TRANSTRONIC AB

MANUAL

INKLINATOR CMI TUNNELLING

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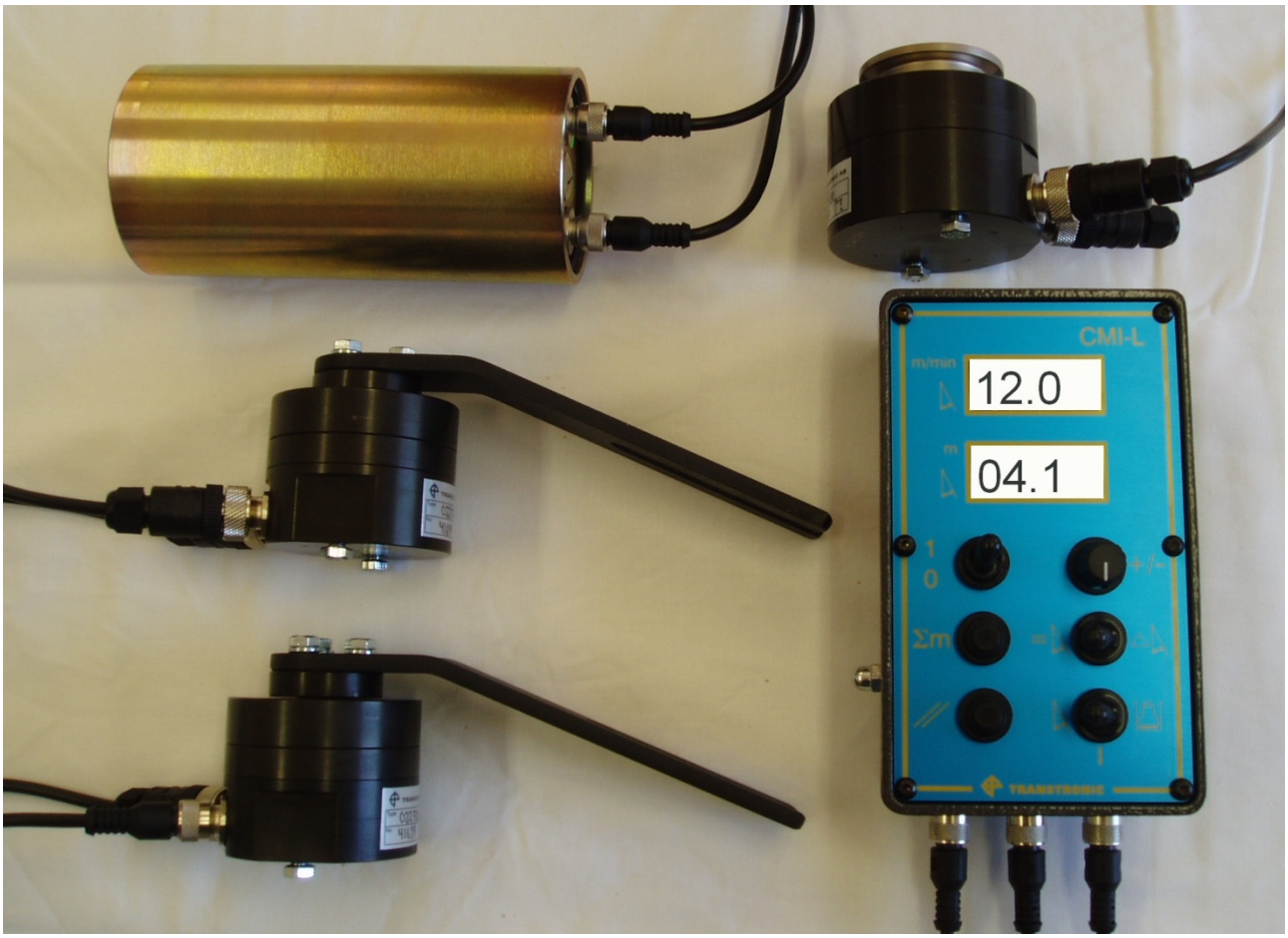
1 GENERAL DESCRIPTION

The **INKLINATOR** CMI Tunnel is designed to for Tunnelling rigs. The CMI Tunnel 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 Tunnel	Basic instrument for angle measurement vertical and horizontal
Module Length	For measuring hole length and penetration rate.
Module Logging	For communication with logging instrument (For special orders, not incl. in this manual.)



The picture shows one CMI Tunnel vertical and horizontal angle measurement and length measurement. (Cylinder feeder)

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 $\pm$ 60^{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

3 FUNCTION MASTER

Upper Display

Lower Display

On/Off Switch

Σm (total) button

Reset // button

mode

+/- Knob

Absolute /Relative

Angle/Pause/Length

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.

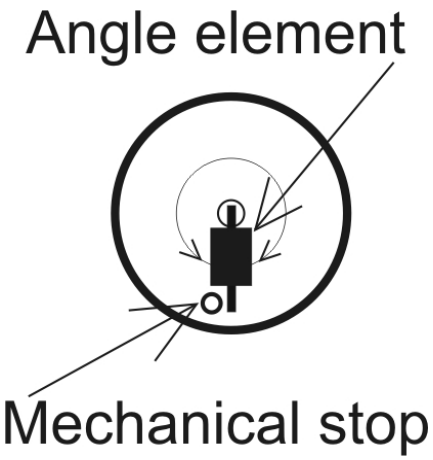
Automatic system check.
The system has an automatic monitoring which checks that the master is communicating with all transducers in a proper way.
If a cable is broken or if a transducer fails the upper display will show "**Err"** the lower display will show the node no which fails. If more than one 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. Mounting instructions.

Master
These shall be mounted in a protected place where the operator can reach and see them.
The central unit shall be connected to a clean stable 24 V DC source. In most cases the rig's battery is the best choice.
The cable shall be protected by a fuse.

Vertical transducer
The vertical transducer shall be mounted in the protective holder, which is screwed on the feeder holder at a well protected place.
The length axis of the transducer shall be parallel with the drill steel. The transducers angle element will rotate around it's length axis when the feeder roll-over is operated.
Inside the transducer there is a mechanical stop of the rotation to prevent cable damage.
This stop shall correspond to the roll-over movement stop.

- Mount the transducer with the connector towards the adjustable mounting hole of the holder.
- Rotate the rollover to one of its end positions. Turn the transducer inside the holder until the transducers angle element hits the mechanical stop.
- Rotate the rollover to the other end position and check that the transducers angle element doesn't hit it's mechanical stop before the roll-over.
- Tighten the screws on the holder.
- Mount the transducer holder on the feeder holder with the connector located towards the carrier.



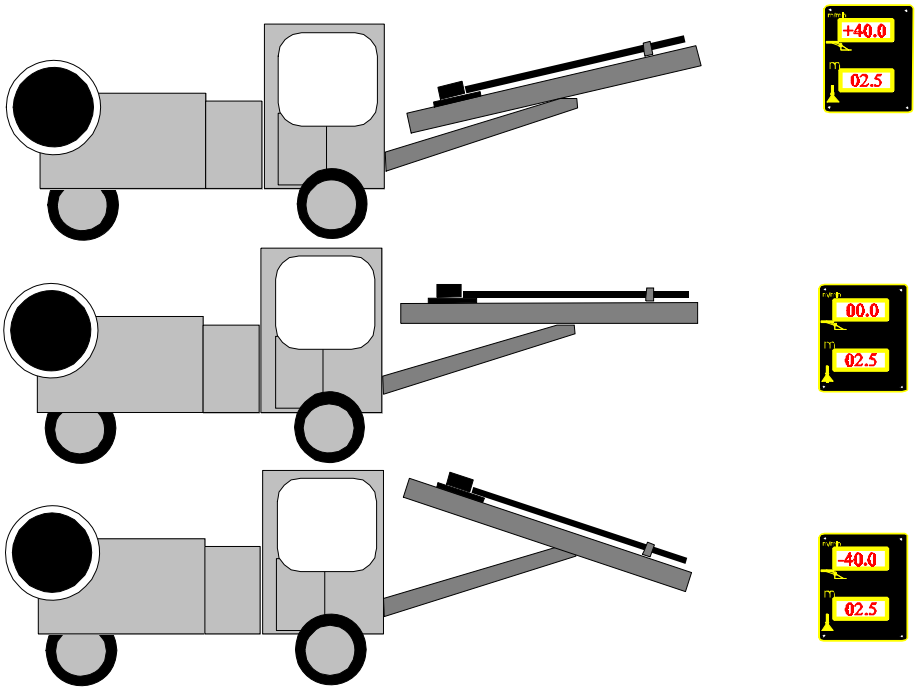
Horizontal transducers
The rear transducer is mounted with the centre of the transducer in line with the centre on the boom joint.
Use the supplied accessories.
The front transducer is mounted in the same way at the front horizontal joint.
Set the transducers with the marking on the rotatable part corresponding to the marking of the transducer housing.
Set the boom and feeder straight forwards and mount the transducer arms and the bolts on the moving part of the joint that shall be measured.
Note: The forward horizontal transducer is Node 5
and the backward horizontal transducer is Node 4.

Length Transducer.
The length transducer is mounted on the feeder so it measure the movement of the cradle.
Contact Transtronic for rig specified mounting instructions.

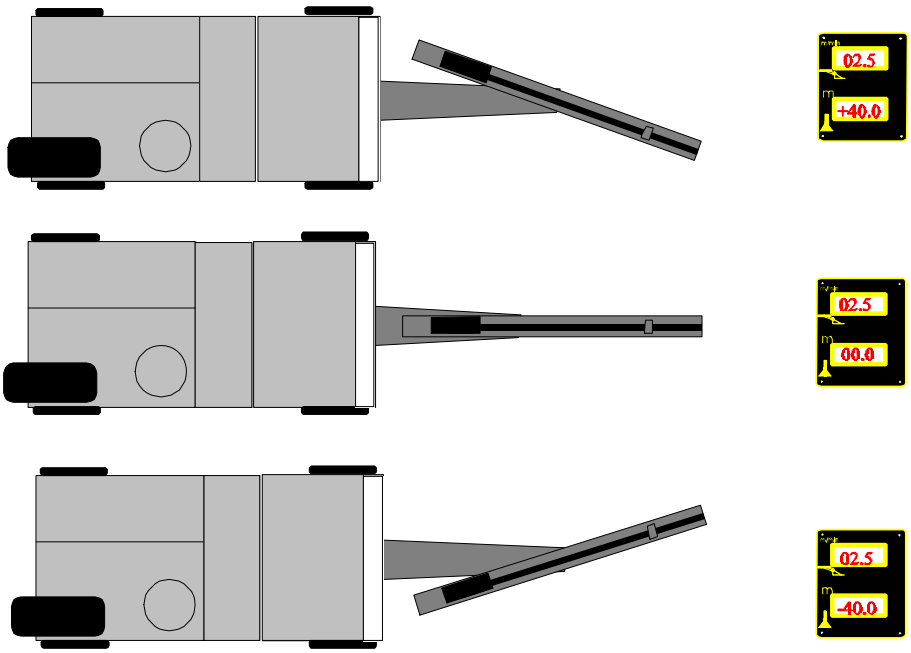
Cables
The cables to the front transducers are protected by hydraulic hoses. Both ends of the hoses must be fixed with the supplied bracket which shall be welded near the transducer.
The hoses shall be placed together with the other hoses on the boom.

5. Angle definition

Vertical angle

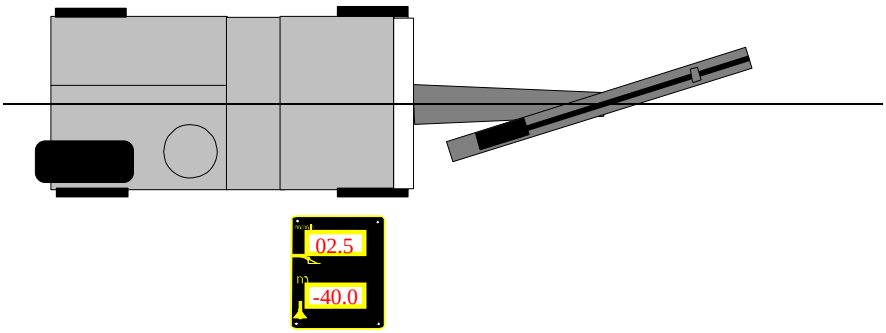


Horizontal angle



6. Absolute/Relative mode

In **absolute mode** the horizontal angle is measured related to the centre-line of the rig's carrier and the vertical angle related to plumb-line.



In **relative mode** both angles are related to the preset angles. This function makes it very easy to drill parallel holes:

I. Set the feeder to the angles for the first hole (and drill it).
II. Set the switch Absolute /Relative on the master to "Relative" (Right) and then press "Reset button". Now both angles on the display are 0.0.
III. Move the feeder to the position for the next hole and align it until both displays shows 0.0. Now the feeder is parallel to the first (reference) hole.

6.1. Length Stop.

In the system there is a length stop. (Note that the master gives a signal and the rig has to take care of this signal and make the drilling stop)
To use length stop press down +/- Knob on the master and adjust to the desired length of the hole. Start drilling.
When the master gets to its set length it gives a signal out to the drill rigg.
If no length stop wanted set it to 0.00.

7 Checking of the system

7.1 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	**4**

Lower display shows the selected application.
4 = Tunnelling ± 60 Deg
If not contact Transtronic AB.
Press Σm (total).

7.2 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
04	Backward Boom-joint transducer. **1** = mounted **0** = not mounted
05	Forward Boom-joint transducer. **1** = mounted **0** = not mounted
08	Vertical transducer. **1** = mounted **0** = not mounted

Mounted transducer's node shell be 1. All others shell be 0.
To change go to setting of the system. (Mounting instruction chapter 14).
Check that all connected transducers have contact with the master.

7.3 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.
1041	**Backward Boom-Joint transducer** 1 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	**Forward Boom-Joint transducer** 2 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.
1081	**Vertical transducer** When the feeder is vertical the shall be approx 0^0 ($\pm 3^0$). When the feeder is moved to the up the value shall be positive and when the feeder is moved to the down the value shall be negative.

If any values count in the wrong direction go to setting of the system. (Chapter 12).

8. Zero Setting

Adjust the feeder to horizontal.
Adjust the boom 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 2041

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

Upper display

2041 Backward Boom joint 1 transducer.
2051 Forward Boom joint 2 transducer.
2081 Vertical transducer.
Note No zero setting for the length transducer.

9. 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

Upper display	**Lower Display**
3101	Not in use

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. Press down the +/- knob and turn it so it shows length of on drill rod. 0.0 is disconnection.

Upper display	**Lower Display**
3103	Shows the resolution in angle measurement. Press down the +/- knob and turn to the resolution you want. 0.1, 0.2, 0.5 is the choice.

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

10. 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'.

11. 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 0 when the switch Absolute /Relative is in position Absolute. Shows 1 when the switch Absolute /Relative is in position Relative
3501	Shows 0 when the switch Angle/Pause/Length is in position Angle. Shows 1 when the switch Angle/Pause/Length is in position Pause. Shows 2 when the switch Angle/Pause/Length is in position Length.

12. Troubleshooting angle system

Fault	Action

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"**.
If **"OFF"** disconnect the cable between the first (backward boom-joint transducer) and the second forward boom-joint transducer or the converter for it) and restart the master.
If the master now is showing error 5,8 then there is a fault in the cable to one of the transducer.
Then disconnect the cable between the first and second transducer and disconnect the cable between the second and third transducer and do the same test.

The displays shows nothing. And the lights in the displays are off.	Check power supply to the master. Should be between 22 and 28V 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 t faulty transducer. (See chapter 7.3) 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.
Vertical transducer check	Go to 1081 in the trouble shooting mode. When the feeder is vertical the value on the lower display is 0Deg. When moving the feeder up or down the angles on the lower display should correspond to the actual angle of the feeder.
Vertical transducer check	Go to 1041 or 1051 in the trouble shooting mode. When the boom is pointing forward the value on the lower display is 0Deg. When moving the boom to the left or right up the angles on the lower display should correspond to the actual movement of the boom. One way is to check that is to measure to movement sideward 2 meter in front of the transducer. 1Deg is 3.49cm movement sideward Tanengs for the angle X the length (distance from the transducer to the point were you are measuring. =side movement

13. Troubleshooting length system

Fault	Action
Length measurement doesn't work	Run the trouble shooting mode and try to locate the fault. See chapter 7.3 (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 drawing 05061730
If no drilling signals	Trouble shoot the control signal connections in the Electrical cabinet. See drawing 04112530

14 Setting of the system

Here you tell the system witch transducer that is connected:
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 down +/- knob and adjust so that you have 0099 on the lower display.
Press Σm (total).
If you what to change press down +/- knob and adjust to 0 or 1.
To save it press // reset button.
Go to next press Σm (total).

Function	**Upper Display**	**Lower Display**
Length Transducer	**01**	
Connected		**1**
Not connected		**0**
Press Σm (total).		
Boom joint transducer 1 Backward	**04**	
Connected		**1**
Not connected		**0**
Press Σm (total).		
Boom joint transducer 2 Forward	**05**	
Connected		**1**
Not connected		**0**
Press Σm (total).		
Vertical transducer	**08**	
Connected		**1**
Not connected		**0**
Press Σm (total).		
Press Σm (total) until 1011 on the upper display. Or the first connected transducer.		
Length transducer direction	**1011**	
Normal		**0* (‘*’ is default)**
Reversed direction		**1**
Boom joint transducer 1 direction	**1041**	
Normal		**0***
Reversed direction		**1**
Boom joint transducer 2 direction	**1051**	
Normal		**0***
Reversed direction		**1**

Function	**Upper Display**	**Lower Display**

Vertical transducer direction **1081**

Normal **0***
Reversed direction **1**

Press Σm (total) until 5001 on the upper display.
Or the first connected transducer.

Chain selection for the length transducer **5002**

022430 cylinder feeder 1:2 **1***
022430 cylinder feeder 1:1 **2**
1" **3**
1 1/4" **4**
1 1/2" **5**
1 3/4" **6**
2" **7**
1"Wire **8**
Setting of measurement distances (mm)/pulse **0**
To change to 10 of mm press Σm. Press // to save value in the length transducer.

Drilling signals connection **5003**

Only one drilling signal (e.g. percussion or rod handling) **1***

Drill 1	Drill 2	
0	x	Length measurement off
1	x	Length measurement on

The normal way to Digital 1 is to mount a relay
over the hour counter for the drill hammer.

Both drilling signal 1 and 2 (Normally drilling rotation and air on) **2**

Drill 1	Drill 2	
0	0	Length measurement off
1	1	Length measurement on

To get in to length measurement, both signals
Must be active.
To get out of length measurement mode both
signals must be inactive.

Not used: **3**

Hole length or hole depth **5004**

Hole length **0***
Hole depth **1**

Type of length measurement mode **5005**

Length of the hole **0**
(Shows the length of the drilled hole).
Position of the bit. **1***
(The system keeps a steady check of the position of bit).

Hammer type on rig	**5006**	
Top Hammer		**0***
ITH hammer		**1**

If ITH hammer selected the system will show distance
from hole bottom on the upper display and the position of the
bit on the lower display when the rod from extracted in the hole.

Measurement units	**5007**	
Metric		**0***
US		**1**

When using metric units the system shows hole length and total length in metres, penetration rate in metres/minute.
With using US units the system shows hole length and total length in feet and inches, penetration rate in feet and inches/minute.

By pressing Σm (total) again the system will go to the start of the setup program again with 0099 on the lower display. This is useful for checking the setup.
If not, shut the system off

Not Used **5008**

15 Checking and setting summary

Checking
No code

9000 Application
9001 Selected application program

1 Check of node
2 Check of node
3 Check of node
4 Check of node
5 Check of node

1000 Measurement values
1011 Length transducer
1012 Not used
1041 Boom joint 1 transducer
1051 Boom joint 2 transducer
1081 Vertical transducer

2000 Zero setting
2031 Zero setting boom joint transducer 1
2041 Zero setting boom joint transducer 2
2051 Zero setting vertical transducer.

3100 Operator settings
3101 Not used
3102 Setting of rod length
3103 Measurement resolution

3200 Output signals
3201 Test of stop signal

3300 Input signals
3301 Check of drilling signals
3401 Check of switch Absolute/Relative
3501 Check of switch Angle/Pause/Lengt

Setup
Code 99

1 Node on/off Length transducer
2 Node on/off Angle transducer
3 Node on/off Sight
4 Node on/off Boom joint transducer
5 Node on/off Swinging cab transducer

1000 Direction node
1011 Direction length transducer

1041 Direction boom joint transducer 1
1051 Direction boom joint transducer 2
1081 Direction verticaltransducer

5000 System settings
5002 Selection of length transducer
5003 No of drilling signals
5004 Hole length/hole depth 0=length 1=depth
5005 Hole length/bit pos 0=hole length 1=pos bit
5006 Hammer 0=top 1=ITH
5007 Units 0=m 1=US
5008 GPS Compass Bench Drilling

Signal cables connection