



## MANUAL

### **INKLINATOR CMI Production Boom**

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## 1 GENERAL DESCRIPTION

The **INKLINATOR** CMI-Production boom is designed for swinging boom production drill rigs and exploration drill rigs. The CMI- Production boom is a **modular system** that collects displays and allows control of 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 mine operations.

**CMI-Production boom**      Basic instrument for the measurement of side and dump angles.

**Module Length**              For measuring hole length and penetration rate.  
There is also a length stop function to stop the drilling when preset length is archived. Note: The system emits a 24V signal when the desired length is reached. This signal can then be used to operate a warning light, alarm and/or to control the rig's hydraulics according to site requirements.



The picture shows one CMI Production Boom Angle and Length Measurement System for a cylinder feeder.

## GENERAL DATA

Power supply	24V DC
Power consumption	0,2A
Working temperature	-20 - +50 ° C
Environmental protection	IP65

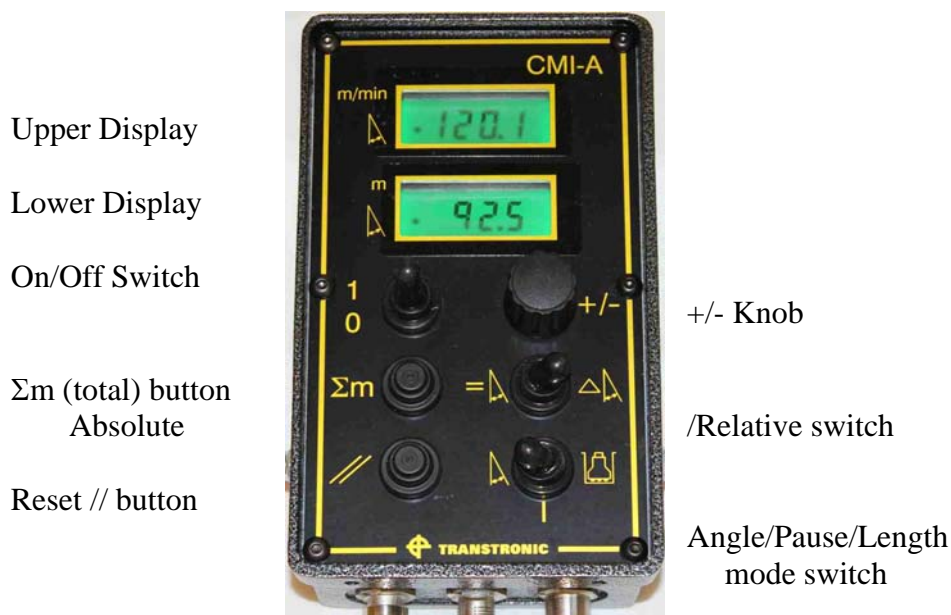
### Angle measuring:

Measurement range inclination	± 60°
Measurement range side	360°
Accuracy All transducer better then	± 0,3 °

### 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	±1%, min 0.05 m

### 3 FUNCTION MASTER



**On/Off (1/0) 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 average rate of penetration for the last rod is shown. To zero set the total length accumulated press both Total (Σm ) button and Reset (//) button at the same time. **Note:** Angle/Pause/Length mode switch has to be in Length mode.

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

**Angle/Pause/Length mode.** If the switch is in Angle mode: the system shows angles. Upper display is side angle and lower display dump angle. **Note:** All angles refer to the direction the lasers are pointing when the reset button was last pressed. If checking angles while drilling, the system will continue to measure the length of the hole being drilled (if this option is being used), 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 on the lower display.

#### Automatic system check.

The system features automatic monitoring which checks that the master is communicating correctly with all transducers.

If a cable is broken or if a transducer fails the upper display will show “**Err**” and the lower

display will show the transducer node no which has failed. If more than one node has failed the display will toggle between the faulty node numbers.

If the master doesn't have contact with any transducer the display will show "OFF".

### 3.1 Absolute Mode (Principle)

On the master there is a switch called *Absolute/Relative*. When the switch is in the *Absolute* position the plane of the ring pattern to be drilled will be perpendicular to the chassis of the rig regardless of any boom-swing movements (See fig 1). Hence, if the lasers are mounted on either side of the carrier for lining up with offset markings parallel to the plane of the ring pattern to be drilled, the resulting pattern will be parallel to the lasers' plane and the angles within this pattern will read from vertical as referred to the "plumb" line. **Note:** Boom extension movements will be required to account for "out of plane" boom swing movements to adjust the drill string back onto the collar markings, as well "out of plane" movements caused by the offset feed of the rig.

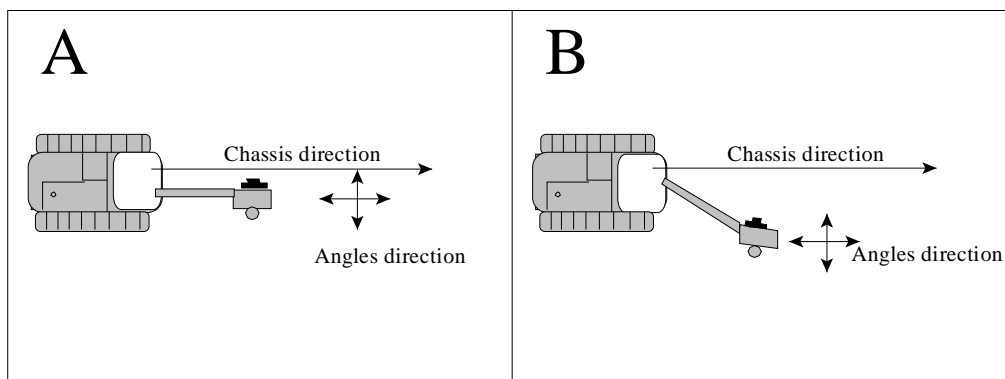


Fig 1

### 3.2 Relative Mode (Principle)

In *Relative* position the display shows **the actual angle as referred to the last reset of the boom angle against the carrier**. Once reset (by pressing the Reset // button when the right hand switches are in 'Angle' and 'Relative' Modes), the pattern to be drilled will always be perpendicular to the boom's horizontal direction when the Reset button was last pressed (see "Note" above). Resetting the boom position via the push-button on the display is in effect giving the rear boom joint transducer (Node 6) a starting value of zero, which in Absolute mode, occurs only when the boom is parallel to the carrier direction. Pressing the reset button in Relative mode "tricks" the system into believing the boom is parallel to the carrier, hence allowing for more flexible carrier set-up positions.

### 3.3 ABSOLUTE MODE: FOR OPERATING WITH CARRIER-MOUNTED LASERS

Absolute mode is used when the rings to be drilled are mostly generally perpendicular to the drive direction and hence, the boom can be kept parallel to the carrier when setting up to each new laser offset marking. In this mode, the lasers are mounted on the rig, for referencing against the laser offset markings. To use this mode:

- 1 Have the Absolute/Relative Switch in Absolute mode and the Angle/Pause/Length switch in Angle Mode.
- 2 Align the chassis of the rig to the reference lines/marks on the walls, with the help of carrier-mounted lasers.
- 3 Adjust the feed boom to the collar marking of the hole to be drilled and the correct drill angle for the hole according to the drill plans, using all available feed and boom movements. Drill the hole.
- 4 Adjust the feeder and boom to the correct drill angles for the next hole etc.

**Note: - Once the drilling of the new ring commences, if any boom swing, boom inclination and/or rotation movements are required to achieve the correct angle for the new hole, a certain amount of boom extension will be required to bring the drill string back (or forward) into the plane of the ring being drilled (i.e. to the collar mark for the new hole).**

### 3.4 RELATIVE MODE: FOR OPERATING WITH BOOM-MOUNTED LASERS

Relative mode is used when the rings to be drilled are:

- offset to the drive direction or
- follow a curve in the drive direction

In this mode, the boom is angled to the carrier during laser set-up procedures. Once this set-up is complete, the system will show all angles as referred to the direction the (boom-mounted) lasers were set to. To use this mode:

- 1 Have the Absolute/Relative Switch in Relative mode and the Angle/Pause/Length switch in Angle Mode.
- 2 Align the boom to the reference lines/marks on the walls with help of the boom-mounted lasers (the boom or feed's angle is not critical during laser alignments).
- 3 Activate the Reset button (this is only done once, prior to commencing drilling each ring).
- 4 Adjust the feed and boom to the collar marking of the hole to be drilled and to the correct drill angle for the hole, according to the plan using all available feed and boom movements. Drill the hole.
- 5 Adjust the feeder and boom to the correct drill angles for the next hole etc.

- 6 Complete the ring to be drilled (using steps 4 & 5) before moving the carrier position, and follow above steps (from step 1) when moved to the new ring to be drilled (or if the rig is moved before the ring is completed).

**Note:** (Same set-up constraints as noted above).

## 4. Mounting instructions.

**Angle-360 Deg** is mounted on the rotation unit and measures the rotation angle of the feed (as referred to the plumb line) (Node 11)

### Boom-joint transducers

**Back** Measure the mechanically measures the angle between the carrier and the boom. (Node 4)

**Forward** Measure the mechanically angle in the forward horizontal movement on the boom. (Node 5)

**Boom/Feeder** measures the mechanically angle between the boom and feeder. (Node 6)

**Angle-1 axis** measures the angle between the plumb-line and the boom. (Node 8)

**Signal cables** to connect the transducers to the next transducer. If needed, the cable is protected in hydraulic hoses.

**Power Supply cable** to connect power supply to the system through a 1Amp fuse.

Connect it directly to the battery to make sure that you have a clean power supply

**Master** with inputs for transducers and outputs for controlling the displays. Signals from transducers are processed in the Master and the calculated values as the dump and side angle on the twin LCD displays. The Master is also used for calibration and troubleshooting functions.

### Options:

**Length Transducer** calculates the length drilled by measuring the cradle movement (Node 1)

**Drilling Signal cable** is connected to the percussion so the system knows when to measure length.

If inactive the system doesn't measure length.

If active the system measures length.

**Note:** All cables are connected with splash-proof, IP67 connectors.

### Length transducer Standard length transducer (with integrated sprocket wheel for chain feeds):

Mount the length transducer on the feeder on the opposite side to the drifter with the chain wheel pointing downwards in a place where it can link into the feeder chain.

### Rig-specific length transducer (measures chain wheel movement):

Measure the distance from the chain wheel to the cover's mounting plate (A). Check that the two proximity switches are placed at a distance 2 mm less than the distance A.

If the distance is incorrect, loosen the switches and adjust to right distance.

*Do not tighten the nuts too much. Max torque 25 Nm ( 18 lb-ft ).*

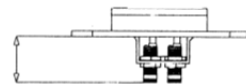
### Cylinder Feeder (transducer for cylinder or rope feeds)

Contact Transtronic AB

### Cables

The cables to the front transducers are protected by hydraulic hoses. Both ends of the hoses must be fixed to the supplied (saddle-type) bracket which shall be welded near the transducer.

The hoses shall be placed together with the other hoses on the boom.





## 5 Checking of the system

### 5.1 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  $\Sigma m$  (total).

<b>Upper Display</b>	<b>Lower display</b>
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Lower display shows the selected application.

101 = Production boom underground MP1 see drawing 09042230

102 = Production boom underground MP2 see drawing 09042231

103 = Exploration drill rig MP3 See drawing 09042232

If not contact Transtronic AB.

Press  $\Sigma m$  (total).

### 5.2 Transducer nodes

Upper display shows transducer node number.

Lower display shows '1' if the transducer node if the master can talk to the sensor and '0' if not.

Press  $\Sigma m$  (total) to select next transducer node.

<b>Upper Display</b>	<b>Lower display</b>
01	Length transducer <b>1</b> = mounted <b>0</b> = not mounted. <u>Note option</u>
04	Boom-joint (back) transducer <b>1</b> = mounted <b>0</b> = not mounted
05	Boom-joint (forward) transducer <b>1</b> = mounted <b>0</b> = not mounted
06	Boom-joint (boom/feeder) transducer <b>1</b> = mounted <b>0</b> = not mounted
	<u>Note used in application 101 and 103</u>
08	Inclination transducer. <b>1</b> = mounted <b>0</b> = not mounted
11	Side transducer. <b>1</b> = mounted <b>0</b> = not mounted

**Mounted transducer's node should show '1'. All other nodes should show '0'.**

To modify the above settings, go to "Setting of the System" (Chapter 12).

Check that all connected transducers are in contact with the master.

### 5.3 Checking transducers.

Press  $\Sigma m$  (total) several times until the upper display shows 16 (i.e. the last transducer node).

Press  $\Sigma m$  (total) again.

Now the system shows the values (after calibration) of the connected transducer.

If a transducer is not connected, the system shows the next transducer.

Upper Display	Lower display
1011	<b>Length transducer</b> counter. When the drifter is moved forwards the value shall increase. <u>Note option</u>
1041	<b>Boom-Joint (Back) transducer</b> (Node 4). Measures the angle between the carrier and the boom. When the boom is straight forward the value shall be approx $0^0$ ( $\pm 3^0$ ). Check that the lower display counts according to 04092230.
1051	<b>Boom-Joint (Forward) transducer</b> (Node 5). Measures the mechanic angle in the forward horizontal movment. When the boom is straight forward the value shall be approx $0^0$ ( $\pm 3^0$ ). Check that the lower display counts according to 04092230.
1061	<b>Boom-Joint (Boom/Feeder) transducer.</b> (Node 6) Measures the angle between the boom and the feed. When the feed is vertical pointing upwards the value shall be approx $0^0$ ( $\pm 3^0$ ). Check that the lower display counts according to drawing 04092230. <u>Note used in application 101 and 103</u>
1081	<b>Inclination transducer</b> (Node 8)When the boom is horizontal the value shall be approx $0^0$ ( $\pm 3^0$ ). Check that the lower display counts according to drawing 04092230.
1111	<b>Side transducer</b> (Node 11)Check that the lower display counts according to drawing 04092230.

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

## 6. Calibrating the System.

Adjust the carrier to level.

Adjust the boom to straight forward and horizontal.

Adjust the feeder to vertical (drilling up on the right hand side of the boom) in both the side and dump directions.

**Note If exploration (application 103) drill rig set the feeder straight forward.**

Turn the system off. (Not necessary if you already are already in trouble shooting mode - then continue to press  $\Sigma m$  (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  $\Sigma m$  (total) several times until the upper display shows 2021

For zero setting of a transducer press reset // button.

To select the next transducer press  $\Sigma m$  (total).

### Upper display

2041	Boom-Joint (Back) transducer.
2051	Boom-Joint (Forward) transducer.
2061	Boom-Joint (Boom/Feeder) transducer.
2081	Inclination transducer.
2111	Side transducer.

### Lower Display

(shows the value of the sensor before and after calibration).  
Note used in application 101 and 103

## 7. Operator settings

Turn the system off. (Not necessary if you already are already in trouble shooting mode then continue to press  $\Sigma m$  (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  $\Sigma m$  (total) several times until the upper display shows 3101

### Upper display

3101

To save value press reset // button.

To change function press  $\Sigma m$  (total).

### Lower Display

Not in use

Drill rod length

### Upper display

3102

### Lower Display

Shows the maximal rod length.

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

0.0 is disconnection (i.e. when length measurement not used)

### Upper display

3103

### Lower Display

Shows the resolution in angle measurement.

Press down the +/- knob and turn to the resolution increment required. 0.1, 0.2, 0.5 are the available choices.

To save value press reset // button.

To change function press  $\Sigma m$  (total).

## 8. Test of Output Signals (Reset Button)

Turn the system off. (Not necessary if you already are in trouble shooting mode then continue to press  $\Sigma m$  (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  $\Sigma m$  (total) several times until the upper display shows 3201

### Upper display

3201

### Lower Display

Shows nothing. When pressing // button the output signal becomes active and the lower display will show '1'.

## 9. Test of Input Signals (i.e. Drilling signal)

Turn the system off. (Not necessary if you already are in trouble shooting mode then continue to press  $\Sigma m$  (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  $\Sigma m$  (total) several times until the upper display shows 3301

### Upper display

3301

### Lower display

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

3401

### Lower display

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.

## 10. Troubleshooting angle system

### Fault

### Action

If a cable is broken or if a transducer fails the upper display will show “**Err**” and the lower display will show the transducer node number which has failed. If more than one node has failed the display will toggle between the faulty node numbers.

If the master doesn't have contact with any transducer the display will show “**OFF**”.

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 dump or side unstable  
or shows incorrect value.

Run the trouble shooting mode and try to locate the  
faulty transducer. (See chapter 5.3)

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 correctly,  
change the master.

## 11. Troubleshooting length system

### Fault

### Action

Length measurement doesn't work

Run the trouble shooting mode and try to locate the  
fault. See chapter 5.3 (Upper Display 1011).

Missing signal from the length transducer.

Check the cable to the length transducer.  
Check that the proximity switches in the length  
transducer are ok by measuring voltage inside the  
connection box on the feeder (if chain feeder sensor  
is used). See drawing 06041830

If no drilling signals

Trouble shoot the control signal connections in the  
Electrical cabinet. See drawing 06041830

## 12 Setting of the system (after new installation or change of master)

Here you tell the system witch transducer that is connected (mounted):

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  $\Sigma$ m (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  $\Sigma$ m (total).

Function	Upper Display	Lower Display
<b>Length Transducer</b>	<b>01</b>	
Connected		<b>1</b>
Not connected		<b>0</b>
Press $\Sigma$ m (total).		
<b>Boom-Joint (Back) Transducer</b>	<b>04</b>	
Connected		<b>1</b>
Not connected		<b>0</b>
Press $\Sigma$ m (total).		
<b>Boom-Joint (Forward) Transducer</b>	<b>05</b>	
Connected		<b>1</b>
Not connected		<b>0</b>
Press $\Sigma$ m (total).		
<b>Boom-Joint (Boom/Feeder) Transducer</b>	<b>06</b>	
Connected		<b>1</b>
Not connected <u>Note used in application 101 and 103</u>		<b>0</b>
Press $\Sigma$ m (total).		
<b>Inclination transducer</b>	<b>08</b>	
Connected		<b>1</b>
Not connected		<b>0</b>
Press $\Sigma$ m (total).		
<b>Side transducer</b>	<b>11</b>	
Connected		<b>1</b>
Not connected		<b>0</b>
Press $\Sigma$ m (total).		

Press  $\Sigma$ m (total) until 1011 appears on the upper display (or the first connected transducer).

<b>Length transducer direction</b>	<b>1011</b>	
Normal		<b>0*</b> (** is default)
Reversed direction <u>Note option</u>		<b>1</b>
<b>Boom-Joint Back direction</b>	<b>1041</b>	
Normal		<b>0*</b> (** is default)
Reversed direction		<b>1</b>
<b>Boom-Joint Forward direction</b>	<b>1051</b>	
Normal		<b>0*</b> (** is default)
Reversed direction		<b>1</b>
<b>Boom-Joint Boom/Feeder direction</b>	<b>1061</b>	
Normal		<b>0*</b> (** is default)
Reversed direction <u>Note used in application 101 and 103</u>		<b>1</b>
<b>Inclination transducer direction</b>	<b>1081</b>	
Normal		<b>0*</b> (** is default)
Reversed direction		<b>1</b>
<b>Side transducer direction</b>	<b>1111</b>	
Normal		<b>0*</b> (** is default)
Reversed direction		<b>1</b>

Press  $\Sigma$ m (total) until 5002 appears on the upper display.  
(or the first connected transducer).

<b>Chain selection for the length transducer</b>	<b>5002</b>	
cylinder feeder 1:2		<b>1*</b>
cylinder feeder 1:1		<b>2</b>
1"		<b>3</b>
1 1/4"		<b>4</b>
1 1/2"		<b>5</b>
1 3/4"		<b>6</b>
2"		<b>7</b>
1"Wire		<b>8</b>
Setting of measurement distance (mm)/pulse		<b>0</b>

To change to 10 of mm press  $\Sigma$ m. Press // to save value in the length transducer.



<b>Drilling signals connection</b>	<b>5003</b>	
Only one drilling signal (e.g. percussion or rod handling)		<b>1*</b>
Drill 1   Drill 2		
0            x            Length measurement off		
1            x            Length measurement on		
The normal way to use one drilling signal 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)		<b>2</b>
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:		<b>3</b>
<b>Hole length or hole depth</b>	<b>5004</b>	
Hole length		<b>0*</b>
Hole depth		<b>1</b>
<b>Type of length measurement mode</b>	<b>5005</b>	
Length of the hole		<b>0</b>
(Shows the length of the drilled hole).		
Position of the bit.		<b>1*</b>
(The system keeps a steady check of the position of bit).		
<b>Hammer type on rig</b>	<b>5006</b>	
Top Hammer		<b>0*</b>
ITH hammer		<b>1</b>
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.		
<b>Measurement units</b>	<b>5007</b>	
Metric		<b>0*</b>
US		<b>1</b>
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 $\Sigma$ m (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		
<b>Not used</b>	<b>5008</b>	

## 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 (Back) values  
 1061 Boom-Joint (Forward) values  
 1081 Inclination angle transducer  
 1111 Side angle transducer

#### 2000 Zero setting

2041 Zero setting Boom-Joint (Back)  
 2061 Zero setting Boom-Joint (Forward)  
 2081 Zero setting Inclination transducer  
 2111 Zero setting Side Angle 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
- 4 Boom-Joint (Back) Transducer
- 6 Boom-Joint (Forward) Transducer
- 8 Node on/off Inclination transducer
- 11 Node on/off Side transducer

#### 1000 Direction node

1011 Direction length transducer  
 1012 Not Used  
 1041 Direction Boom-Joint (Back) transducer  
 1061 Direction Boom-Joint (Forward) transducer  
 1081 Direction Inclination transducer  
 1111 Direction Side Angle Transducer

#### 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 for Benching

### Signal cables connection

