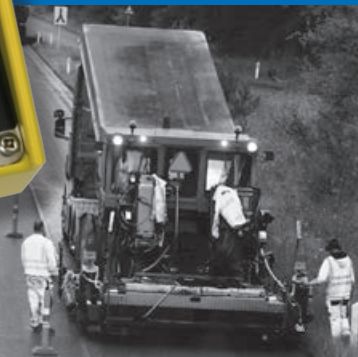


Mini-Line® Grade and Slope Control System

PL2005 User Manual



Mini-Line® Grade and Slope Control System **PL2005 User Manual**



About PL2005 User Manual

Content and structure

This user manual for Mini-Line® Grade and Slope Control System with PL2005 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 PL2005 Control Box. 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 PL2005 Control Box. 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. 69 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 don'ts, 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.

Copyright

This manual has been developed exclusively for users of Mini-Line® PL2005 to provide the necessary information to operate the Mini-Line® Grade and Slope Control System, and may only be used for this particular purpose. All information, text and pictures are the intellectual property of, and copyrighted material of TF-Technologies A/S. All rights are reserved. The manual may not be copied, displayed, quoted, published, sold, modified, or distributed without the written consent of TF-Technologies A/S.

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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: PL2005
Serial number: TF-37126
Part number: S-51001

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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

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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 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 or 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 make 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 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® series



HS301

Simple and mobile asphalt paving

On paving jobs with easy access to both sides of the paver, yet requiring operator mobility e.g. for operator safety the HS301 is a simple and handheld controller that enables the operator to move freely during operation.



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 gets 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 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 in 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.

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 smoothing 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.

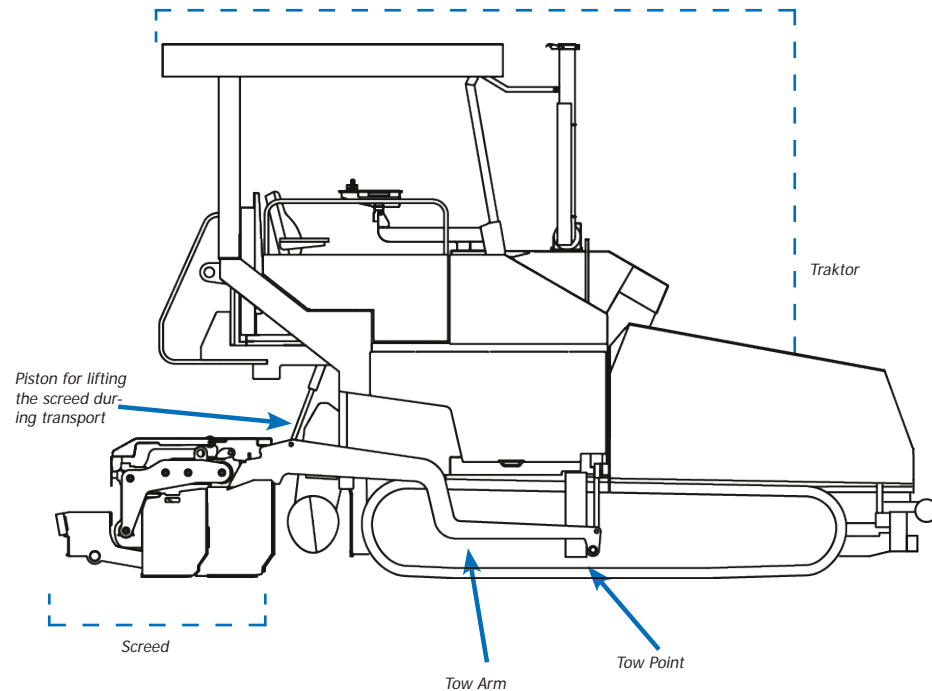
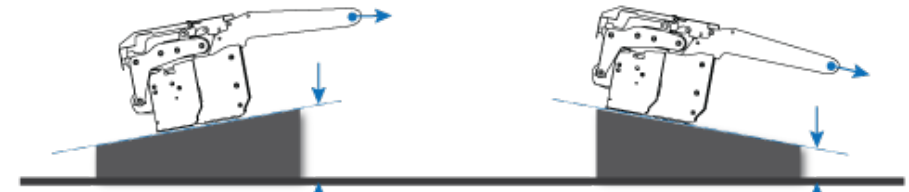


Figure 1 - Structure of the asphalt paver



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

Figur 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 mat thickness is fully achieved. This delay is what provides the smoothing 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 lengths, 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 smoothing will take place due to the smoothing 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.



The PL2005 automatically adjusts the brightness of the LED display for bright or dark surroundings.

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.

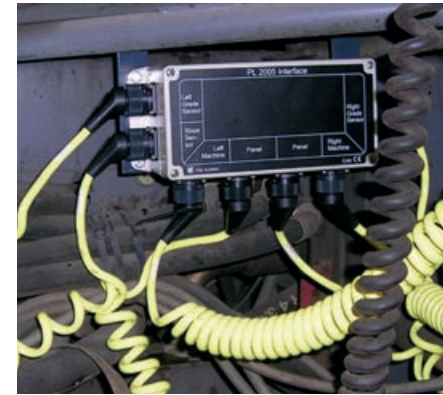
By using the averaging sensor G224 or the Averaging Beam of the Mini-Line® Grade and Slope Control System an even better result can be obtained, as they calculate an average across the measurements of the sensors. This enables an averaging effect which evens out the existing irregularities of the reference,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

In manual operation, the operator must wait several tow arm lengths before a change takes full effect, or he must adjust the tow point



All parts of the PL2005 system connect to the Interfacebox located centrally on the machine.

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 existing lane. 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, thereby compensating 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 smoothing 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 PL2005



PL2005 in auto mode with grade control in both sides

Mini-Line® PL2005 is a controller specifically designed for asphalt pavers that can regulate the grade and slope of the paved mat in relation to a chosen reference.

With the PL2005 the operator acquires a full overview and full control of all sensors and settings in both sides of the paver from one unit.

On smaller pavers, where it is easy to maintain overview of both sides of the screed, the PL2005 offers the advantage of operating both sides of the screed from the same controller.

On larger pavers, where the operator is unable to maintain overview of both sides of the screed, the PL2005 offers operator the advantage of being able to follow the regulation on the opposite side. This is useful, as the change in grade on one side affects the total slope of the screed, if the grade in the other side is not regulated correspondingly.

The PL2005 synchronizes grade and slope sensors which provides for a faster slope

regulation, which is particularly useful on large pavers with a very wide screed.

The controller is very easy to use and can be set up 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 PL2005 in combination with a grade sensor, the reference is set to zero (the setpoint) at the desired grade and the Control Box is switched to auto mode. Likewise, when using PL2005 in combination with a slope sensor, the setpoint is entered at the desired slope and the Control Box is switched to auto mode.

Now the PL2005 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.

Full control of both sides

The screed is controlled by adjusting the height of the tow points on both sides of the paver, and they work independently of one another.

The PL2005 regulates both tow points and offers full overview and operation from each Control Box (typically one PL2005 Control Box is located in each side of the paver).

The Control Box is divided into three sections, with the regulation of each side of the screed in each side of the panel, and monitoring of the slope in the middle.

The Control Boxes are protected against two operators undertaking opposing adjustments simultaneously. When an operator performs adjustments in one side, the PL2005 automatically locks the other side and turns on a red light, so that the operator in the other side can see that this side is already regulating.

Simple operation

The Control Box shows the actual regulation in both sides, and which sensors are connected.

Diodes indicate the status of all the sensors, so that any potential errors are easily found.

The turning knobs make it easy to precisely set the correct grade and slope in auto mode.

Push buttons connected directly to the tow points of the paver make it quick and easy to adjust the tow point in manual mode.

Easy operator adjustments

The PL2005 can be set to mm or inches. The system remembers the preferred setting when the PL2005 is turned off, and "mm" or "inch" will always be lit with the measured values in the display, so that the operator is never doubt what unit the controller operates in.

The lighting in the Control Box automatically adjusts to the surrounding lighting conditions, so that the PL2005 is pleasantly operated in darkness as well as bright sunlight.

Safe storage

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

The Interfacebox, mounting brackets and Snap Connector are all designed for permanent mounting on the paver, and make it fast and easy to mount controllers and sensors.

System Overview

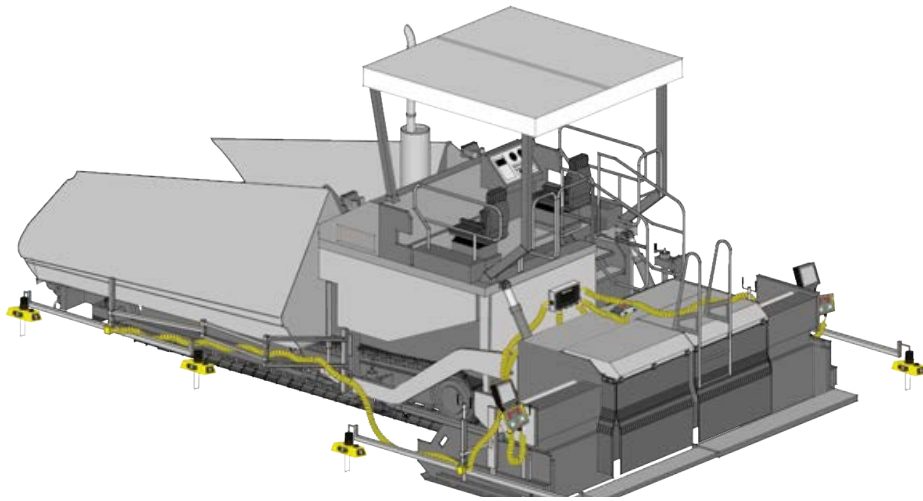


Figure 4 Asphalt paver with PL2005, slope sensor and Averaging Beams in both sides

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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® PL2005 Control Box

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 PL2005 is able to very precisely maintain the desired grade or slope throughout the paving job.

The PL2005 consists of an Interfacebox and two Control Boxes. The Control Boxes provide full overview and control of the regulation in both sides from each Box.



System Configurations

This section provides an overview of possible system configurations for Mini-Line® Grade and Slope Control System with the use of the PL2005 controller.

The PL2005 system consists of an Interface-box mounted permanently on the asphalt paver, and two PL2005 controllers placed conveniently in each side of the paver.

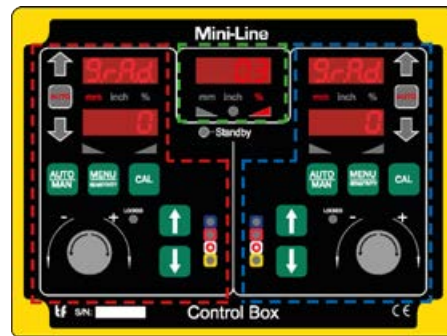
One or more sensors are used in each side of the paver and I-cables connect all units to the Interfacebox. The Interfacebox and Slope Sensor are designed for permanent mounting, whereas the grade sensors, controllers and cables are best kept in their Carry Case when not in use. Mounting brackets and Snap Connectors provides for a fast and easy daily routine.

The PL2005 uses input from the sensors in each side to regulate grade or slope based on the reference chosen. If a sensor measures a change in the grade or slope compared to the setpoint, the PL2005 will adjust the height of the relevant tow point, so that the desired grade or slope is maintained, despite changes in the existing base.

Controlling and monitoring

A Mini-Line® Grade and Slope Control System with PL2005 offers the options of either controlling grade in both sides or controlling grade in one side and slope in the other side. At the same time, the system can monitor the slope as a supplement to controlling grade in both sides.

The operator panels are divided simply into three sections, with the regulation of each side of the screed located in each side of the panel, and the monitored slope in the middle display.



- Display for left side of the screed
- Display for right side of the screed
- Display for monitoring slope

Displays for each side of the screed

Each side of the PL2005 has two displays: The top display shows your choice of either grade or slope ("Grad." / "Slop."), while the bottom display shows the chosen setpoint in auto mode, and the measured value in manual mode.

The setpoint is shown as a 0 for grade (calibrated setpoint) and as a %-value for slope. You can add or subtract from this value if a change to the setpoint is required.

Monitoring display

The display in the middle is used for monitoring the slope, when using grade control in both sides.

Setting up the PL2005 system

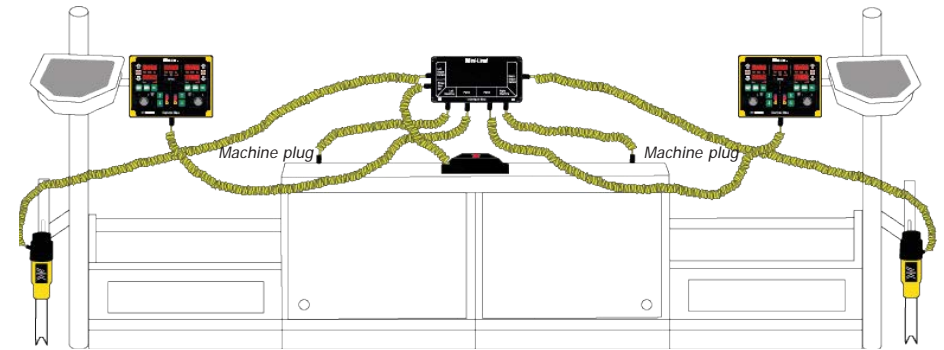


Figure 5 - Setting up the Mini-Line Grade and Slope Control System with PL2005. Here shown with single-sonic sensors.

The PL2005 can be set up with G221 Ultrasonic Grade Sensors or G224 Multi-Sonic Grade Sensors, cf. p. 26 Choice of sensors.

Irrespective of the type of grade sensor used, the same standard setup as displayed above is used.

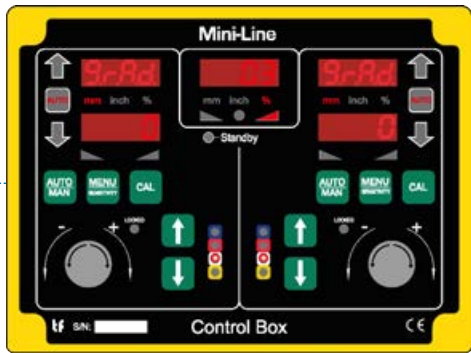
The Interfacebox is located centrally on the machine. Two PL2005 controllers, two grade sensors and a slope sensor are connected to the Interfacebox with I-cables. Two coiled cables connect the Interfacebox with the 10-pin plugs on the machine.

No matter the grade sensor type, the PL2005 can be used for grade control in both sides (with slope monitoring) or grade and slope control (one in each side).



It is impossible to use slope control in both sides, as the mat thickness and material consumption will come out of control without a set grade

Grade control in both sides with slope monitoring



PL2005 controlling grade in both sides and monitoring slope. The top display shows your choice of either grade or slope ("Grad." / "Slop."), while the bottom display shows the chosen setpoint (as a 0 - calibrated setpoint) in auto mode. The middle display shows the monitored slope in %. The triangle lit shows to which side the screed is sloping.

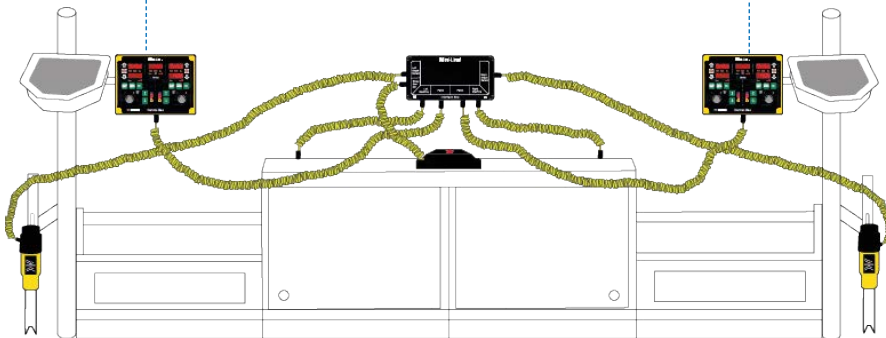


Figure 6 - Setting up the Mini-Line Grade and Slope Control System with PL2005. Here shown with single-sonic sensors.

Grade control in both sides of the screed, as seen from the Control Box displaying "Grad." in the top display in both sides. The slope sensor is used for monitoring purposes, and the measured value is shown in the middle display. Both PL2005 Control Boxes show the same information and provide a full overview of the regulation of the screed in both sides.

The operator can easily switch to slope control in one side, if desired, which will result in the grade in that particular side switching places with the measured slope.

Grade and slope control



PL2005 controlling grade in one side and slope in the other side. The top display shows your choice of either grade or slope ("Grad." / "Slop."), while the bottom display shows the chosen setpoint (as a 0 - calibrated setpoint) for grade and the slope in %. The triangle lit shows to which side the screed is sloping.

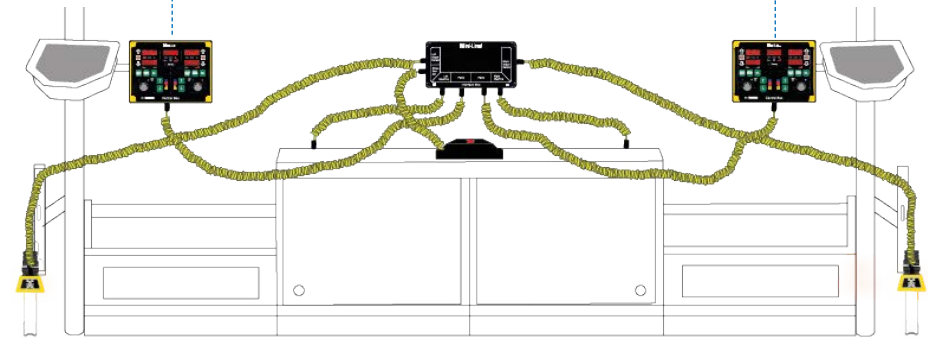


Figure 7 - Setting up the Mini-Line Grade and Slope Control System with PL2005. Here shown with Multi-Sonic sensors.

Grade control in the left side and slope control in the right side, as seen from the Control Box displaying "Grad." in the left side and "Slop." in the right side. The grade sensor on the right hand side is not used. Both PL2005 Control Boxes show the same information and provide a full overview of the regulation of the screed in both sides.

The operator can easily switch to grade control in the right side, if desired, which will result in the slope in that particular side switching places with the grade.

Choosing between Grade and Slope Control

The two tow points on an asphalt paver are controlled independently of one another with one Control Box. The operator can choose between controlling grade or slope on each side using one Control Box, however, grade must be controlled in at least one side. An additional sensor can be added for monitoring purposes, so that both grade and slope can be displayed. 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.

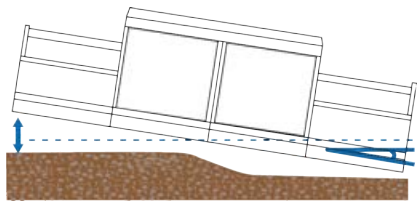


Figure 8 - Grade and slope control

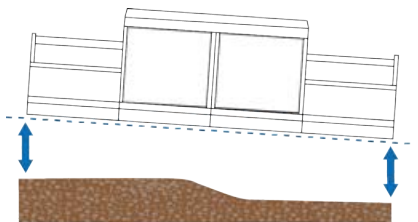


Figure 9 - Grade control in both sides

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.



We recommend grade control, if the material thickness or material consumption 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.



We recommend slope control or slope monitoring, 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 $\pm 1 \text{ mm} / \pm 0,1 \text{ inches}$ no matter the width of the screed, whereas the measuring accuracy of the slope sensor is $\pm 0.1 \%$, equaling $\pm 1 \text{ mm per meter screed width} / \pm 0,01 \text{ inch per feet screed width}$.



We recommend grade control when mat thickness is important to secure durability and material use

The accuracy is the precision the slope sensor is able to deliver even in unstable conditions such as shifting temperatures and vibrations. Under more stable conditions the regulation will be more accurate (cf. Technical Specifications p.134)

Additionally, the slope sensor and grade sensors are synchronised with the PL2005, offering faster and more accurate slope changes. For example, if the operator performs a slight change in the side with the grade sensor, a similar change is automatically performed in the other side controlled by a slope sensor, so that the precise slope is maintained.



We recommend grade control in both sides for a small layer thickness



We recommend grade control in both sides on very wide screeds

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 the PL2005. 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.

Sensor overview for PL2005



Every sensor in the Mini-Line® series is easily connected to the PL2005 system with standard I-cables, available in many different lengths to suit different asphalt pavers.

For more information on cables and connections, please refer to Cables and Connectors, p. 96



Niveausensor G220

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



Niveausensor G221

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 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

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 string-line 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.

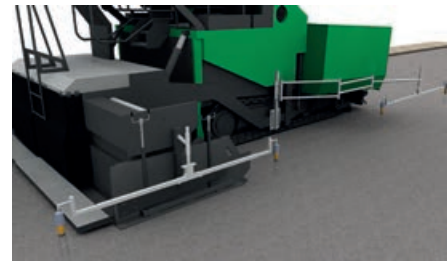
When mounted with the transducers parallel to the direction of driving, the sensor is able to undertake local averaging and even out small irregularities in the existing surface. When mounted across the direction of driving, no averaging effect will be achieved. However, this will increase the sensor 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.

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 smoothed out across the length of the beam, significantly improving the quality of the paved mat.

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



Asphalt Paver with Averaging Beam with 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 S299 Slope Sensor is specifically designed for use with PL2005 on an asphalt paver.



Hældningssensor S299

Slope Sensor S299

The S299 Slope Sensor is a compact, high precision slope sensor. It can be connected to the Interfacebox with an I-cable. The S299 is designed for asphalt pavers and maintains its high precision even under strong vibrations from screed and machine.

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.

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 smoothing effect



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

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.

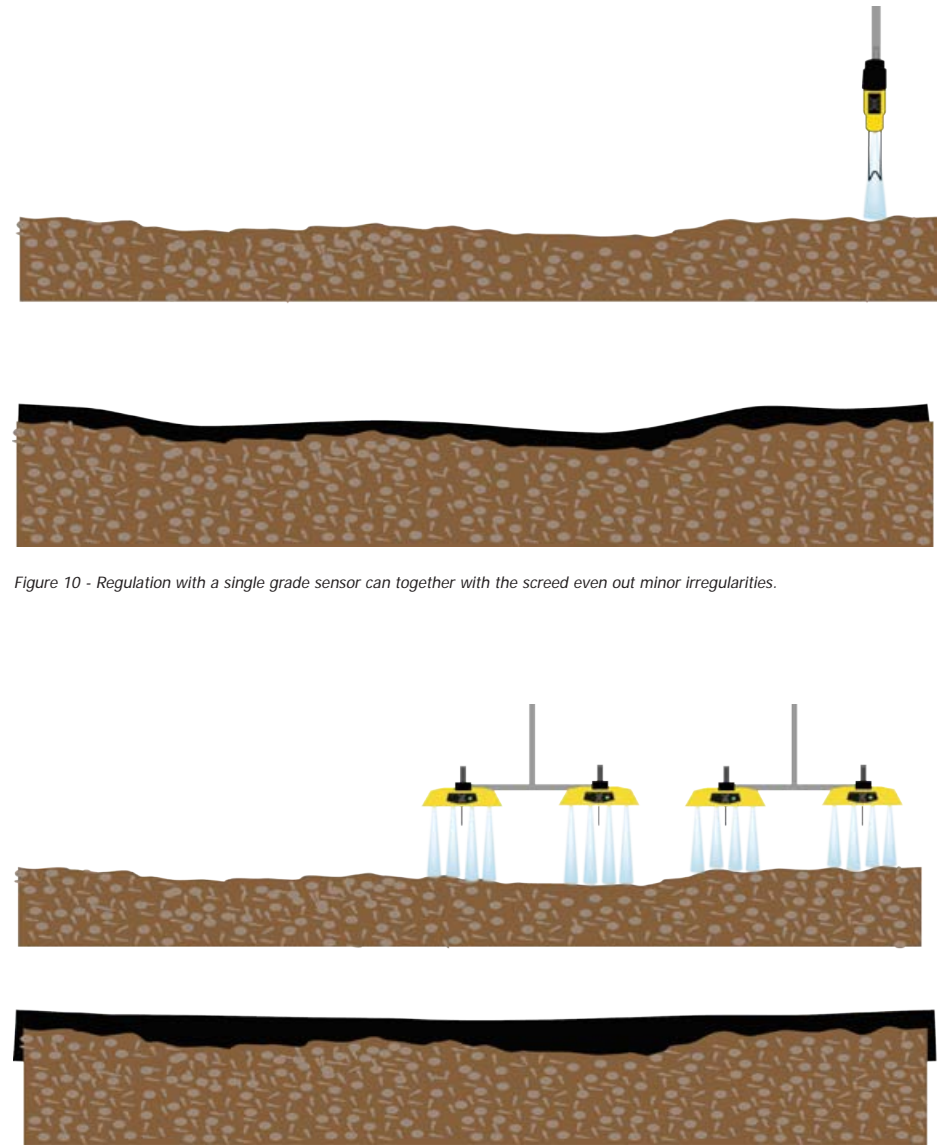


Figure 10 - Regulation with a single grade sensor can together with the screed even out minor irregularities.

Figure 11 - Regulation with an Averaging Beam can also even out larger irregularities and smoothen the surface of the road.

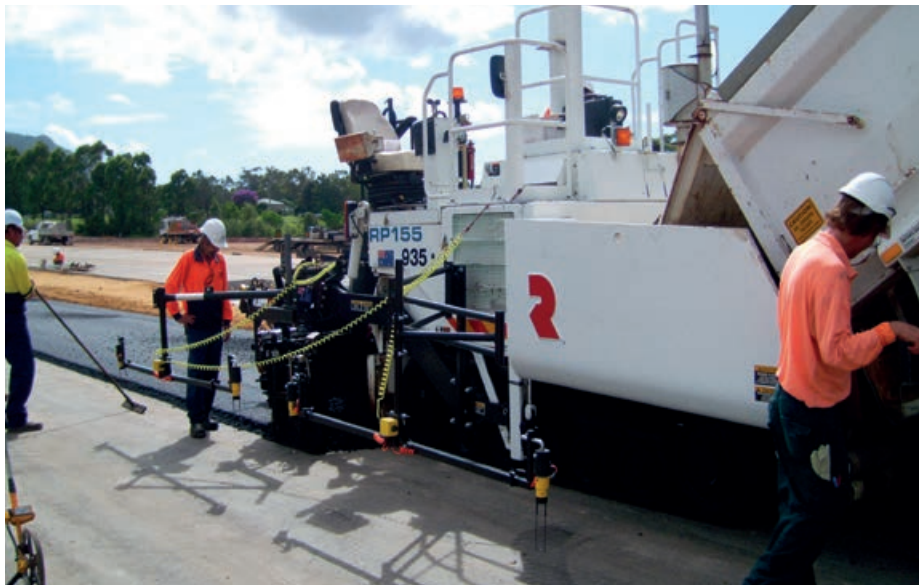
Configurations with the Averaging Beam

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 as if it were a single sensor. When choosing the Averaging beam, the sensor in the relevant side is simply interchanged with the Averaging Beam, so that the I-cable is simply connected to the connector box on the rear sensor beam. 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. 109. 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

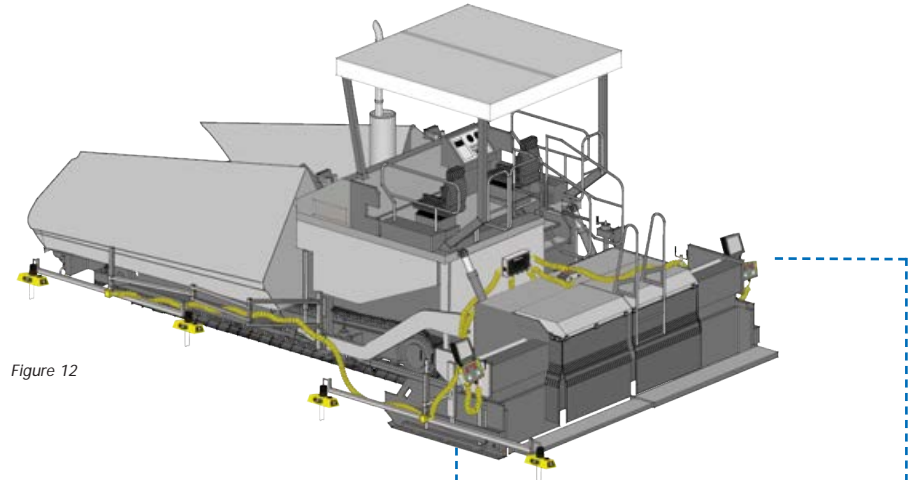


Figure 12

Grade control in one side with the use of an Averaging Beam and slope control in the other side. The grade sensor in the left side has been replaced with an Averaging Beam with four grade sensors.



Left side of the Control Box displays the chosen setpoint based on which the system regulates in the left side. The setpoint is shown as a 0 for grade (calibrated setpoint), calculated as an average of the measurements of the four sensors on the Averaging Beam. Right side of the Control Box displays the chosen setpoint based on which the system regulates in the right side. The setpoint is shown as a %-value for slope. The number of sensors connected to the system is seen from the diodes in both sides of the display.

Grade control in both sides - Averaging Beam in both sides

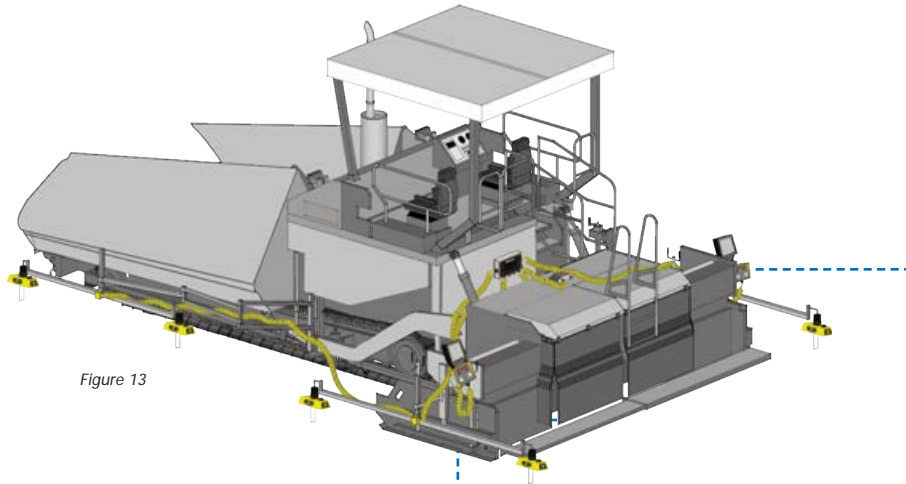


Figure 13

Grade control in both sides with the use of an Averaging Beam. The grade sensors in the sides have been replaced with an Averaging Beams with four grade sensors each.



Each side of the operator panel displays the chosen setpoint based on which the system regulates in that side. The setpoint is shown as a 0 for grade (calibrated setpoint), calculated as an average of the measurements of the four sensors on each Averaging Beam. The middle display shows the monitored slope. The number of sensors connected to the system is seen from the diodes in both sides of the display.

Grade control in both sides - Averaging Beam in one side

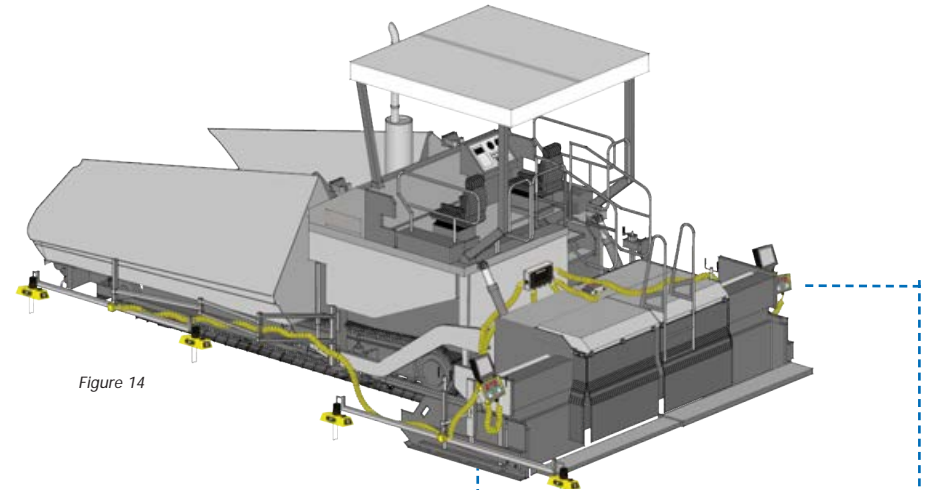


Figure 14

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. In the left the grade sensor has been replaced with an Averaging Beam with four grade sensors.



Left side of the operator panel displays the chosen setpoint based on which the system regulates in the left side. The setpoint is shown as a 0 for grade (calibrated setpoint), calculated as an average of the measurements of the four sensors on the Averaging Beam. Right side of the operator panel displays the chosen setpoint based on which the system regulates in the right side. The setpoint is shown as 0 for grade (calibrated setpoint) based on the measurements of a single grade sensor. The middle display shows the monitored slope. The number of sensors connected to the system is seen from the diodes in both sides of the display.



Operation

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Operating PL2005

Safe use

Before operating the Mini-Line® system, please read and understand the section Safety Instruction p. 69, describing the responsibility of the operator and some of the situations that should be avoided while paving.

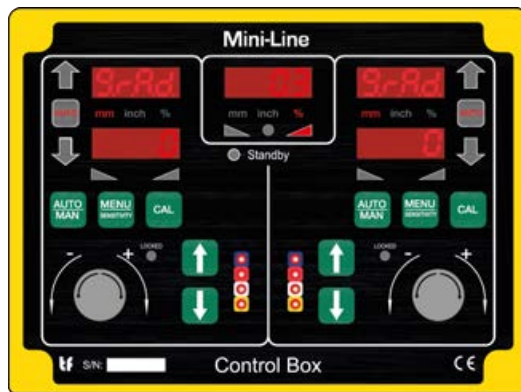
Two modes of operation

The PL2005 has two modes of operation that the operator can choose between: manual and auto.

In manual mode, the tow point can be

can be adjusted by pressing the up and down **arrows**. The reference level (setpoint) is also entered in manual mode. In auto mode the PL2005 takes control of the regulation, and controls the tow point hydraulics based on the setpoint. Each side of the screed is controlled individually, and one side can be in auto mode while the other is in manual mode.

For grade sensors, the reference level is displayed as a setpoint (zero-point) ± additions, e.g. 0 mm.



Monitoring display - monitoring slope of the screed

Right side tow point regulation. Here in manual mode.

Left side tow point regulation. Here in auto mode.

Auto

- Increase or decrease mat thickness or slope froms setpoint
- Calibrate sensor value
- Switch to manual mode

Manual

- Adjust tow point manually
- Enter setpoint
- Adjust hidden settings anc control parameters
- Switch to auto mode

- Switch between sensor types, if more sensors are connected
- Switch between display of setpoint and measured value
- Adjust the control parameter sensitivity
- Adjust the control parameter working window

Display of Measured Value or Setpoint

The operator can easily switch between the display of measured value and chosen setpoint on the Control Box.

Display of measured value

Particularly when mounting the grade sensors and when commencing the paving job, the measured value is relevant in order to ensure that the sensors are positioned correctly, and to choose the correct setpoint.

Display of setpoint

While paving, it is better to see the setpoint than the measured value, as the extent to which the setpoint needs adjustment is relevant to the operator, and not the measured value as such.

To adjust the setpoint, simply adjust the turning knob in the desired direction. The display will show the increments (MM or IN) added to or subtracted from the setpoint.

PL2005 remembers all settings

The PL2005 always start up in manual mode, but remembers setpoint, settings and control parameters (cf. Settings p. s. 51) when power is cut off.

In case of a pause in the paving job, where power is cut off to the system, the PL2005 remembers the setpoint, so that the paving job can continue immediately when powering up again.



When mounting a grade sensor, it is important to ensure that it is positioned in the correct height above reference. The operator can easily check this by switching to measured value, and verify that the measured value is within the sensor range



When commencing paving in manual mode, the paver will often proceed a couple of tow arm lengths before the operator enters the setpoint. Here, it can be relevant to maintain the view of the measured value until a setpoint is chosen

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.

The PL2005 automatically starts up in manual mode when power is applied. Typically, this also requires the grade and slope automatics on the machine to be switched on. (Some machines are also required to be at speed for supplying power to the levelling system).

We recommend the operator to wait until the machine is warm and at working RPM before

Step-by-step instructions for daily operation

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. (See recommended height p. 95). Check the measured value on the Control Box.
3. When mat thickness/slope is correct, press **CAL** to set the reference level (the setpoint)
4. Press **AUTO/MAN** to enter auto mode. The system will now maintain the level of the tow point constant relative to the setpoint.
5. Use the **turning knob** to increase or decrease mat thickness from the setpoint. (only in auto mode)
6. When the paving job is completed, press **AUTO/MAN** to return to manual mode

switching to auto mode.

Check that the grade and slope correct and enter the setpoint and switch to auto. The PL2005 automatically follows the set reference.

If it is the first time you use the PL2005 on a particular paver, you need to enter the settings for output type minimum pulse and screed width (cf. Settings p.51) before commencing the paving job.

Paving with slope

When paving with the use of a slope sensor, we recommend 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 **turning knob** and press **CAL** again to save.

This function is only available in auto mode.



We recommend 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, we recommend to only use a single sensor or switch to manual mode, to keep the height constant

Buttons and Symbols of PL2005

The Control Box contains five buttons and a turning knob in each side. The Control Box has no on/off button, but simply starts up when power is applied.

Before commencing to pave, we recommend you check that the control parameters are set correctly, cf. Settings p. 51. Normally, only the setpoint and the control parameter sensitivity will need adjustment while paving.

The Control Box is easily operated:



Up and down **arrows** are used to change the height/slope of the tow point in manual mode



The **turning knob** adjusts the setpoint for grade or slope in auto mode. When turning the knob slowly, one click is one step in the display, while turning fast entails each click jumps several steps in the display.



One push switches between auto mode and manual mode



Switch between grade and slope sensor by holding down the button while turning the **turning knob**. The controlled values are always displayed in each side, while the monitored value is displayed in the middle.



Adjust the control parameter sensitivity with one push (cf. Settings p. 51). You can adjust sensitivity in both manual and auto mode.



Choose between different control parameters and settings by holding down the button while turning the **turning knob**. Only control parameters sensitivity and working window are accessible without entering a code. All other control parameters and settings must be performed in manual mode and are protected with a code, in order for an operator not to access and change these by accident, (cf. Accessing advanced settings with a code p. 49).



One push on the **CAL** button sets the reference (setpoint). This can be done in manual mode and auto mode.



Switch between sensor value and setpoint by holding down the button for three seconds. This change can be performed in both manual and auto mode.



Calibrate connected sensors by holding down the button while turning the **turning knob** in auto mode.

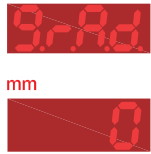


Values for sensors controlling and monitoring the regulation

Connected grade sensors in each side

Actual regulation in each side. Displays in which direction the tow point is moving, and whether the system operates in manual or auto mode

Display and symbols



Two displays in each side of the Control Box shows the regulation in each side. The top display shows the sensor type selected (grade or slope), and the bottom display shows the measured value on manual mode and the setpoint in auto mode.

The unit of measure (MM, IN or %) is indicated between the two displays.

The two displays are also used when adjusting the control parameters of the PL2005.



When a slope sensor is connected to the PL2005, the triangle corresponding to the side the screed is sloping lights up.

In case of negative slope, the triangle changes side (no negative values are used). When the screed is level, both triangles light up.



When the auto indicator is lit, the corresponding side of the screed is in auto mode. When the auto indicator is turned off it is in manual mode.



In manual mode, the arrows light up, when pressing the arrows to adjust the tow point, or when the position of the sensors deviate from the setpoint. The arrows indicate which direction the tow point is moving, if switched to auto mode.

In auto mode, the arrows light up when the position of the sensors deviate from the setpoint and the system regulates the tow point.

%

When a slope sensor is connected to the PL2005, the %-field lights up above the display of sensor value.

mm & inch

The PL2005 can be set to millimeter or inches. When a grade sensor is connected, the unit chosen lights up above the display with the measured value/setpoint of the sensor



Light indicators signify the number of grade sensors connected to the system in each side of the paver. Each grade sensor has a label color corresponding to the color around one of the lights, making it easy to identify each sensor and correct potential errors.



If the PL2005 system is set to use the standby signal of the paver, the light in front of the Standby text lights up, when the paver is in standby mode (e.g. when the paver is at a standstill).

While the diode is lit, no tow point regulation is performed, but the other functions of the Control Box can still be used. For example, the operator can still switch between manual mode and auto mode.



Each side of the Control Box contain a small lamp that lights up, when another Control Box is operating that side. This is a safeguard against two operators in each side attempting to make adjustments at the same time

When the light is on, the Control Box is locked in this side



No communication between sensor and PL2005

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 Control Box. 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 ball missing	No Control Box 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 displaced 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

List of functions in both auto and manual mode

Setting	Shortcut	Display	Change	Confirm/Cancel
Switch between sensors		Left display: 0.00 Right display: 0.00 Middle display: 0.00 Bottom display: 0.00	AUTO MAN + [Knob]	
Switch between measured value and setpoint		Left display: 0.00 Right display: 0.00 Middle display: 0.00 Bottom display: 0.00	CAL (3sec)	MENU / CAL
Sensitivity	MENU [Knob]	Left display: 0.00 Right display: 0.00 Middle display: 0.00 Bottom display: 0.00	[Knob]	MENU / CAL
Working window	MENU + [Knob]	Left display: 0.00 Right display: 0.00 Middle display: 0.00 Bottom display: 0.00	[Knob]	MENU / CAL

List of functions in auto mode

Setting	Shortcut	Display	Change	Confirm/Cancel
Adjust setpoint		Left display: 0.00 Right display: 0.00 Middle display: 0.00 Bottom display: 0.00	[Knob]	
Calibrate sensor value		Left display: 0.00 Right display: 0.00 Middle display: 0.00 Bottom display: 0.00	CAL + [Knob]	
Switch to manual mode		Left display: 0.00 Right display: 0.00 Middle display: 0.00 Bottom display: 0.00	AUTO MAN	

List of functions in manual mode

Setting	Shortcut	Display	Change	Confirm/Cancel
Manual tow point adjustment		Left display: 0.00 Right display: 0.00 Middle display: 0.00 Bottom display: 0.00	[Up/Down]	
Set the reference (setpoint)		Left display: 0.00 Right display: 0.00 Middle display: 0.00 Bottom display: 0.00	CAL	
Enter code	AUTO MAN (left) + CAL (right)	Left display: code Right display: 39 Middle display: 0.00 Bottom display: 0.00	[Knob] (left)	MENU / CAL
Switch to auto mode		Left display: 0.00 Right display: 0.00 Middle display: 0.00 Bottom display: 0.00	AUTO MAN	



When confirming settings and control parameters with the top left display shows "S.t.o.r" for "store".



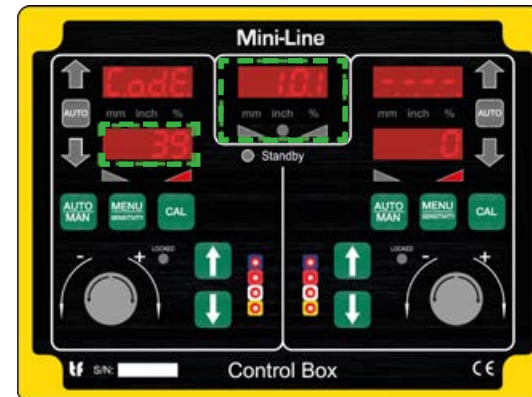
When cancelling settings and control parameters with the top left display shows "C.A.N.C." for "cancel".

Accessing advanced settings with a code

To enter the code and access the advanced settings and control parameters, the operator must hold down the left **AUTO MAN** button, and press the right **CAL** button, while the Control Box is in manual mode. When the top left display shows "code" both buttons can be released.

Enter the code with the left **turning knob**. Turn it until left display shows "39" as seen below.

After entry of the code, confirm with the **MENU** button. Alternatively, leave the code entry section by pressing **CAL**.



Firmware version

Enter code 39 with the left turning knob

List of functions in **manual** mode after entering code

Setting after code	Shortcut	Display	Change	Confirm
Sensitivity	MENU + [Up]	56.4	[Up]	MENU / CAL
Working window	MENU + [Up]	0.00	[Up]	MENU / CAL
Minimum pulse	MENU + [Up]	0.00	[Up]	MENU / CAL
Screed width	MENU + [Up]	0.00	[Up]	MENU / CAL
Units	MENU + [Up]	0.00 0.00	[Up]	(3 sec) MENU / CAL
Re-set factory settings	MENU + [Up]	0.00 0.00	[Up]	(3 sec) MENU / CAL
Output	MENU + [Up]	0.00	[Up]	MENU / CAL
Standby-signal	MENU + [Up]	56.4	[Up]	MENU / CAL

Settings

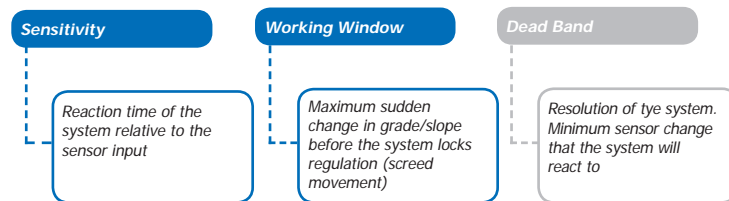
- Control Parameters 52
 - How to Adjust Sensitivity 53
 - How to Adjust Working Window 55
 - Built-in Dead Band 57
- Machine Parameters 58
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 - How to Adjust Standby Signal 66
- Re-set Factory Settings 68

Settings

The PL2005 system has a range of control parameters and machine parameters that can be adjusted when setting up the system for use.

Control Parameters

The PL2005 has three control parameters. The control parameters Sensitivity and Working Window can be set by the operator, while the Dead Band is adjusted automatically by the PL2005 system.



The first time the PL2005 system is used on a paver, the operator must adjust the machine parameters, cf. Machine Parameters p. 58. After that only the two control parameters can require changes, and most often only Sensitivity needs adjustment. The standard factory setting for Working Window is suitable for most situations, and normally do not require adjustment.



Once the PL2005 system is set up for the first time on a paver, we recommend you do not adjust anything other than Sensitivity

How to Adjust Sensitivity

Sensitivity

Sensitivity is the parameter of the PL2005 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 system 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 system 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.
2.
3.

1 Press Shortcut
Press **Menu/Sensitivity**.
Top display shows "S.E.N", bottom display shows the current value

2 Adjust Sensitivity
Increase or decrease Sensitivity with the **turning knob**

3 Save Sensitivity
Press **Menu/Sensitivity** to save the new Sensitivity value.
(Press **CAL** to cancel)



Fast hydraulics require a lower Sensitivity value



A change in paving speed can require an adjustment in Sensitivity

Standard factory setting

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

Standard factory setting for Sensitivity is 5.0.
Sensitivity can be adjusted in the range 0.0 – 10.0.

Symbol



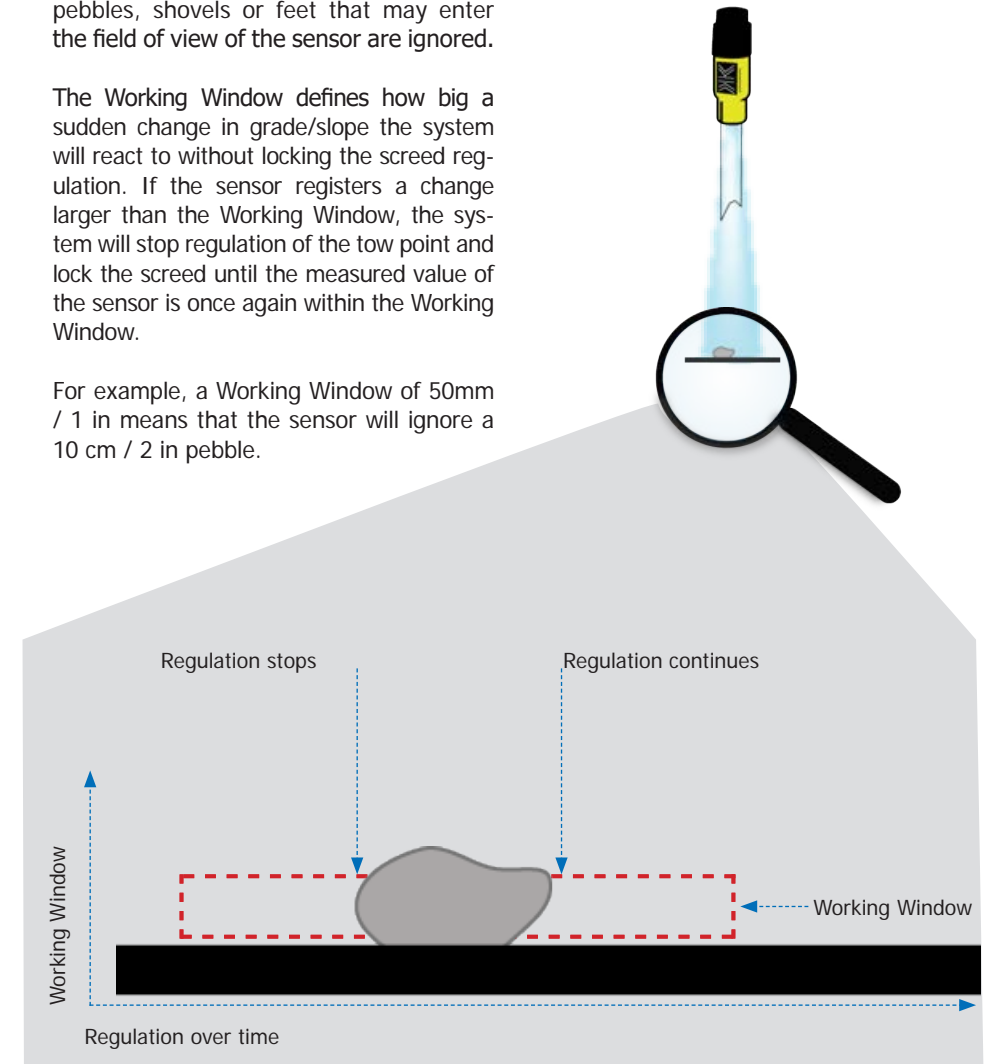
How to Adjust Working Window

Working Window

The Working Window prevents larger objects from disturbing the measurements of the grade sensors, so that any larger pebbles, shovels or feet that may enter the field of view of the sensor are ignored.

The Working Window defines how big a sudden change in grade/slope the system will react to without locking the screed regulation. If the sensor registers a change larger than the Working Window, the system 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.

For example, a Working Window of 50mm / 1 in means that the sensor will ignore a 10 cm / 2 in pebble.



Figur 15 - 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 **Menu/Sensitivity** and choose the Working Window symbol
Top display shows "[. . .]" and bottom display shows the current value

2 Adjust Working Window

Increase or decrease Working Window value with the **turning knob**

3 Save Working Window

Press **Menu/Sensitivity** to save the new Working Window value.
(Press **CAL** to cancel)

Standard factory setting

Standard factory setting for grade sensors is ± 50 mm/20.0 in. Working Window can be adjusted in the range ± 15 mm to ± 200 mm/ ± 0.6 in to ± 8 in.

Standard factory setting for slope sensors is ± 5 %. Working Window can be adjusted in the range ± 1.5 % to ± 9.5 %.

If the Working Window is exceeded, the Control Box will display "O.U.T" and stop regulation of the tow point until sensor measurements are within the Working Window again.

Symbol

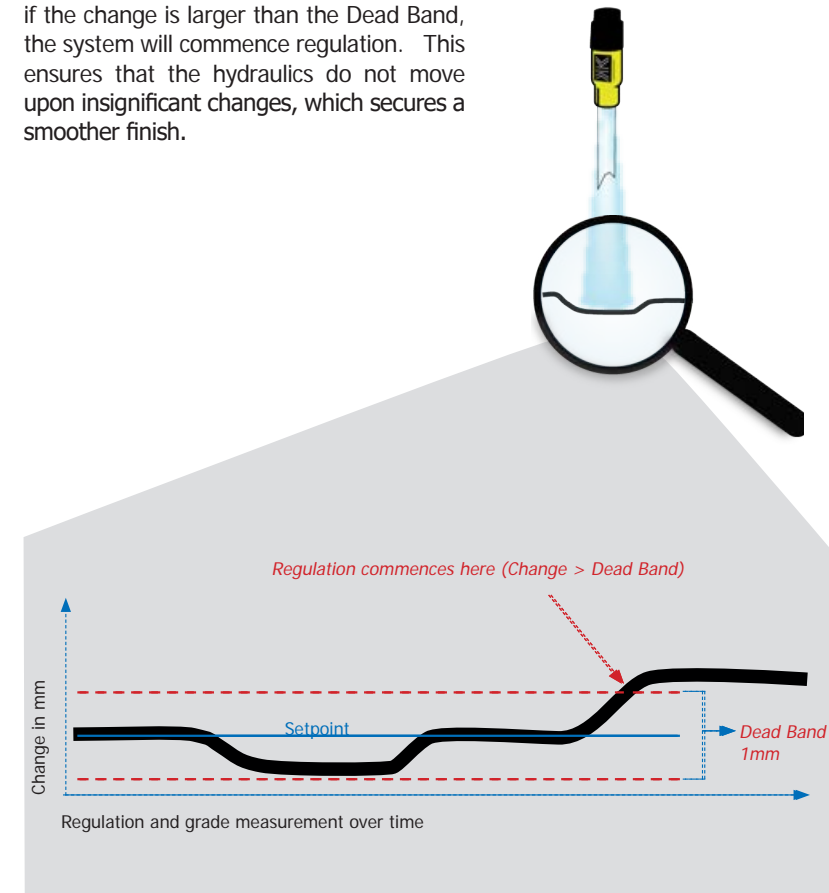


Built-in Dead Band

The Dead Band is built into the PL2005 system, and does not require any adjustment. Below is explained what the Dead Band is and how it works.

Dead Band

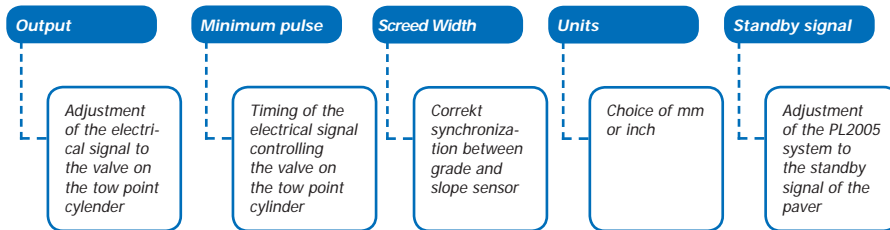
Dead Band is the resolution of the system, and defines the sensor change that the system will react to. If a change in measurement is smaller than the Dead Band the system will not commence any regulation, but if the change is larger than the Dead Band, the system will commence regulation. This ensures that the hydraulics do not move upon insignificant changes, which secures a smoother finish.



Figur 16 - If the grade sensor measures an insignificant change ($< 1\text{mm}/0,04\text{in}$) 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 ($> 1\text{mm}/0,04\text{in}$).

Machine Parameters

The PL2005 has five machine parameters that are important for how the system works the with particular machine and operator.



The first time the PL2005 is used on a paver, all five machine parameters must be adjusted. After initial adjustment, the system remembers the settings, and they need not be re-adjusted again¹.



If moving the PL2005 system to a new machine, the machine parameters must be adjusted to the new machine



When the PL2005 system is returned from service, the machine parameters must be re-adjusted

¹The machine parameters are saved in the Interfacebox. The Control Boxes can therefore be moved freely from one machine to another without impacting the machine parameter settings.

How to Choose Output

Output type

The PL2005 system can deliver NPN and PNP output. The output type defines how the paver receives control signals. If the output setting is incorrect, the regulation will not work.

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

1.
2.
3.

1 Press Shortcut
Press **Menu/Sensitivity** and choose the symbol for output. Top display shows "O.U.t" and bottom display shows the currently selected output type

2 Choose Output
Switch output with the **turning knob**



3 Save Output
Press **Menu/Sensitivity** to save the output shown in the bottom display. (Press **CAL** to cancel)

Standard factory setting

NPN is the standard factory setting for output. When the PL2005 system is returned from service or moved to a new machine, the output must be re-adjusted if the machine requires a PNP output.

Symbol



The output can be either NPN or PNP with the symbols  or . The output can only be changed in manual mode after entering the code, cf. Accessing advanced settings, p.49.

How to Adjust Minimum Pulse

Different types of asphalt pavers use different hydraulics. Therefore, the Minimum Pulse on the PL2005 system must be adjusted, before the system is used for the first time on an asphalt paver.

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

Minimum pulse

The PL2005 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 paver to paver, and in some cases it can even vary from the left side to the right side of the same machine.

Step-by-step instruction for adjusting minimum pulse

- 1.
- 2.
- 3.

1 Press Shortcut
Press **Menu/Sensitivity** and choose the symbol for Minimum Pulse. Top display shows "P.U.L.L.", and bottom display shows the current value.

2 Adjust Minimum Pulse
Increase the Minimum Pulse value with the **turning knob** until the tow point cylinder starts to move up and down. Then decrease the Minimum Pulse value, while sensing the movement of the hydraulic piston with your hand. When the movement of the hydraulic piston is only just noticeable, increase the value by one. This is the optimal Minimum Pulse value.

3 Save Minimum Pulse
Press **Menu/Sensitivity** to save the Minimum Pulse value shown in the bottom display. Press **CAL** to cancel



The correct Minimum Pulse setting is the value, where you are just able to feel the movement of the hydraulic piston. The Minimum Pulse should not be set lower than this



When setting the Minimum Pulse, the hydraulic piston moves slowly in one direction (up or down), which may result in the piston ending up in one of the outer positions of the piston. If this happens, press **CAL** to cancel, and retract the piston to its middle position with the **arrows** in manual mode

Standard factory setting

The Minimum pulse can be adjusted in the range 1-100. The Minimum Pulse can only be adjusted in manual mode, after entering the code, cf. Accessing advanced settings p. 49.

The standard factory setting for Minimum Pulse is 20. Most asphalt pavers require a Minimum Pulse setting > 20. When the PL2005 system is returned from service or moved to another machine, the Minimum Pulse should be re-set.

Symbol



How to Adjust Screed Width

The precision of the slope sensor depends of the screed width, as the accuracy of the slope sensor is $\pm 0,1 \%$, equalling ± 1 mm per meter screed width. The accuracy is the minimum precision the slope sensor can deliver, even in unstable conditions such as changing hot and cold temperatures. Under stable conditions, the sensor regulates with a larger accuracy.

To ensure the slope sensor works with its best accuracy, the PL2005 needs to calculate how much the tow point needs to be regulated. The Screed Width is used to calculate this.

Step-by-step instruction for adjusting Screed Width

1.
2.
3.

- 1 Press Shortcut**
Press **Menu/Sensitivity** and choose the symbol for Screed Width. Top display shows "V.I .d.t" and bottom display shows the chosen current Screed Width
- 2 Adjust Screed Width**
Adjust Screed Width with the **turning knob**
- 3 Save Screed Width**
Press **Menu/Sensitivity** to save the Screed Width shown in the bottom display. Press **CAL** to cancel

Standard factory setting

Screed Width can be set in the range 1000 - 9000 mm/40 - 360 in. If the Screed Width is wider than this, set the Screed Width to 9000 mm/360 in, as this is also suitable for wider Screeds. Screed Width can only be adjusted in manual mode, after entering the code, cf. Accessing advanced settings p. 49.

The standard factory setting for Screed Width is 2500 mm/100 in. When the system is returned from service or moved to another machine, the Screed Width must be re-set.

Symbol



How to choose unit (mm/inch)

The PL2005 system works in both mm and inches. When changing the unit of measurement, all control parameters and machine parameters containing mm/inch are re-calculated. To avoid rounding errors, we recommend you check all settings and re-enter the setpoint after changing the units.

Step-by-step instruction for choosing Unit

1.
2.
3.

- 1 Press Shortcut**
Press **Menu/Sensitivity** and choose the symbol for Units. Top display shows "U.n.I .t" and the field between the two displays shows the unit currently selected *felterne mellem de to displays viser den valgte enhed*
- 2 Choose Unit**
Switch between units on the **turning knob**
- 3 Save Unit**
Press **Menu/Sensitivity** to save, and keep pressing the button for 3 seconds. Press **CAL** to cancel



After changing unit, you need to re-enter the setpoint in both sides to avoid any rounding errors



After changing unit, it may be necessary to check that all parameters are still adjusted correctly

Standard factory setting

Standard factory setting can be either mm or inch. The unit can only be changed in manual mode, after entering the code, cf. Accessing advanced settings p. 49.

Remember to check and re-adjust the unit setting, when the PL2005 system is returned from service.

Symbol**How to Adjust Standby Signal**

Many asphalt pavers have a standby signal, which is sent out to controllers, so that the regulation does not continue, when the paver is at a standstill.

This can be an advantage, as the sceed will sink slightly at a standstill, which can make the PL2005 system attempt to regulate the tow point, if in auto mode. If the paver does not use the standby signal, we recommend to switch to manual mode, if the paver needs to come to a standstill.

To use the standby signal of the paver, often requires a specially adapted cable to suit the particular paver in question. See Connecting the Mini-Line System, p. 95.

Step-by-step instruction for choosing Standby Signal

If you do not know the type of standby signal, trial and error is your easiest approach. You have found the correct standby signal, when you can move the tow point with the arrows in manual mode, while the paver is at speed, but not move the tow point when the paver is at a standstill.

- 1.
- 2.
- 3.

- 1 Press Shortcut**
Press **Menu/Sensitivity** and choose the symbol for adjusting the standby signal. The top display shows "S.t.b.y" and bottom display shows the current standby signal
- 2 Choose Standby Signal**
Switch between the different standby signals with the **turning knob**
- 3 Save Standby Signal**
Press **Menu/Sensitivity** to save the standby signal shown in the bottom display. Cancel by pressing **CAL**

Standard factory setting

In the standard factory setting, the standby signal is turned off, but if available, we recommend you adjust the standby signal, when installing the PL2005 system on your machine. The standard cable does not support the standby signal functionality. When the system is returned from service or moved to another machine, the standby signal must be re-set.

Symbol

There are five different ways of using the standby signal:



N.A.:Not Applied. Standby signal is not used



GND:Ground, version 0. Deactivates controllers, when the standby signal is low



GND 1:Ground, version 1. Activates controllers, when the standby signal is low



BAT: Battery, version 0. Deactivates controllers, when the standby signal is high



BAT 1: Battery, version 1
Activates controllers when the standby signal is high

Re-set Factory Settings

It may become necessary to re-set factory settings, for instance when moving the PL2005 system from one paver to another.

Step-by-step instruction for Re-setting Factory Settings

- 1.
- 2.
- 3.

1 Find the symbol in the menu

Press **Menu/Sensitivity** and choose the symbol for re-setting factory settings. The top displays show "r.E.S" and "A.L.L"

2 Choose re-set Factory Settings

Release the **Menu/Sensitivity** button to choose to re-set factory settings

3 Re-set Factory Settings

Press **Menu/Sensitivity** for 3 seconds to re-set factory settings

When re-setting factory settings, all control parameters and machine parameters are assigned the standard factory settings.

Symbol

Safety Instruction

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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 reg-

ulation. The key safety requirements of asphalt pavers which have an influence on the safe use of the Mini-Line® system is therefore outlined below.

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



The asphalt paver must comply with the requirements described in EN 60204 Safety on Machinery - Electrical equipment of Machines or similar, and in the EU be CE marked



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 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 EN 60204, for instance via the battery of the asphalt paver

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



The Mini-Line® system 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. Check this 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. 134



After installing the Mini-Line® Grade and Slope Control System on a new asphalt paver, test 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



Mount the mounting bracket for the Control Boxes 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 manual
In case of questions, contact your local representative



Be aware of the situations described under Examples of Incorrect Use p. 74, Warnings and Dangerous Situations p. 76 and be able to avoid them



Be aware of the specifications of the PL2005 and the sensors to ensure that they are working properly. See Technical Specifications (data sheets) p. 134¹

¹TF-Technologies reserves the right to make changes in specifications without further notice. Refer to www.TF-Technologies.com/paving-academy for latest versions of data sheets.

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. 75



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 PL2005 and sensors are working within their specifications. See Technical Specifications (data sheets) p. 134¹



Inform TF-Technologies or your local representative, if the PL2005 or any of the sensors for any reason are not safe to use

¹TF-Technologies reserves the right to make changes without further notice. Refer to www.TF-Technologies.com/paving-academy for latest versions of data sheets.

Examples of Incorrect Use

The Mini-Line® Grade and Slope Control System should only be used for 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 behaviour are outlined below, and should be avoided.

Examples of incorrect use before the paving job



Do not remove any of the labels on the Interfacebox, Control Boxes 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 Control Boxes, Interfacebox or sensors, as this will expose the electronics and can damage the products



Do not rebuild or refurbish any parts of the Mini-Line® Grade and Slope Control System, 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 during the paving job



Do not use unauthorised cables or unauthorised spare parts, as this can damage the Mini-Line® system or lead to unpredictable control of the asphalt paver, which may result in serious personal injury or material damage



Do not mount the Mini-Line® System on a paver when power is already applied, as the material 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



Do not adjust the screed manually on the built-in controller on the asphalt paver while the PL2005 is in auto mode, as the system will seek to counter the adjustment. Switch the PL2005 to manual mode instead, if adjustments on the built-in controller are required



Do not mount the Mini-Line® Grade and Slope Control System on an asphalt paver on the move or in operation, as this may remove focus from the surrounding traffic or moving parts of the machine, which may result in serious personal injury



Do not attempt to re-adjust the mounting of the Mini-Line® Grade and Slope Control System 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 Control Boxes, 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® system must not be used



Do not use the Mini-Line® system if it is obviously damaged



Do not use the Mini-Line® system if it has been rebuilt



Do not use the Mini-Line® system if the PL2005 Control Boxes or Interface-box are connected to other sensors than those in the Mini-Line® series



Do not use the Mini-Line® system if the system is connected to asphalt pavers that use other types of input than the output the system is able to deliver

The Mini-Line® system can be damaged



If welding 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



Remove the sensors before transport of the asphalt paver. During transport of the asphalt paver when the screed is lifted and especially if using an Averaging Beam, the sensors may come too close to the ground.



Remove the Mini-Line® system before cleaning the asphalt paver. 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® 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 Mini-Line® system 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. 72



If the Mini-Line® system is used in dangerous areas or in dangerous atmospheres/pressure levels, as the system is not designed for such operation.

Emergency Procedure

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

- 1.
- 2.
- 3.

- 1** Press emergency stop
- 2** Turn off the asphalt paver and remove the key
- 3** Disconnect the cables between the Mini-Line® System and both sides of the asphalt paver
- 4** Commence repair

Mounting the Mini-Line® System

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Mounting the Interfacebox

The Interfacebox connects the PL2005 system, and should be placed centrally at the back of the paver, with easy access to connect cables for Control Boxes and sensors.

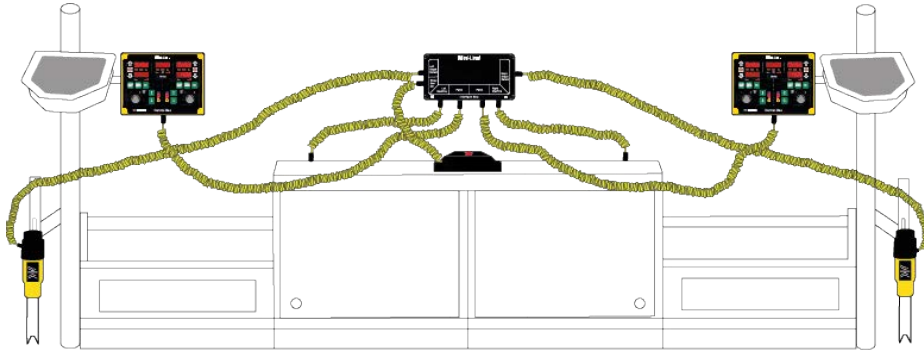


Figure 17 - PL2005 system with Interfacebox two Control Boxes, two grade sensors and a slope sensor.

Interfacebox and the slope sensor are designed for permanent mounting on the machine. Only Control Boxes, sensors and cables need to be removed after each paving job.

Interfacebox front



Mount the Interfacebox so that the plug "Right Grade Sensor" is located to the right.

Interfacebox back



Mount the Interfacebox on a suitable surface with screws in the four screw holes.



Position the Interfacebox at the back of the asphalt paver, out of the way of other equipment.

- Do not place the Interfacebox so that cabinets and doors cannot open
- Position the Interfacebox so that it does not require the re-positioning of cables or other equipment.
- Cabling for paver and slope sensor can be put out of the way as they can be permanently mounted. Do ensure that they remain protected, and removed from excessive radiant heat.

Dimensions of Interfacebox



Choose Place of Operation

The Control Boxes are mounted on the paver with a Mounting Bracket fitted permanently on the paver, ensuring quick mounting and removal of the system.

Typically, one Control Box is placed in each side of the screed. However, there are certain considerations the operator should take into account before setting up the Control Boxes and sensors.

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



It can be an advantage to mount hooks in various positions around the paver for a more permanent and secure mounting of the cables

If practically possible the Control Boxes 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 Control Boxes

The Mounting Bracket for the PL2005 ensures a solid mounting of the Control Boxes.

A triangle is milled out of the back of the Control Box which fits the Mounting Bracket, making the mounting and dismounting of the Control Boxes very simple.



The milled out triangle at the back of the Control Box ensures a sturdy grip on the Mounting Bracket and an easy mounting.



The Mounting Bracket can be mounted on all surfaces with two bolts in the screw holes.



Figure 18 - Example of mounting of Control Box with a bended metal plate fitting the PL2005 Mounting Bracket



Figure 19 - Example of mounting of Control Box by mounting a square metal tube on the side plate of the screed.

Mount the Mounting Bracket on a vertical surface with two bolts wherever suitable. Some pavers have not prepared sufficient room for levelling systems, and here we recommend the mounting of a metal plate on each side of the screed to ensure sufficient room for operation.



Place the Control Boxes on the back of the paver, out of the way of other equipment

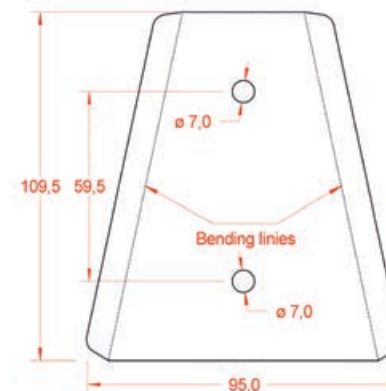
- The operator should be able to reach the Control Box, when the screed is fully extended and fully contracted
- The Control Box should be placed in a safe position, where the operator does not need to lean over moving parts of the machine or come too close to the surrounding traffic



Place the Control Boxes ergonomically accessible

- The Control Boxes should be located at a height corresponding to the distance between the hip and shoulder of the operator
- The Control Boxes should be located within a forearm's length of the operator, so that he does not need to stretch unnecessarily, when operating the system

Mounting Bracket Dimensions



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



Ensure sufficient distance (minimum 50cm / 20in) to major heat sources such as the paver exhaust or a joint heater

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 Control Box. As an example, a 2mm / 0,08 inch increase is obtained at a 0.4% slope with a 0.5m / 16 inch distance.

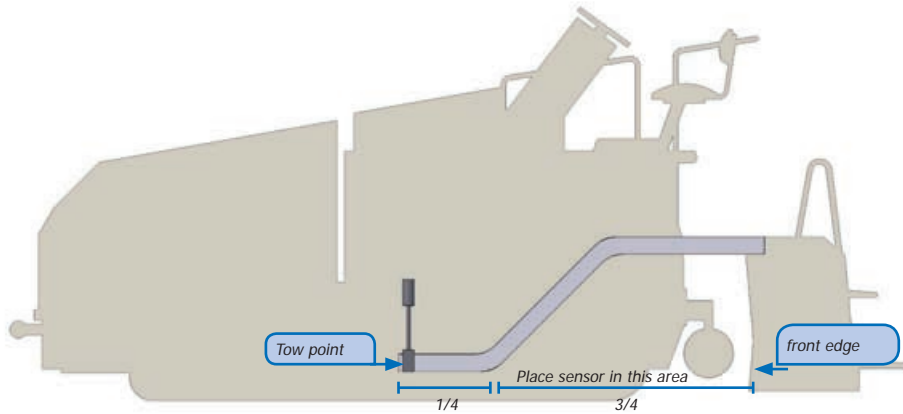
$$\text{Change} = \frac{\text{Slope [\%]}}{100} \times \text{Distance}$$



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

Achieving the best result

The grade sensor should always be located between the tow point and the front edge of the screed in order to follow the movements of the screed. In order to achieve a rapid regulation that leaves a smooth surface, we recommend to position the balance point inside the rear 3/4 of the distance between the tow point and the front edge.



If the sensor is positioned too close to the tow point, regulation speed is reduced. As faster regulation is one of the big advantages of using the Mini-Line® Grade and Slope Control System rather than manual regulation, we do not recommend to place the sensor inside the last 1/4 of the distance between the tow point and the front edge of the screed, as this location results in overly slow regulation.

On the other hand, if the sensor is positioned very close to the front edge, the regulation becomes very aggressive. In such cases, the operator should be careful to adjust the control parameter Sensitivity of the controller and to adapt the speed of the paver, in order to prevent this from resulting in over-compensation and an uneven road.²



As a rule of thumb, we recommend positioning the grade sensor in front of the auger sensor, and adjust Sensitivity to the paving speed. This position is suitable for paving speeds of 5 – 12 m/min / 15 - 50 ft/min

² The control parameter Sensitivity should always be adjusted to the sensor position. When changing the sensor position you may need to change the Sensitivity setting. See Settings p. 52.

Mounting grade sensors in the Snap Connector

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

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.



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.



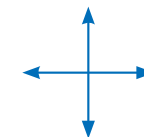
Figure 20 - Mounting G221



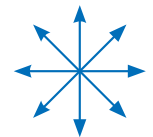
Figure 21 - Mounting G224

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 45° 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

i 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 dismantled 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

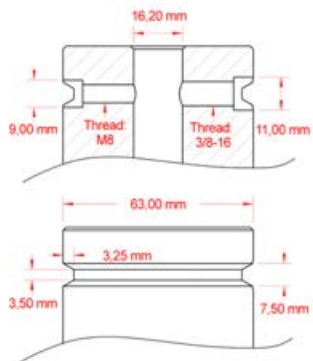
- 1** Place the Snap Connector in the cup of the support arm, so that the outer groove in the Snap Connector fits with the screw of the cup.
- 2** Turn the Snap Connector so that one of its screw holes is pointing in the same direction that the sensor display should be pointing
- 3** Tighten the cup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

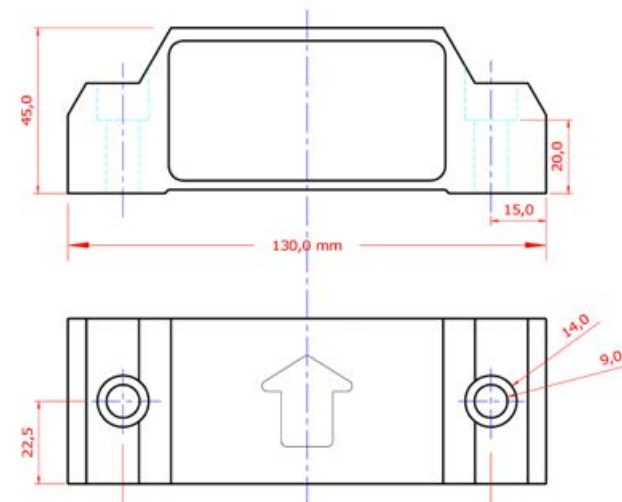
Advice on positioning the S299 Slope Sensor

i Mount the S299 in the middle of the cross beam over the screed, so that the yellow arrow points in the direction of driving

i Mount the S299 on a clean and even surface

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

Dimensions of Slope Sensor





Connecting the Mini-Line® System

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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

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

PL2005 uses two types of standard cables for all connections, coiled cables (machine cables) and I-Cables.

Coiled cables

Coiled Cables connect the Interfacebox to the 10-pin plug on the machine. Two cables are required, one for each side of the screed (to control the tow point in each side).



Connect two coiled cables to the Interfacebox with 6-pin bayonet connectors. Connect the other end of the cables to the 10-pin plug on the machine.



Coiled Cable with 6-pin bayonet connector in one end and 10-pin screw connector in the other end. Connect to sensor and Interfacebox.

The cables have a standard length of 4m (maximum length recommended), and a 6-pin bayonet connector in one end, (connects to Interfacebox) and a 10-pin screw connector in the other end (connects to the machine).

I-Cables

I-Cables connect Control Boxes and sensors to the Interfacebox. One cable for each unit is required, five I-cables in total.

The I-cable is coiled with 6-pin bayonet connectors in both ends, and is available in several different lengths - 1.5m, 2.2m, 3.3m, 4m and 6m (maximum length recommended). The 4m I-Cables are standard for connecting Control Boxes and all grade sensors, the 2.2m I-Cable is standard for connecting the slope sensor.

When using the Averaging Beam with four sensors, an additional 6m I-Cable is required.



I-Cables with 6-pin bayonet connectors connect the Interfacebox to sensors and Control Boxes

S-50280/6,0



I-Cable with 6-pin bayonets connectors in both ends

Connecting PL2005

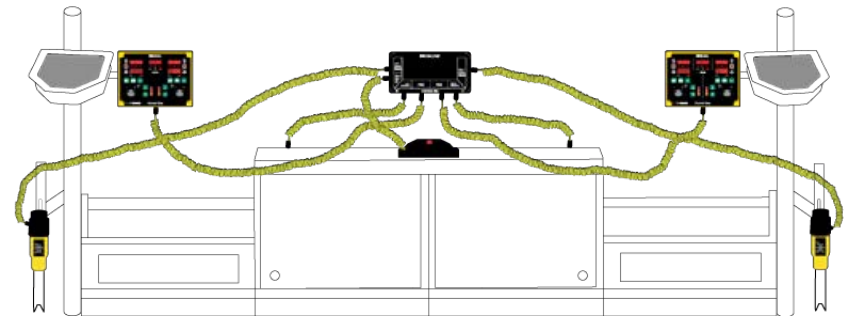


Figure 19: Example with 2 pcs G221 grade sensors, 1pcs 299 slope sensor, 2 pcs Control Boxes and cables.

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 Leebooy Converter Kit

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

sors to the converter. Please refer to the separate installation guide for the HPD100 Leebooy Converter Kit.



S-50577 - HPD100 Leebooy 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

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 Control Boxes and sensors to the Interfacebox with the appropriate cables

2 Power On

Turn on the power from the asphalt paver. All displays light up briefly. The PL2005 starts up in manual mode

3 Confirm Connection

Confirm that the system is connected correctly by adjusting the height with the **arrow** buttons in manual mode. The Control Boxes 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 Power Off

Turn off the power from the asphalt paver. The PL2005 automatically switches to manual mode.

2 Disconnect system

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 PL2005

The PL2005 and sensors should be connected to the asphalt paver when it is turned off, and automatically start up in manual mode, when the asphalt paver powers up and power is supplied to the Mini-Line® system.

It is recommended to follow the individual instruction for connecting each product every time the system starts up, before commencing the paving job.

Connecting the Interfacebox

Connect the Interfacebox to the 10-pin plug on the machine with the standard Coiled Cables. If your paver does not have a 10-pin plug, you may need a converter or specialty cable.

The Interfacebox is designed for permanent mounting on the paver, and does not need to be disconnected from the paver between paving jobs. Disconnection of the Interfacebox is only necessary for service or removal from the machine.

When leaving cables permanently on the paver, we recommend you fasten them to the paver or hide them behind the panels.

The system saves all settings on the Interfacebox. Control Boxes and sensors can therefore be used on different machines without having to re-set the preferred settings for each machine.

Connecting Control Boxes

1.
2.
3.

- 1 Mount Control Box**
Mount the Control Box on the PL2005 Mounting Bracket
- 2 Connect Control Box**
Connect the cable between the Control Box and the Interfacebox. Verify you have connected it in the correct side.
- 3 Verify Connection**
The displays of the Control Box will light up briefly. If no sensors have been connected yet, the displays will be empty.

i

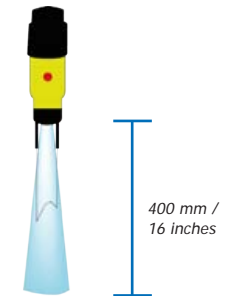
As each Control Box has its own address (1 or 2 - as displayed on the back), the PL2005 is able to tell the two sides apart. It does not matter which Control Box you connect to which side of the paver, but it is not possible to connect two Control Boxes with the same address (and part number).

Connecting the G220

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

1.
2.
3.

- 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 between G220 and Interfacebox verify that the Control Box displays approximately 400mm / 16 inches



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

Connecting the G221

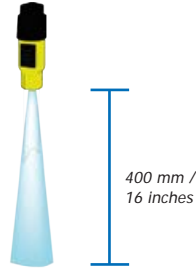
Step-by-step instructions for connecting the G221 (ground)

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 between G221 and Interfacebox and verify that the display shows approximately 400mm / 16 inches



Switch between measured value and setpoint by pressing **CAL** for 3 seconds

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.

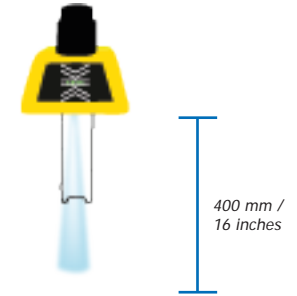
Step-by-step instructions for connecting the G224 (ground)

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 between G224 and Interfacebox in the relevant side, and verify that the display shows 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 Control Box 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.
2.
3.**1 Mount Sensor**

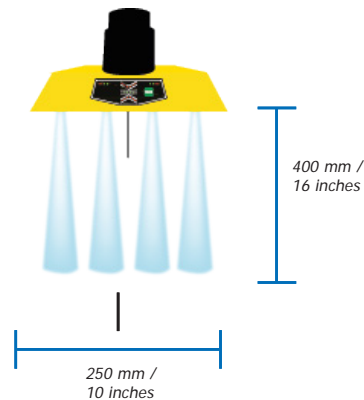
Mount the G224 in the Snap Connector, so that the four sensor heads run perpendicular to the driving direction and the large display is oriented towards the operator. Check that the reference bail is positioned correctly on the sensor. Adjust the Support Arm, so that the sensor is positioned directly 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 the Control Box and sensor and verify that the Control Box 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 Control Box displays "E.R.1".



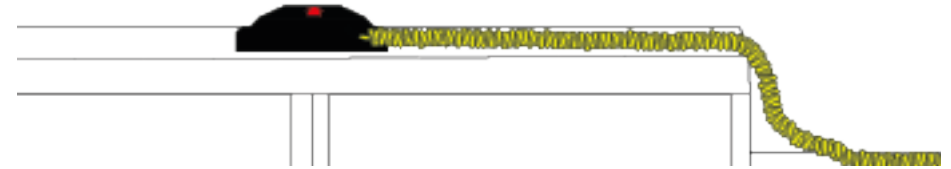
When the G224 is in stringline mode, the measurement from the sensor head with the shortest distance to the reference is used. This mode can therefore also be used to follow a curved surface such as a sloped curb, where the sensor will follow the highest point of contact



Switch between display of sensor value and setpoint by pressing **CAL** in 3 seconds

Connecting the S299

The slope sensor is often mounted permanently on the paver, cf. Mounting the grade sensor p. 93. It is therefore simply connected to the Interfacebox while the paver is turned off, and remain connected between paving jobs. However, it is important to verify the slope measurement when commencing the paving job.



Verify that the slope sensor is mounted so that the red 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 S299

1.
2.
3.**1 Mount sensor**

Verify that the S299 is mounted so that the red arrow points in the direction of driving and that it is connected to the Interfacebox

2 Prepare calibration

Switch one side of the screed to slope regulation, and enter auto mode. (Calibration of S299 can only be done in auto mode)

3 Calibrate sensor

Calibrate the slope value displayed on the Control Box against a measurement on an electronic spirit level placed directly on the paved mat. Push **CAL**, adjust value with the **tuning knob** so that the spirit level and Control Box display the same value, and press **CAL** to save.



Switch between grade and slope sensor by holding down the **CAL** button and turn the **turning knob**



Switch between auto mode and manual mode by pressing **AUTO/MAN**



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



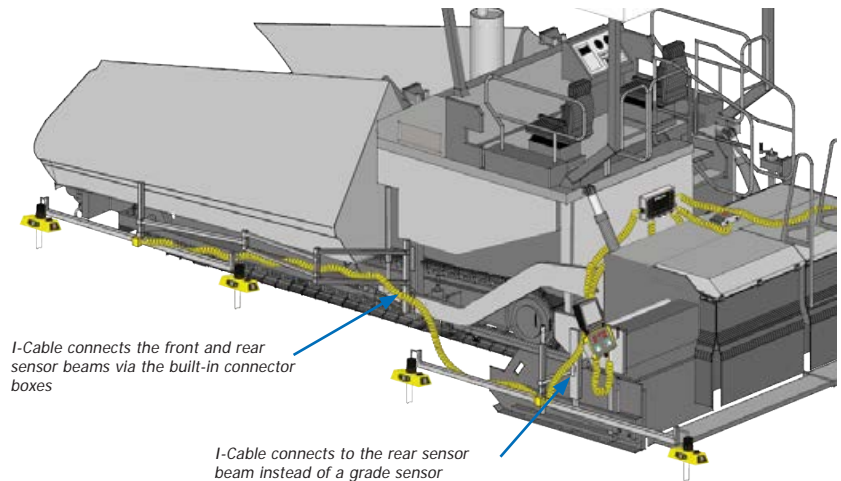
During the paving job, the measurements of the slope sensor should be verified continuously by placing a spirit level directly on the paved mat. If the slope sensor requires calibration, the asphalt paver should not be stopped, as the calibration can be performed while the machine is at speed

Connection of the Averaging Beam

The Averaging Beam is connected to the Interfacebox with a Mini-Line® I-Cable the same way as an individual grade sensor.

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, cf. Mounting p. 97.

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 long (maximum length recommended).



Figur 22 - Connecting the Averaging Beam to the PL2005 , here with G224 grade sensors

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.

You connect the grade sensors to the Averaging Beam via the integrated cables as displayed in figure 23.



Figure 23 Connect grade sensors to the Averaging Beam using the internal cables.

In order for the PL2005 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.

The color of the grade sensor labels

The different addresses of the grade sensors can be seen from the different colors of



Niveausensorer med forskellige labelfarver

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).

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.



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



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 Control Box is switched to auto

The S299 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

Paving with the Averaging Beam

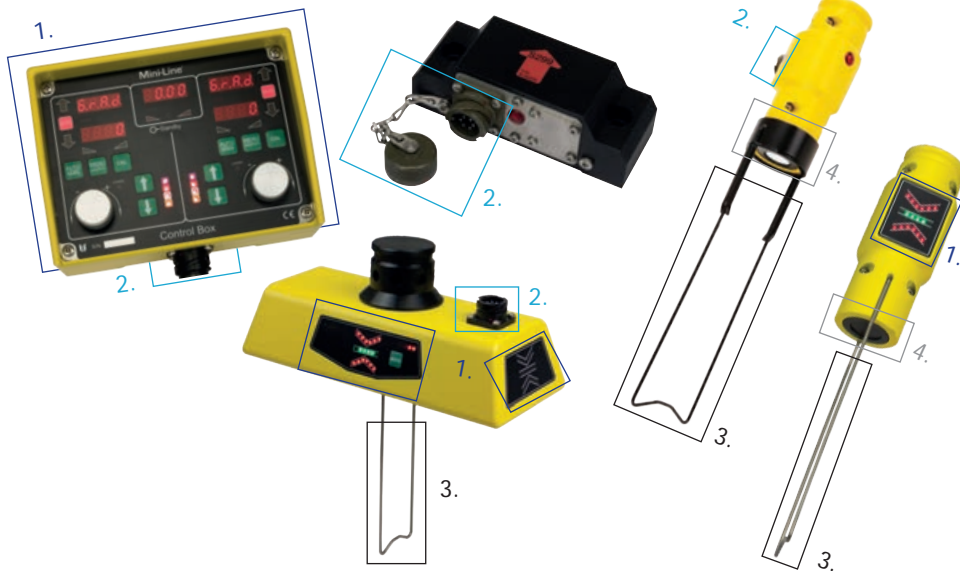
During the paving job, it is important that all the grade sensors can see the reference. Because the reference is not always completely parallel to the asphalt paver, it is recommended to monitor the grade sensors and disconnect those sensors that lose target, or change briefly to manual mode where the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

Maintenance

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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. Frontfolie - 2. Stik - 3. Referencebøjle - 4. Sensorhoved

We recommend you 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

We recommend you inspect all parts after use

Part Exposed	Inspection	Frequency	Action
Cables	Mechanical damage	After use	Replace cable
Connectors on PL2005 Control Boxes, Interfacebox, 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	Clean 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 Displays	Dirty	After use	Clean with water or benzine
	Mechanical damage	After use	Replace display
General for PL2005 Control Boxes, 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
	Wet	After use	Wipe off with dry cloth
Accessories	Insignificant mechanical damage	After use	Continue use
	Significant mechanical damage	After use	Replace accessories
	Functionality testing	Once a year	Thoroughly inspect the system/Send equipment to service
PL2005 Control Boxes, Sensors and Cables	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 Mini-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



Separate the PL2005 Control Boxes and sensors from the cables to protect cables from harmful twisting



Transport the Mini-Line® system in a suitable carry case, where all parts rest firmly without being able to clash against each other. We recommend the use of Mini-Line® Carry Cases with custom-cut foam.

- Protect the display of the PL2005 Control Boxes from any sharp objects
- Protect the displays and the sensor heads of the grade sensors from any sharp objects
- Protect cables from harmful twisting, and permanently mounted cables protected from heat sources



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

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



If the Mini-Line® system is packed up wet, do not close the Carry Case completely. Wipe the Carry Case and content dry before the Carry Case is completely closed and put in storage.

When receiving the Mini-Line system, inspect the following



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



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



If the Mini-Line® system is damaged at reception, we recommend the following:

- 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



Keep the Mini-Line® system dry and out of direct sunlight for long-term storage



When storing the Mini-Line® system in a car, notice that high temperatures can build up 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. Note that the G220 as a different operating temperature

Product	Storage Temperature	Operating Temperature
Mini-Line® PL2005 Control Box	-40°C – 85°C	-10°C – 70°C
Mini-Line® PL2005 Interfacebox	-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 note that benzine is an organic solvent, which is flammable and harmful to health and environment. It 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 any direct skin contact

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:



Do not submerge any parts of the Mini-Line® system in any fluids



Never use cellulose thinner or acetone to clean the equipment, as they dissolve paint and plastic respectively, which will degrade the functionality of the equipment. Other cleaning agents may 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 damage the equipment



Never scrape on the display, connectors or sensor heads, when rinsing the equipment mechanically, as these parts are particularly sensitive.



Never expose the sensor heads to chemical liquids. 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 solvent.



Using 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.

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Troubleshooting







Connection of PL2005

Symptom	Probable Cause	Appropriate Action
No display (all displays are off)	No power to Control Box	<ul style="list-style-type: none"> Verify paver power supply Verify cable connections Inspect cables for damages
	No sensors have been connected to the Interfacebox	<ul style="list-style-type: none"> Connect sensors
The display of the Control Boxes show erroneous segment characters	Power-up glitch	<ul style="list-style-type: none"> Re-connect main power

Erroneous Behaviour

Symptom	Probable Cause	Appropriate Action
Arrows light up on the Control Boxes, but no regulation of tow point observed	Problem with tow point solenonoids	<ul style="list-style-type: none"> Verify that the pacer has grade and slope automatics switched to the on position Check paver power supply
	Incorrect output type setting	<ul style="list-style-type: none"> Check cables and connections
Slow or sluggish reactions Long elongated waves produced on asphalt mat	Inccorect settings of PL2005	<ul style="list-style-type: none"> Adjust sensitivity p. 53 Adjust minimum pulse p. 53
	Mechanical/hydraulic settings	<ul style="list-style-type: none"> Check tow point solenoids
Fast or hunting reactions	Incorrect settings of PL2005	<ul style="list-style-type: none"> Juster følsomhed s.53 Juster minimum puls s. 53
Tow point moves up, but not down or vice versa	No connection or power supply to tow point solenoids	<ul style="list-style-type: none"> Check cables and connections Slope sensor may be connected to the wrong side
	Incorrect settings of tow point up or down regulation	<ul style="list-style-type: none"> Adjust sensitivity p. 53
The tow point moves a little up and down while the paver stands still (paver has jitter)	Sensitivity too high	<ul style="list-style-type: none"> Adjust sensitivity p. 53
	Minimum pulse too high	<ul style="list-style-type: none"> Adjust minimum pulse p. 53
Asphalt mat shows sign of irregular ripples	Dead band too big	<ul style="list-style-type: none"> Adjust working window p. 53
	Sensitivity too high	<ul style="list-style-type: none"> Adjust sensitivity p. 53
Slope sensor shows incorrect slope	Lack of calibration	<ul style="list-style-type: none"> Calibrate sensor (Mounting S299, p. 93)





PL2005 Error Codes

Symptom	Probable Cause	Appropriate Action
 Flashes in top display when entering AUTO	Setpoint not entered before pressing AUTO	<ul style="list-style-type: none"> Enter setpoint p. 52
	Sensor out of range	<ul style="list-style-type: none"> Adjust sensor position
	Reference bail damaged or missing	<ul style="list-style-type: none"> Check or replace reference bail
	Sensor is faulty	<ul style="list-style-type: none"> Re-connect main power
	Sensor is out of working window	<ul style="list-style-type: none"> Check working window
		<ul style="list-style-type: none"> Check sensor mounting
		<ul style="list-style-type: none"> Clean up sensor field of view
	No communication between sensor and PL2005	<ul style="list-style-type: none"> Check cables and connections

G220 and S299 Error Codes

Symptom	Probable Cause	Appropriate Action
Slow flashes (2 short flashes per second)	No problems	
	Missing connection	<ul style="list-style-type: none"> Check connection to PL2005
Fast flashes (4 flashes per second, on/off equal amount of time)	Sensor out of range	<ul style="list-style-type: none"> Adjust sensor position
	G220: Reference bail missing	<ul style="list-style-type: none"> Install

G221 and G224 Error Codes

	(Red arrows flash alternately)	Target out of range	<ul style="list-style-type: none"> Adjust sensor position
	(Red arrows flash simultaneously)	Reference ball missing	<ul style="list-style-type: none"> Install reference ball
	(Green bar and red arrows flash)	No Control Box connected	<ul style="list-style-type: none"> Connect Control Box Check connections
	(Red arrows flash alternately)	The sensor has lost sight of the wire. Tow point is locked	<ul style="list-style-type: none"> Adjust paver direction Adjust sensor position

Reading Control Box Configuration

Reading Control Box configuration at start-up

When the Control Box is connected or when the PL2005 starts up, the Control Box configuration is briefly displayed before the system starts to measure or regulate.

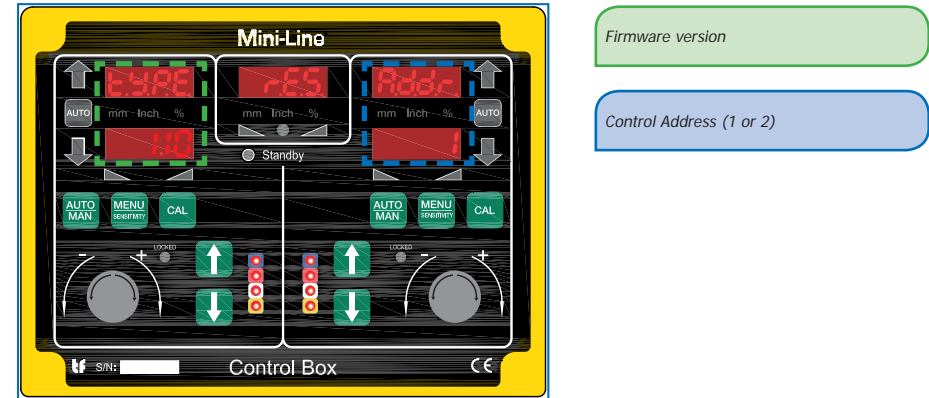





Figure 24 - At startup firmware version and address of the Control Box is briefly displayed

If you are experiencing problems a qualified service representative from TF-Technologies or a distributor of TF-Technologies may ask you for the firmware version of both the Control Box and the Interfacebox. The firmware version of the Control Boxes can be found as detailed above, whereas the firmware version of the Interfacebox require entry of a code cf. Advanced Settings p. 49.

The address of the Control Box can be found at start-up as well as on the label at the back of the Control Box.

Socket Types

Type	Use
6-pin bayonet chassis plug	Control Box and all sensors
	<ul style="list-style-type: none"> Mini-Line® PL2005 Mini-Line® Interfacebox Mini-Line® G220 Mini-Line® G221 Mini-Line® G224 Mini-Line® S299
6-pin bayonet connector	All Mini-Line® cables
	<ul style="list-style-type: none"> Mini-Line® I-cable
10-pin screw connector	Mini-Line® cables with connection to the asphalt paver
	<ul style="list-style-type: none"> Mini-Line® Coiled cable

Benforbindelser

	6-polet bayonet chassisstik	6-polet bayonet hunstik	10-polet hunskruestik
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 for PL2005

PL2005 Mounting Bracket



S-50607

PL2005 Mounting Bracket ensures a solid mounting of the Control Box.

The PL2005 Mounting Bracket can be mounted on a vertical or sloping surface with bolts in the two screw holes.

Accessories for G220, G221 and 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.

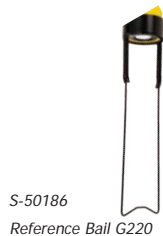
The Snap Connector can be mounted on a support arm or an averaging beam, which is attached to the tow arm or the side plate of the screed.

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



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



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 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.

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. Two Coiled Cables are used for connecting the Mini-Line® Interfacebox with the 10-pin plug of the asphalt paver in each side (in case the asphalt paver is equipped with an alternative plug, see converters and adaptor cables below). Standard I-cables connect sensors and Control Boxes to the Interfacebox.

Coiled Cable

S-50101/2,2
S-50101/4,0



Coiled Cable with 10-pin screw connector and 6-pin bayonet. The Coiled Cable connects the machine to the Interfacebox. inkablet benyttes til at tilslutte maskinen til Interfaceboksen. The cable is coiled and available in 2.2m and 4m (maximum recommended length).

The 4m version is standard in the PL2005 System.

I-Cable

S-50280/X,X



I-cable with two 6-pin bayonet. The I-Cable is used for connecting Control Boxes and sensors to the Interfacebox, as well as when using Averaging Beam. The I-Cable is coiled and available in several lengths, cf. below. The length specified is the maximum recommended length.

S-50280/1,5	I-Cable 1.5m
S-50280/2,2	I-Cable 2.2m
S-50280/3,3	I-Cable 3.3m
S-50280/4,0	I-Cable 4.0m
S-50280/6,0	I-Cable 6.0m

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 dismantled 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 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.

Sensor Beam with internal cabling, Connector Box and Snap Connectors

Consists of two sensor beams that each can hold two grade sensors, fully-fitted with Snap Connectors, connector boxes and internal cabling integrated into the beams.

S-50315



Front Beam Mounting

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

S-50790



Rear Beam Mounting

Arm to mount the rear sensor beam on the screed.

S-50787



Grade Support Arm

S-50513

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



Technical Specifications (Data Sheets)

PL2005 Control Box

PL2005 Control Box Grade and Slope Control System

Mini-Line®

The PL2005 is the control box for the Mini-Line Grade and Slope Control System designed to automatically maintain the desired grade and slope when paving.

With a simple user-interface the PL2005 can be operated in manual and auto mode, and minimum pulse, working window, sensitivity and dead band can be set up. In auto mode, the PL2005 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. Turning knobs 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, and the split display panel provides a full overview of grade and slope for both sides of the machine.

The PL2005 control box can adapt both grade and slope sensors, allowing the operator to quickly switch from grade to slope control and to monitor the slope when operating grade control in both sides of the machine. In addition to a slope sensor, up to four sonic grade sensors can be supported in an averaging setup on each side.



PL2005 Paver Control specifications	
Part number	S-51001 (for one side) S-51002 (for the other side) S-51003 Interface Box
Power supply	12/24 Volt System (10-30 VDC)
Power consumption	Typical at 24 VDC 75 mA (Control Box) Typical at 24 VDC 40 mA (Interface Box) Max 200 mA (Control Box) Max 200 mA (Interface Box)
Dimensions (LxWxH)	175x145x75mm (Control Box) 230x117x85mm (Interface Box)
Weight	1.9 kg (Control Box) 1.5 kg (Interface Box)
Output (to valves)	ON/OFF, PNP or NPN max 1.2A continuously, 2.0A pulsed
Operating temperature	-10°C to 70°C
Storage temperature	-40°C to 85°C
Resolution	Grade 1 mm Slope 0.05%
System control parameters	Sensitivity Working window Minimum pulse Machine width Dead band
Communication bus	Control Box: CAN Interface Box: CAN + RS485 for sensors
Connectors	Cannon bayonet plug, male 6 pin

Sensor Options



v. H803503

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G220 Ultrasonic Grade Sensor

TECHNOLOGIES
PAVING INNOVATION

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.

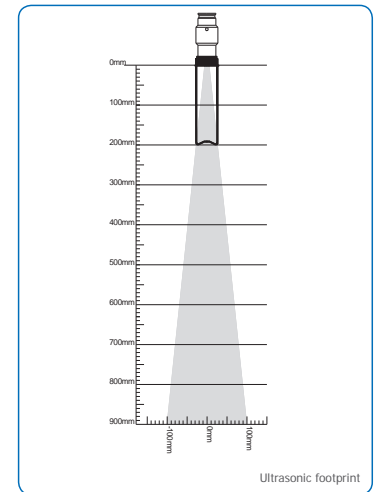
The sensor has a wide sensing span and features a reference ball for optimum temperature and wind compensation.

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 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	12" +/- 2"
Temperature Compensation	200mm / 8in Detachable Ball
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



TF-Technologies reserves the right to make changes without further notice.

v. H803204

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G221 Ultrasonic 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 ball for optimum temperature and wind compensation. The ball is made of spring steel and is designed to detach from the sensor body if struck by an obstacle to prevent damaging ball 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.

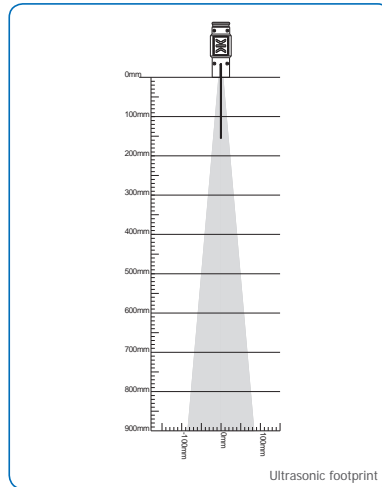


G221 Sonic Sensor

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	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	1x 125kHz Ultrasonic Transducer
Transducer Beam width (-3dB full angle)	10° +/- 2°
Temperature Compensation	155mm / 6.1in Detachable Ball
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

TF-Technologies reserves the right to make changes without further notice.

v. H800504



Ultrasonic footprint

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 ball for optimum temperature compensation. The reference ball 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.

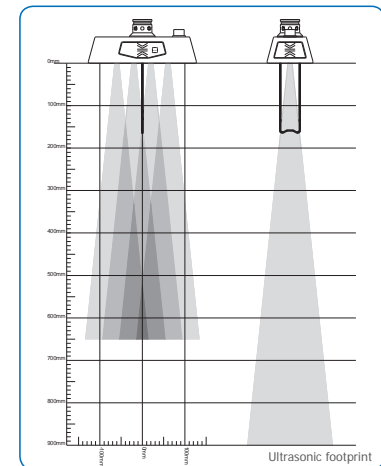


G224 Multi-Sonic

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 Ball
Resolution	1mm / 0.1in
Accuracy - Dynamic	+/- 1mm / 0.1in
Sensor Range	250-900mm / 9.8-35.4in Ground Mode 270-450mm / 10.6-25.5in 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

TF-Technologies reserves the right to make changes without further notice.

v. H800705



Ultrasonic footprint

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S299 Slope Sensor

S299 Slope Sensor
for Slope Sensing

Mini-Line®

The S299 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 S299 Slope Sensor is operated with a PL2005 control box, 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 can be used for monitoring the slope of the road.

The sensor can be used for controlling the slope from either side of the machine, but only one side at a time. It is controllable from the PL2005 control box from both sides of the machine.

The S299 Slope Sensor has a strong and accurate inclinometer specifically designed to withstand high vibration levels on high compaction screeds.



S299 Slope Sensor

S299 Slope Sensor Specifications	
Part Number	S-50220
Application	Slope Control and Slope Monitoring
Power Supply	12/24 Volt System (10-30 VDC)
Power Consumption	Typical at 24 VDC 30 mA Max 200 mA
Dimensions (LxWxH)	130x74x45mm
Weight	0.5kg
House	Aluminium
Storage Temperature	-40°C to +85°C
Operating Temperature	-10°C to +70°C
Sensor Type	Inclinometer
Resolution	0.01%
Accuracy	+/- 0.1%
Sensor Range	-9.99% to +9.99%
Communication Bus	Standard: RS485
Connector	Cannon Bayonet Plug, Male 6-Pin A: Vbat D: NC B: Gnd E: Com A RS485 C: NC F: Com B RS485

TF-Technologies reserves the right to make changes without further notice.

v. H805504

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Declarations of Conformity

TECHNOLOGIES
PAVING INNOVATION

 EC Declaration of Conformity
 Document no.: J9001301
 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 S299 Slope Sensor
 MODEL S299
 APPLICATION Slope sensor for PL2005 paving control systems
 Slope control and slope monitoring
 PART NUMBER S-50220

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



EC Declaration of Conformity
Document no.: J9006501
Published: December 15, 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 PL2005 Paver Control System
MODEL PL2005
APPLICATION Control Boxes and Interface Box for PL2005 Paver Control system
PART NUMBER S-51001 S-51002 S-51003

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

December 15, 2015

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



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



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)

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



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

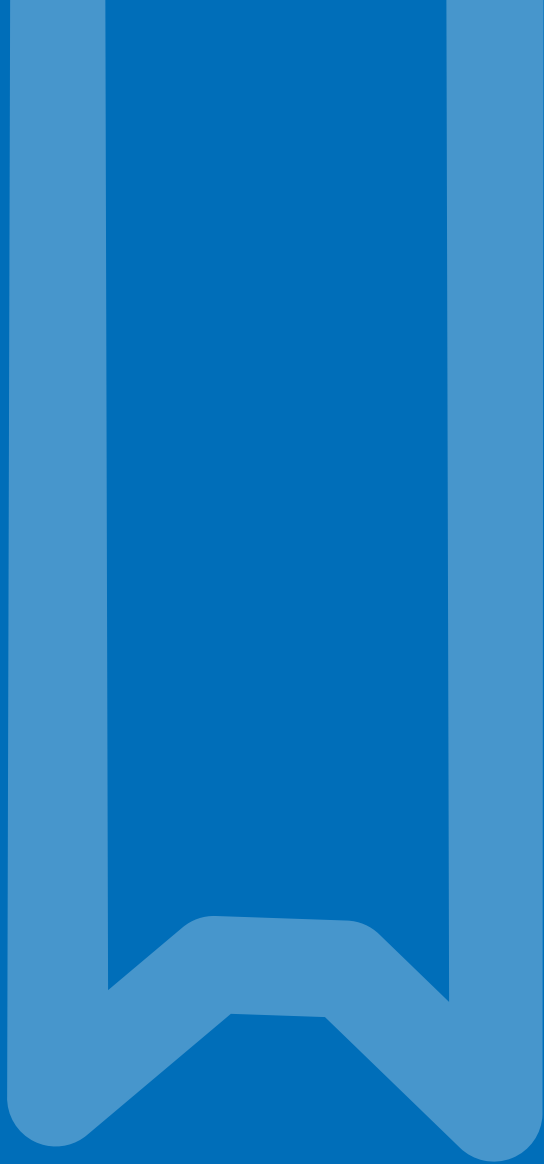
Additional Compliance

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

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



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