grade and slope are easily adjusted during asphalt work, and deviations are indicated on the controller as well as the sensors with display in both manual and auto mode.

Years of experience provide reliable and durable design

Based on experience with asphalt work since 1978, Mini-Line® Grade and Slope Control System has been built specifically for the rough environmental conditions present in asphalt paving and milling.

- **Strong aluminium casting resistant to corrosion and a tough environment**
- **Electronics encapsulated in silicone, ensuring protection against water and moisture**

The communication between controllers and sensors use a robust industrial protocol, and the hardy Mini-Line® cables with casted connectors can endure many years of use.

Asphalt Paving

To operate Mini-Line® Grade and Slope Control System safely, it is important to understand how an asphalt paver works and how the Mini-Line® Grade and Slope Control System interacts with the paver.

The smoothening effect of the screed

An asphalt paver consists of two primary parts – a tractor that propels the paver forward and ensures the constant supply of material, and a screed that distributes, compacts and smoothens the material, so that the paved mat obtains the correct thickness and a smooth surface.

The screed is connected to the tractor solely via a tow point at the end of a tow arm on each side. This implies that the screed is dragged like a sled that can move freely up and down behind the tractor, and causes the screed to "float" on the material. The thickness of the mat paved is thus determined by adjusting the height of the tow points.

The screed floats on top of the material. Any change in the height of the tow point will change the angle of attack of the screed, which leads to a change in the thickness of the paved mat.

Small changes over small distances in the base are evened out, as it takes some time for the screed to work its way up or down through the material. Small irregularities in the base are therefore not copied to the newly laid material, and the resulting mat becomes more pleasant to drive on.

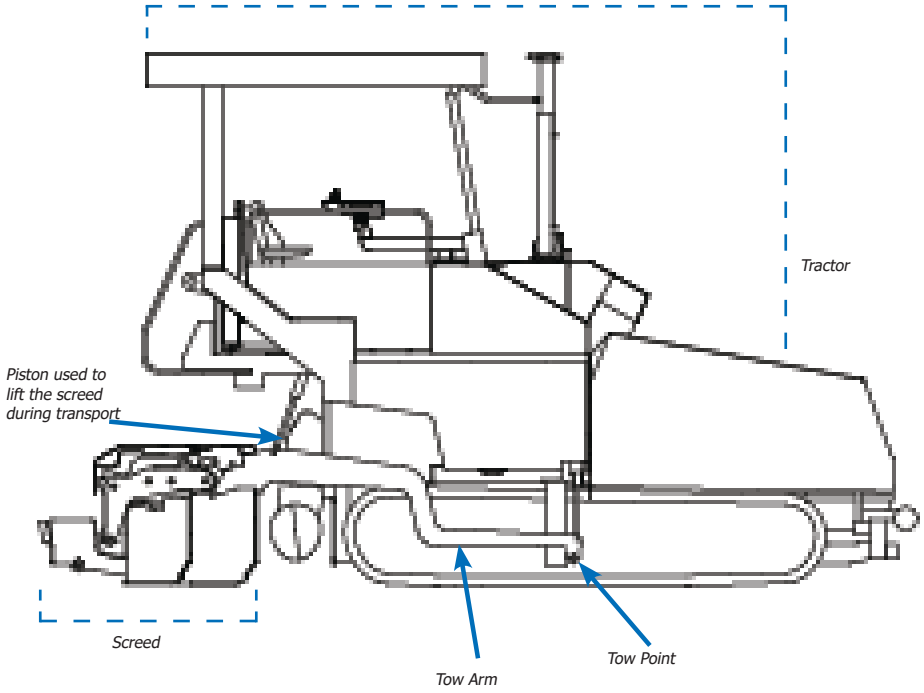


Figure 1 - The structure of the asphalt paver

Figure 2 - Increase in angle of attack - increased mat thickness

Figure 3 - Decrease in angle of attack - decreased mat thickness

The delayed screed effect

When a change in the tow point height is performed, there will be a delay as to when the change in the mat thickness is fully achieved. This delay is what provides the smoothening effect of the screed:

- **After one tow arm length, 2/3 of the change in thickness is achieved**
- **After two tow arm lengths, 4/5 of the change in thickness is achieved**
- **After three tow arm lenghts, 95% of the change in thickness is achieved**

Change of slope

The two tow points of the screed can be adjusted independently. Adjusting the tow points to different heights entail that the screed is sloping and the paved mat will acquire a slope.

A change in the slope of the screed is performed with a delay similarly to a change in thickness, which means that if a curve requires additional slope, it must be initiated a certain amount of time before the change should take full effect.

Constant forces affecting the angle of attack of the screed

To obtain a smooth result when paving asphalt, the operator must first and foremost try to keep constant all the forces affecting the angle of attack of the screed that he can control. These forces consist of ground speed, amount of material in front of the screed, and the mix (and temperature) of the material.

Changes in ground speed will result in a change of the angle of attack of the screed, which can lead to marks and grade differences in the paved mat that cannot be evened out by a roller. The machine operator must therefore ensure that the ground speed of the asphalt paver is as constant as possible.

The amount of material in front of the screed must also be held constant, as less material will result in a change in thickness of the paved mat. The amount of material in front of the screed is held constant by using a material controller, referring to e.g. AC700 material controller and corresponding user manual.

Finally, the mix and temperature affects the angle of attack, as changes in material mix and temperature changes the obtainable compaction level, as this varies with varying materials. A constant temperature and material mix should therefore be maintained throughout any paving job.

Asphalt Paving with Mini-Line® Grade and Slope Control System

Having secured that the forces affecting the angle of attack of the screed are constant, the asphalt paver is able to pave a defined thickness of asphalt on top of the existing foundation. Irregularities in the existing surface will thus be copied to the new mat, although a minor smoothening will take place due to the smoothening effect of the screed.

Mini-Line® Grade and Slope Control System for an improved result

Using Mini-Line® Grade and Slope Control System offers the opportunity to significantly improve the quality of the paved road compared to the existing surface. In addition to being able to precisely copy the quality of the existing foundation, the Mini-Line® Grade and Slope Control System offers the opportunity to use an alternative reference, making the operator less dependent on the quality of the pre-existing road.

Using Mini-Line® ultrasonic grade sensors, many different types of references can be used, including ground, curb, wire or joint of adjoining lane. This enables the operator to choose the best available reference and he can thereby optimize the resulting mat, as the asphalt paver will pave the determined thickness according to the chosen reference. The choice of reference thus has a large impact on the final result, and an even curb or correctly setup wire is a pre-requisite for a good road. The better the reference, the better the result.

The HS301 handset has a metal hanger, so that the operator can easily hang it on the paver.

By using the averaging sensor G224 or the Averaging Beam of the Mini-Line® Grade and Slope Control System an even better result can be obtained, as they calculate an average across the measurements of the sensors. This enables an averaging effect which evens out the existing irregularities of the reference, cf. Using the Averaging Beam p. 29.

Mini-Line® Grade and Slope Control System prevents overcompensation

Another great advantage of the Mini-Line® Grade and Slope Control System is that the system prevents manual overcompensation. For example in joint matching, it is particularly important that the new mat precisely follows the grade of the previously laid lane. Undertaking this task without the use of a levelling system entails that an operator must continuously track the changes in grade of the existing lane and undertake correct regulations in the pavement of the adjoining lane.

Besides the fact that this task requires the full focus of the operator(s), at the same time it requires extremely good regulation abilities of the operator. In practice, it is an impossible task for an operator due to the delayed effect of the screed, which entails that the operator very precisely must predict how a certain change affects the material paved several tow arms ahead. This almost always results in overcompensation and an uneven road.

Mini-Line® regulates with mm-precision. Here is seen HS301 and the grade sensor furthest back on the Averaging Beam.

In manual operation, the operator must wait several tow arm lengths before a change takes full effect, or he must adjust the tow point far more aggressively than required to begin with, and readjust when the desired grade is obtained. The latter method provides quick changes, but almost always results in overcompensation, where the grade alternates between being too high or too low, as a result of the attempt of the operator to hit the desired grade. Overcompensation thereby results in an uneven road that is unpleasant to drive on.

By using a Mini-Line® Grade and Slope Control System, overcompensation is prevented, as the controller takes control of the tow point and automatically regulates the height of the tow point, so that the grade and slope of the new lane precisely follow the chosen reference.

By the use of the ultrasonic sensors, the system constantly monitors the movement of the screed and undertakes small corrections, thereby securing the screed delivers the correct grade and slope.

Because the system constantly monitors the regulations and is able to register even small changes, it is able to continuously undertake corrections, for the response time of the screed. An operator on the other hand, must settle with observing the effect of regulations undertaken several tow arms ago, and therefore rarely is able to react with the correct regulation in time. At the same time, it is extremely difficult manually to assess the effect of a given change, and therefore a manual regulation will almost always result in a poorer road quality.

With a Mini-Line® Grade and Slope Control System this problem is completely avoided. Combined with a good reference and the smoothening effect of the screed, the precise regulation of the Mini-Line® system can secure a tremendously smooth surface. At the same time, the risk of overcompensation of manual operation negatively affecting material use, durability and road quality is removed.

Final road result depends on several factors

Nevertheless, any operator must remember that the final road result to a great extent is affected by the subsequent compaction. A perfectly paved mat can easily be ruined by incorrect rolling, so to ensure a good final result, the recommended compaction techniques of the manufacturer of the roller must be followed.

Introduction to HS301

HS301 in manual mode, where both grade and slope sensor is connected.

Mini-Line® HS301 is a handset specially designed for asphalt pavers that can regulate the grade and slope of the paved mat in relation to a chosen reference.

The HS301 handset is very easy to use and works in combination with one or more sensors, or an Averaging Beam, cf. Configurations p. 19.

Automatic regulation

The Mini-Line® Grade and Slope Control System measures the distance between the screed and a chosen reference used as the basis for the new mat. The reference can be the joint of an adjoining lane, a curb, a wire or existing foundation.

When using HS301 in combination with a grade sensor, the reference is set to zero (the setpoint) at the desired grade and the handset is switched to auto mode. Likewise, when using HS301 in combination with a slope sensor, the setpoint is entered at the desired slope and the handset is switched to auto mode.

Now the HS301 handset will automatically regulate the tow point of the screed, so that the reference is followed in relation to the chosen grade or slope.

Subsequent required changes are easily achieved by adding or subtracting to the setpoint.

Free operation on both sides of the machine

The screed is adjusted by regulating the height of the tow points in each side of the asphalt paver, and each tow point is controlled completely independently of the other. Depending on which sensor set-up is chosen, the HS301 regulates either grade or slope in one side, and therefore two HS301 handsets are always required for one asphalt paver.

The compact design of the handset provides mobility and offers the opportunity to operate it with just one hand. This enables the operator to walk at the side of the screed when paving new roads without traffic, and remain behind the paver on paving jobs with heavy traffic passing by.

The HS301 handset is easy to operate, even with gloves on.

HS301 available in millimeter or inch version

Regulation and display of sensor values can take place in either millimeters or inches, depending on the handset version. The faceplate of the handset shows whether it is a millimeter or inch version.

Simple mounting

HS301 is easily mounted by use of the mounting bracket, or by simply hanging the handset in its metal hanger in a place where it is readily available.

Safe storage

Both handset and sensors are dismounted by simply unclicking the mounting brackets and disconnecting the cables, and stored safely in the accompanying, Mini-Line® Carry Case.

The Carry Case protects HS301, sensors and cables.

System Overview

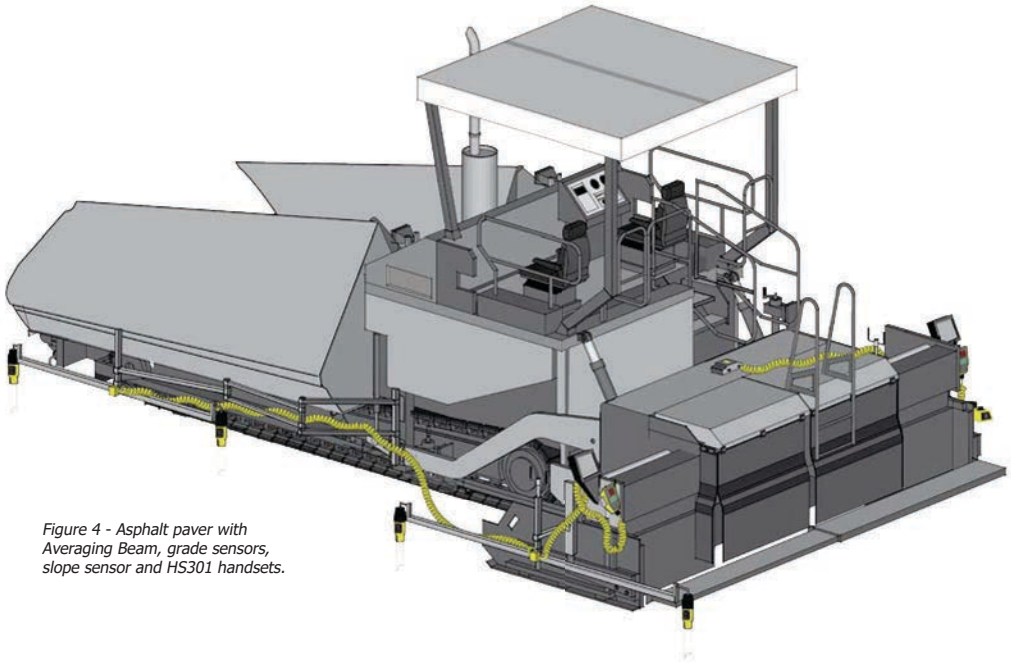


Figure 4 - Asphalt paver with Averaging Beam, grade sensors, slope sensor and HS301 handsets.

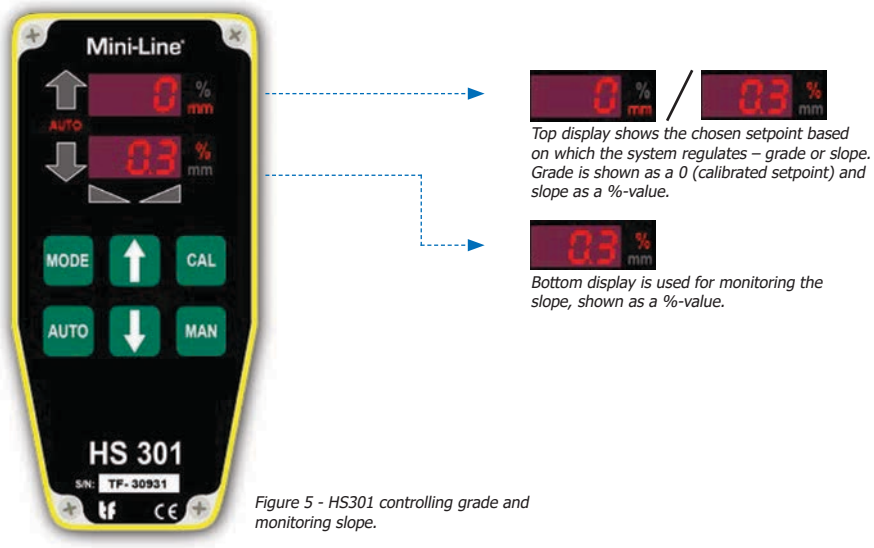
Mini-Line® Grade Sensor
Follows the movements of the screed and measures the distance between the sensor and the chosen reference. Choose between Single-Sonic and Multi-Sonic and add up to four sensors on an Averaging Beam in each side, depending on the paving job.

Mini-Line® Slope Sensor
Measures the cross slope of the screed. Often used for monitoring purposes, but can also be used for regulation in one side, while a grade sensor is used on the opposite side.

Mini-Line® Handset
The grade or slope of the paved road is controlled by regulating the tow point of the screed. Based on the precise measurements from the grade or slope sensor, the HS301 is able to very precisely maintain the desired grade or slope throughout the paving job.

Configurations

System Configurations



Top display shows the chosen setpoint based on which the system regulates – grade or slope. Grade is shown as a 0 (calibrated setpoint) and slope as a %-value.

Bottom display is used for monitoring the slope, shown as a %-value.

Figure 5 - HS301 controlling grade and monitoring slope.

This section provides an overview of possible system configurations for Mini-Line® Grade and Slope Control System with the use of the handheld controller, HS301. For possible system configurations with other controller types, please refer to the user manuals for PL2005 and LRL2000 respectively.

An asphalt paver requires two handsets to regulate the grade or slope of the paved road. One handset is mounted on each side of the screed and each handset uses one or more sensors. Cables connect handset and sensors to each other and the paver.

The HS301 uses input from the sensor to regulate grade or slope based on the reference chosen. If the sensor measures a change in grade or slope compared to the setpoint, the HS301 will adjust the height of the tow point, so that the desired grade or slope is maintained, despite changes in existing base.

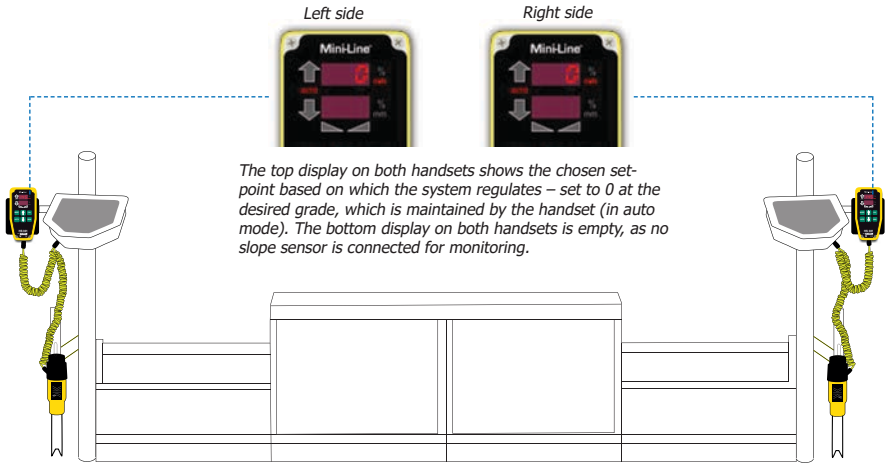
Controlling and monitoring

A Mini-Line® Grade and Slope Control System with HS301 offers the opportunity to control grade in both sides, or control grade in one side and slope in the other side.

Additionally, the HS301 can monitor the slope as a supplement to controlling the screed, so that both grade and slope is displayed in the same handset.

The HS301 therefore has two displays. The top display is used to show the chosen setpoint based on which the system regulates, in the form of a calibrated setpoint for grade control or a %-value for slope control. The bottom display is used to show the monitored slope value, when a slope sensor is connected in addition to a grade sensor.

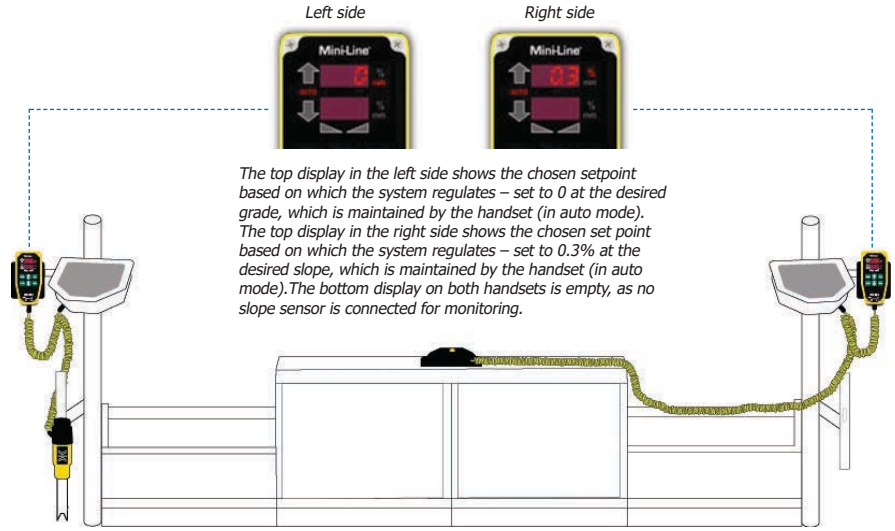
Grade control in both sides



The top display on both handsets shows the chosen set-point based on which the system regulates – set to 0 at the desired grade, which is maintained by the handset (in auto mode). The bottom display on both handsets is empty, as no slope sensor is connected for monitoring.

Grade control in both sides of the screed. Two HS301 handsets, two grade sensors (Single-Sonic or Multi-Sonic) and two V-cables are required.

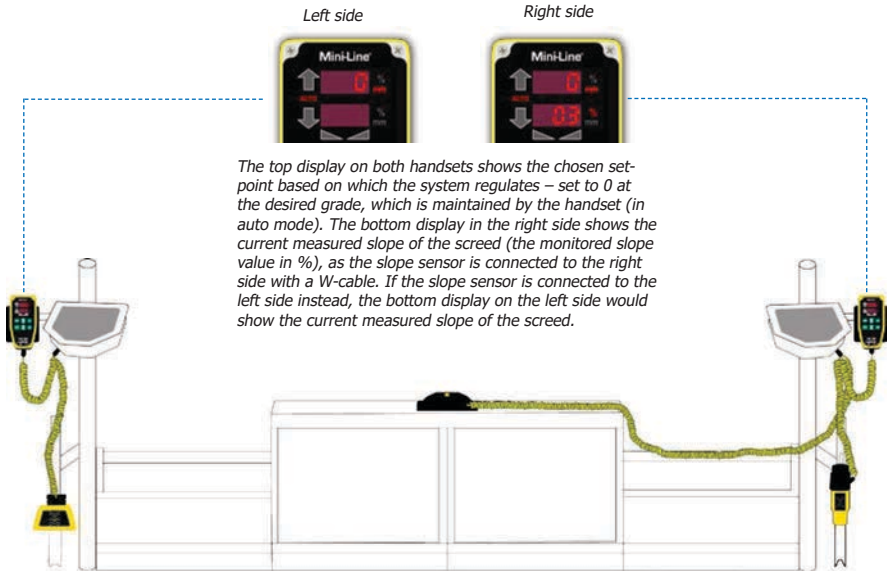
Grade and slope control



The top display in the left side shows the chosen setpoint based on which the system regulates – set to 0 at the desired grade, which is maintained by the handset (in auto mode). The top display in the right side shows the chosen set point based on which the system regulates – set to 0.3% at the desired slope, which is maintained by the handset (in auto mode).The bottom display on both handsets is empty, as no slope sensor is connected for monitoring.

Grade control in one side and slope control in the other side. Two HS301 handsets, one grade sensor (Single-Sonic or Multi-Sonic), one slope sensor and two V-cables are required.

Grade control in both sides with slope monitoring



The top display on both handsets shows the chosen set-point based on which the system regulates – set to 0 at the desired grade, which is maintained by the handset (in auto mode). The bottom display in the right side shows the current measured slope of the screed (the monitored slope value in %), as the slope sensor is connected to the right side with a W-cable. If the slope sensor is connected to the left side instead, the bottom display on the left side would show the current measured slope of the screed.

Grade control in both sides of the screed, while a slope sensor is used to monitor the slope. It is possible to display the value of the slope in one or both handsets, depending on whether the slope sensor is connected to one or both handsets. For this configuration, two HS301 handsets, two grade sensors (Single-Sonic or Multi-Sonic), one slope sensor as well as cables are required. A V-cable or a W-cable is used for each handset – a V-cable when connecting one sensor to the handset, a W-cable when connecting both grade and slope sensor to the handset.

It is recommended to only connect the slope sensor to one handset at a time, in order to prevent the risk of controlling slope by mistake from both sides of the machine, which will lead to a faulty result

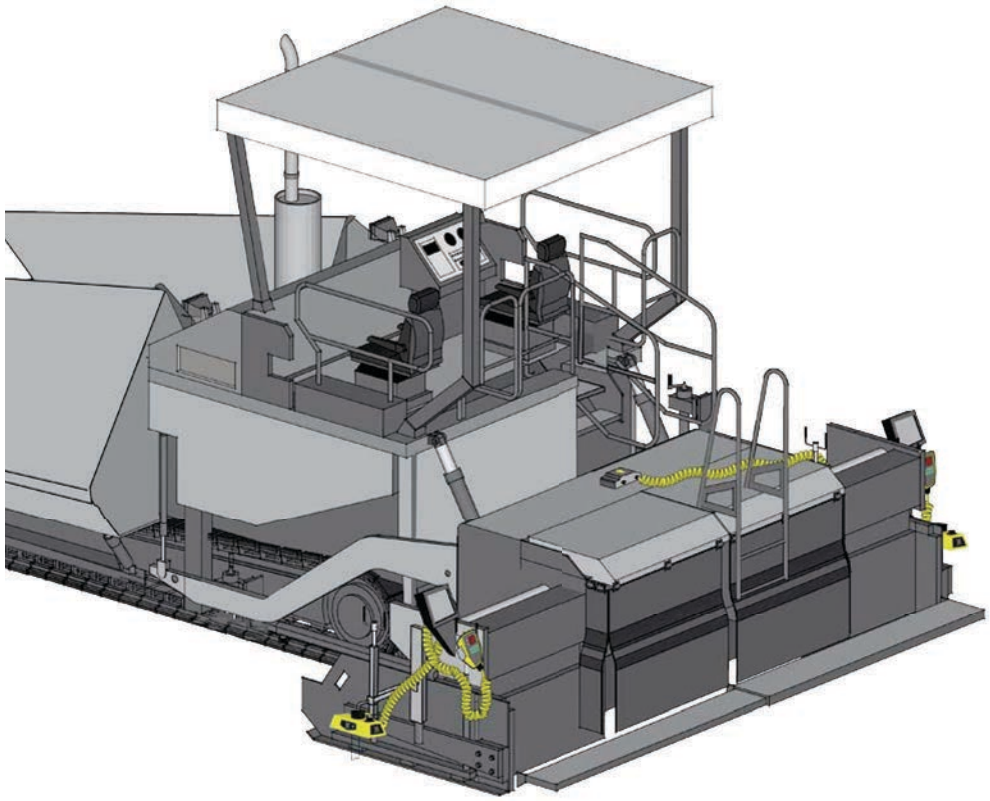


Figure 6 - Asphalt paver with grade control in both sides and slope monitoring in the right side.

Choosing between Grade and Slope Control

The two tow points on an asphalt paver are controlled independently of one another with one handset each. The operator can choose between controlling grade or slope on each handset, however, grade must be controlled in at least one side. An additional sensor can be added for monitoring purposes, so that a handset displays both grade and slope. The chosen setpoint (grade or slope) based on which the system regulates is always showed in the top display, whereas the bottom display shows the monitored slope.

Controlling grade or slope

Slope control follows the slope no matter the ground or wire, and grade control follows the ground or wire no matter the slope.

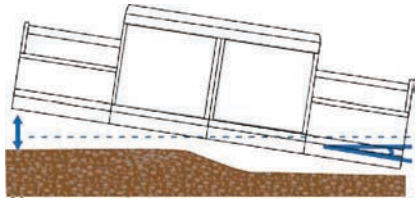


Figure 7 - Grade and slope control

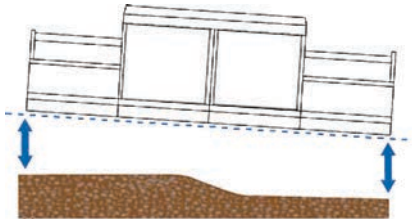


Figure 8 - Grade control in both sides

Grade must always be controlled in at least one side, and many operators prefer to have grade control in both sides, as this is the only way to keep track of material use without complete reliability of the reference.

Grade control is recommended, if the material thickness or material use is important

To ensure water will run off the road instead of collecting in puddles, a slope must be applied to the mat. With a reliable ground base the correct slope can be obtained with grade control in both sides, but it is more easily obtained using a slope sensor.

Slope control or slope monitoring is recommended, when the ability of the road to divert water is important

Paving with precise grade

Grade control offers a more precise mat thickness than slope control does, as the measuring accuracy of the grade sensor is ±1 mm / ±0,1 inches no matter the width of the screed, whereas the measuring accuracy of the slope sensor is ± 0.1 %, equaling ±1 mm per meter screed width / ±0,01 inch per feet screed width.

Grade control is recommended when mat thickness is important to secure durability and material use

Choice of Sensors for HS301

Grade sensor

TF-Technologies has developed three ultrasonic grade sensors in the Mini-Line® series that can all be used with HS301. The sensors are contact-free and thus typical annoyances of sticky mechanical skis prone to hitting obstacles are eliminated. All sensors are highly accurate and able to indicate to the operator whether they are connected and functioning properly.

All sensors are easily mounted and dismounted using the Snap Connector, cf. Mounting grade sensors in the Snap Connector, p. 76, and should be stored in the carry case together with the rest of the system.

Every sensor in the Mini-Line® series is easily connected to HS301 and paver via a durable standard V-cable. If the HS301 needs to display both grade and slope values (one controlled value and one monitored value), an additional sensor must be connected to HS301. In this case, both sensors are easily connected to the HS301 with the standard W-cable of the Mini-Line® system.

Alternative cable configurations are also available, please refer to Cables and Connectors, p. 84.

Sensor overview for HS301

The G220 Sonic Grade Sensor

The G221 Sonic Grade Sensor

The G224 Multi-Sonic Grade Sensor

The G220 Sonic Grade Sensor

The G220 Sonic Grade Sensor

The G220 Sonic Grade Sensor is an entry-level grade sensor with a well-proven record of functionality and durability. Just like the other grade sensors in the system, it perfectly follows the reference be that for ground sensing, curb sensing or joint matching.

The G220 has a red blinking diode indicating to the operator whether the sensor is connected correctly and positioned within its sensor range. The G220 sensor features a reference bail for optimum temperature compensation. The reference bail must always be mounted when the sensor is in use.

Specifications for G220

Reference Bail	Firm bail
User Communication	Indication of errors
Accuracy (Dynamic)	±1mm / ±0,04”
Sensor Range	280 – 900mm 11,2” – 36”
Application	Ground sensing Curb sensing Joint matching

The G221 Sonic Grade Sensor

The G221 Sonic Grade Sensor

The G221 Sonic Grade Sensor is an upgraded version of the G220, and has been improved with an extended working range and a large display that gives the operator a visual indication of how the current mat thickness is following the reference.

The reference bail compensating for changes in temperature is also improved with a click-on feature, designed to detach from the sensor body if struck by an obstacle to prevent damaging the bail or sensor. The reference bail must always be mounted when the sensor is in use.

Finally, the G221 has an upgraded transducer, which is encapsulated making this sensor particularly resilient to the harsh working conditions of a construction site.

Specifications for G221

Reference Bail	Click-on bail
User Communication	Indication of errors Indication of reference
Accuracy (Dynamic)	±1mm / ±0,04”
Sensor Range	220 – 900mm 8,8” – 36”
Application	Ground sensing Curb sensing Joint matching

The G224 Multi-Sonic Grade Sensor

The G224 Multi-Sonic Grade Sensor

The G224 Multi-Sonic Grade Sensor is a versatile, high precision sensor that is designed for use in both ground and stringline sensing mode. It is equipped with four ultrasonic sensors, which gives the G224 excellent abilities for stringline sensing due to the large sensing span, and enables high precision ground sensing by the use of advanced averaging technology.

When mounted with the transducers parallel to the direction of driving, the sensor is able to undertake local averaging and even out small irregularities in the existing surface. When mounted across the direction of driving, no averaging effect will be achieved. However, this will increase the sensor measuring span, making the sensor optimal for stringline use, as the sensor will use the transducer directly above the string and indicate its position over the string to the operator. The large sensing span also enables this sensor to measure on curved surfaces, as the sensor will track the highest point of the surface by using the transducer with the shortest distance to the reference.

The operator can easily switch between the two sensor modes, by turning the sensor 90° and pressing the MODE button.

The sensor uses a reference bail for temperature compensation. The reference bail must always be mounted when the sensor is in use, and with its click-on feature it is easily removed when the sensor not in use.

Specifications for G224

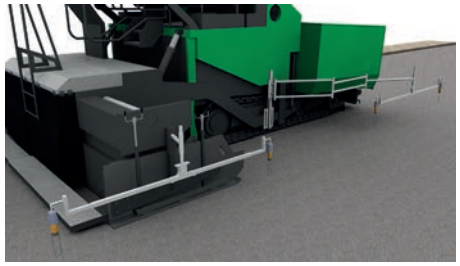
Reference Bail	Click-on bail
User Communication	Indication of errors Indication of reference Indication of wire position
Accuracy (Dynamic)	±1mm / ±0,04”
Sensor Range	250 – 900mm 10” – 36” (ground mode) 270 – 650mm 10,8” – 26” (stringline mode)
Application	Ground sensing Curb sensing Joint matching Stringline sensing Sloped curb sensing

Averaging beam as sensor

TF-Technologies has developed an Averaging Beam in the Mini-Line® series that can be fitted with four grade sensors for a large-scale averaging effect. The averaging beam can be considered as one sensor choice, as the Averaging Beam is connected to the HS301 as if it were a single sensor.

With the Averaging Beam an averaging effect is achieved as the sensor input to the HS301 consists of an average of all the sensor values from the grade sensors. This way, irregularities are smoothened out across the length of the beam, significantly improving the quality of the paved mat.

All grade sensors are easily mounted and dismounted on the Averaging Beam, which features integrated cabling, connector boxes and Snap Connectors.



Asphalt paver with Averaging Beam and four grade sensors.

The Averaging Beam, system configurations and advantages of its use is described in the following sections.

Slope sensor

TF-Technologies has developed several slope sensors in the Mini-Line® series, and the S298 Slope Sensor is specifically designed for use with the HS301 on an asphalt paver.

The S298 Slope Sensor

Slope sensor S298

The S298 Slope sensor is a compact, high precision slope sensor. It can be connected to the HS301 handset on either side of the machine, so that both sides can share one sensor. The S298 is designed for asphalt pavers and maintains its high precision even under strong vibrations from screed and machine.

Specifications for G298

User Communication	Indicates errors
Accuracy (Dynamic)	±0.1%
Sensor Range	0-9.99%
Resolution	0.01%

Using the Averaging Beam

A single grade sensor is able to perfectly follow a reference. For a significantly improved result, several grade sensors can be combined on an Averaging Beam. On an Averaging Beam, four grade sensors take individual measurements across the entire length of the asphalt paver and these measurements constitute the base of the grade regulation. Rough spots in the existing surface, which would normally affect the quality of the new road, are effectively evened out.

This averaging effect is what makes the Averaging Beam highly desirable when paving a road. It is therefore always recommended to use an Averaging Beam in at least one side of the asphalt paver, for an optimal result.

However, when the existing foundation is used as a reference, it will always have an effect on the final result, so that even with an Averaging Beam, larger irregularities will be copied to the paved mat. Due to the delayed screed effect, the asphalt paver is not able to completely even out larger hills or curves, and therefore such larger irregularities should be removed by improving the base before new asphalt is applied.

Situations where an Averaging Beam is a particular advantage

If the foundation has been milled with a single sensor grade configuration, the milling machine will have copied the roughness of the pre-existing road. Without the use of an Averaging Beam, these rough spots will be copied to the paved mat when adding a new asphalt layer

If the base layer has already been paved based on the existing foundation, the paver may have left small bumps or dents in the paved mat from starts and stops during paving. These irregularities are minimised or evened out completely across the length of the paver with the use of an Averaging Beam

The more layers paved with an Averaging Beam, the larger the smoothening effect

The higher the driving speed intended on the road when completed, the larger the need for an Averaging Beam

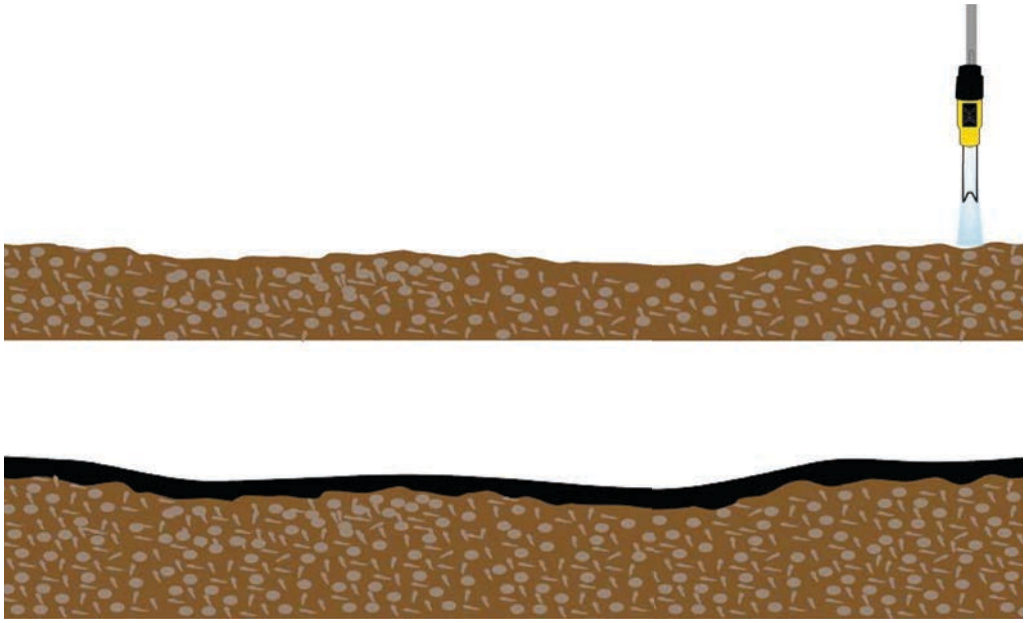


Figure 9 - Regulation with a single grade sensor can together with the screed even out minor irregularities.

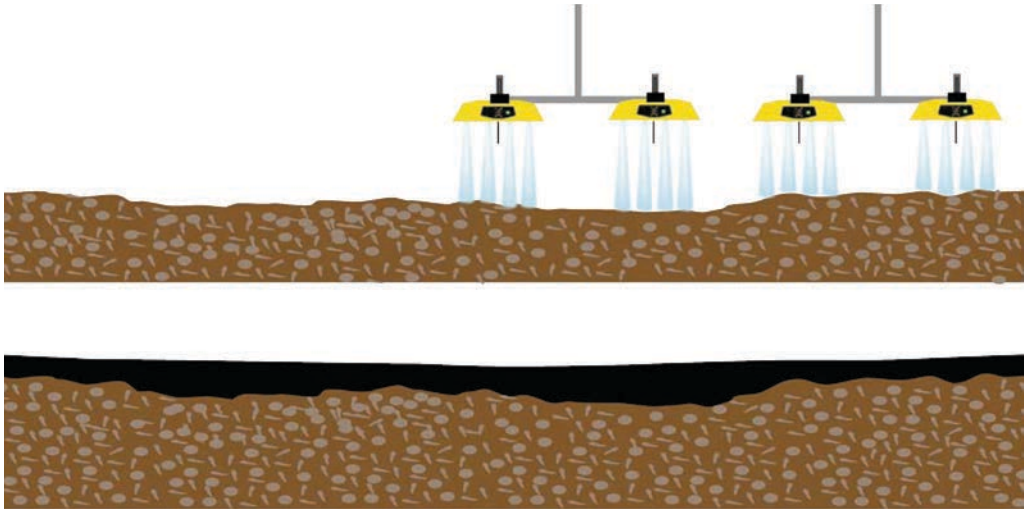


Figure 10 - Regulation with an Averaging Beam can also even out larger irregularities and smoothen the surface of the road.

Configurations with the Averaging Beam

The main part of the Averaging Beam consists of two horizontal sensor beams, fully-fitted with connector boxes and cabling integrated into the beams. The sensor beams are easily mounted with corresponding rear beam and front beam mounting brackets.

As previously noted, the Averaging Beam can be considered as one sensor choice, since the Averaging Beam is connected to the HS301 as if it were a single sensor. When choosing the Averaging beam, the V-cable is simply connected to the connector box on the sensor beam closest to the HS301 handset instead of a grade sensor. A standard I-cable then connects the rear sensor beam and the front sensor beam, as it plugs into the connector boxes on each sensor beam.

The Averaging Beam can be mounted with all the mentioned grade sensors in the Mini-Line® Grade and Slope Control System. As all sensors are fully compatible, it is possible to setup one Averaging Beam with different sensor types provided that the correct colour-codes are still used, cf. Connecting sensors to the Averaging Beam p. 99. In practice, most operators will choose four sensors of the same type, as per the requirements of the paving job at hand.

Averaging Beam with four grade sensors.

Grade control with Averaging Beam and slope control

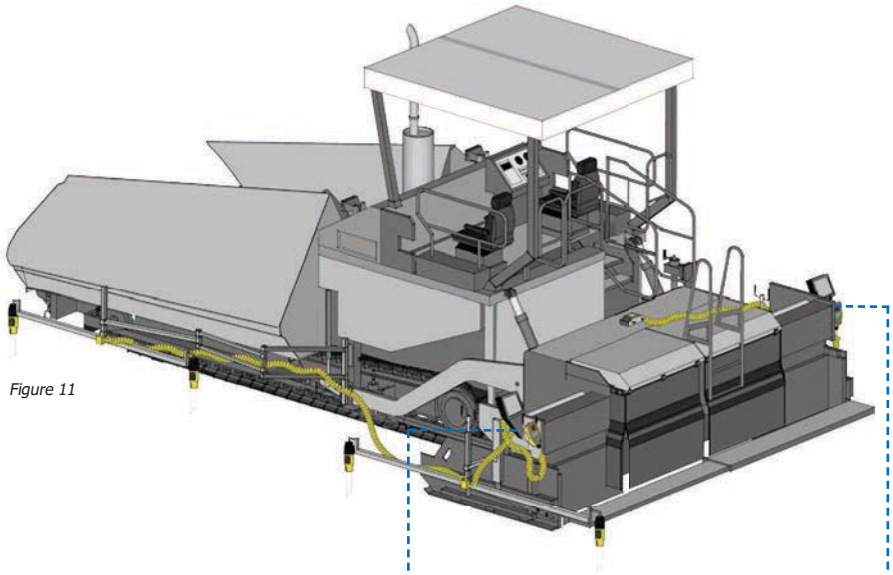


Figure 11

Grade control in one side with the use of an Averaging beam and slope control in the other side. Two HS301 handsets, one complete Averaging Beam with four grade sensors, one slope sensor and two V-cables are required. An additional I-cable is used to connect the front sensor beam to the rear sensor beam via the integrated connector boxes.

The top display in the left side shows the chosen setpoint based on which the system regulates – calculated as an average of the measurements of the four sensors. It is set to 0 at the desired grade, which is maintained by the handset (in auto mode). The top display in the right side shows the chosen setpoint based on which the system regulates – set to 0.3% at the desired slope, which is maintained by the handset (in auto mode).The bottom display on both handsets is empty, as no slope sensor is connected for monitoring.

Grade control in both sides – Averaging Beam in both sides

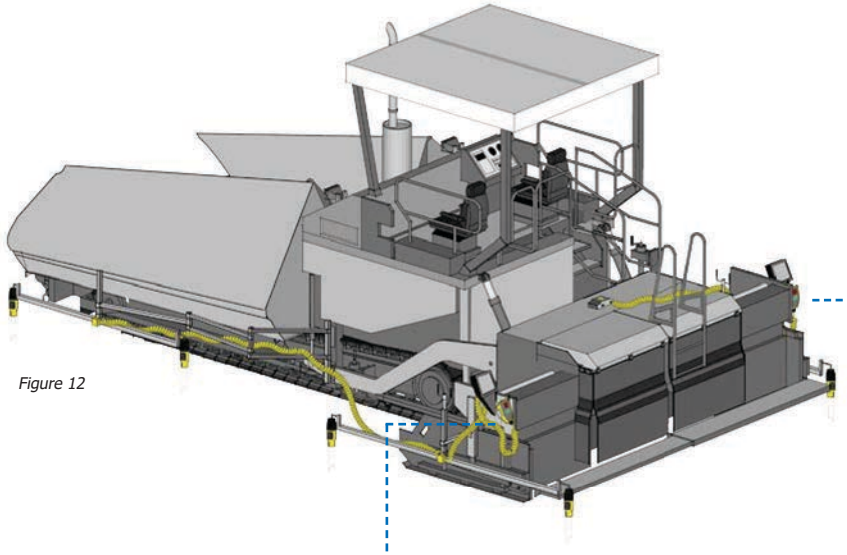
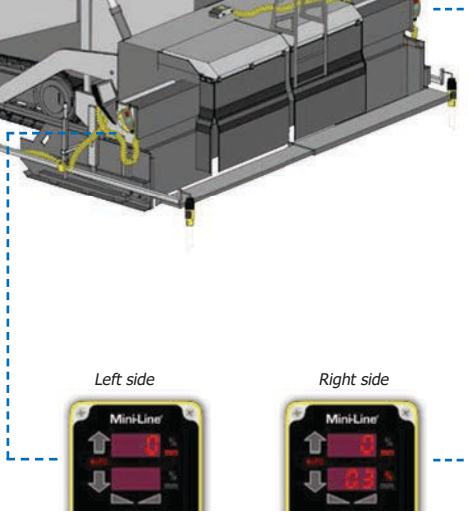


Figure 12

Grade control with the use of Averaging Beams in both sides. Two HS301 handsets, two complete Averaging Beams with eight grade sensors, and two V-cables are required. Two additional I-cables are used, one on on each side of the asphalt paver, to connect the front sensor beam to the rear sensor beam via the integrated connector boxes. If slope monitoring is desired, a slope sensor is added and one V-cable is exchanged with a W-cable.



The top display on both handsets shows the chosen setpoint based on which the system regulates – calculated as an average of the measurements of the four sensors. It is set to 0 at the desired grade, which is maintained by the handset (in auto mode). The bottom display on both handsets is empty, if no slope sensor is connected for monitoring (the drawing shows a slope sensor connected to the right side).

Grade control in both sides – Averaging Beam in one side

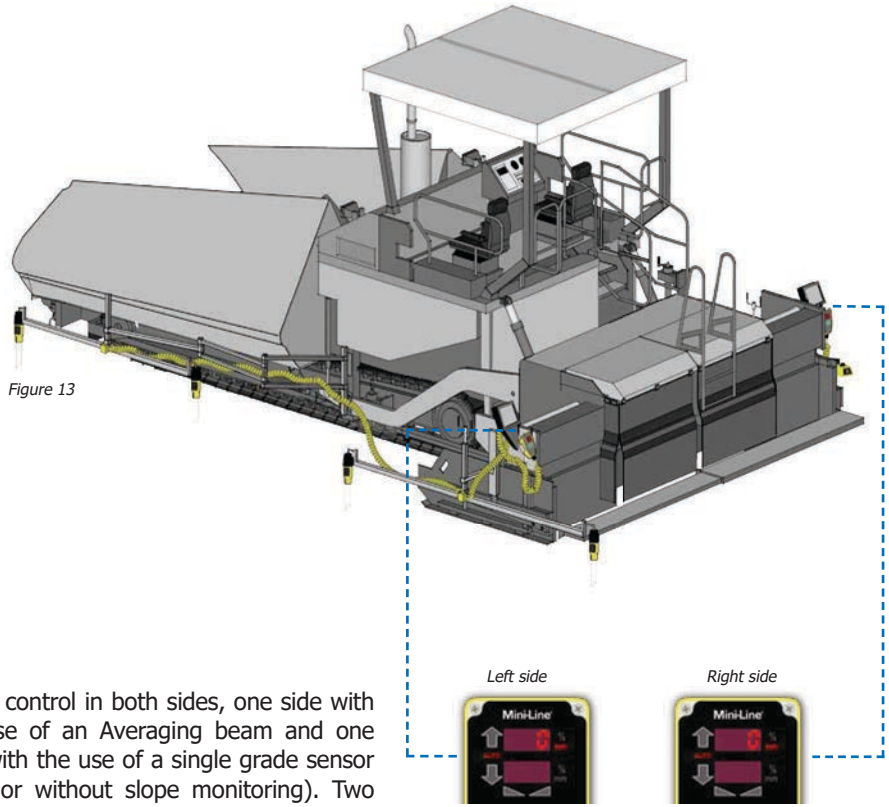


Figure 13

Grade control in both sides, one side with the use of an Averaging beam and one side with the use of a single grade sensor (with or without slope monitoring). Two HS301 handsets, one complete Averaging Beam with four grade sensors, one additional grade sensor and two V-cables are required. An additional I-cable is used to connect the front sensor beam to the rear sensor beam via the integrated connector boxes. If slope monitoring is desired, a slope sensor is added and one V-cable is exchanged with a W-cable.

The top display in the left side shows the chosen setpoint based on which the system regulates – calculated as an average of the measurements of the four sensors. It is set to 0 at the desired grade, which is maintained by the handset (in auto mode). The top display in the right side also shows the chosen setpoint based on which the system regulates – but based on the measurement from a single sensor. It is set to 0 at the desired grade, which is maintained by the handset (in auto mode). The bottom display on both handsets is empty, as no slope sensor is connected for monitoring.

Operation

Operating HS301

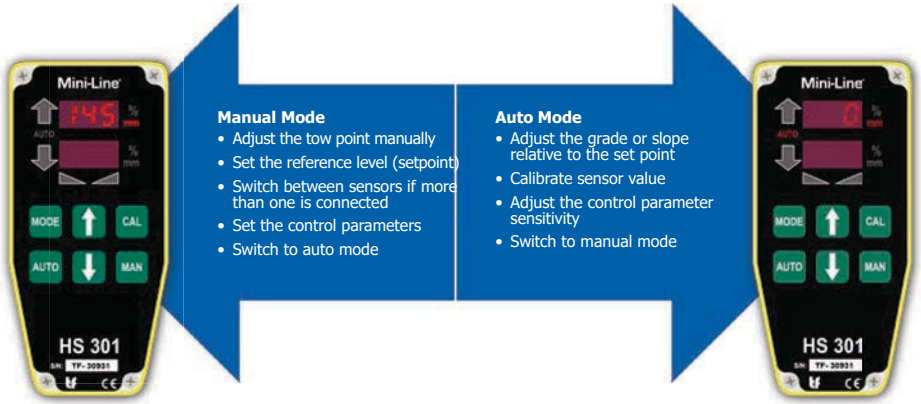
Safe use

Before HS301 is used it is important that the operator has read and understood the section Safety Instruction, p. 57, describing the responsibility of the operator and some of the situations that should be avoided while paving.

Two modes of operation

The HS301 has two modes of operation that the operator can choose between: manual and auto.

In manual mode, the tow point can be adjusted freely by the operator by pressing the up and down arrows. It is also in manual mode that the reference level (setpoint) is set. In auto mode the HS301 takes over the control of the regulation, and controls the tow point hydraulics based on the setpoint. For grade sensors, the reference level is displayed as a setpoint (zero-point) ± additions, e.g. 0 mm / 0,0 inch. For the slope sensor, the setpoint is displayed as the desired slope, e.g. 0.3 %.



HS301 remembers all settings

HS301 remembers all its settings, such as mode, setpoint, and control parameters, cf. Settings p. 45, when power is cut off. In case of a pause during paving, where power is cut off to the Mini-Line® Grade and Slope Control System, the handset remembers the settings from when paving was stopped, allowing for an easy re-start. When a paving job is fully completed, it is therefore recommended to switch the HS301 back into to manual mode.

When a paving job is fully completed, it is recommended to switch the HS301 back into to manual mode

Daily Operation

It takes time for the screed to build up a certain thickness of material, if paving is initiated from ground level. It is therefore recommended to build up a land of material or stack blocks to achieve the desired height before paving is initiated.

When the machine is at working RPM and the hydraulics are warm, and grade and slope automatics are switched to the on position (some machines also require the machine to be at speed), the operator can start up HS301 in manual mode. Grade or slope should then be checked to be in the desired position before the reference level is set and the HS301 switched to auto. When the HS301 is switched to auto, the system will control the tow point to follow the setpoint.

The first time the HS301 is used on a particular asphalt paver, the minimum pulse, cf. Settings p. 47, must be adjusted before startup.

Step-by-step instructions for daily operation

1.
2.
3.

Manual Mode

1. Lower the screed to the desired material thickness and make the machine ready for paving
2. Adjust sensor height to the recommended height over the reference. Check the value in the display of the handset. (The recommended height can be seen under Connecting HS301 and Sensors p. 92
3. Commence paving using the arrows of the handset to toggle the tow point to the right level. When mat thickness/slope is correct, press CAL to set the reference level (setpoint)

Auto Mode

4. Press AUTO to enter auto mode. The system will now maintain the level of the tow point constant relative to the setpoint
5. To increase mat thickness while paving in auto mode, press the arrows on the handset up or down. The change in mat thickness is displayed in the top display of the handset (only in auto mode)
6. When paving is completed, press MAN to return to manual mode, and the handset will stop controlling the tow point

Paving with slope

When paving with the use of a slope sensor, it is recommended to use an electronic spirit level directly on the paved mat while paving, and calibrate the slope sensor against the measured value. Press CAL and adjust the value with the arrows and press CAL again to save.

This function is only available in auto mode.

It is recommended to use a spirit level directly on the paved mat while paving, and calibrate the slope sensor against the measured value

Paving sharp turns

While paving asphalt with Mini-Line® Grade and Slope Control System, it is important that the grade sensor is placed directly above the reference throughout the paving job. This is difficult when paving sharp turns, as the ground or wire will no longer run parallel to the asphalt paver.

When paving sharp turns with a single sensor mounted on a mounting arm, it can be beneficial to change the position of the arm while paving

When paving sharp turns with an Averaging Beam, it is recommended to only use a single sensor or switch to manual mode, to keep the height constant

Buttons and Symbols of HS301

Buttons

The HS301 has six buttons for operating the handset. The HS301 has no on/off button, but simply starts up when power is applied.

Before paving is commenced, it is recommended to check whether the control parameters, cf. Settings p. 45, are adjusted correctly. Normally, only the setpoint and the control parameter sensitivity will need adjustment while paving.

The HS301 is easily operated by pressing the buttons:

A single push on the MAN button switches the handset into manual mode.

Push MAN down for 2 sec in manual mode, to switch between connected sensors. The controlled value is always showed in the top display, while the monitored value is showed in the bottom display.

A single push on the AUTO button switches the handset into auto mode.

Up and down arrows are used to change the height/slope of the tow point, and to change the settings of the handset in manual mode. The arrows are also used to adjust the setpoints for grade and slope in auto mode.

A single push on the CAL button will set the reference level in manual mode and start calibration of sensors in auto mode.

A single push on the MODE button is used to adjust the control parameter sensitivity. Sensitivity can be adjusted in both manual and auto mode.

Combinations of MODE, CAL and MAN are used as shortcuts for changing the control parameters of the handset, cf. Control Parameters p.46.

Displays and symbols

The two displays of the handset show the measured values in manual mode and the setpoint in auto mode. The top display always shows the controlled sensor value and the bottom display the monitored sensor value. The two displays are also used when setting the control parameters.

When pushing CAL or AUTO in manual mode the settings for the controlling sensor are displayed briefly. The number of grade sensors and the side connected to the slope sensor are displayed.

In manual mode, the arrows light up when pressing the up and down arrows, or when the position of the controlling sensor deviates from the setpoint. In auto mode, the arrows light up when the HS301 is controlling the tow point.

When a slope sensor is connected, the triangle lights up corresponding to the side which the screed slopes. In case of negative slope, the triangle changes side (as no negative numbers are used).

AUTO

The operation mode of the handset is displayed via the auto field, which lights up when the HS301 is switched to auto, and turned off when the HS301 is in manual mode.

%

When a slope sensor is connected to the handset, the %-field next to the slope sensor value lights up.

mm

When a grade sensor is connected and the handset version is mm, the mm next to the grade sensor value lights up.

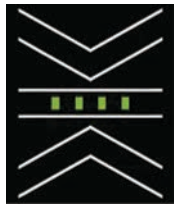
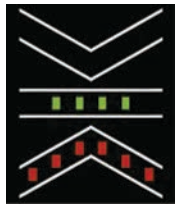
inch

When a grade sensor is connected and the handset version is inch, the inch next to the grade sensor value lights up.

Sensor Display

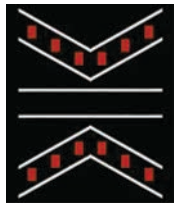
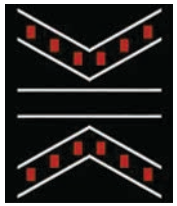
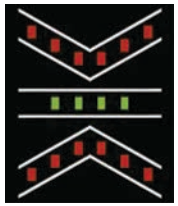
Light indicators for grade

The G221 Sonic Grade Sensor and the G224 Multi-Sonic Grade Sensor use the same light indicators to indicate the position of the sensor in relation to the setpoint.

Green bar flashes	*Green bar and red arrow flashes*	*Red arrow flashes*	*Red arrow constantly on*
			
On grade ±1	*2-5 mm / 0,1-0,2 inches off grade*	*5-10 mm / 0,2-0,4 inches off grade*	*>10 mm / 0,4 inches off grade*
On grade	*Correcting in direction of the arrow*		

Error indications

The red arrows of the sensor will flash in case of errors, where the sensor is unable to measure the reference and send the value to the handset. There are three different types of errors that the operator can encounter.

Red arrows flash alternately	*Red arrows flash simultaneously*	*Green bar and red arrows flash*
		
Target out of range	*Reference bail missing*	*No handset connected*

Light indicators for the position of the sensor over wire

When the G224 Multi-Sonic Grade Sensor is in stringline mode, the display on the wide side of the sensor is used. This display indicates the position of the sensor in relation to the setpoint, as well as the position of the sensor over the wire.

The indication of the position of the sensor over the wire is shown in four steps to enable the operator to correct the position of the sensor or the asphalt paver, before the wire becomes out of range for the sensor.

Green LEDs in both sides (On grade)	Green LEDs in one side (On grade)	Green and red LEDs in one side (On grade)	Red LEDs in one side (Red arrows flash alternately)
			
Sensor is directly over the wire	The sensor is dis-placed left relative to the wire	The sensor is now further displaced left relative to the wire	The sensor has lost sight of the wire. Tow point is locked
No correction required	Correct the sensor to the right		

List of Functions of the HS301

List of functions in auto mode

Setting	Shortcut	Display	Change	Confirm
Adjust setpoint			↓ ↑	
Calibrate sensor value	CAL	AUTO (flashes)	↓ ↑	CAL
Sensitivity	MODE	SEn	↓ ↑	MODE
Switch to manual mode			MAN	

List of functions in manual mode

Setting	Shortcut	Display	Change	Confirm
Manual tow point adjustment			↓ ↑	
Set the reference (setpoint)			CAL	
Switch between sensors			MAN (2 sec.)	
Minimum Pulse	MAN + MODE	PUL	↓ ↑	MODE
Sensitivity	MODE	SEn	↓ ↑	MODE
Working Window	CAL + MODE	CO	↓ ↑	MODE
Dead Band	MAN + CAL	db	↓ ↑	MODE
Switch to auto mode			AUTO	

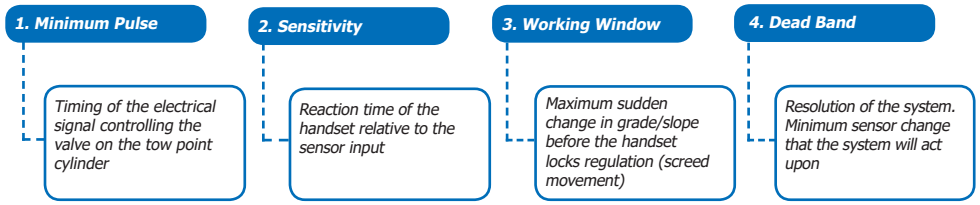
Changing output during handset startup

	Shortcut	Display	Change	Confirm
Output (NPN or PNP)	AUTO (at startup)	OUt	↓ ↑	MODE

Settings

Control Parameters

The HS301 handset has four control parameters that are vital for how the handset works with the sensors and the asphalt paver.



The first time HS301 is used on an asphalt paver, the **minimum pulse** must be adjusted, so that the handset match the hydraulics of the asphalt paver. **Sensitivity** can need adjustment while paving, but the standard settings for **working window** and **dead band** should fit most situations, and as a general rule do not require to be changed.

When the HS301 has been set up for the first time on an asphalt paver and minimum pulse set, it is not recommended to change any other control parameters than sensitivity

How to Adjust Minimum Pulse

Minimum pulse

Before the HS301 is used for the first time on an asphalt paver, the HS301 must be adjusted to the hydraulics of the paver. This is also the case when the HS301 is returned from service or transferred from one asphalt paver to another, and is due to the fact that different asphalt paver types use different hydraulics.

To adjust the minimum pulse, the asphalt paver must be in operation, warm and at working RPM.

The HS301 handset controls the movement of the hydraulic tow point by sending a series of electrical impulses to the solenoid valve. When the minimum pulse is adjusted, the duration of these impulses is adjusted to match the valve.

The optimal minimum pulse value is different from asphalt paver to asphalt paver, and in some cases it can even vary from the left side to the right side of the same machine. In such cases, it is recommended to mark the handsets to denote which side of the machine each should be mounted on.

Step-by-step instruction for adjusting minimum pulse

1. 2. 3.

1 Press Shortcut
Press MAN and MODE at the same time. The top display shows the value for minimum pulse, the bottom display shows "P.U.L."

2 Adjust Pulse
Increase the minimum pulse value by pressing the up arrow button until the tow point cylinder starts to move up and down. Then decrease the minimum pulse value by pressing the down arrow button stepwise while sensing the movement of the hydraulic piston with your hand. When movement of the hydraulic piston is only just noticeable, increase the pulse value by one. This is the optimal minimum pulse value

3 Save Pulse
Press MODE to save the minimum pulse value

The minimum pulse is the step where you are just able to feel the movement of the hydraulic piston. The minimum pulse must not be set lower than this value

Values for minimum pulse

For HS301 ON/OFF minimum pulse can be adjusted in the interval 1mS – 150mS (150 increments).

For HS301 Proportional minimum pulse can be adjusted 75 steps corresponding to 0 - 75%.

Please note that the previous version of the handset, HS300, only has 20 increments available in the same interval 1mS – 150mS. The settings on previous versions can therefore not be re-used, as the setting is not comparable between the two versions.

Shortcut

Minimum pulse can only be adjusted when HS301 is in manual mode.

When setting the minimum pulse on a HS301 Proportional handset , used on an asphalt paver with proportional valves, movement of the hydraulic piston can be very hard to detect by hand. This is because the piston will alternate up and down in 3 second intervals.
We therefore recommend monitoring the hydraulic piston very closely instead, possibly with the help from a colleague.

How to Adjust Sensitivity

Sensitivity

Sensitivity is the parameter of the HS301 that determines how fast the system will react to a change in grade or slope measured by a sensor. An increase in sensitivity entails a faster reaction, while a decrease in sensitivity means a slower reaction.

The position of the grade sensor in relation to the tow point is a determining factor in how much the tow point is moved to obtain the desired grade, and therefore affects the need for sensitivity adjustments. The paving speed also affects the need for sensitivity adjustments, as it affects the ability of the screed to float on top of the material.

Since the optimal value for sensitivity depends on several factors, sensitivity has no measuring value. It is simply changed until the speed and finish of the regulation is satisfactory, and therefore it can be necessary to adjust sensitivity while paving.

Sensitivity set wrongly

The need to adjust sensitivity typically arises if the asphalt paver overreacts/underreacts to changes from the sensors.

If sensitivity is too high, a problem may arise where the tow point is constantly moving up and down, even though minimum pulse is set correctly. This happens because the handset has become so sensitive that it moves the tow point in too big steps at a time.

If sensitivity is too low, the tow point moves in smaller steps when the handset regulates and changes are undertaken too slowly.

Optimal sensor position

If the sensor is placed too close to the tow point or the front edge of the screed, the operator will often experience the screed as overreacting or underreacting. A change in sensitivity will partly compensate for this.

The position of the grade sensor both affects when a change is discovered, and how fast the system will react to this change. Therefore, it can be necessary to adjust sensitivity, if the sensor is moved further back (towards the front edge of the screed) or forward (towards the tow point).

It is recommended to place the grade sensor aligned with the auger, and adjust sensitivity for this placement to the paving speed. (This recommendation on sensor position is based on a paving speed of 5-12km/h / 3-8MpH)

If the operator wishes to copy the reference, e.g. when a bump is paved based on a template, the paving speed must be reduced significantly, the grade sensor must be placed in line with the front edge of the screed and sensitivity must be high enough to follow the changes without overreacting

Step-by-step instruction for adjusting sensitivity

1. **Press Shortcut**
   Press MODE. The top display shows the current sensitivity level, the bottom display shows "S.E.N."
2. **Adjust Sensitivity**
   Increase or decrease the sensitivity value by pressing the up and down arrow buttons
3. **Save Sensitivity**
   Press MODE to save the value for Sensitivity

Fast hydraulics require a lower sensitivity value

A change in paving speed can require an adjustment in sensitivity

Standard value for sensitivity

The optimal value for sensitivity depends on several factors, and is simply changed until the speed and finish of the regulation is satisfactory.

The standard factory value for Sensitivity is 5.0.
Sensitivity can be adjusted in the interval 0.0 – 10.0.

Shortcut

MODE

How to Adjust Working Window

Working window

The working window defines how a big a sudden change in grade/slope the handset will react to with locking regulation (screed movement).

The working window is a protection against incorrect regulation due to faulty sensor measurements, e.g. caused by a sensor losing target or a large obstacle such as a stone or a boot is blocking sensor measurements. If the sensor observes a larger sudden change than the working window, the HS301 handset will stop regulation of the tow point and lock the screed until the measured value of the sensor is once again within the working window.

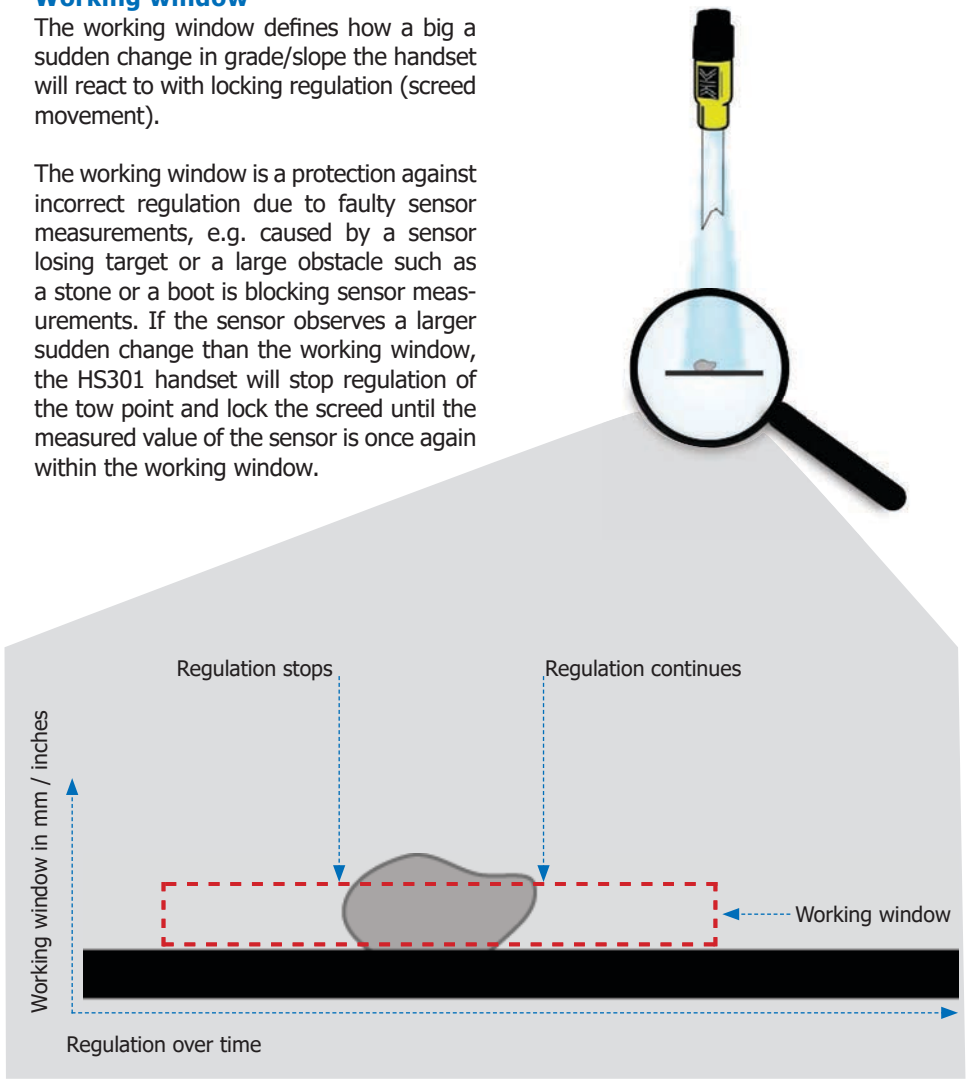


Figure 14 - The system ignores any stone or pebble placed under the sensor, if it is larger than the working window. When the stone is passed, regulation continues automatically. This means that the stone does not result in a bump on the road.

Step-by-step instruction for adjusting working window

1.
2.
3.

1 Press Shortcut
Press MODE and CAL at the same time. The top display shows the value for the working window and the bottom display shows "[ ]"

2 Adjust Working Window
Increase or decrease the working window value by pressing the up and down arrow buttons

3 Save Working Window
Press MODE to save the working window value

Standard value for working window

The standard factory value for grade sensors is ± 50mm / 2 inches.
Working window can be adjusted in the interval ± 15mm to ± 200 mm / ± 0,6 inches to ± 8,0 inches.

The standard factory value for slope sensors is ± 5 %.
Working window can be adjusted in the interval ± 1.5 % to ± 9.5 %

When the working window is exceeded, the HS301 handset will display "O.U.T" and the handset will stop regulation of the tow point and lock the screed until sensor measurements are within the working window again.

Shortcut

MODE + CAL

Working window can only be adjusted when the HS301 is in manual mode.

How to Adjust Dead Band

Dead band

Dead band is the resolution of the system, and the control parameter defines the sensor change that the system will act upon. If a change in measurement is smaller than the dead band, the handset will not commence any regulation, but if the change is larger than the dead band, the HS301 will commence regulating the grade or slope.

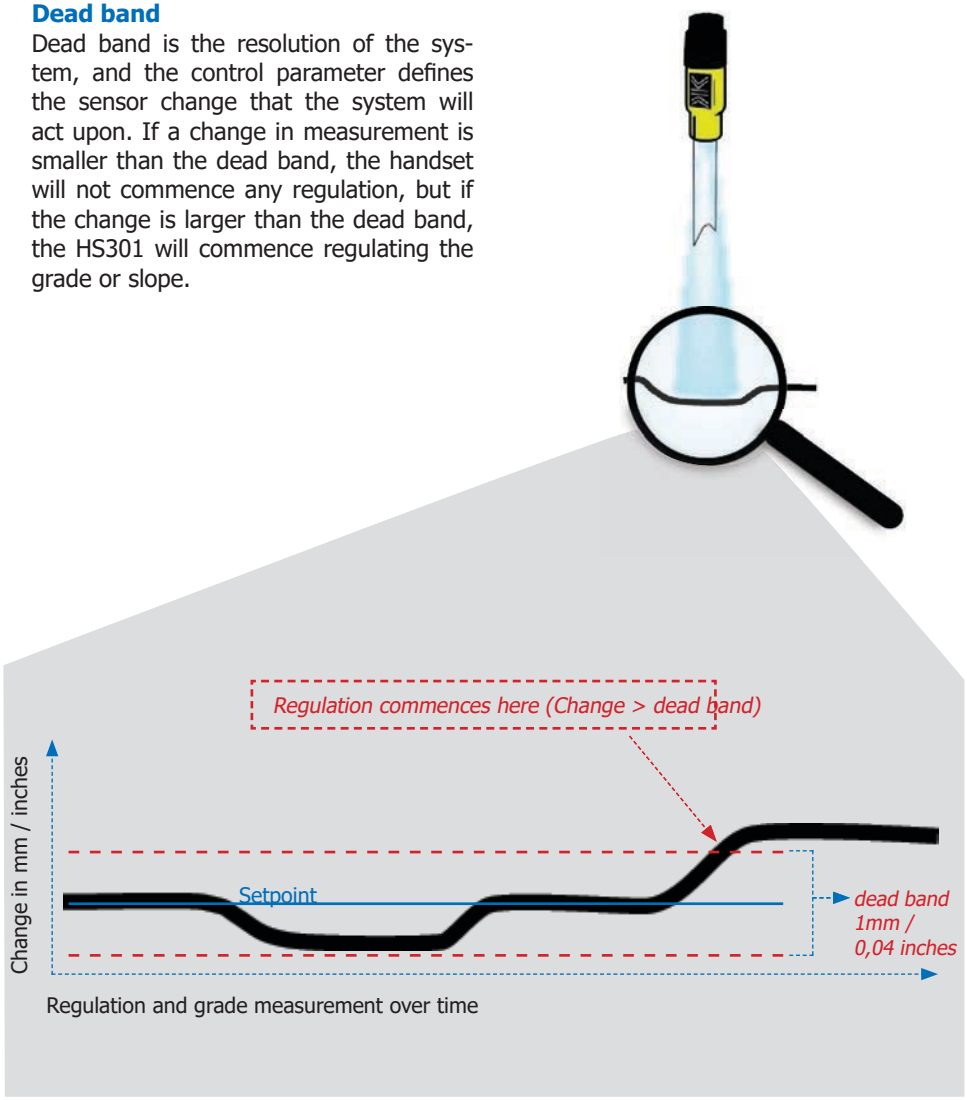


Figure 15 - If the grade sensor measures an insignificant change (<1mm / 0,04 inches), the system will not begin to regulate the tow point of the screed. To maintain a smooth surface, regulation only commences when a significant change is measured (>1mm / 0,04 inches).

Step-by-step instruction for adjusting dead band

1. **Press Shortcut**
Press MAN and CAL at the same time. The top display shows the value for dead band and the bottom display shows ".d.b."

2. **Adjust Dead Band**
Increase or decrease the dead band value by pressing the up and down arrow buttons

3. **Save Dead Band**
Press MODE to save the dead band value

Standard value for dead band

It is not recommended to change the standard factory value for dead band.

Standard factory value for grade sensors is ± 1mm / ± 0,04 inches
Dead band can be adjusted in the interval ± 1mm to ± 10mm / ± 0,04 inches to 0,4 inches

Standard factory value for slope sensors is ± 0.05 %
Dead band can be adjusted in the interval ± 0.01 % to ± 1 %

Shortcut

MAN + CAL

Dead band can only be adjusted when the HS301 is in manual mode.

How to Choose Output

Output type

The HS301 handset can operate NPN or PNP, so that the HS301 is compatible with most paver types. The output type defines the form of communication with the asphalt paver, and if set incorrectly, the HS301 will not be able to function.

Step-by-step instruction for choosing output (NPN or PNP)

1. **Press Shortcut**
Disconnect the HS301 from the power supply.
Press down AUTO while connecting the power supply. Keep pressing AUTO until the bottom display shows "C.A.L"

2. **Choose Output Type**
Press the up and down arrow buttons to choose between NPN or PNP

3. **Save Output Type**
When the correct output is displayed, press MODE to save.
Press AUTO to delete the choice and leave the output setup menu

Standard value for output

The standard factory setting for the output for HS301 is NPN. When receiving the HS301 back from service or repair, the output setting must therefore be switched back to PNP, if the asphalt paver requires a PNP output.

Shortcut

AUTO

(Pressed down for 3 seconds during startup)

Safety Instruction

Asphalt Paver Requirements

A pre-condition for the safe use of Mini-Line® Grade and Slope Control System in accordance with applicable safety regulations is that the system is only used on asphalt pavers that comply with the applicable safety regulation. The key safety requirements of asphalt pavers which have an influence on the safe use of Mini-Line® Grade and Slope Control System is therefore outlined below.

Key safety requirements of asphalt pavers for the safe use of Mini-Line® Grade and Slope Control System

Within the EU the asphalt paver must be CE marked and thereby comply with the requirements described in EN60204, Safety on Machinery - Electrical Equipment of Machines

The asphalt paver must be equipped with an emergency stop that can stop all potentially dangerous parts of the machine, including switching off the power supply to the Mini-Line® Grade and Slope Control System

The asphalt paver must stop all potentially dangerous parts of the machine in case of a malfunction in the power supply, including switching off the power supply to the Mini-Line® Grade and Slope Control System

Mini-Line® Grade and Slope Control System is developed for use on both asphalt pavers with a 12V system and asphalt pavers with a 24V system. The asphalt paver must be able to deliver a stable power supply as described in EN60204, for instance via the battery of the asphalt paver

Key safety requirements for safe installation of Mini-Line® Grade and Slope Control System

The controller and sensors must be installed, mounted and connected in accordance with the instructions in this user manual

A form of overcurrent protection must be installed between the power supply of the asphalt paver and the Mini-Line® Grade and Slope Control System. This should be checked prior to the connection of the system. The overcurrent protection is usually built into the asphalt paver in the form of a fuse in a central fuse box.

The short circuit breaking capacity must be adapted to the total maximum power consumption of the Mini-Line® Grade and Slope Control System, or equal the prospective fault current in case of short-circuiting. The maximum power consumption of all the parts in the Mini-Line® Grade and Slope Control System can be found under Technical Specifications (data sheets) p.124

After installing the Mini-Line® Grade and Slope Control System on a new asphalt paver, it should be tested that the emergency stop covers the system, so that power supply to the Mini-Line® Grade and Slope Control System is switched off when the emergency stop is activated

The mounting bracket for the HS301 must be mounted in proximity to the emergency stop, so that the operator has access to it while paving

Correct Use

The Mini-Line® Grade and Slope Control System has been developed as a levelling system for an asphalt paver, and correct use therefore entails that the system is used for this purpose. The Mini-Line® Grade and Slope Control System should only be operated by a trained operator, so that personal injury and damaged equipment is avoided.

The operator must:

Read and understand the user manual.
In case of questions, contact your local representative

Be aware of the situations described under Examples of Incorrect Use p. 63, Warnings and Dangerous Situations p. 65 and be able to avoid them

Be aware of the specifications of the HS301 and the sensors to ensure they are working optimally. See Technical Specifications (data sheets) p. 124[1]

[1]TF-Technologies reserves the right to make changes in specifications without further notice.

Responsibility of the Operator

When planning the paving job, the operator must remember the following:

Investigate local legislation regarding road construction work and the use of protective equipment required for the paving job

Investigate local health and safety regulation concerning the operation of heavy machinery, and incorporate any risks involved in the use of external controllers in the total risk assessment of the machine, e.g. placing operation stations outside dangerous areas

Make sure the total risk assessment of the machine is accessible to everyone working with and around the asphalt paver

Make sure all personnel working with and around the asphalt paver understands how the Mini-Line® Grade and Slope Control System affects the asphalt paver

When commencing the paving job, the operator must remember the following:

Avoid the situations described under Examples of Incorrect Use, p. 63

Avoid situations described in the total risk assessment

Ensure that the Mini-Line® Grade and Slope Control System is not damaged, including securing that the reference bails of the grade sensors are clean and have their original shape

Ensure that the Mini-Line® Grade and Slope Control System is connected correctly to the asphalt paver

Make sure that the measuring areas of the sensors are free from spilled asphalt or other obstacles that will lead to faulty reactions of the system

Ensure that the HS301 and sensors are working within their specifications. See Technical Specifications (data sheets) p. 124[1]

Inform TF-Technologies or your local representative, if the HS301 or any of the sensors for any reason are not safe to use

[1]TF-Technologies reserves the right to make changes in specifications without further notice.

Examples of Incorrect Use

The Mini-Line® Grade and Slope Control System should only be used to what it is constructed to, and most examples of incorrect use are self-explanatory and therefore not described. However, certain key examples of misuse or inappropriate behavior are outlined below, and should be avoided.

Examples of incorrect use of the system before the paving job:

Do not remove any of the labels on the HS301 or sensors, as they are required for product identification, e.g. in relation to repair and disposal

Do not open the aluminium house of the HS301 handset or sensors, as this will expose the electronics and can damage the products

Neither HS301, sensors nor other parts of the Mini-Line® Grade and Slope Control System must be rebuilt or refurbished, as TF-Technologies will no longer be able to vouch for the quality, and rebuilding units may cause serious personal injury or material damage. The Mini-Line® cables must not be disconnected from their connectors or in any way disassembled

Examples of incorrect use of the system during the paving job:

Do not use unauthorised cables or unauthorised spare parts, as this can damage the HS301 handset and lead to unpredictable control of the asphalt paver, which may result in serious personal injury or material damage

It is not recommended to connect HS301 or sensors on a paver, when power is already applied, as the metal jacket on the cable under unfortunate circumstances may lead to short circuiting the asphalt paver, if the metal jacket hits the two power supply pins at the same time

It is not recommended to adjust the screed manually on the built-in controller on the asphalt paver, while HS301 is in auto mode, as the handset will seek to counter the adjustment. Switch the HS301 to manual mode instead, if adjustments on the built-in controller are required

It is not recommended to mount the HS301 or sensors on an asphalt paver on the move or in operation, as this may remove focus from the surrounding traffic, which may result in serious personal injuries

It is not recommended to re-adjust the mounting of the HS301 or sensors on an asphalt paver on the move or in operation

- It can remove focus from the surrounding traffic, which may result in serious personal injuries
- It can remove focus from the moving parts of the machine, which may result in serious personal injuries
- The HS301, sensors or other parts can be dropped, squashed or otherwise damaged by the moving parts of the machine

Warnings and Dangerous Situations

The Mini-Line® Grade and Slope Control System must not be used:

If the Mini-Line® Grade and Slope Control System is obviously damaged

If the Mini-Line® Grade and Slope Control System has been rebuilt

If the HS301 is connected to other sensors than those in the Mini-Line® system

If the Mini-Line® Grade and Slope Control System is connected to asphalt pavers that use other types of input than the output the system is able to deliver

The Mini-Line® Grade and Slope Control System can be damaged:

If welding is performed on the asphalt paver, the Averaging Beam or Support Arm, as large currents may travel through the construction and damage the electrical equipment.

The following precautions should be taken before welding:

- Remove all electrical equipment wherever possible
- Disconnect the negative pole on the battery of the asphalt paver, or mount voltage protection on the battery
- Place the negative electrode close to the welding point
- Remove paint before welding

During transport of the asphalt paver when the screed is lifted and if using the Averaging Beam, as the sensors may come too close to the ground. The sensors should therefore be removed before transport.

When cleaning the asphalt paver, e.g. if using a high-pressure cleaner, as this may expose the Mini-Line® system to too large forces. The Mini-Line® Grade and Slope Control system should therefore be removed before cleaning the asphalt paver

The Mini-Line® Grade and Slope Control System can lead to serious personal injury

If an ultrasonic sensor connected to power supply is taken up to an ear or pointed towards others, as the ultrasound can damage hearing. This is also the case, even if the ultrasound may not be audible.

If warnings from the total risk assessment are not complied with

If the HS301 is operated by a person without training in operation and safe use, as he will not be able to fulfill the responsibility of the operator, cf. p. 61

If the the Mini-Line® Grade and Slope Control System is used in dangerous areas or in dangerous atmospheres/pressure levels, as the system is not designed to such operation

Emergency Procedure

In case of accidents, break-downs or otherwise dangerous situations, the following procedure should be followed:

1. Press emergency stop
2. Turn off the asphalt paver and remove the key
3. Disconnect the cable between the Mini-Line® Grade and Slope Control System and the asphalt paver
4. Commence repair

Mounting the Mini-Line® System

Choosing Place of Operation

The HS301 is a handheld controller that offers mobility around the asphalt paver. The metal hanger on the HS301 enables the operator to quickly hang the HS301 on any available hook on the asphalt paver, whenever required. This is practical when the operator needs to take up and put down the HS301 with short intervals during the paving job.

Nevertheless, the operator will still need a primary place of operation. When the operator needs to leave the HS301 for a longer period, it is recommended to use the HS301 Mounting Bracket.

This is typically placed on the side of the screed, however, there are certain considerations the operator should take into account before setting up the Mini-Line® Grade and Slope Control System.

Advice on choosing the place of operation

The place of operation should to the extent possible be located outside of any dangerous areas, securing the operator from exposure to

- Ejection of objects from the machine or any machine emissions
- Moving parts of the asphalt paver
- Excessive radiant heat

From the place of operation, the operator should be able to ensure that no one is located in dangerous areas that can be affected by the operation of the system

The place of operation should be within reach of the emergency stop of the machine

The place of operation should have sufficient room for the operator to move all parts of his body, and for him to use appropriate safety equipment

The place of operation should have easy access without any obstacles the operator can stumble upon or get his clothes caught in

The operator should be able to have a full overview of all the operating stations of the machine (e.g. position of HS301, the operating station of the asphalt paver, the emergency stop)

General advice on mounting the Mini-Line® Grade and Slope Control System

If practically possible, the HS301 and sensors should be:

Easily accessible for operation and adjustments

Mounted so that the probability of material damages is minimized, e.g. where they are unexposed to the moving parts of the asphalt paver, excessive radiant heat, as well as potential shocks or pulls from the cables

Placed so that the displays can be orientated towards the operator without the need to move any cables or other equipment

Placed in a position accessible for the operator that does not require him to bend or stretch unnecessarily

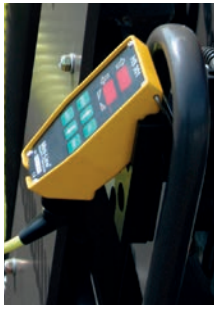
Mounting the HS301 Mounting Bracket

The HS301 handset is designed for the operator to walk around with it in his hand, and therefore has a metal hanger on the back, so that the operator can quickly hang the HS301 on any available hook on the asphalt paver, whenever required.

In practice, however, the operator will not maintain the handset in and out of his hand all the time, and it is therefore an advantage to have a permanent mounting bracket for the HS301.

When the operator is not walking around with the HS301 in his hand for an extended period of time, it is recommended to mount the handset in the HS301 Mounting Bracket

The HS301 Mounting Bracket secures a solid mounting of the handset that prevents the HS301 from falling off the asphalt paver and getting damaged, e.g. due to vibration from the screed or small pulls in the cables.



At the same time, the mounting bracket ensures a suitable angle of the HS301, enabling the operation of the handset without dismounting it from the bracket.

The tap on the back of the HS301 fits into the groove on the mounting bracket. If the operator wishes to take the HS301 into his hand, it is easily clicked on and off the mounting bracket. The hole in the middle of the groove makes sure it does not fill with water.

Mounting on surface

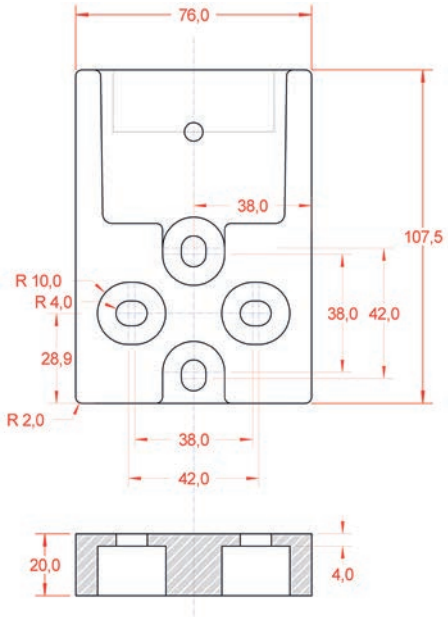
The HS301 Mounting Bracket is easily mounted on any vertical surface, and can also be mounted on any available tube with the tube fitting included, based on what is available on the asphalt paver, where it is appropriate to place the handset.

The HS301 Mounting Bracket can be mounted on all surfaces by using either the two vertical or the two horizontal screw holes. The bracket is mounted with 8mm.

Mounting on tube

The HS301 Mounting Bracket can be mounted on all round or square tubes with a maximum diameter of 30mm / 1,2 inches by use of the tube fitting. The four screw holes makes it possible to mount the HS301 Mounting Bracket on both vertical and horizontal tubes.

Dimensions of HS301 Mounting Bracket



Advice on mounting the HS301 Mounting Bracket for optimal operation

Place the HS301 on the back of the asphalt paver, in a location where it is not in the way of other equipment

- The operator should be able to reach the HS301 when the screed is both contracted and extended at its full length
- The HS301 should be placed in a safe position, where the operator does not need to lean over moving parts of the machine or come too close to potential surrounding traffic

Place the HS301 ergonomically accessible

- The HS301 should be placed at a height corresponding to the distance between the hip and shoulder of the operator
- The HS301 should be placed within a forearm's length of the operator, so that he does not need to stretch unnecessarily when using the handset

Mounting the Grade Sensors

TF-Technologies develops high precision grade sensors, however, mistakes in positioning and mounting can result in less accurate paving control results.

Positioning the grade sensors

Advice on positioning the grade sensors

Mount the grade sensor so that it is perpendicular to the area it is measuring on

Position the grade sensor within its sensor range, as described in Technical Specifications (data sheets) p. 124. In case of light rain or condensation it is extra important that the sensor is positioned in the middle of its sensor range

Do not place the grade sensor too close to the side plates of the screed, as they can reflect the ultrasound waves and lead to a faulty result

Position the grade sensor so that it is unexposed to shocks and the moving parts of the asphalt paver to prevent it from being damaged when the side plates are moved in and out

Position the grade sensor, so that it is aligned with the auger when mounting the grade sensor with a support arm. (The position of the grade sensor influences reaction time and sensitivity)

Distribute the grade sensors evenly across the full length of the Averaging Beam, when mounting multiple sensors on an Averaging Beam

Place the grade sensor so that the display or status diode is visible for the operator

Positioning the grade sensor when paving with a slope

The grade measurement can be affected by a given slope, as the grade sensor is placed with a certain distance to the edge of the screed. If a grade sensor is placed in the side that the screed is tilting, the grade sensor will get closer to the ground than the edge of the screed, and the actual grade level can be larger than that displayed on the handset. As an example, a 2mm / 0,08 inch increase is obtained at a 0.4% slope with a 0.5m / 16 inch distance.

$$\text{Change} = \frac{\text{Slope [\%]}}{100} \times \text{Distance}$$

When paving with a slope, the grade change caused by the positioning of the grade sensors should be considered

The grade sensor should be positioned with an appropriate distance to the edges of the screed.

Mounting grade sensors in the Snap Connector

All grade sensors in the Mini-Line® system can be mounted using the Mini-Line® Snap Connector.

The Snap Connector can be mounted on a support arm or an averaging beam, cf. Mounting the Snap Connector p. 78. Its spring-loaded release reduces installation time and makes it easy to detach sensors, if the asphalt paver must be left unattended or the paving job is completed.

The Snap Connector has a locking mechanism that gives a firm grip on the sensor and locks it in a fixed angle, so the display can be orientated towards the operator. It also ensures that the G224 can easily change position when switching between stringline and ground mode.

The Snap Connector is made of robust materials ideal for the rough working conditions on a paver.

The Snap Connector offers a flexible mounting solution, as all types of grade sensors in the Mini-Line® system can replace or supplement each other, depending on the requirements on the particular asphalt paver or paving job.

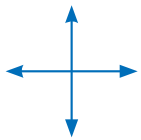
Locked positions of the Snap Connector

The Snap Connector is able to lock the G220 and G221 in four different positions, and the G224 in eight positions.

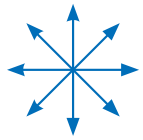
Mounting of G221 og G224

When the screw holes in the Snap Connector is aligned with the display of the sensor, the sensor is always in a locked position. This can be used as a reference, when finding the locked positions.

The locked positions are evenly spaced. This means that the G220 and G221 can be locked in four positions, where the display is either aligned with the screw holes in the Snap Connector or perpendicular to the screw holes. The G224 can be locked in a total of eight positions, including the same positions as the G220 and G221, as well as four extra positions 45º between each of these.



G221 locks in four positions



G224 locks in eight positions

Step-by-step instructions for mounting grade sensor in Snap Connector

1. Retract the outer cover and insert the sensor, while still holding on to the sensor so that it does not fall out
2. Turn the sensor to one of the locked positions
3. Release the outer cover and lock the position. It is important that the Snap Connector has locked correctly before letting go of the sensor

When a grade sensor is mounted in the Snap Connector, the outer cover should conceal the ¾ spring clip

Visible ¾ spring clip
– not locked correctly

Concealed ¾ spring clip
– locked correctly

Mounting the Snap Connector

The Snap Connector is constructed in robust materials and is designed for permanent mounting on a support arm or an averaging beam. The Snap Connector can be mounted on an existing support arm on the asphalt paver, or by using the Support Arm or the Averaging Beam of the Mini-Line® system.

The Snap Connector can be mounted with an inner mounting or an outer mounting, of which the latter is the most commonly used.

The Snap Connector has two screw holes with different threads for the inner mounting, a mm thread and an inch thread:

- Large screw hole thread: 3/8-16 UNC (inch)
- Small screw hole thread: 8M (mm)

The two different sizes of thread should make it easy for the operator to find a suitable screw in the local area that can be used, if the Snap Connector has been dismounted and the screw included has disappeared.

The screw included is located in the small screw hole in the Snap Connector, and has a hex key head (Allen key) which fits both a 4mm key and a 5/32 inch key.

Outer mounting

The outer mounting is the mounting most commonly used. For the outer mounting, the Snap Connector is placed and fastened in the cup of the support arm. The size of the Snap Connector suits the standard cup size of most support arms.

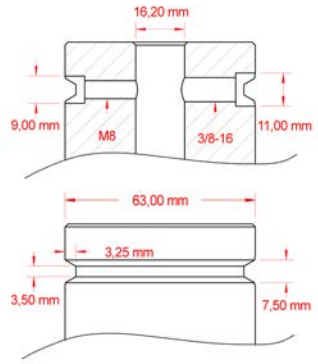
Step-by-step instructions for outer mounting

1. Place the Snap Connector in the cup of the support arm, so that the outer groove in the Snap Connector fits with the screw of the cup.
2. Turn the Snap Connector so that one of its screw holes is pointing in the same direction that the sensor display should be pointing
3. Tighten the cup grip, so that the Snap Connector is firmly mounted

Inner mounting

The inner mounting is primarily used on the Averaging Beam of the Mini-Line® sy- stem, but it can be used in all cases where it is considered more suitable than the outer mounting. For the inner mounting, a metal rod of 16mm / 0,63 inches in diameter with a groove is inserted in the hole in the top of the Snap Connector. The screw included captures the groove of the metal rod and ensures a firm mounting of the Snap Connector.

Dimensions of Snap Connector



Step-by-step instructions for inner mounting

1. Insert the metal rod into the Snap Connector
2. Turn the Snap Connector so that one of its screw holes is pointing in the same direction that the sensor display should be pointing
3. Fasten the screw included, while ensuring it is captured by the groove at the end of the rod

Mounting the Slope Sensor

TF-Technologies develops high precision slope sensors, however, mistakes in positioning and mounting can result in less accurate paving control results. The S298 is a compact slope sensor, which is easily mounted with two bolts on the cross beam over the screed, by either drilling mounting holes or cutting threads where it should be placed.

The S298 features two mounting holes in its housing, suitable for 8mm bolts and placed with a distance of 100mm / 3,94 inches (center to center).

The S298 must be placed so that the yellow arrow points in the direction of driving.

It is important that the surface of the cross beam is clean and even, in order to secure the contact to the slope sensor, so that the slope sensor is able to follow its every move – even under strong vibrations from the screed.

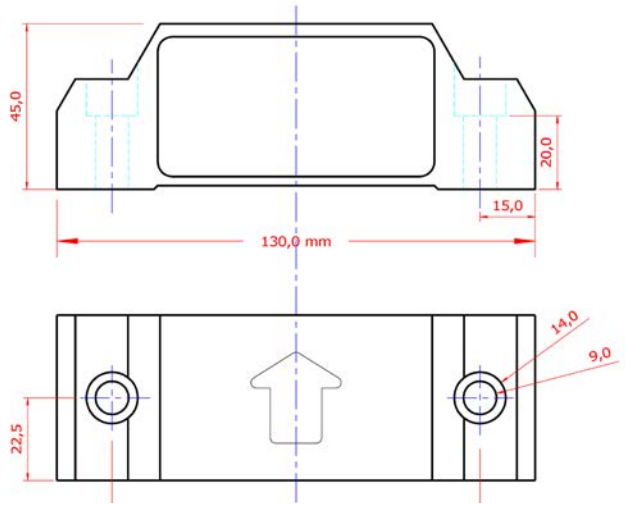
Advice on positioning the S298 slope sensor

Mount the S298 in the middle of the cross beam over the screed, so that the yellow arrow points in the direction of driving

Mount the S298 on a clean and even surface

Place the slope sensor so that the status diode is visible for the operator

Dimensions of slope sensor



Mounting the Connector Box

A Connector Box can be used to connect the Mini-Line® Grade and Slope Control System, as an alternative to connecting the system with the standard V-cable or W-cable, cf. Connecting the Mini-Line® System, p. 83.

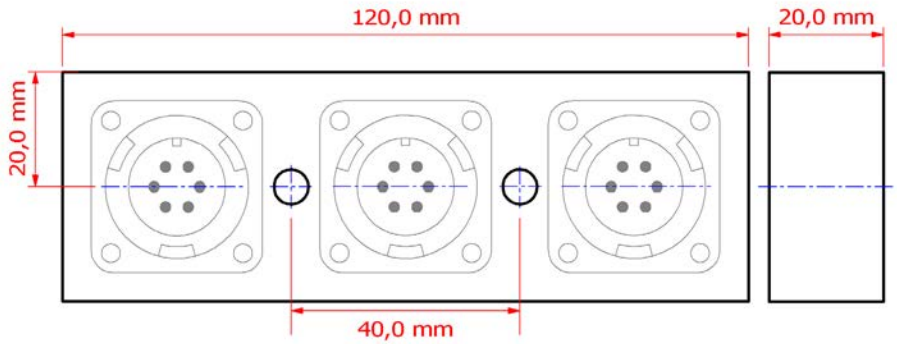
The Connector Box can be an advantage, if the 10-pin plug of the asphalt paver used for connection of the Mini-Line® system is not readily accessible or practically placed.

The Connector Box is designed for permanent mounting on the apshalt paver, and should be placed as outlined under the general advice on how to mount the Mini-Line® Grade and Slope Control System, cf. p. 71.

The Connector Box is easily mounted with two bolts, by either drilling mounting holes or cutting threads where it should be placed.

The Connector Box features two mounting holes in its housing, suitable for 5mm bolts placed with a distance of 40mm / 1,57 inches (center to center).

Dimensions of Connector Box



Connecting the Mini-Line® System

Cables and Connections

The Mini-Line® Grade and Slope Control System is designed to easily connect and disconnect to/from the 10-pin plug standard on many machine types for connecting levelling systems. All cables in the Mini-Line® series therefore have a 10-pin screw connector for connection to the asphalt paver. For connections to controller and sensors is used a 6-pin bayonet connector, which secures fast and reliable connection.

6-pin bayonet connector 45° *10-pin screw connector*

There are two standard cables in the Mini-Line® series, the V-cable and the W-cable, used to connect the Mini-Line® system to the asphalt paver via the 10-pin plug. Additionally, an alternative form of connection can be made with the Mini-Line® Connector Box and I-cables.

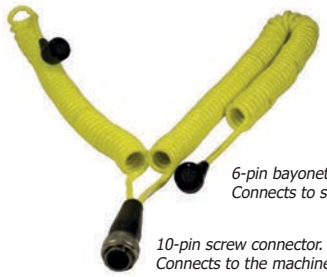
In case the asphalt paver is equipped with an alternative plug, a series of converters and adaptor cables is available to be used between the machine plug and the chosen form of connection, so that the Mini-Line® system can also be connected to these types of asphalt pavers.

Connection with Standard Cables

The cables are designed to fit a variety of paving jobs, and as the HS301 can be used with and without monitoring slope, the Mini-Line® system contains two standard cables – a V-cable used when one sensor type is connected to the handset, and a W-cable used when two sensor types are connected to the handset. Both cables are simple to connect, and easily packed up in the accompanying carry case with the rest of the Mini-Line® system.

V-cable

6-pin bayonet connector
Connects to HS301



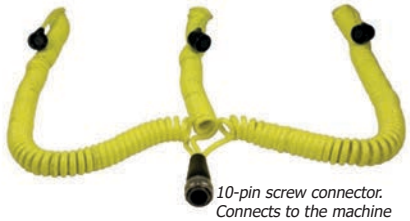
6-pin bayonet connector
Connects to sensor

S-50433

10-pin screw connector.
Connects to the machine

W-cable

6-pin bayonet connector *6-pin bayonet connector* *6-pin bayonet connector*
Connects to HS301 *Connects to sensor* *Connects to sensor*



10-pin screw connector.
Connects to the machine

S-50429

Connecting the HS301 with one sensor type

The V-cable is used if the HS301 is to be connected with one sensor type (a grade sensor or a slope sensor).

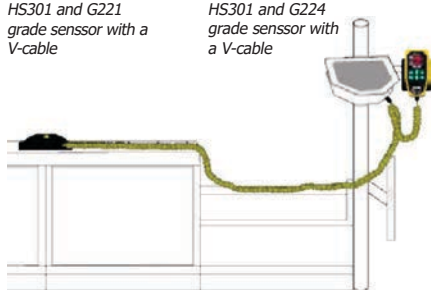
The V-cable is shaped as a V, and has a 10-pin screw connector in the pointy end, and a 6-pin bayonet connector in each of the two other ends.

The 10-pin screw connector should be connected to the 10-pin plug of the asphalt paver, and the two 6-pin bayonet connectors should be connected to the HS301 and sensor.

The V-cable is coiled and 2.2m + 4m in length, corresponding to the maximum recommended length used.

Connecting the HS301 and G221 grade senssor with a V-cable

Connecting the HS301 and G224 grade senssor with a V-cable



Connecting the HS301 and S298 slope sensor with a V-cable

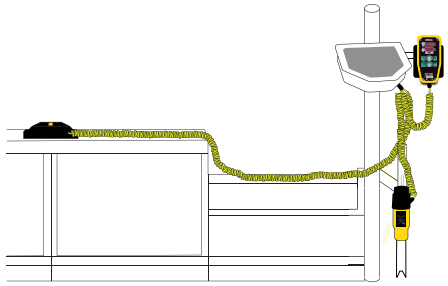
Connecting the HS301 with two sensor types

The W-cable is used if the HS301 is to be connected with two sensor types (a grade sensor and a slope sensor).

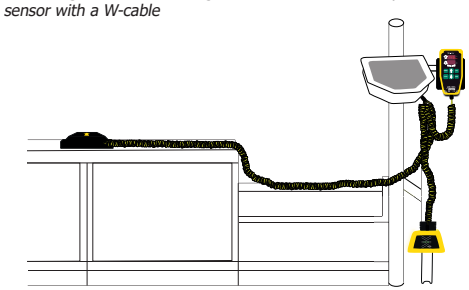
The W-cable is shaped as a W, and has a 10-pin screw connector in the pointy end, and a 6-pin bayonet connector in each of the three other ends.

The 10-pin screw connector should be connected to the 10-pin plug of the asphalt paver, and the three 6-pin bayonet connectors should be connected to the HS301, grade sensor and slope sensor.

The W-cable is coiled and 2.2m + 2x4m in length, corresponding to the maximum recommended length used.



Connecting the HS301, G221 grade sensor and S298 slope sensor with a W-cable



Connecting the HS301, G224 grade sensor and S298 slope sensor with a W-cable

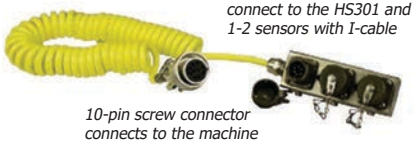
Connection with Connector Box and I-cables (alternative connection)

If the operator prefers not to use the standard cables of the Mini-Line® system, the HS301 and sensors can instead be connected with a Connector Box and 2-3 I-cables (depending on how many sensors that need to be connected). This can be an advantage if the plug of the asphalt paver is not readily accessible.

The Connector Box consists of 3x6-pin bayonet chassis plugs, and has a permanent cable with a 10-pin screw connector to connect it to the 10-pin plug of the asphalt paver.

Connector Box with 2.2m coiled cable

S-50198

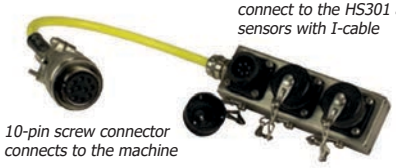


6-pin bayonet chassis plugs connect to the HS301 and 1-2 sensors with I-cable

10-pin screw connector connects to the machine

Connector Box with 0.3m cable

S-50198/0,3



6-pin bayonet chassis plugs connect to the HS301 and 1-2 sensors with I-cable

10-pin screw connector connects to the machine

The Connector Box is available in two versions, one with a short cable (0.3m) and one with a longer cable (2.2m coiled). It is connected to HS301 and sensors with an I-cable.

I-cable

S-50280/1,5

6-pin bayonet connector

6-pin bayonet connector

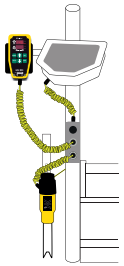
The I-cable is coiled and available in several lengths (1.5m, 2.2m, 3.3m, 4m, and 6m), corresponding to the maximum recommended length used.

For further details see Appendix

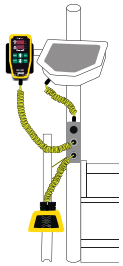
Connecting the Connector Box and I-cables

When connecting the Mini-Line® system with a Connector Box, an I-cable should be used to connect the box with the HS301, as well as an additional I-cable for each sensor type to be connected (the Connector Box can accommodate one or two sensor types as required).

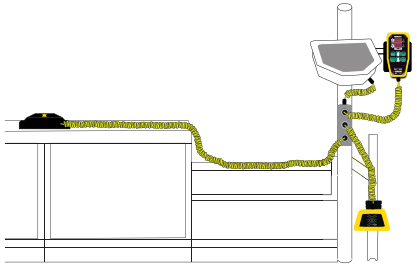
The 10-pin screw connector of the Connector Box should be connected to the asphalt paver, and the Connector Box is connected to the handset and sensors with an I-cable with a 6-pin bayonet connector in each end. One I-cable must be used for each unit to be connected.



Connecting the HS301 and G221 grade sensor with the Connector Box and I-cables



Connecting the HS301 and G224 grade sensor with the Connector Box and I-cables



Connecting the HS301, G224 grade sensor and S298 slope sensor with the Connector Box and I-cables

Connection with Converters and Adaptor cables

In case the asphalt paver is equipped with an alternative plug, a series of converters and adaptor cables is available to be used between the machine plug and the chosen form of connection, so that the Mini-Line® system can also be connected to these types of asphalt pavers. There is a range of converters and adaptor cables available in the Mini-Line® system, as new types are added continuously as new types of pavers become available in the market (contact your local representative for information about which converters and adaptor cables are currently available).

Vögele Converter Kit

The Vögele Converter Kit enables the connection of the Mini-Line® Grade and Slope Control System to Vögele asphalt pavers, by functioning as an adaptor cable, as well as an interface that stops the regulation during the stand-by mode used by Vögele pavers. The Vögele Converter Kit is mounted between the machine plug and the chosen form of connection. Please refer to the separate installation guide for the Vögele Converter Kit.

S-50288 - Vögele Converter Kit

HPD100 Leeboy Converter Kit

The HPD100 Leeboy Converter Kit enables the connection of the Mini-Line® Grade and Slope Control System to asphalt pavers with electric powered screed actuators, e.g. Leeboy pavers, by converting the control signals of the Mini-Line® system to fit electrically driven actuators. Please note that when using the HPD100 Leeboy Converter Kit, the Mini-Line® standard cables cannot be used, as I-cables are required to connect the HS301 and sensors to the converter. Please refer to the separate installation guide for the HPD100 Leeboy Converter Kit.

S-50577 - HPD100 Leeboy Converter Kit

Adaptor Cable with 7-pin screw connector and 10-pin plug

This adaptor cable is used on machines with a 7-pin plug. The adaptor cable is connected to the 7-pin plug of the paver, after which the other end with the 10-pin plug enables easy connection to the Mini-Line® Grade and Slope Control System via the standard cables or the Connector Box of the system.

S-50430 - Adaptor cable 7-pin plug

Adaptor cable with 11-KPT connector and 10-pin plug

This adaptor cable is used on machines with an 11-KPT plug. The adaptor cable is connected to the 11-KPT plug of the paver, after which the other end with the 10-pin plug enables easy connection to the Mini-Line® Grade and Slope Control System via the standard cables or the Connector Box of the system.

S-50497 - Adaptor cable 11-KPT plug

Connection of the Averaging Beam

The Averaging Beam is connected to the asphalt paver and the HS301 in the same way as an individual grade sensor, with either a V-cable or a W-cable (or an I-cable from a Connector Box).

Instead of connecting directly to a grade sensor, the 6-pin bayonet connector is connected to the integrated connector box of the rear sensor beam. In addition, an I-cable is required to connect the connector boxes of the front and rear sensor beams. The I-cable is coiled and 6m in length, corresponding to the maximum recommended length used.

The cables integrated in the sensor beams are used to connect the individual grade sensors to the Averaging Beam.

The sensors are connected by the internal cabling of the Averaging Beam.

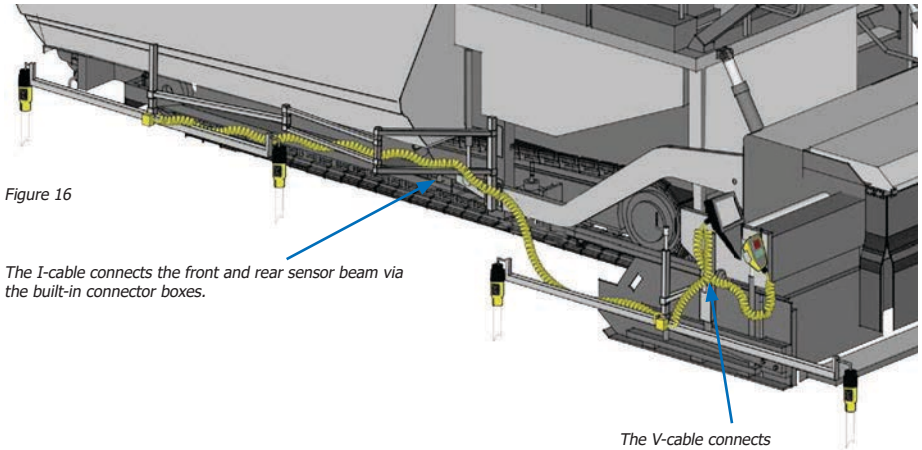


Figure 16

The I-cable connects the front and rear sensor beam via the built-in connector boxes.

The V-cable connects the HS301 and the rear sensor beam.

Connecting the Averaging Beam with V-cable and I-cable.

Safe Connection and Disconnection

Connection and disconnection of the Mini-Line® Grade and Slope Control System should be undertaken in the correct order, so as not to adversely affect the asphalt paver or damage the equipment.

Step-by-step instructions for connecting the Mini-Line® Grade and Slope Control System

1.
2.
3.

1 Connect System
Make sure the power supply to external controllers is disconnected. Connect HS301 and sensors to the paver with the appropriate cables

2 Power On
Turn on the power from the asphalt paver. All displays light up briefly. Check that the HS301 starts up in manual mode (If the handset was turned off in auto mode and the same sensor configuration is used as the last time, the handset will start up in auto mode)

3 Confirm Connection
Confirm that the system is connected correctly by adjusting the height with the arrow buttons in manual mode. The handset should register the change as demonstrated by the arrows in the display

Step-by-step instructions for disconnecting the Mini-Line® Grade and Slope Control System

1.
2.
3.

1 Change Mode
Switch the handset to manual mode. (If the HS301 is disconnected in auto mode, it will continue regulation when it is reconnected)

2 Power Off
Turn off the power from the asphalt paver

3 Remove Sensors
Disconnect and dismount the Mini-Line® system. Pack up all parts properly in a Mini-Line® Carry Case for next time

All units in the Mini-Line® system also have an individual instruction for connection, focusing on the optimal operation for each product, but this safety guide should always be used.

Advice on connecting the Mini-Line® Grade and Slope Control System

Make sure the supply voltage is appropriate (between 10VDC and 30VDC) before connecting the Mini-Line® system

Make sure there is a fuse between the power supply of the asphalt paver and the Mini-Line® Grade and Slope Control System before connecting the system

It is recommended to only use Mini-Line® cables, as the use of unauthorized cables can result in material damages or serious personal injury

The use of other cables is at your own risk and if used anyway, the following should be checked at minimum:

- Check the polarity of the cables
- Use shielded cables to prevent noise from affecting the communication to the sensors

Advice on protecting the cables while paving:

The cables should not touch the ground and be prevented from dragging

The asphalt paver or other machinery should not be able to accidentally run over any of the cables

The cables should not be exposed to the moving parts of the asphalt paver

The cables should not be exposed to excessive radiant heat

The cables should not be exposed to repeated or large friction

The tow arm and the screed should be able to move freely without the cables becoming overly stretched or exposed to the moving parts of the asphalt paver

Long cables should be twisted around beam, support arm or other, so that they are out of the way and prevented from dragging on the ground

Connecting the HS301 and Sensors

The HS301 and sensors should be connected to the asphalt paver when it is turned off, and automatically start up when the asphalt paver powers up and power is supplied to the Mi-ni-Line® system.

It is recommended to follow the individual instruction for connecting each product every time the system starts up, as it is important that the grade sensors are suitably positioned, the slope sensor measurements are verified with a spirit level, and the sensor configuration of the HS301 is verified, before commencing the paving job.

Connecting the HS301line

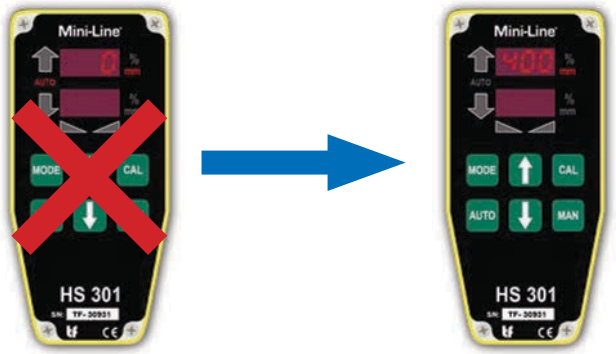
The HS301 is a handheld controller that does not require to be positioned correctly before connection. If the HS301 starts up in auto mode, the handset will have saved the setpoint from its previous use, if the sensor configuration is the same.

This is an advantage in case the asphalt paver is required to stop under a paving job and power is cut off, but the setpoint should not be reused on the following paving job. The HS301 should therefore be switched to manual mode after the completion of a paving job.

Check the HS301 during startup when it is used for the first time on a paving job, and switch the handset to manual mode if it starts up in auto

Remember to verify the number of grade sensors connected, and the side the slope sensor is connected to, before entering the setpoint

Auto mode *Manual mode*



Switch to manual mode, if the HS301 starts in auto.

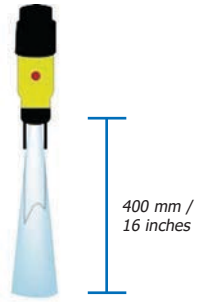
Connecting the G220

Step-by-step instructions for connecting the G220 (ground)

1. Mount Sensor
Mount the G220 in the Snap Connector. Check that the reference bail is positioned correctly on the sensor

2. Adjust Height
Adjust the height of the Support Arm or the Averaging Beam, so that the bottom of the sensor is positioned approximately 400mm / 16 inches above the reference

3. Connect Sensor
Connect the cable to handset and sensor and verify that the handset displays approximately 400mm / 16 inches



The G220 sensor range is 280-900mm / 11,2"-36"
If the sensor is out of range the handset displays "E.R.1".

Connecting the G221

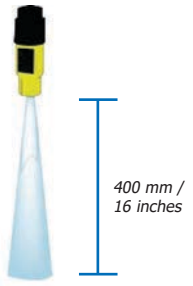
Step-by-step instructions for connecting the G221 (ground)

1.
2.
3.

1 Mount Sensor
Mount the G221 in the Snap Connector. Check that the reference bail is positioned correctly on the sensor

2 Adjust Height
Adjust the height of the Support Arm or the Averaging Beam, so that the bottom of the sensor is positioned approximately 400mm / 16 inches above the reference

3 Connect Sensor
Connect the cable to handset and sensor and verify that the handset displays approximately 400mm / 16 inches



The G221 sensor range is 220-900mm / 8,8"-36".
If the sensor is out of range, the handset displays "E.R.1".

Connecting the G224

The G224 is designed to be used in both ground mode and stringline mode. Therefore, there is an instruction for each of those purposes.

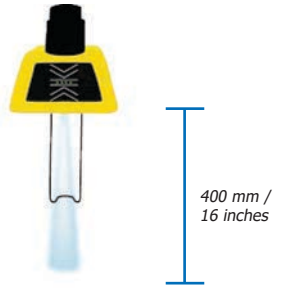
Step-by-step instructions for connecting the G224 (ground)

1.
2.
3.

1 Mount Sensor
Mount the G224 in the Snap Connector, so that the four sensor heads run parallel to the driving direction and the small display is oriented towards the operator. Check that the reference bail is positioned correctly on the sensor.

2 Adjust Height
Adjust the height of the Support Arm or the Averaging Beam, so that the bottom of the sensor is positioned approximately 400mm / 16 inches above the reference.

3 Connect Sensor
Connect the cable to handset and sensor and verify that the handset displays approximately 400mm / 16 inches. Verify that the **small** display lights up. If this is not the case, press the green MODE button on the sensor



The G224 sensor range in this position is 250-900mm / 10"-36". If the sensor is out of range, the handset displays "E.R.1"

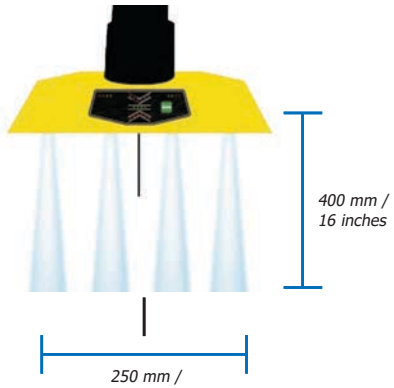
When the G224 is in ground mode, the sensor calculates an average of the measurements from the four sensor heads, and the total measurement becomes more robust to small irregularities. It is therefore important that all the sensor heads are measuring on the same base

Step-by-step instructions for connecting the G224 (stringline)

1 Mount Sensor
Mount the G224 in the Snap Connector, so that the four sensor heads run perpendicular to the driving direction and the large display is oriented towards the operator. Check that the reference bail is positioned correctly on the sensor. Adjust the Support Arm, so that the sensor is positioned directly above the wire

2 Adjust Height
Adjust the height of the Support Arm, so that the bottom of the sensor is positioned approximately 400mm / 16 inches above the reference

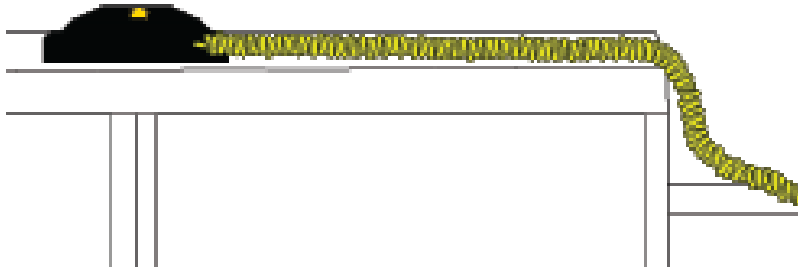
3 Connect sensor
Connect the cable to handset and sensor and verify that the handset displays approximately 400mm / 16 inches.Verify that the **large** display lights up. If this is not the case, press the green MODE button on the sensor



Up to 250mm sensing width is possible
The G224 sensor range in this position is 270-650mm / 10,8"-26"
If the sensor is out of range, the handset displays "E.R.1" .

When the G224 is in stringline mode, the measurement from the sensor head with the shortest distance to the reference is used. This mode can therefore also be used to follow a curved surface such as a sloped curb, where the sensor will follow the highest point of contact

Connecting the S298
The slope sensor is often mounted permanently on the asphalt paver, so connecting the S298 therefore simply consists of connecting the S298 to the HS301 with a cable. However, it is important to verify the slope measurement of the sensor when commencing the paving job.



Verify that the S298 is mounted so that the yellow arrow points in the direction of driving.

Calibration
The purpose of the slope sensor is to ensure the correct slope of the screed when paving. It is therefore important the slope measurement of the sensor is aligned with the measurement on an electronic spirit level placed directly on the paved mat. For this reason, the slope sensor can be calibrated to ensure it is always aligned with the actual slope of the road.

The mounting of the slope sensor or a previous calibration can cause the slope sensor to display a slope to one side, even though the screed is level. Therefore, the slope sensor should always be verified before and during the paving job.

Step-by-step instructions for calibrating S298

1 Mount Sensor
Verify that the S298 is mounted so that the yellow arrow points in the direction of driving

2 Connect Sensor
Connect the cable to handset and sensor. The handset should be connected to the plug on side of the slope sensor closest to the handset. Switch the HS301 to auto mode. (Calibration of the S298 is only possible in auto mode)

3 Calibrate Sensor
Calibrate the slope value displayed on the handset against a measurement on an electronic spirit level placed directly on the paved mat. Push CAL, adjust value with the arrows, and press "CAL" to save.

Before commencing the paving job, it can be appropriate to calibrate the sensor by placing the screed on a horizontal surface, such as a wooden block, in order to have a good starting point

During the paving job, the measurements of the slope sensor should be verified continuously by placing a spirit level directly on the paved mat. If the slope sensor requires calibration, the asphalt paver should not be stopped, as the calibration can be performed while the machine is at speed

Because the S298 can be shared by two handsets, the operator must be particularly cautious as to whether the HS301 is connected to the correct side of the S298, as an incorrect connection can lead to faulty results. The handset must always be connected to the plug on the side of the slope sensor closest to the handset

Connecting Sensors to the Averaging Beam

The Averaging Beam is designed for the mounting and connection of four grade sensors that delivers individual measurements to the HS301 that calculates an average of these measurements, so that rough spots in the existing foundation are effectively evened out. However, it is possible to connect fewer grade sensors, or connect and disconnect some sensors during the paving job, if required. Between one and four sensors on an Averaging Beam can be connected to the same handset, and when more grade sensors are connected, their measurements automatically become part of the averaging calculation.

In order for the HS301 to tell the grade sensors apart, each grade sensor has a different address that it is important that the operator is aware of, when connecting and disconnecting the sensors.

Grade sensors with different label colors

The color of the grade sensor labels

The different addresses of the grade sensors can be seen from the different colors of the labels on the sensors. The four standard colors in an averaging kit are: White (address 8), red (address 9), yellow (address 10) and blue (address 11).

Two grade sensors with the same color must never be connected to the same handset, as this will create a conflict resulting in incorrect regulation

In addition to the four standard colors, a grade sensor with a green label (address 4) is available which can be used as a replacement sensor. The advantage of the green color sensor is that it can replace all other colors, in case one of the grade sensors is damaged during the paving job.

The color coding of the labels on the grade sensors is the same across all grade sensor models (G220, G221 and G224). This means that different sensor models with identically colored labels cannot be connected to the Averaging Beam. However, the operator can mix and match the sensor models (G220, G221 and G224) on the Averaging Beam as he desires, as long as the sensors maintain the different colors.

The S298 can be combined with any label color of the grade sensors, despite having the same label color, as all the slope sensor labels are yellow, which has no effect on the grade regulation.

Connecting additional sensors

Connecting grade sensors should be performed in manual mode, in order for new sensors to become registered. After connection, a new setpoint for the new configuration should be entered before the handset is switched to auto

Paving with the Averaging Beam

During the paving job, it is important that all the grade sensors can see the reference. Because the reference is not always completely parallel to the asphalt paver, it is recommended to monitor the grade sensors and disconnect those sensors that lose target, or change briefly to manual mode where the grade is maintained steady despite any of the sensors losing target, until all grade sensors are able to see the reference again.

Maintenance

Maintenance

The most important part of the maintenance of the Mini-Line® Grade and Slope Control System is to keep all parts clean, dry and dirt free. Remember to follow the cleaning instructions, as incorrect cleaning agents or too large forces can damage the equipment and cause degrading functionality.

1. Display - 2. Connector - 3. Reference Bail - 4. Sensor Head

It is recommended to inspect all parts after use:

- Are all displays and connectors clean and free from dirt?
- Are the sensor heads on the grade sensors clean and free from dirt?
  Be careful when cleaning the sensor heads
- Are the contact points of the reference bails with the grade sensors clean and free from dirt, so that they click on to the grade sensors effortlessly?
- Are the reference bails clean and dirt free?
  Lumps of material sticking to the bail can affect grade measurements
- Have the reference bails maintained their original shape?
  The reference bail must not be bent or damaged, as it can lead to unstable or incorrect grade measurements

Inspection

It is recommended to inspect all parts after use:

Cables	Mechanical damage	After use	Replace cable
Connectors on HS301, Sensors and Cables	Wet connectors	After use	Wipe off with dry cloth
	Dirty	After use	Clean with water or benzine
	Mechanical damage	After use	Replace cable/ Replace connector on HS301/ Replace connector on sensor
Sensor Head	Dirty	After use	Cleane with water or benzine
	Mechanical damage	After use	Replace sensor head
Reference Bail	Dirty	After use	Clean with water or benzine
	Mechanical damage	After use	Replace reference bail
Buttons and Display	Dirty	After use	Clean with water or benzine
	Mechanical damage	After use	Replace display
General for HS301, Sensors, and Cables	Wet	After use	Wipe off with dry cloth before storing
	Insignificant mechanical damage	After use	Continue use
	Significant mechanical damage	After use	Damaged parts should be repaired or replaced
	Dirty	After use	Clean with water or benzine
Accessories	Wet	After use	Wipe off with dry cloth
	Insignificant mechanical damage	After use	Continue use
	Significant mechanical damage	After use	Replace accessories
HS301 and Sensors	Functionality testing	Once a year	Thoroughly inspect the system/Send equipment to service

Do not attempt to repair the equipment yourself. Replacement of connectors, sensor head, display or any other parts must be undertaken by TF-Technologies or an appointed service representative of TF-Technologies. Contact your local representative for further information

Service and Repair

In case of problems with the Mini-Line® Grade and Slope Control System, please see Troubleshooting, p. 110, providing answers to the most common problems. If problems persist, contact TF-Technologies or your local representative for assistance.

Do not attempt to repair the equipment yourself. Replacement of connectors, sensor head, display or any other parts must be undertaken by TF-Technologies or an appointed service representative of TF-Technologies. Contact your local representative for further information

Service and repairs of the HS301, sensors, cables or other parts of the Mi-ni-Line® Grade and Slope Control System undertaken by anyone else than TF-Technologies or an appointed service representative of TF-Technologies can result in serious personal injuries and/or damaged equipment

Transport

Advice on transport of the Mini-Line® system:

The HS301 and sensors must be separated from the cables to protect cables from harmful twisting

The Mini-Line® system should be transported in a suitable carry case, where all parts rest firmly without being able to clash against each other. The use of Mini-Line® Carry Cases with custom-cut foam is recommended.

- The display of the HS301 must be protected from any sharp objects
- The displays and the sensor heads of the grade sensors must be protected from any sharp objects

The transport case must protect the equipment from shock and pressure, as the Mini-Line® system is often transported together with heavy equipment for the paving job

- The reference bails of the grade sensors must not be placed under any heavy objects, as it can change their shape

If the Mini-Line® system is packed up wet, the Carry Case should not be completely closed. Both Carry Case and content should be wiped dry before the Carry Case is completely closed and put in storage.

When receiving the Mini-Line® system, the following should be inspected:

Are display, connectors, reference bails and sensor heads still intact?

Check the house for label and any loose connections, e.g. display and connectors

If parts of the Mini-Line® system have been damaged at reception, the following is recommended:

- Reject the package if it is visibly damaged (regress)
- Document any potential damage in the form of text and pictures
- Inform seller of the damages
- Do not use damaged products

Storage

Advice on storage of the Mini-Line® system:

For long-term storage, the Mini-Line® system should be kept dry and out of direct sunlight

Notice that high temperatures can be obtained by storing the Mini-Line® system in a non-ventilated car in the summer

All products in the Mini-Line® series have the same storage temperature and can be stored together. It should be noted that the G220 has a different operating temperature

Product	*Storage Temperature*	*Operating Temperature*
Mini-Line® HS301	-40°C – 85°C	-10°C – 70°C
Mini-Line® G220	-40°C – 85°C	0°C – 70°C
Mini-Line® G221	-40°C – 85°C	-10°C – 70°C
Mini-Line® G224	-40°C – 85°C	-10°C – 70°C
Mini-Line® S298	-40°C – 85°C	-10°C – 70°C
Mini-Line® Cables	-40°C – 85°C	-10°C – 70°C

Cleaning

It is important that the Mini-Line® system is cleaned often, so that it does not lose functionality. However, inappropriate cleaning agents or an incorrect cleaning method can damage the equipment and cause degrading functionality.

It is generally recommended to use a dry cloth with a little water or benzine, as the equipment is secured against water, and because benzine evaporates quickly. A quick evaporation ensures that the benzine does not collect in nooks and crannies and has long-term dissolving effects, as can be the case with other cleaning agents.

Please not that benzine is an organic dissolvent, which is flammable and harmful to health and environment. I must therefore be used responsibly and with respect for its harmful effects. The operator should follow these instructions before use:

Follow the instructions on the bottle of benzine

Always use as little as possible

Avoid breathing vapors and direct contact with the skin

When cleaning with fluids, only small amounts should be dapped on the areas to be cleaned, and these areas should be wiped with a dry cloth afterwards. The equipment must never be submerged in chemical liquids or exposed to cleaning agents in larger quantities, as the fluids can gather in nooks and crannies and have long-term dissolving effects.

Be particularly aware of:

No parts of the Mini-Line® system should be submerged in fluids as it may gather in nooks and crannies

Never use cellulose thinner or acetone, as these dissolve paint and plastic respectively, which will degrade the functionality of the equipment. Other cleaning agents can also be harmful, but experience shows that these two in particular should be avoided

Never use a high-pressure cleaner to remove dirt, as it will expose the equipment to too large forces

When mechanically rinsing the equipment, no scraping must be undertaken on the display, connectors or sensor heads as these parts are particularly sensitive

The sensor heads of the grade sensors are porous and therefore able to draw liquids, which means the material can slowly dissolve if exposed to a dissolvent. The sensor heads must therefore not be exposed to chemical liquids

Use of benzine to clean cables can make the writing on the cables disappear, but the cables will not be damaged

Disposal

When disposing the Mini-Line® system the equipment must be treated as electronic waste in compliance with the local regulations of the country in which the equipment is disposed.

The responsibility for safe and appropriate disposal is transferred to the buyer in the sale of the Mini-Line® system.

Appendix

Troubleshooting

Connection of HS301

Symptom	Probable Cause	Appropriate Action
No display (top and bottom displays are off)	*No power to HS301 handset*	• *Verify paver power supply* • *Verify cable connections* • *Inspect cables for damages*
Top and bottom display show erroneous segment characters	*Power up glitch*	• *Re-connect main power*

Erroneous Behaviour

Symptom	Probable Cause	Appropriate Action
Arrows light up on HS301, but no regulation of tow-point observed	*Problems with tow point solenoids*	• *Verify that the paver has grade and slope automatics switched to the on position* • *Check paver power supply* • *Check cables and connections* • *Paver must be at speed*
	Incorrect output type setting	
Slow or sluggish reactions *Long elongated waves produced on asphalt mat*	*Incorrect settings of HS301*	• *Adjust sensitivity, p. 49* • *Adjust minimum pulse p. 47*
	Mechanical/hydraulic settings	• *Check tow point solenoids*
Fast or hunting reactions	*Incorrect settings of HS301*	• *Adjust sensitivity, p. 49* • *Adjust minimum pulse, p. 47*
Tow point moves up, but not down or vice versa	*No connection or power supply to tow point solenoids*	• *Check cables, connections, and connectors* • *Slope sensor may be connected to the wrong side*
The tow point moves a little up and down while the paver stands still (paver has jitter)	*Sensitivity too high*	• *Adjust sensitivity, p. 49*
	Minimum pulse too high	• *Adjust minimum pulse, p. 47*
Asphalt mat shows sign of irregular ripples	*Dead band to big*	• *Adjust dead band, p. 53*
	Working window too small	• *Adjust working window, p. 51*
	Sensitivity too high	• *Adjust sensitivity, p. 49*
Slope sensor shows incorrect slope	*Lack of calibration*	• *Calibrate the sensor p. 97*

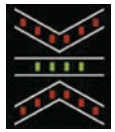
HS301 Error Codes

Symptom	Probable Cause	Appropriate Action
 Flashes on top display when entering AUTO mode	Setpoint not entered before pressing AUTO	• Enter setpoint p. 37
	Sensor out of range	• Adjust sensor position
	Reference bail demaged or not installed	• Check or replace reference bail
	Sensor is faulty	• Re-connect main power
	Using slope sensor on both sides	• Adjust slope sensor to one side only
	Sensor is out of working window	• Check working window • Check sensor mounting • Clean up sensor field of view
	No communication between HS301 and sensor	• Check cables and connections

G220 and S298 Error Codes

Symptom	Probable Cause	Appropriate Action
Slow flashes *(2 short flashes per second)*	*No problems*	
Fast flashes *(4 flashes per second, on/off equal amount of time)*	*HS301 missing*	• *Check connection to HS301*
	Sensor out of range	• *Adjust sensor position*
	G220: Reference bail missing	• *Install reference bail*

G221 and G224 Error Codes

 *(Red arrows flash alternately)*	*Target out of range*	• *Adjust sensor position*
 *(Red arrows flash simultaneously)*	*Reference bail missing*	• *Install reference bail*
 *(Green bar and red arrows flash)*	*No handset connected*	• *Connect handset* • *Check connections*
(Red arrows flash alternately) 	*The sensor has lost sight of the wire. Tow point is locked*	• *Adjust paver direction* • *Adjust sensor position*

Reading Handset Configuration

Reading handset configuration at start-up

When the HS301 is connected, the handset configuration is briefly displayed before the system starts to measure or regulate.

1. All displays and fields light up on the handset and any sensors connected. (Can also be used for inspection of displays and fields)

2. Handset type is shown, for HS301 for example:

(controller type)

3. Afterwards, handset setup and firmware version is shown, for example:

(Setup)

(Firmware-version)

4. Then output type is shown, while firmware-version stays, for example:

(Output type)

(Firmware-version)

5. Then HS301 and sensor configuration is displayed briefly in auto mode.

   a. If the handset is in auto mode with **grade control**, the setpoint and number of grade sensors is shown

(Example setpoint)

(Example, 4 grade sensors on an Averaging Beam) If "C.A.L." is displayed instead, the setpoint has not been entered.

   b. If the handset is in auto mode with **slope control**, the setpoint and side the slope sensor is connected to is shown

(Example setpoint)

(Example setpoint)

(Example left side)

(Example right side)

If "C.A.L." is displayed instead, the setpoint has not been entered.

Reading handset configuration when changing mode

When the handset changes from manual mode to auto mode, the HS301 and sensor configuration is displayed briefly.

1. If the handset is set to **grade control**, the setpoint and number of grade sensors is shown


(Example setpoint)


(Example, 4 grade sensors on an Averaging Beam)

2. If the handset is set to **slope control**, the setpoint and side the slope sensor is connected to is shown


(Example setpoint)


(Example setpoint)


(Example left side)


(Example right side)

Reading handset configuration when entering setpoint

When the operator enters a new setpoint in manual mode by pressing CAL the HS301 and sensor configuration is displayed briefly.

1. If the handset is set to **grade control**, the setpoint is shown


(Example, 4 grade sensors on an Averaging Beam)

1. If the handset is set to **slope control**, the setpoint and side the slope sensor is connected to is shown


(Example left side)


(Example right side)


(Example left side)


(Example right side)

Socket Types

Type	Use
6-pin bayonet chassis plug 	Handset and all sensors • Mini-Line® HS301 • Mini-Line® G220 • Mini-Line® G221 • Mini-Line® G224 • Mini-Line® S298 • Mini-Line® Connector Box
6-pin bayonet connector 	All Mini-Line® cables • Mini-Line® I-cable • Mini-Line® V-cable • Mini-Line® W-cable
10-pin screw connector 	Mini-Line® cables with connection to the asphalt paver • Mini-Line® V-cable • Mini-Line® W-cable • Mini-Line® Connector Box

Pin-Out

	6-pin bayonet chassis plug	6-pin bayonet connector	10-pin screw connector
A	***Power supply*** *- 12/24 Volt System (10-30 VDC)*	***Power supply*** *- 12/24 Volt System (10-30 VDC)*	***Ground (GND)***
B	***Ground (GND)***	***Ground (GND)***	***Power supply*** *- 12/24 Volt System (10-30 VDC)*
C	***Output*** *- (up)*	***Output*** *- (up)*	***Output*** *- (up)*
D	***Output*** *- (down)*	***Output*** *- (down)*	***Output*** *- (down)*
E	***RS485*** *- (data communication)*	***RS485*** *- (data communication)*	-
F	***RS485*** *- (data communication)*	***RS485*** *- (data communication)*	-
G			-
H			-
I			-
J			-

Accessories

Accessories to HS301

HS301 Mounting Bracket

S-50487

The metal hanger on the HS301 enables the operator to quickly hang the HS301 on any available hook on the asphalt paver, whenever required. This is convenient when the operator needs to briefly leave the handset during the paving job.
When the operator is not walking around with the HS301 in his hand for an extended period of time, it is recommended to mount the handset in the HS301 Mounting Bracket.

The HS301 Mounting Bracket secures a solid mounting of the handset that prevents the HS301 from falling off the asphalt paver and getting damaged. At the same time, the mounting bracket ensures a suitable angle of the HS301, enabling the operation of the handset without dismounting it from the bracket. If the operator wishes to take the HS301 into his hand, it is easily clicked on and off the mounting bracket.

The HS301 Mounting Bracket is easily mounted on any vertical surface by fastening 8mm bolts in the screw holes. With the tube fitting included, it can also be mounted on any available vertical or horizontal tube with a maximum diameter of 30mm / 1,2 inches, based on what is available on the asphalt paver, where it is appropriate to place the handset.

Accessories to G220, G221 og G224

Snap Connector

S-50531

The G220, G221 and G224 are all easily mounted on the asphalt paver with a Snap Connector. Its spring-loaded release reduces installation time and makes it easy to attach and detach sensors, if the asphalt paver must be left unattended or the paving job is completed. The Snap Connector has a locking mechanism that gives a firm grip on the sensor and locks it in a fixed angle, so the display can be orientated towards the operator. It also ensures that the G224 can easily change position when switching between stringline and joint match mode.

The Snap Connector can be mounted on a support arm or an averaging beam, which is attached to the tow arm or the side plate of the screed.

Reference bails to grade sensors

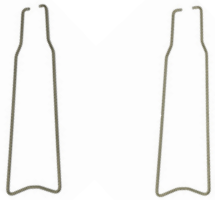
All ultrasonic sensors are equipped with reference bails, in order for the sensors to measure precisely despite the large temperature changes inherent when working with hot mix asphalt. The reference bails are mounted on the grade sensors, so that they have a known distance as a reference. The known distance is used to calculate a temperature compensation factor, as the speed of ultrasound varies with temperature. With this temperature compensation, the grade sensors are able to provide measurements with very high accuracy, while remaining unaffected of the large temperature changes during asphalt work.

If a reference bail is damaged, it should be replaced immediately, as a damaged bail can negatively affect the precision of the performed measurements.

The shape of the reference bail is designed, so that light rain or condensation can drip off the bail with out affecting the temperature compensation.

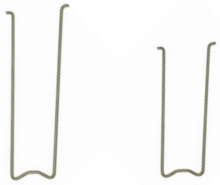
S-50186
Reference Bail G220

The reference bail for the G220 is made of steel and mounted on the sensor with a single screw.



S-50690 *S-50691*
Reference Bail G221

The reference bail for the G221 is made of spring steel and easily clicks onto the sensor. The bail is designed to protect itself and the sensor against shock, by simply falling off, if it hits an obstacle such as a curb. The reference bail comes in two versions. The S-50690 is used on serial number TF-63305 and lower while the S-50691 is used on TF-63306 and higher.



S-50695 *S-50614*
Reference Bail G224

The reference bail for the G224 is made of spring steel and easily clicks onto the sensor. The spring steel makes it robust and the inner shape of the sensor ensures that the sensor will not sustain any damage, if the reference bail is exposed to large forces, gets bent or otherwise damaged.
The reference bail comes in two versions.
The S-50695 is used on part number S-50651 - S-50656 and the S-50614 is used on S-50610 - S-50613, S-50617 and S-50619.

Cables for the Mini-Line® Grade and Slope Control System

Standard Cables

The Mini-Line® Grade and Slope Control System is designed to easily connect and disconnect to/from the 10-pin plug standard on many machine types for connecting levelling systems. There are two standard cables in the Mini-Line® series used to connect the Mini-Line® system to the asphalt paver via the 10-pin plug (in case the asphalt paver is equipped with an alternative plug, see converters and adaptor cables below), and an I-cable used to connect the sensors on the sensor beams of the Averaging Beam.

V-cable

S-50433

V-cable with 10-pin screw connector and 2x6-pin bayonet connectors. The V-cable is used to connect the machine to the HS301 and one sensor – either grade or slope sensor. When using the Averaging Beam, the V-cable is used to connect the machine to the HS301 as well as the rear sensor beam (front sensor beam is connected via an I-cable between the rear and front sensor beams) The V-cable is coiled and 2.2m (86,6 inches) + 4m (157,5 inches) in length, corresponding to the maximum recommended length used.

W-cable

S-50429

W-cable with 10-pin screw connector and 3x6-pin bayonet connectors. The W-cable is used to connect the machine to HS301 and two sensors – one grade and one slope sensor. When using the Averaging Beam, the W-cable is used in the same way, but instead of connecting to a single grade sensor, the cable is connected to the rear sensor beam (front sensor beam is connected via an I-cable between the rear and front sensor beams) The W-cable is coiled and 2.2m (86,6 inches) + 2x4m (2x157,5 inches) in length, corresponding to the maximum recommended length used.

I-cable

S-50280/6,0

I-cable with 2x6-pin bayonet connectors. The I-cable is used to connect the Averaging Beam, by connecting the built-in connector box on the front sensor beam to the connector box on the rear sensor beam. As the connector box on the rear beam is connected to the HS301 via a standard V-cable, the entire Averaging Beam is connected to the asphalt paver in this way. The I-cable is coiled and 6m (236,2 inches) in length, corresponding to the maximum recommended length used.

Connector Boxes and Alternative Cables

If the operator prefers not to use the standard cables of the Mini-Line® system, the HS301 and sensors can instead be connected with a Connector Box and one or more I-cables (depending on how many sensors that need to be connected). This can be an advantage if the plug of the asphalt paver is not readily accessible.

The Connector Box is designed to the rough environmental conditions of a paver, and can be mounted permanently on the asphalt paver, where it is connected to the 10-pin plug of the asphalt paver.

Connector Box with 2.2m cable (coiled)

S-50198

Connector Box with 10-pin screw connector and 3x6-pin bayonet chassis plug. The Connector Box facilitates the connection of HS301 and two sensors – a grade sensor and a slope sensor – by use of the I-cables of the Mini-Line® system.

Connector Box with 0.3m cable

S-50198/0,3

Connector Box with 10-pin screw connector and 3x6-pin bayonet chassis plug. The Connector Box facilitates the connection of HS301 and two sensors – a grade sensor and a slope sensor – by use of the I-cables of the Mini-Line® system.

To connect the Mini-Line® system with a Connector Box, an I-cable is required to connect the box with the HS301 handset, as well as one additional I-cable for each sensor to be connected. When connecting the Averaging Beam, one I-cable is also used to connect the HS301, and one I-cable is used to connect the rear sensor beam (additional cabling on the Averaging Beam remains the same).

I-cable

I-cable with 2x6-pin bayonet connectors. The I-cable is used to connect the HS301 or a sensor to a Connector Box. The I-cable is coiled and available in several different in lengths, cf. below. The length specified corresponds to the maximum recommended length used.

S-50280/1,5	I-cable 1.5m / 59,0 inches
S-50280/2,2	I-cable 2.2m / 86,6 inches
S-50280/3,3	I-cable 3.3m / 129,9 inches
S-50280/4,0	I-cable 4.0m / 157,5 inches
S-50280/6,0	I-cable 6.0m / 236,2 inches

Converters and Adaptor cables

In case the asphalt paver is equipped with an alternative plug, a series of converters and adaptor cables is available, so that the Mini-Line® system can also be connected to these types of asphalt pavers. There is a range of converters and adaptor cables available in the Mini-Line® system, as new types are added continuously, as new types of pavers become available in the market (contact your local representative for information about which converters and adaptor cables are currently available).

Vögele Converter

S-50288

The Vögele Converter Kit enables the connection of the Mini-Line® Grade and Slope Control System to Vögele asphalt pavers, by functioning as an adaptor cable as well as an interface that stops the regulation during the stand-by mode used by Vögele pavers.

HPD100 Converter

S-50577

The HPD100 Leeboy Converter Kit enables the connection of the Mini-Line® Grade and Slope Control System to asphalt pavers with electric powered screed actuators, e.g. Leeboy pavers, by converting the control signals of the Mini-Line® system to fit electrically driven actuators. Please note that when using the HPD100 Leeboy Converter Kit, the Mini-Line® standard cables cannot be used, as I-cables, cf. above, are required to connect the HS301 and sensors to the converter.

Adaptor Cable for 7-pin Screw Plugs

S-50430

This adaptor cable is used on machines with a 7-pin screw plug.

Adaptor Cable for 11-KPT Plugs

S-50497

This adaptor cable is used on machines with an 11-KPT plug.

Carry Cases for the Mini-Line® Grade and Slope Control System

Mini-Line® Carry Cases

TF-Technologies has developed a series of Mini-Line® carry cases, especially designed for the various configurations that the Mini-Line® Grade and Slope Control System offers.

The Mini-Line® Grade and Slope Control System is designed to be easily disconnected and dismounted and is best stored in a Mini-Line® Carry Case.

All Mini-Line® Carry Cases are designed for heavy duty transport, and contain custom-cut foam to ensure optimal protection of the Mini-Line® system during transport. All Mini-Line® Carry Cases are watertight and corrosion proof.

	Can contain
S-50901	2xHS301, 2xG221, 1xS298, 2xSnap Connector and cables
S-50902	2xHS301, 2xG224, 1xS298, 2xSnap Connector and cables
S-50903	2xHS301, 1xG224, 1xG221, 1xS298, 2xSnap Connector and cables
S-50904	2xHS301, 4xG224, 1xG221, 1xS298, 1xSnap Connector and cables
S-50905	2xHS301, 5xG224, 1xS298, 1xSnap Connector and cables
S-50906	2xHS301, 5xG221, 1xS298, 1xSnap Connector and cables
S-50907	2xHS301, 4xG221, 1xG224, 1xS298, 1xSnap Connector and cables
S-50908	2xPL2005, 2xG221, 1xS299, 2xSnap Connector and cables
S-50909	2xPL2005, 2xG224, 1xS299, 2xSnap Connector and cables
S-50910	2xPL2005, 1xG221, 4xG224, 1xS299, 2xSnap Connector and cables
S-50911	2xPL2005, 8xG221, 1xS298, 1xSnap Connector and cables
S-50912	2xPL2005, 1xG224, 4xG221, 1xS298, 1xSnap Connector and cables
S-50960	2xLRL2000, 2xY398, 1xS297 and cables

Mountings in the Mini-Line® Grade and Slope Control System

Averaging Beam

The Averaging Beam is used to mount four grade sensors, and consists of two sensor beams mounted with specially designed mountings on the tow arm and the screed of the paver.

Averaging Beam with internal cabling, Snap Connector and Connector Boxes

S-50315

Sensor beam that holds two grade sensors, fully-fitted with Snap Connectors, connector box and internal cabling integrated into the beam.

Front Beam Mounting

S-50790

Arm to mount the front sensor beam on the tow arm.

Rear Beam Mounting

S-50787

Arm to mount the rear sensor beam on the screed.

Complete EASY Averaging Beam

S-50311

Tow Arm Bracket Kit

SP-51618

Clamping Plates Kit

SP-51628

Support Arm

S-50513

Grade Support Arm for the mounting of a single grade sensor. The Grade Support Arm has built-in heigh adjustment and vibration damping.

Technical Specifications (data sheets)

Handset HS301

HS301 Handset
Grade and Slope Control System

Mini-Line®

The HS301 handset is the handheld controller for the Mini-Line Grade and Slope Control System designed to automatically maintain the desired grade or slope when paving.

With a simple user-interface the HS301 can be operated in manual and auto mode, and minimum pulse, working window, sensitivity and dead band can be set up. In manual mode the tow point is adjusted manually, and desired reference level set. In auto mode, the HS301 will take control over the tow point valve and automatically adjust the grade or slope to follow the set reference so that mat thickness is maintained with millimeter precision. Up and down buttons allow the operator make necessary adjustments to the mat thickness during paving.

The LED panel with high visibility in poor and bright sunlight gives the operator a visual indication of how the current mat thickness is following the set reference. As a handheld device, the handset features a bail, allowing the operator to easily grab, operate and re-mount the HS301 handset during operation.

The HS301 handset can adapt both grade and slope sensors, allowing the operator to quickly switch from grade to slope control. In addition to a slope sensor, up to four sonic grade sensors can be supported in an averaging setup.

HS301 Handset

HS301 Handset Specifications	
Part Number	S-50332 (mm, default output NPN) S-50324 (inches, default output NPN)
Application	Handheld Controller for Grade and Slope Control
Power Supply	12/24 Volt System (10-30 VDC)
Power Consumption	Typical at 24 VDC 60 mA Max 200 mA
Dimensions (LxWxH)	135x68x45mm / 5.3x2.7x1.8in
Weight	350g / 0.8lbs
House	Aluminium
Storage Temperature	-40°C to 85°C / -40°F to 185°F
Operating Temperature	-10°C to 70°C / 14°F to 158°F
Display Resolution	Grade 1mm / 0.1 inch Slope 0.1%
Handset Control Parameters	Sensitivity Working Window Minimum Pulse Dead Band
Communication Bus	RS485
Connector	Cannon Bayonet Plug, male 6 pin A: Vbat D: Output down B: Gnd E: Com A RS485 C: Output up F: Com B RS485
Output (to valves)	ON/OFF, PNP or NPN max 1.2A Continuously, 2.0A Pulsed

Sensor Options


G224


G221


S298


G220

v. H803907

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Handset HS301 Proportional

HS301 Proportional Handset
Grade and Slope Control System

Mini-Line®

The HS301 handset is the handheld controller for the Mini-Line Grade and Slope Control System designed to automatically maintain the desired grade or slope when paving.

With a simple user-interface the HS301 can be operated in manual and auto mode, and minimum pulse, working window, sensitivity and dead band can be set up. In manual mode the tow point is adjusted manually, and desired reference level set. In auto mode, the HS301 will take control over the tow point valve and automatically adjust the grade or slope to follow the set reference so that mat thickness is maintained with millimeter precision. Up and down buttons allow the operator make necessary adjustments to the mat thickness during paving.

The LED panel with high visibility in poor and bright sunlight gives the operator a visual indication of how the current mat thickness is following the set reference. As a handheld device, the handset features a bail, allowing the operator to easily grab, operate and re-mount the HS301 handset during operation.

The HS301 handset can adapt both grade and slope sensors, allowing the operator to quickly switch from grade to slope control. In addition to a slope sensor, up to four sonic grade sensors can be supported in an averaging setup.

HS301 Handset

HS301 Proportional Handset Specifications	
Part Number	S-50333 (mm, default output NPN) S-50334 (inches, default output NPN)
Application	Handheld Controller for Grade and Slope Control
Power Supply	12/24 Volt System (10-30 VDC)
Power Consumption	Typical at 24 VDC 60 mA Max 200 mA
Dimensions (LxWxH)	135x68x45mm / 5.3x2.7x1.8in
Weight	350g / 0.8lbs
House	Aluminium
Storage Temperature	-40°C to 85°C / -40°F to 185°F
Operating Temperature	-10°C to 70°C / 14°F to 158°F
Display Resolution	Grade 1mm / 0.1 inch Slope 0.1%
Handset Control Parameters	Sensitivity Working Window Minimum Pulse Dead Band
Communication Bus	RS485
Connector	Cannon Bayonet Plug, male 6 pin A: Vbat D: Output down B: Gnd E: Com A RS485 C: Output up F: Com B RS485
Output (to valves)	Proportional, NPN or PNP max 1.2A Continuously, 2.0A Pulsed

Sensor Options


G224


G221


S298


G220

v. H811603

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G220 Sonic Grade Sensor

G220 Sonic Grade Sensor
for Ground Sensing

Mini-Line®

The G220 Sonic Grade Sensor is an entry-level grade sensor with a well proven record of functionality and durability.

The G220 Sonic Grade Sensor is a high precision sensor operating at an optimized frequency for high precision. As a non-contact sensor with an ultrasonic transducer, typical annoyances of a sticky mechanical ski prone to hitting obstacles are eliminated.

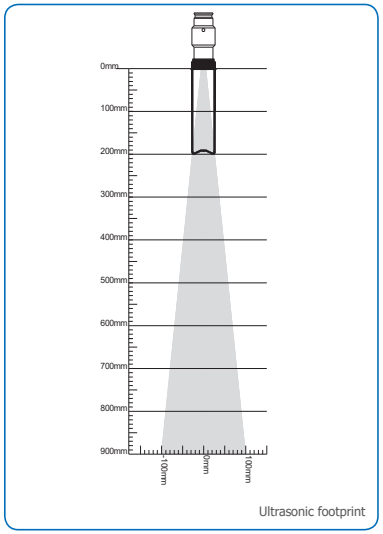
The sensor has a wide sensing span and features a reference bail for optimum temperature and wind compensation.

The G220 Sonic Grade Sensor can be used with all controllers in the Mini-Line® series. The standard and additional versions can be used both as a single sensor or as a part of an averaging system.

The replacement version is an extra sensor for the averaging system that can replace either of the other four sensors in case of malfunction.

G220 Sonic Sensor

G220 Sonic Grade Sensor Specifications	
Part Number	S-50380 (standard, adr. 8, white) S-50381 (additional for averaging, adr. 9, red) S-50382 (additional for averaging, adr. 10, yellow) S-50383 (additional for averaging, adr. 11, blue) S-50384 (replacement for averaging, adr. 4, green)
Application	Grade Control Non Contact Ground Sensing
Power Supply	12/24 Volt System (10-30 VDC)
Power Consumption	Typical at 24 VDC 40 mA Max 200 mA
Dimensions (LxWxH)	130x53x69mm / 5.1x2.1x2.7in
Weight	350g / 0.8lbs
House	Aluminium
Storage Temperature	-40°C to 85°C / -40°F to 185°F
Operating Temperature	0°C to 70°C / 32°F to 158°F
Sensor Type	1x 125kHz Ultrasonic Transducer
Transducer Beam Width (-3dB full angle)	12° +/- 2°
Temperature Compensation	200mm / 8in Detachable Bail
Resolution	1mm / 0.04in
Accuracy - Dynamic	+/- 1mm / +/- 0.04in
Sensor Range	280-900mm / 11-35.4in
Communication Bus	Standard: RS485 OEM Option: CAN Analog Voltage Output
Connector	Cannon Bayonet Plug, male 6 pin A: Vbat D: NC B: Gnd E: Com A RS485 C: NC F: Com B RS485



Ultrasonic footprint

v. H803204

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G221 Sonic Grade Sensor

G221 Sonic Grade Sensor
for Ground Sensing

Mini-Line®

The G221 Sonic Grade Sensor is a non-contact grade sensor optimized to work in the harsh conditions of the construction industry.

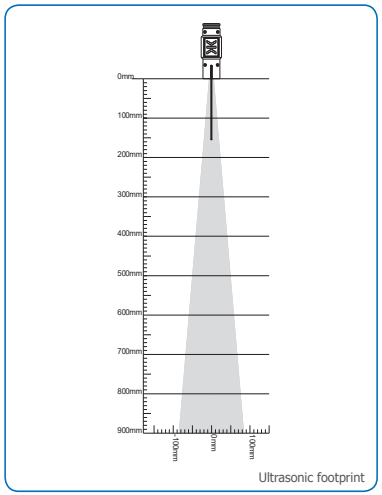
The sensor operates at an optimized frequency for very precise measurements, and it features a highly resilient encapsulated transducer. The sensor is equipped with an LED panel that gives the operator a visual indication of how the current mat thickness is following the set reference. The G221 features a reference bail for optimum temperature and wind compensation. The bail is made of spring steel and is designed to detach from the sensor body if struck by an obstacle to prevent damaging bail or sensor.

The G221 can be used with all controllers in the Mini-Line® series. The standard and additional versions can be used both as a single sensor or as a part of an averaging system.

The replacement versions are extra sensors for the averaging system that can replace either of the other four sensors in case of malfunction, or as additional sensors on an averaging beam with six sensors.

G221 Sonic Sensor

G221 Sonic Grade Sensor Specifications	
Part Number	S-50620 (standard, adr. 8, white) S-50621 (additional for averaging, adr. 9, red) S-50622 (additional for averaging, adr. 10, yellow) S-50623 (additional for averaging, adr. 11, blue) S-50624 (replacement for averaging, adr. 4, green) S-50625 (replacement for averaging, adr. 12, grey)
Application	Grade Control Non contact Ground Sensing
Power Supply	12/24 Volt System (10-30 VDC)
Power consumption	Typical at 24 VDC 60 mA Max 200 mA
Dimensions (LxWxH)	130x53x67mm / 5.1x2.1x2.6in
Weight	350g / 0.8lbs
House	Aluminum
Storage Temperature	-40°C to 85°C / -40°F to 185°F
Operating Temperature	-10°C to 70°C / 14°F to 158°F
Sensor Type	1x 125kHz Ultrasonic Transducer
Transducer Beam width (-3dB full angle)	10° +/- 2°
Temperature Compensation	155mm / 6.1in Detachable Bail
Resolution	1mm / 0.04in
Accuracy - Dynamic	+/- 1mm / 0.1in
Sensor Range	220-900mm / 8.7-35.4in
Communication Bus	Standard: RS485 OEM option: CAN Analog Voltage Output
Connector	Cannon Bayonet Plug, male 6 pin A: Vbat D: NC B: Gnd E: Com A RS485 C: NC F: Com B RS485



Ultrasonic footprint

v. H800504

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G224 Multi-Sonic Grade Sensor

G224 Multi-Sonic Grade Sensor
for Ground and String Line Sensing

Mini-Line®

The G224 Multi-Sonic Grade Sensor is a versatile, high precision sensor that is designed for use in both ground and string line sensing mode. It is equipped with four ultrasonic sensors operating at an optimized frequency for high precision. The integration of four ultrasonic sensors gives the Multi-Sonic excellent abilities for string line sensing due to the large sensing span, and enable high precision ground sensing by the use of advanced averaging technology. You can easily switch between ground and string line mode with a simple push on the Mode button.

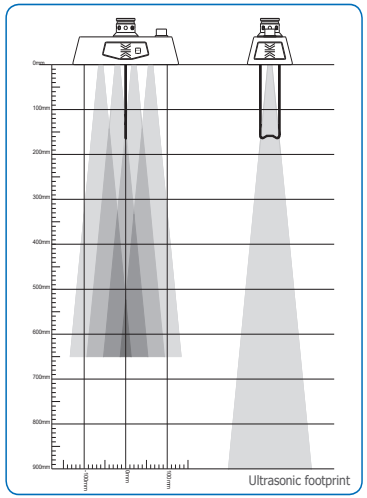
The sensor is equipped with LED panels on two sides. The active panel facing the operator gives a visual indication of how the current mat thickness is following the set reference. When in string line sensing mode an LED indicator also shows if the sensor is working within or is about to exceed its operating range. The G224 Multi-Sonic features a reference bail for optimum temperature compensation. The reference bail can easily be removed when the sensor is not in use.

The G224 Multi-Sonic can be used with all controllers in the Mini-Line® series. The standard and additional versions can be used both as a single sensor option or as a part of an averaging system.

The replacement versions are extra sensors for the averaging system that can replace either of the other four sensors in case of malfunction, or as additional sensors on an averaging beam with six sensors.

G224 Multi-Sonic

G224 Multi-Sonic Specifications	
Part Number	S-50651 (standard sensor, adr. 8, white) S-50652 (additional for averaging, adr. 9, red) S-50653 (additional for averaging, adr. 10, yellow) S-50654 (additional for averaging, adr. 11, blue) S-50655 (replacement for averaging, adr. 4 green) S-50656 (replacement for averaging, 12 grey)
Application	Grade Control Non contact ground or string line sensing
Power Supply	12/24 Volt System (10-30 VDC)
Power Consumption	Typical at 24 VDC 120 mA Max 200 mA
Dimensions (LxWxH)	257x110x104mm / 10.1x4.3x4.1in
Weight	1400g / 3.1lbs
House	Aluminium
Storage Temperature	-40°C to 85°C / -40°F to 185°F
Operating Temperature	-10°C to 70°C / 14°F to 158°F
Sensor Type	4x125kHz Ultrasonic Transducer
Transducer Beam Width (-3dB full angle):	12° +/- 2°
Temperature Compensation	165mm / 6.5in Detachable Bail
Resolution	1mm / 0.1in
Accuracy - Dynamic	+/- 1mm / 0.1in
Sensor Range	250-900mm / 9.8-35.4in Ground Mode 270-650mm / 10.6-25.6in String Mode Up to 25cm / 9.8in Sensing width in String-Line Mode
Communication Bus	Standard: RS485 OEM option: CAN Analog Voltage Output
Connector	Cannon Bayonet Plug, male 6 pin A: Vbat D: NC B: Gnd E: Com A RS485 C: NC F: Com B RS485



Ultrasonic footprint

v. H800705

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S298 Slope Sensor

S298 Slope Sensor
for Slope Sensing

Mini-Line®

The S298 Slope Sensor measures the cross slope of the screed, when a defined slope of the road is required or an appropriate reference is not available in one side of the machine.

The S298 Slope Sensor is operated with a HS301 handset and is always used together with grade control setting the reference of the grade in one side. If operating with grade control in both sides of the machine, the slope sensor can be used for monitoring the slope of the road.

The sensor can be used for controlling slope from either side of the machine, but only one side at a time and is only controllable from the handset from that side.

The S298 Slope Sensor has a strong and accurate inclinometer specifically designed to withstand high vibration levels on high compaction screeds.

S298 Slope Sensor

S298 Slope Sensor Specifications	
Part Number	S-50170
Application	Slope Control and Slope Monitoring for HS301 Grade and Slope Control System
Power Supply	12/24 Volt System (10-30 VDC)
Power Consumption	Typical at 24 VDC 30 mA Max 200 mA
Dimensions (LxWxH))	130x75x44mm / 5x3x1.7in
Weight	0.5kg / 1.1lbs
House	Aluminium
Storage Temperature	-40°C to +85°C / -40°F to 185°F
Operating Temperature	-10°C to +70°C / 14°F to 158°F
Sensor Type	Inclinometer
Resolution	0.01%
Accuracy	+/- 0.1%
Sensor Range	-9.99% to +9.99%
Communication Bus	Standard: RS485 OEM Option: CAN
Connector	2 x Cannon Bayonet Plug, Male 6-Pin A: Vbat D: NC B: Gnd E: Com A RS485 C: NC F: Com B RS485

v. H807202

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TECHNOLOGIES
PAVING INNOVATION

EC Declaration of Conformity
Document no.: J9006202
Published: October 1, 2015

EC Declaration of Conformity

Electromagnetic Conformity Directive 2004/108/EC

Manufacturer within European Community

COMPANY NAME	TF-Technologies A/S
ADDRESS	Kratbjerg 214 3480 Fredensborg Denmark

Description of Product

PRODUCT NAME	HS301 Handset
MODEL	HS301
APPLICATION	Controller for Grade and slope
PART NUMBER	S-50332 S-50323 S-50324 S-50333 S-50334

Conformity and Assessment Procedure Followed

DIRECTIVE	Electromagnetic Conformity Directive 2004/108/EC
HARMONIZED STANDARD	EN 13309:2010 – Construction machinery - Electromagnetic compatibility of machines with internal power supply
TEST METHOD	ISO 10605 ISO 11452-2 CISPR 25 ISO 7637-2
NOTIFIED BODY	Delta A/S Venlighedsvej 4, 2970 Hørsholm, Denmark

Additional Compliance

HARMONIZED STANDARD	EN 60204-1:2006+A1:2009 – Safety of machinery - Electrical equipment of machines: General requirements (Harmonized standard under the Machinery Directive 2006/42/ec)

Valid if both installation and use follow the instructions of TF-Technologies A/S

October 1, 2015

Lisbeth Teilmann Melchior, CEO, TF-Technologies A/S

Declarations of Conformity

TECHNOLOGIES
PAVING INNOVATION

EC Declaration of Conformity
Document no.: J9000301
Published: September 12, 2013

EC Declaration of Conformity

Electromagnetic Conformity Directive 2004/108/EC

Manufacturer within European Community

COMPANY NAME	TF-Technologies A/S
ADDRESS	Kratbjerg 214 3480 Fredensborg Denmark

Description of Product

PRODUCT NAME	HS301 Handset
MODEL	HS301
APPLICATION	Controller for Grade and slope
PART NUMBER	S-50332 S-50323 S-50324

Conformity and Assessment Procedure Followed

DIRECTIVE	Electromagnetic Conformity Directive 2004/108/EC
HARMONIZED STANDARD	EN 13309:2010 – Construction machinery - Electromagnetic compatibility of machines with internal power supply
TEST METHOD	ISO 10605 ISO 11452-2 CISPR 25 ISO 7637-2
NOTIFIED BODY	Delta A/S Venlighedsvej 4, 2970 Hørsholm, Denmark

Additional Compliance

HARMONIZED STANDARD	EN 60204-1:2006+A1:2009 – Safety of machinery - Electrical equipment of machines: General requirements (Harmonized standard under the Machinery Directive 2006/42/ec)

Valid if both installation and use follow the instructions of TF-Technologies A/S

September 12, 2013

Lisbeth Teilmann Melchior, CEO, TF-Technologies A/S

TECHNOLOGIES
PAVING INNOVATION

EC Declaration of Conformity
Document no.: J9001201
Published: September 13, 2013

EC Declaration of Conformity

Electromagnetic Conformity Directive 2004/108/EC

Manufacturer within European Community

COMPANY NAME	TF-Technologies A/S
ADDRESS	Kratbjerg 214 3480 Fredensborg Denmark

Description of Product

PRODUCT NAME	S298 Slope Sensor
MODEL	S298
APPLICATION	Slope sensor for HS301 paving control systems Slope control and slope monitoring
PART NUMBER	S-50166B

Conformity and Assessment Procedure Followed

DIRECTIVE	Electromagnetic Conformity Directive 2004/108/EC
HARMONIZED STANDARD	EN 13309:2010 – Construction machinery - Electromagnetic compatibility of machines with internal power supply
TEST METHOD	ISO 10605 ISO 11452-2 CISPR 25 ISO 7637-2

Additional Compliance

HARMONIZED STANDARD	EN 60204-1:2006+A1:2009 – Safety of machinery - Electrical equipment of machines: General requirements (Harmonized standard under the Machinery Directive 2006/42/ec)

Valid if both installation and use follow the instructions of TF-Technologies A/S

September 13, 2013

Lisbeth Teilmann Melchior, CEO, TF-Technologies A/S

TECHNOLOGIES
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EC Declaration of Conformity
Document no.: J9000101
Published: September 12, 2013

EC Declaration of Conformity

Electromagnetic Conformity Directive 2004/108/EC

Manufacturer within European Community

COMPANY NAME	TF-Technologies A/S
ADDRESS	Kratbjerg 214 3480 Fredensborg Denmark

Description of Product

PRODUCT NAME	G220 Sonic Grade Sensor
MODEL	G220
APPLICATION	Grade control Non-contact ground sensing for control unit
PART NUMBER	S-50380 S-50381 S-50382 S-50383 S-50384 S-50380/V S-50381/V S-50382/V S-50383/V S-50384/V

Conformity and Assessment Procedure Followed

DIRECTIVE	Electromagnetic Conformity Directive 2004/108/EC
HARMONIZED STANDARD	EN 13309:2010 – Construction machinery - Electromagnetic compatibility of machines with internal power supply
TEST METHOD	ISO 10605 ISO 11452-2 CISPR 25 ISO 7637-2

Additional Compliance

HARMONIZED STANDARD	EN 60204-1:2006+A1:2009 – Safety of machinery - Electrical equipment of machines: General requirements (Harmonized standard under the Machinery Directive 2006/42/ec)

Valid if both installation and use follow the instructions of TF-Technologies A/S

September 12, 2013

Lisbeth Teilmann Melchior, CEO, TF-Technologies A/S

TECHNOLOGIES
PAVING INNOVATION

EC Declaration of Conformity
Document no.: J9001101
Published: September 13, 2013

EC Declaration of Conformity

Electromagnetic Conformity Directive 2004/108/EC

Manufacturer within European Community

COMPANY NAME	TF-Technologies A/S
ADDRESS	Kratbjerg 214 3480 Fredensborg Denmark

Description of Product

PRODUCT NAME	G224 Multi-Sonic Grade Sensor
MODEL	G224
APPLICATION	Grade control Non-contact ground or string line sensing for control unit
PART NUMBER	S-50651 S-50652 S-50653 S-50654 S-50655 S-50610 S-50611 S-50612 S-50613 S-50619

Conformity and Assessment Procedure Followed

DIRECTIVE	Electromagnetic Conformity Directive 2004/108/EC
HARMONIZED STANDARD	EN 13309:2010 – Construction machinery - Electromagnetic compatibility of machines with internal power supply
ADDITIONAL REQUIREMENTS	ISO 13766
TEST METHOD	ISO 10605 ISO 11452-2 CISPR 25 ISO 7637-2
NOTIFIED BODY	Delta A/S Venlighedsvej 4, 2970 Hørsholm, Denmark

Additional Compliance

HARMONIZED STANDARD	EN 60204-1:2006+A1:2009 – Safety of machinery - Electrical equipment of machines: General requirements (Harmonized standard under the Machinery Directive 2006/42/ec)

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September 13, 2013

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TECHNOLOGIES
PAVING INNOVATION

EC Declaration of Conformity
Document no.: J9000201
Published: September 12, 2013

EC Declaration of Conformity

Electromagnetic Conformity Directive 2004/108/EC

Manufacturer within European Community

COMPANY NAME	TF-Technologies A/S
ADDRESS	Kratbjerg 214 3480 Fredensborg Denmark

Description of Product

PRODUCT NAME	G221 Single Sonic
MODEL	G221
APPLICATION	Grade control Non-contact ground sensing for control unit
PART NUMBER	S-50620 S-50621 S-50622 S-50623 S-50624

Conformity and Assessment Procedure Followed

DIRECTIVE	Electromagnetic conformity Directive 2004/108/EC
HARMONIZED STANDARD	EN 13309:2010 – Construction machinery - Electromagnetic compatibility of machines with internal power supply
ADDITIONAL REQUIREMENTS	ISO 13766
TEST METHOD	ISO 10605 ISO 11452-2 ISO 11452-2 CISPR 25 ISO 7637-2
NOTIFIED BODY	Delta A/S Venlighedsvej 4, 2970 Hørsholm, Denmark

Additional Compliance

HARMONIZED STANDARD	EN 60204-1:2006+A1:2009 – Safety of machinery - Electrical equipment of machines: General requirements (Harmonized standard under the machinery directive 2006/42/ec)

Valid if both installation and use follow the instructions of TF-Technologies A/S

September 12, 2013

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