TRANSTRONIC AB

MANUAL

INKLINATOR CMI BENCH

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1. GENERAL

The **INKLINATOR** CMI Bench is designed to **complement** benching rigs. The CMI Bench is a **modular- built system** showing, controlling and collecting drilling-related information. This improves the quality and accuracy of the drilling operation which in turn improves productivity and working conditions for the operator and in all subsequent operations in the quarry or open pit.

CMI Bench	Basic instrument for angle measurement in the sight direction.
Module Cab	Extra transducer for rigs with swinging cabs.
Module Length	For measuring hole length and penetration rate.
Module Laser	For measuring hole length from a laser plane.
Module Length Stop	Stops drilling at pre-set hole length. (For special orders, not incl. in this manual.)
Module GPS Compass	For showing the angles in a blasting direction. No sight.
Module GPS Level	Hole depth measurement related to a GPS reference.

Inklinator CMI Bench with module Length and Laser receiver.

2. GENERAL DATA

Power supply	24V DC
Power consumption	0,2A
Working temperature	-20 - +50 ^{o} C
Environmental protection	IP65
Angle measuring:	
Measurement range	2 x $\pm$ 30^{o}
Accuracy	$\pm$ 0,3 ^{o}
Hole length/penetration rate measuring:	
Measurement range hole length	0 - 99.9 m, 0 – 99’ 11’’
Measurement range penetration rate	0 - 9.99 m/min, 0 – 32’ 7’’/min
Accuracy length measurement	$\pm$1%, min 0.05 m
GPS compass accuracy	Better than ± 1°
Type of laser for detection	Rotating visible red. Wavelength: 630 – 680 nm
GPS Level system accuracy	Better than $\pm$ 0.1 m

3 FUNCTION MASTER

Upper Display

Lower Display

On/Off Switch

Σm (total) button

Reset // button

+/- Knob

GPS Compass/Sight

Angle/Pause/Length mode

On/Off Switch. Turns the system On/Off.

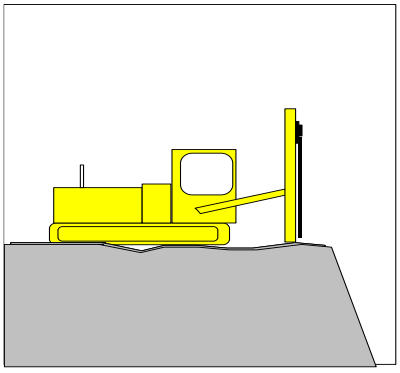
Σm (total) button. When pressed the total length (drilled in rock) is shown on the lower display. On the upper display the actual rate of penetration is shown.
To zero set press both Total (Σm) button and Reset (//) button at the same time.
Note: Angle/Pause/Length mode switch has to be in mode Length.

Reset // button. When pressed length measured for the last hole is zeroed.
Note Angle/Pause/Length mode switch has to be in mode Length.

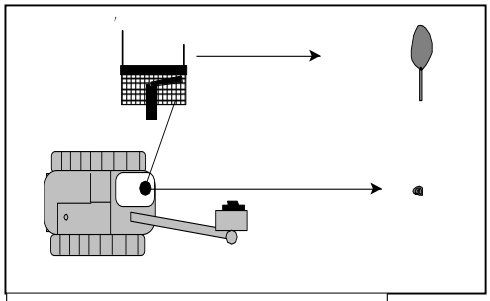
Angle/Pause/Length mode. If the switch is in Angle mode: the system shows angles.
Upper display is side angle and lower display inclination angle. **Note:** All angles refer to the direction the sight is pointing. If checking angles while drilling, the system will continue to measure the length of the hole being drilled, while in Angle mode.
If the switch is in Pause mode: both displays will show '-----'. **Note:** In this mode, the system will stop measuring length. Hence, if the driller wants to stop measuring length to avoid any hole length errors, e.g. during flushing a hole with percussion and assuming percussion is being used as a drilling signal, then this mode can be used.
If the switch is in Length mode: the system shows the rate of penetration on the upper display (updated every 3 seconds) and the position of the bit from the collar (or laser line) on the lower display.

Automatic system check.
The system has an automatic monitoring which checks that the master is communicating with all transducers in a proper way.
If a cable is broken or if a transducer fails the upper display will show "**Err"** the lower display will show the node no which fails. If more than one node is failing the display will toggle between the faulty node numbers.
If the master doesn't have contact with any transducer the display will show **"OFF"**.

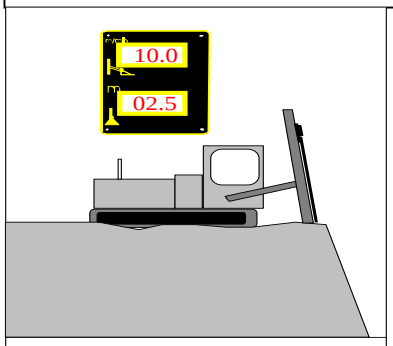
4.1 HOW TO USE INCLINATOR CMI Bench



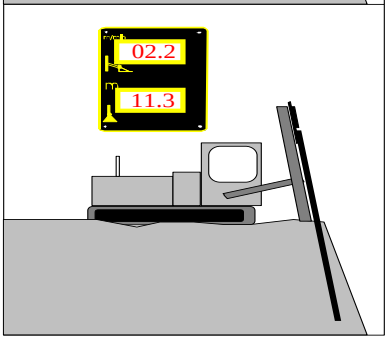
Drilling position



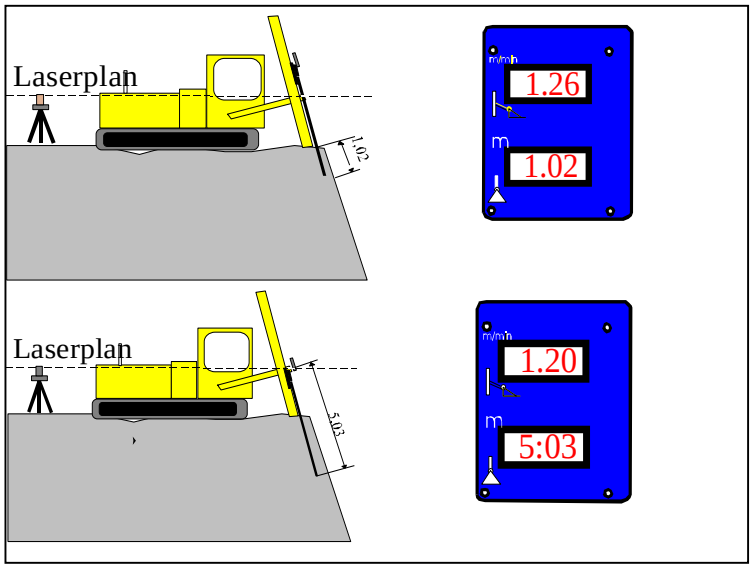
Aiming position *If no GPS*



Angles position



Drill bit position



Drilling with laserplane

Hit by laserplane

4.2 PROCEDURE TO USE INCLINATOR CMI Bench

Sight or GPS compass can be used for setting of blasting direction. The selection is done by the GPS Compass/Sight switch on the front.

If sight is used, the blasting direction has to be set every time the rig has been moved.
Aim with the sight at a point in the blasting direction as far as possible from the rig.

If GPS compass is used the blasting direction has to be set once for the blast being drilled.
Set the switch "Angle/Pause/Length " to position Length and press +/- Knob.
Adjust to the blasting direction on the lower display by turning +/- Knob. The upper display shows the actual direction of the carrier
.
The setting can be done in some different ways:

1. If the blasting direction is known, set the direction by turning the knob.
2. Turn the rig into the blasting direction. The upper display is showing the direction of the rig. Turn the +/- Knob until the lower display shows the same value as the upper display.
3. Aim with the sight in the blasting direction. Hold the +/- Knob down and press the // Reset button. Now the blasting direction is set. If needed it can be adjusted by turning the +/- Knob.

If there are problems to get a correct value from the GPS Compass, i.e. if the rig is near a vertical rock wall, the sight can be used by setting the switch GPS Compass/Sight in position Sight.

1. Set the crawler in position for the first hole.

2. Aim with the sight at a point which is located as far as possible from the crawler position.
   Note: When GPS Compass is used, the sight can be used for setting of blasting direction.
   All drilling direction angles are related to this aiming direction.

3. Set the switch "Angle/Pause/Length " to position Angles.
   Manually position the feeder to the drill angles for the hole.

4. Manoeuvre the drill bit against collaring point (ensure angles remain correct for the hole).

5. Set the switch "Angle/Pause/Length " to position Length.
   If length stop is used, press the +/- knob at set the desired stop length.
   If stop length is set to 0.00, the stop function is disabled.

   When the drilling signal(s) becomes active the system begins to show length.
   On the upper display the rate of penetration is shown (updated every 3 seconds).
   On the lower display the actual bit position is shown.

   The hole length is measured when the cradle moves downwards and the drilling signal(s) are ON. The current bit position is presented continuously on the instrument's display.
   The instrument keeps a steady check of the cradle's position on the feeder. If the switch "Angle/Pause/Length " is moved to the Angle position during drilling, the system will show the current angle of the feeder. The system will continue to measure length, if the switch i returned to length the display shows the actual position of the drill bit.

6. Drill first rod.
   If 'Module Laser' is connected: When the laser receiver on the cradle is hit by the laser plane during the drilling of the first rod, the length display starts to count from this position. To indicate this has occurred, the decimal point will change to a colon.

   Note: If at any time during drilling the operator **does not** want length measurement, he can set the switch "Angle/Pause/Length " to position Pause. In this mode, the system will stop measuring length. Hence, if the driller wants to stop measuring length to avoid any hole length errors, e.g. during flushing a hole with percussion **and** assuming percussion is being used as a drilling signal, then this mode can be used.

   If laser used the drilled hole length is shown on the lower display when drilling ends. (Drilling signal OFF).

7. Add the necessary number of rods to the string and drill the hole to the correct length.

8. Press Reset button // to zero-set the length measured for the last hole.

9. Set the switch "Angle/Pause/Length " to position Angle.

10. Take the rods up from the hole.

11. Manoeuvre the drill rig into position for the next hole (restart procedure from Step 2.)

5 PRINCIPLE OF OPERATION

The system comprises separate functions for A: **showing drilling angles** and B: **showing length measurement.**

5.1 Drilling angles definition

The drilling angles system comprises:
Transducer to measure the swing movement of the boom against the carrier. (Boom Joint transducer)
Transducer to measure the angles of the feed in both the X and Y direction. (Angle transducer).
Sight to measure the decided aiming (i.e. blast) direction against the chosen carrier position.
Readout with two displays showing the calculated angles (Master)
GPS compass to calculate the direction of the carrier.
Signal cables for connecting the transducers to the master.
When the switch "Angle/Pause/Length " is in position Angle the master takes the values from the transducers and uses them to calculate the 'Side' and 'Inclination' angles. These are the angles shown on the displays.

All angles are calculated against the aiming direction.
Or blasting direction if GPS compass is used
This means that if the boom and the sight point straight forward, the angles are shown according to fig 3A.
If the boom is moved, the system will detect the movement and recalculate so that the angle of the feed is still in the same aiming direction as the sight. See fig 3B.
If you now move the sight, the system will detect the movement and recalculate so that the angles shown are according to the new aiming direction. See fig 3C.

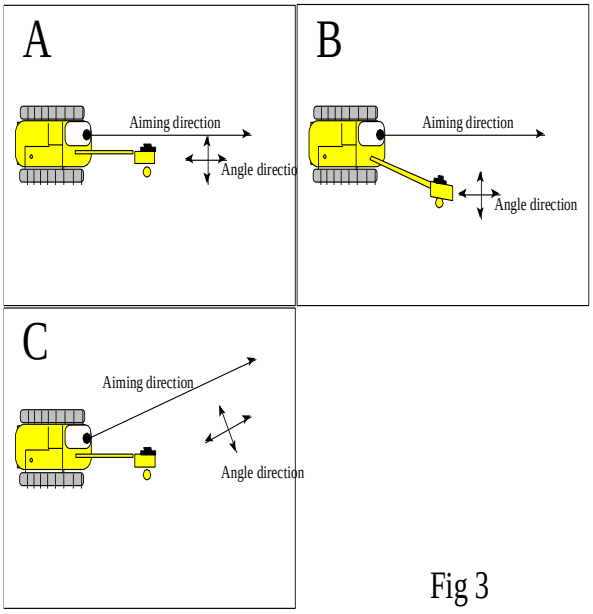


Fig 3

The angles shown on the display are referring to the direction of the drill bit in relation to the sight direction. Therefore if the sight is pointing forwards and the upper display is showing

$+10^0$ and the lower shows -1.2^0, it means that the drill bit is pointing 10^0 forward and

1.2^0 to the left in the sight direction, as seen from inside the cabin..

Switch "Angle/Pause/Length " in position Length + +/- Knob = Length stop
Switch "Angle/Pause/Length " in position Angle + +/- Knob = Blasting direction

5.2 Length Measurement Definition

The system comprises separated functions for A: **showing drilling angle** and B: **length measurement**. When the switch "Angle/Pause/Length " is in position Length the Master takes the values from the transducers and uses these values to calculate the position of the bit and the rate of penetration. These values are shown on the displays.

Drilling signals for controlling the length measurement.
The Master needs to know when it should measure the length. The Master can work with either one or two input signals (Signal 1 and Signal 2) depending which combination is best suited for the rig concerned. Two signals give higher accuracy.
Signal 1 is normally connected to the hammer percussion pressure and
Signal 2 to the rotation left (drilling) hydraulic circuit.
The hole length measuring will START when both signal 1 and 2 comes ON.
The measuring will go on even if one of the signals goes OFF once it has started.
The hole length measuring will STOP when both signals 1 and 2 go OFF.

If one signal is used, then using an input signal for 'Rod Handling On/Off' works well. If not, 'Percussion On/ Off' is suitable, noting that if at any time during drilling the operator **does not** want length measurement, he can set the switch "Angle/Pause/Length " to position Pause. In this mode, the system will stop measuring length. Hence, if the driller wants to stop measuring length to avoid any hole length errors during flushing a hole with percussion (**and** assuming percussion is being used as a drilling signal), then this mode can be used. If the switch "Angle/Pause/Length " is moved to Angles while the drilling signal(s) are active, the Master will continue to measure length.

The length measurement system comprises:
Transducer to measure the movement of the cradle (Length Transducer).
Switch for turning the system ON / OFF.
Push-button // for zero-setting the length.
Push-button Σm for showing total meters drilled from the last time this value was reset.
Readout with two displays showing the calculation of the length and rate of penetration. (Master)

Operation:
The switch "Angle/Pause/Length " has to be in position Length or Angle.
The position of the bit is measured when the cradle moves downwards and the drilling signal(s) are ON. The current bit position is presented continuously on the instrument's display.

The instrument keeps a steady check of the cradle's position on the feeder.

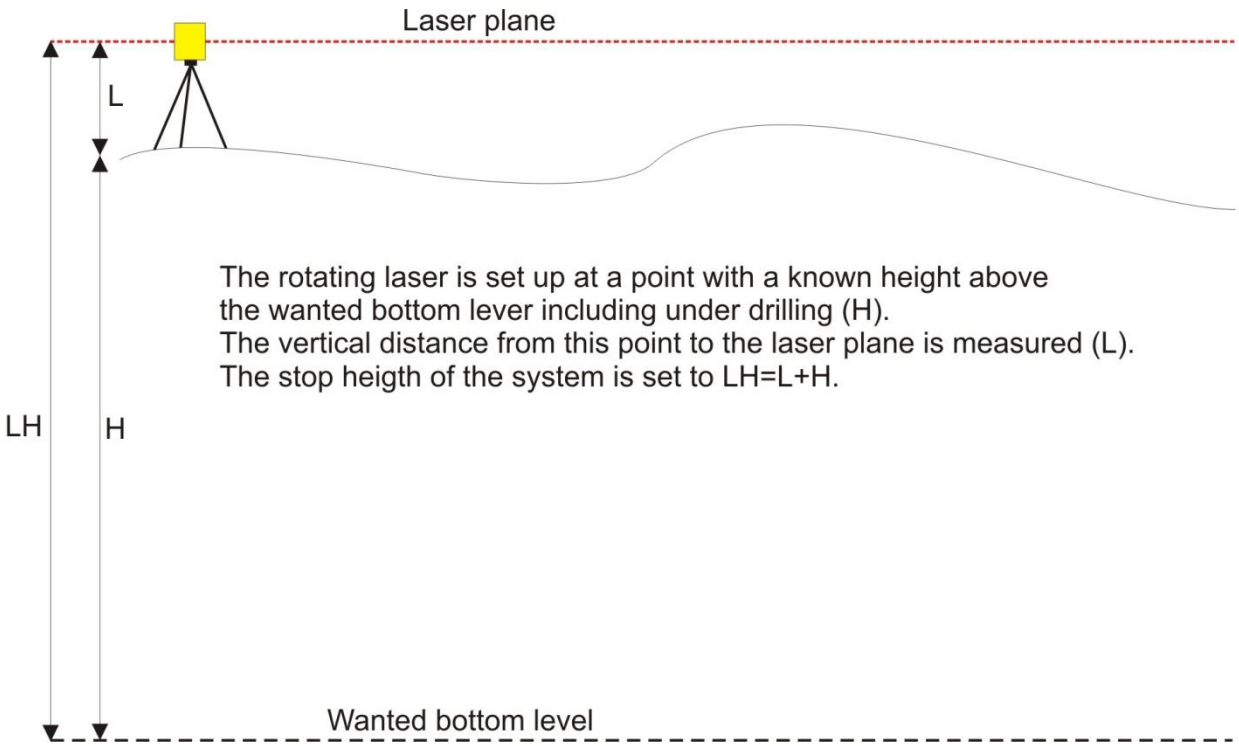
When the hole is finished, the value for this hole can be zero-set only when the "Angle/Pause/Length " switch is in Length position, when there is no drilling signal(s) active and when the push-button "//" (reset) is pressed.

The penetration rate is calculated every 3 second and presented on the display.
The lower display will show total drilled length (drilled in rock) when the push-button Σm (total length) is pressed and the upper display will show the actual rate of penetration.
The counters can be reset to zero by activating Σm (Total length) and // (Reset) at the same time.
If only the push-button // (Reset) is pressed it zero-sets the hole length.

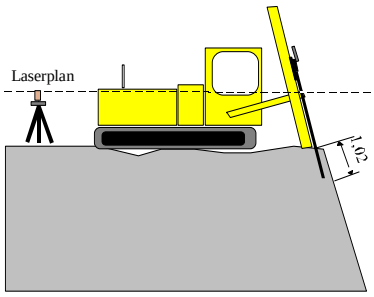
5.3 Laser Definition

The rotating laser plane (set up at a known height from the bench bottom , max 150 m from the rig) sends out a laser beam which rotates horizontally (or at a pre-set ‘grade’, depending on the type of laser plane being used). The laser plane is used as a reference to height measurement.

Hole length from a laser plane:



On the cradle there is a sensor which signals to the instrument when it is hit by the beam of the laser plane. When mounting the system, the distance from the drill bit to the laser sensor is measured. To program this value see Section 5 Set-up and Trouble shooting mode. When the drilling starts, the instrument measures the hole length from the collar, See fig 5. When the sensor is hit by the plane laser beam it accesses the programmed length and continues the length measuring from this point, See fig 6. The length now displayed is from the laser plane. This is indicated by the decimal point being changed to a colon on the length display.



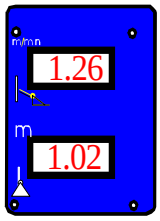
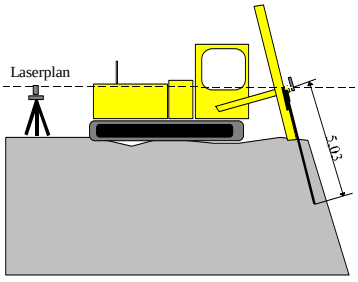


Fig 5



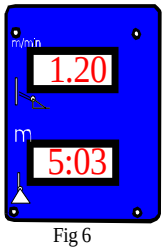


Fig 6

If laser used the drilled hole length is shown on the lower display when drilling ends. (Drilling signal OFF)

5.4 GPS compass

The GPS compass comprises a double receiver unit and two antennas, one primary and one secondary, mounted at known spacing.

The antennas are mounted on top of the carrier of the rig. There must be no fixed objects between the antennas and the horizon except for the feeder.

The compass computes the heading by measuring positions of the antennas. The receivers use all GPS satellites that are 5^{o} or more above the horizon for the calculation.

Ideally, the system wants free sight of the horizon from the antennas all the way around. If there are obstacles between the antennas and the satellites, the system will work poorer depending of how many satellites it is missing. Normally it works just fine when operating nearby trees and smaller buildings.

Reflections
If the system in used nearby a vertical wall, a building or a bench, which height is above the antennas the receivers will get double massages from the satellites due to reflections of GPS signals from the wall.
This will in some cases make it impossible for the system to calculate the heading.
If this occurs, try to move a couple of metres from the wall. If it still doesn't work, alternative heading devices, optical sight etc, must be used.

The GPS compass has 3 LED's on the front with the following functions:

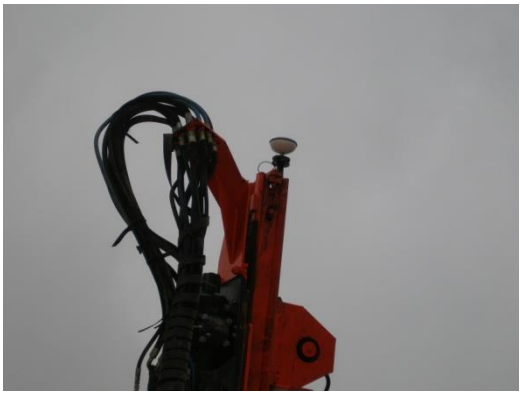
PWR – Green, indicates that the power supply in order.

GPS lock – Yellow, indicates that the unit is receiving signals from the number of satellites needed for calculation of a position.

HDG – Green, indicates that the unit has calculated the heading and sends heading to the system.

5.5 Hole depth measurement from GPS reference

At a known height a base station is placed.
The Base station sends correction- and height data to the Rover (GPS unit on rig) by radio modem.



The antenna of the Rover (GPS receiver on rig) is mounted at the top of the feeder. The Rover calculates the vertical distance of the Rover antenna related to the Base station antenna.
The distance between the Rover antenna and the bottom of the feeder is programmed into the system.
The system shall operate in hole depth mode.

When the drilling of a hole is started, the bottom of the feeder related to the Base station antenna, is set as the starting depth and the measurement goes on from this.
The display will now show the distance between the drill bit and the Base station antenna.

All holes, in a blast or in a whole quarry, can be drilled to a exact level.

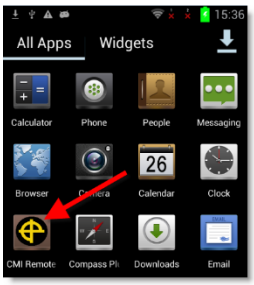
GPS level replaces the use of laser and laser receiver.

5.6 Mobile phone as Remote display

A mobile phone (Android) can, as an option, be connected to show angles, drill length and penetration rate.

The remote display connects through WIFI against the CMI master. The CMI master shares an access point with name “TranstronicAP_....” where the number after the underscore is the CMI master serial number.

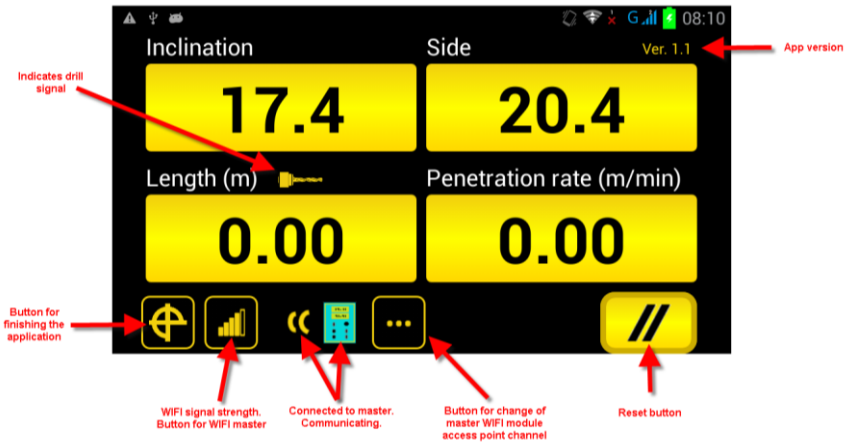
Only one mobile phone can communicate with a CMI master simultaneously. A message will be shown if another mobilephone already are communicating with the CMI master.



Start of application CMI Remote Display
To start the application from mobile phone, press the button “CMI Remote” found under “All Apps”.

WIFI access check
When the application starts, it will check if a connection to CMI master WIFI exists. If the mobile phones is not connected to a CMI master WIFI, a message will be shown with a list of available CMI accesspoints. If the mobile phone WIFI is disabled, a message with request to enable WIFI will be shown. If the mobile previously has been connected to a CMI master WIFI accesspoint, then the application automatically will connect to that accesspoint (if available).

After startup the application will show its main screen.



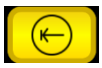
CMI communication status
If the application is connected to a CMI master, a blue icon and a yellow indicator will be shown (the indicator moves if there is ongoing communication).

CMI WIFI signal strength and choice of accesspoint
The second button from bottom left shows WIFI accesspoint signal strength. If the signal is missing, then the button has a red cross over it. By pressing the button for about one second, a dialog with available CMI master accesspoints will be shown from where a change of accesspoint can be made.

Drill signal indicator
An indicator shows if there is a drill signal.

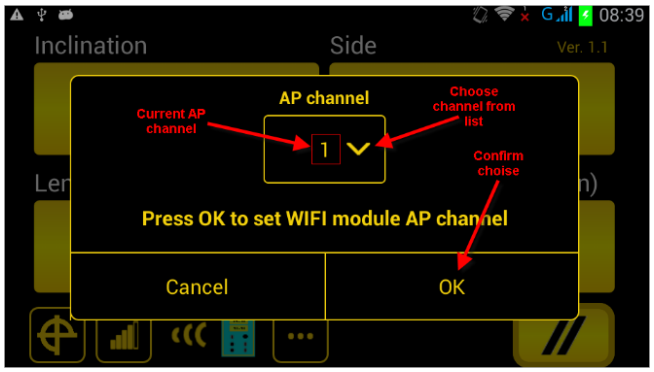
Reset of hole length
To reset the hole length, press the “Reset” button at the bottom right for about one second. Reset is only possible when drill signal is missing.

If the CMI master is configured for multiple drill signals, then the “Reset” button will, after reset, change to a “Start” button (a circle with arrow). To start the drill, press the “Start” button for about one second. Drilling will start and the button toggles back to a “Reset” button.

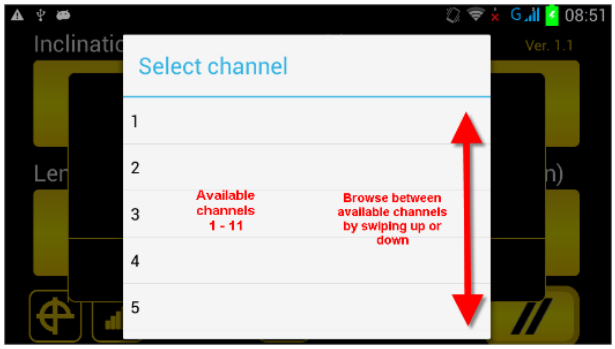


Change of the CMI master WIFI module accesspoint channel
If the signal strength of given CMI master WIFI network seems weak, then a change of CMI master WIFI module accesspoint channel may help. Recommended WIFI accesspoints are 1, 6, and 11 which are least overlapping.

To show current CMI master WIFI module accesspoint channel, press the “Channel” button (icon with three yellow dots) for about one second. A dialog will show from where a change of channel can be performed.



Press the down arrow to show a list of available channels 1 to 11.



Swipe up or down to browse between available channels. Choose a channel from the list and click on the button “OK”. Wait about 10 seconds for mobile phone and app to connect against the WIFI modules new channel.

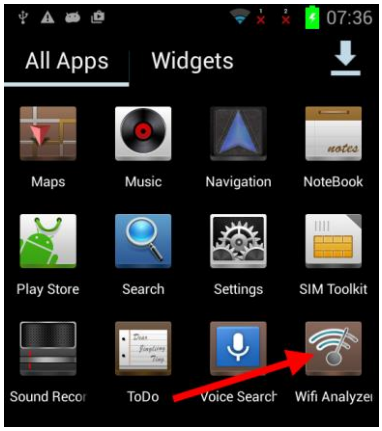
Exit application
To stop the application, press the button down to left and hold it for about 1 second. A dialog will show from where you have to confirm a stop of the application.

5.6.1 Tool for analyzing WIFI networks

If the signal strength of the CMI master WIFI is weak or if the mobile app often loses its connection, then a change of the WIFI module channel may help. See chapter 5.6 above “Change of the CMI master WIFI module accesspoint channel”.

To analyse WIFI signal and its strength, there is an app installed on the mobile called “Wifi analyser”. The app shows, among other things, surrounding WIFI networks, which channel they operate in and signal strength for each channel.

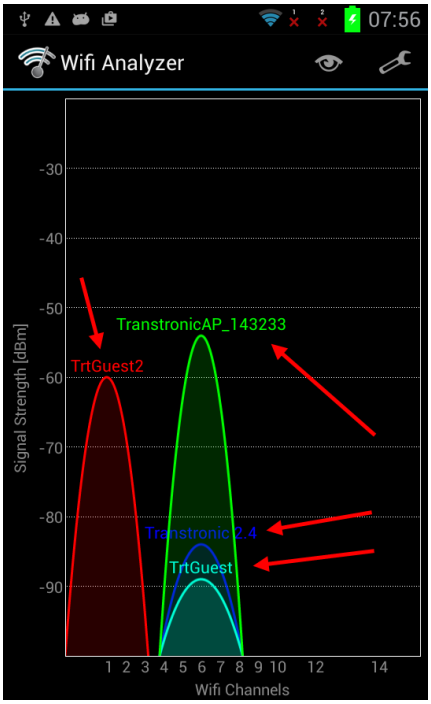
The application is found under installed apps and starts by pressing the icon “Wifi analyzer”.



After starting the application, the main screen shows all available surrounding WIFI networks.

The height of each chart curve shows the strength of the signal. The higher curve, the higher signal strength.

The example picture next, shows that there are two other WIFI networks operating at the same WIFI channel (channel 6) as the CMI master WIFI (TranstronicAP). The more WIFI networks operating at same channel, the more traffic and risk for disturbance. In this example, a change of CMI master WIFI module channel to channel 9, may help (see chapter 5.6 above “Change of the CMI master WIFI module accesspoint channel”).



6. TROUBLE SHOOTING MODE

6.1 Application program.

Make sure that the switch Angle/Pause/Length is in position Angle. (Left).
Turn the system off.
Press the reset // button down and hold it.
Turn the system on.
Release the reset // button.
Now the upper display shows 9999
Lower display shows 0
Press Σm (total).

Upper Display	**Lower display**
9001	**1**

Lower display shows the selected application.
1 = Benching
If not contact Transtronic AB.
Press Σm (total).

6.2 Transducer nodes

Upper display shows transducer node number.
Lower display shows '1' if the transducer node is connected and '0' if not.
Press Σm (total) to select next transducer node.

Upper Display	**Lower display**
01	Length transducer **1** = mounted **0** = not mounted
02	Angle transducer. (on feeder) **1** = mounted **0** = not mounted
03	Sight **1** = mounted **0** = not mounted
04	Boom-joint transducer. **1** = mounted **0** = not mounted
05	Swinging cab transducer. **1** = mounted **0** = not mounted
12	GPS Compass. **1** = mounted **0** = not mounted
13	GPS level receiver
...	
16	

Mounted transducer's node shell be 1. All others shell be 0.
To change go to setting of the system, described in the mounting instruction.
Check that all connected transducers is in contact with the master.

6.3 Checking transducer directions.

Press Σm (total) several times until the upper display shows 16.
Press Σm (total).
Now the shows the values (after calibration) of the connected transducer.
If a transducer is not connected the system shows next transducer.

Upper Display	Lower display
1011	**Length transducer** counter. When the cradle is moved downwards the value shall increase.
1012	**Laser receiver** signal. Lowest digit 1 when active, 0 when inactive.
1021	**Side angle** transducer. When the feeder is in the plumb line the value shall be approx 0^0 ($\pm 3^0$). When the bit is moved to the left the value shall be positive and when the bit is moved to the right the value shall be negative.
1022	**Inclination angle** transducer. When the feeder is in the plumb line the value shall be approx 0^0 ($\pm 3^0$). When the bit is moved is moved forwards the value shall be positive and when the bit is moved backwards the value shall be negative.
1031	**Sight.** When the sight is straight forward the value shall be approx 0^0 ($\pm 3^0$). When the sight is moved to the right the value shall be positive and when the sight is moved to the left the value shall be negative.
1041	**Boom-Joint transducer**. When the boom is straight forward the shall be approx 0^0 ($\pm 3^0$). When the boom is moved to the right the value shall be positive and when the boom is moved to the left the value shall be negative.
1051	**Swinging cab transducer**. When the cabin is straight forward the shall be approx 0^0 ($\pm 3^0$). When the cabin is moved to the right the value shall be negative and when the cabin is moved to the left the value shall be positive.
1121	**GPS Compass**. Shows the direction of the carrier
1131	**GPS Level.** Shows the vertical distance of the Rover antenna related to the Base station antenna.

If any values count in the wrong direction go to setting of the system, described in the mounting instruction.

7. Zero Setting

Adjust the feeder to the plumb line on the machine.
Adjust the boom straight forward.
Adjust the cabin and the sight straight forward.

Turn the system off. (Not necessary if you already are already in trouble shooting mode - then continue to press Σm (total) until 2021 is shown.)
Press the reset // button down and hold it.
Turn the system on.
Release the // button.
Now the Upper display shows 9999
Lower display shows 0
Press Σm (total)several times until the upper display shows 2021

For zero setting of a transducer press reset // button.
To select the next transducer press Σm (total).

Upper display		**Lower Display**
2021	Side angle transducer.	Shows the value from the transducer.
2022	Inclination transducer.	After zero setting it shows 0.0
2031	Sight.	
2041	Boom joint transducer.	
2051	Swinging cab transducer.	

8. Operator settings

Turn the system off. (Not necessary if you already are already in trouble shooting mode then continue to press Σm (total) until 3101 is shown.)
Press the reset // button down and hold it.
Turn the system on.
Now the Upper display shows 9999
Lower display shows 0000
Press Σm (total)several times until the upper display shows 3101

The laser receiver distance or the distance between the GPS Rover antenna and the bottom of the feeder. The function is set in the setup of the system.

Upper display	**Lower Display**
3101	Shows the value between the laser receiver and the drill bit with first rod inserted or the distance between the Rover antenna and the bottom of the feeder. Use the +/- knob and turn it until it shows the length between the laser receiver and the drill bit e.g. 3.45 (metre). (Leave at 0.0 if laser receiver not connected).

To save value press reset // button.
To change function press Σm (total).

Drill rod length.

Upper display	**Lower Display**
3102	Shows the maximal rod length. Use the +/- knob and turn it until it shows length of on drill rod. 0.0 is disconnection.

To save value press reset // button.
To change function press Σm (total).

Measurement resolution angles

Upper display	**Lower Display**
3103	Shows the resolution. Use the +/- knob to select 0.1, 0.2 or 0.5 degrees

To save value press reset // button.
To change function press Σm (total).

9. Test of Output Signals

Turn the system off. (Not necessary if you already are in trouble shooting mode then continue to press Σm (total) until 3201 is shown)
Press the reset // button down and hold it.
Turn the system on.
Now the upper display shows 9999
Lower display shows 0000
Press Σm (total) several times until the upper display shows 3201

Upper display	**Lower Display**
3201	Shows nothing. When pressing // button the output signal becomes active (lower display will show '1'.

10. Test of Input Signals

Turn the system off. (Not necessary if you already are in trouble shooting mode then continue to press Σm (total). until 3301 is shown)
Press the reset // button down and hold it.
Turn the system on.
Now the upper display shows 9999
Lower display shows 0000
Press Σm (total) several times until the upper display shows 3301

Upper display	**Lower display**
3301	Shows 0000. If an input gets active it changes to 1

Drilling signal 4	Drilling signal 3	Drilling signal 2	Drilling signal 1	Lower Display
0	0	0	1	0001
0	0	1	0	0010
0	1	0	0	0100
1	0	0	0	1000

Upper display	Lower Display
3401	Shows 1 when the switch Absolute /Relative is in position Absolute. Shows 2 when the switch Absolute /Relative is in position Relative
3501	Shows 1 when the switch Angle/Pause/Length is in position Angle. Shows 2 when the switch Angle/Pause/Length is in position Pause. Shows 3 when the switch Angle/Pause/Length is in position Length.

11. Troubleshooting the Angle System

Fault	Action
The displays shows nothing. And the lights in the displays are off.	Check power supply to the master. Should be between 22 and 30V DC. (Input voltage) If no voltage check the fuse.
Display for inclination or side unstable or shows incorrect value.	Run the trouble shooting mode and try to locate the faulty transducer. (See chapter 6.3) Connect a spare (lose) cable to the faulty transducer. If system now functions OK, change the signal cable If not change the transducer. If the measurement still doesn't work correct, change the master.

11.1 Troubleshooting the GPS compass System

Fault	Action
The display shows nnnn	The GPS doesn’t have contact with the satellites. Note that the GPS needs 4-5 min after power on to start .

The GPS compass has 3 LED’s on the front with the following functions:

PWR – Green, indicates that the power supply in order.

GPS lock – Yellow, indicates that the unit is receiving signals from the number of satellites needed for calculation of a position.

HDG – Green, indicates that the unit has calculated the heading and sends heading data to the system.

12. Troubleshooting the Length System

Fault	Action
Length measurement doesn't work	Run the trouble shooting mode and try to locate the fault. See chapter 6.3 (Upper Display 1011).
Missing signal from the length transducer.	Check the wire on the length transducer. Check that the proximity switches in the length transducer is ok by measuring voltage inside the connection box on the feeder (if chain feeder used). See enclosed drawing.
If no drilling signals	Trouble shoot the control signal connections in the Electrical cabinet. See enclosed drawing.

NOTE: When changing cable. Tighten the connector by hand only, no tools allowed.

13. Troubleshooting the Laser System

Fault	Action
No laser indication	Run the trouble shooting mode and try to locate the fault. See chapter 6.3 (Upper Display 1012) Connect B-C in the laser cannon plug and see if the display indicates laser signal. If the indicator indicates laser signal measure A-B =24 VDC, B-C 10.5 VDC. If power is OK change laser-receiver. If no indication on the display or if one voltage is missing. Measure voltage on the laser side in the connection box for the laser. (On the feeder) Red-white = +24 VDC. Blue-white=10.5 VDC. If power OK change cable between the connection box and the laser receiver. If no power change the cable between the connection box for the laser and the connection box on the length transducer. See enclosed drawing. **NOTE When changing cable. Tighten the connector by hand only, no tools allowed.**

14. Trouble shooting GPS Level system

Base station:
The Base station is power supplied by battery with an operating time of 24 hours.
On the case there is a power supply switch and a green LED indicating that the Base station is working.
Inside the case is a 100-240 VAC battery charger and a 5A fuse mounted.

The Base station GPS unit has 3 LEDs for operation status indication:
PWR – green indicates power supply to the unit.
GPS lock – yellow indicates that the receiver is in contact with satellites and has calculated the position.
Corr data – red flashes when the Base station is sending correction data.
At start of the unit, first the GPS lock is lit and after 5 minutes it starts sending correction data.

Rover (unit on rig):
The Rover has 4 LEDs for for operation status indication:
PWR – green indicates power supply to the unit.
GPS lock – yellow indicates that the receiver is in contact with satellites and has calculated the position.
Corr data – red flashes when the Rover is receiving correction data from the Base station.
RTK – green indicates that the unit is ready and sends height data to the system.