



EA Heightmaster +

Operators Guide



This guide describes operation of the
PROLEC EA HEIGHTMASTER+

Model covered :	MODEL NAME	EA HEIGHTMASTER+
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Manufacturers original instructions

Section	Subject	Page
1.0	System Description	6
1.1	RCI	6
1.2	Height Limiting	7
1.3.0	MIN Radius Limiting (Cab Protection)	9
1.3.1	Dual Redundancy Bucket System (Optional)	10
2.0	System Components	11
3.0	System Operation	13
3.1	Power On	13
3.2	Initialisation	13
3.3	Key Switch Positions	13
3.4	Key Switch in RCI Position	14
3.5	Key Switch in VARIABLE ADJUST Position	15
4.0	Key Switch in 3.7m and 4.6m positions - Fixed Height Limits	16
5.0	Functions of the RCI Key Switch Position	17
5.1	Time/ Date Mode	17
5.2	Rated Capacity Indicator Mode	18
5.3	Dig Depth Monitoring Mode	19
5.4	Change Duty Mode	21

Section	Subject	Page
6.0	Functions of the VARIABLE ADJUST Key Switch Position	22
6.1.0	Setting the height limit at an operator derived equipment position	22
6.1.1	Setting the Height Limit to a Known Height	24
6.1.2	Switching OFF Height Monitoring	26
6.1.3	Variable Height Limit Active Indicators	27
6.2	No Protection Transport Mode	28
6.3.0	MIN Radius Limiting (Cab Protection)	29
6.3.1	Selecting the MIN Radius limits (Bucket or Attachment) (Cab Protection)	29
6.3.2	MIN Radius Limiting (Cab Protection) Dual redundancy Bucket System	30
7.0	Variable Height Limit - Key Switch in Variable Existing Setting Position	31
8.0	Height Alarm Conditions	32
9.0	System Test	33
10.0	Error Conditions	36

1.0 System Description

EA Heightmaster+ provides a Rated Capacity Indicator (RCI), Height Limiting, Cab Protection, Dig Depth Monitoring and a Transportation mode for use on monoboom and triple articulated machines.

The system will allow the use of telescopic sections along with secondary booms and arms giving real time height measurements with automatic/ manual duty switching.

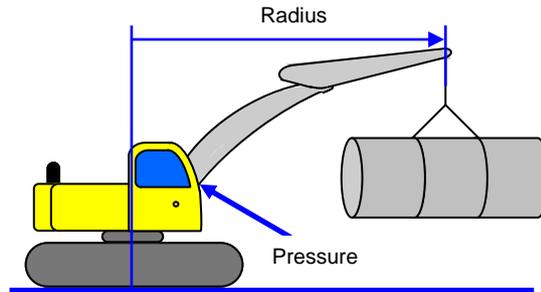
A keyswitch is supplied allowing quick access to functions along with locking the system into certain modes.

Motion control is standard on the EA Heightmaster+ allowing motion to be cut to the boom, artic and arm for Height Limiting and Cab Protection.

1.1 RCI

EA Heightmaster+ RCI mode displays the current maximum safe working load (SWL) in tonnes. In RCI mode, the top line of the display shows the current bucket pin radius and the maximum safe working load at that radius. The bar graph on the lower line will indicate the proximity of the current load to the maximum available safe working load. The system indicates an approach to overload and an overload condition via internal and external alarms along with visual indicators on the display.

To calculate the SWL, the radius of the bucket pin (Or Lifting point) and the pressure within the boom lifting rams are used.



1.2 Height Limiting

The EA Heightmaster+ provides accurate monitoring of height and will alarm and cut motion at a user definable height or by selecting one of the two predefined height limits of 3.7 and 4.6 m. These are indicated on a lamp bar. EA Heightmaster + uses a COMBI BOX (see section 2.0) which allows the system to interface with hydraulic solenoid valves on the pilot control circuits to physically prevent the height limit from being exceeded. The system is suitable for monoboom or triple articulation excavators and those with telescopic

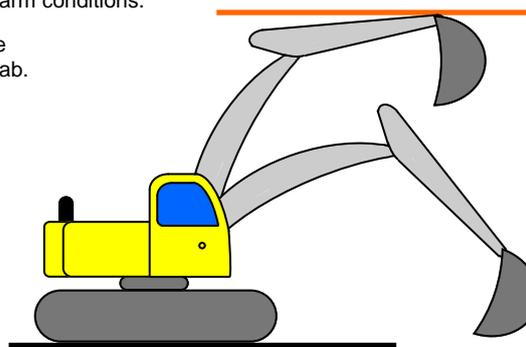
The EA Heightmaster+ :

1. Allows the machine to work under restricted areas.
2. Can control the machine equipment motion to prevent access into the restricted area.
3. Provides the user with a clear display of the equipment height and of alarm conditions.
4. Allows the height limit to be set from the safety of the cab.

When the excavator equipment reaches the set height limit, the visual and audible alarms will activate and the corresponding equipment motion will be cut, halting further movement into the height limit.



Lamp Bar

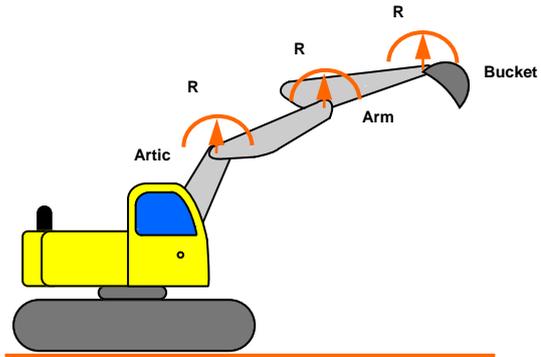


Raising of the Boom, artic or Arm will be cut depending upon which section is at the height limit.

Excavator operates uninhibited under the set height limit.

1.2 Height Limiting - Continued

The EA Heightmaster+ system calculates the height of each articulation at its pivot pin and can take into account any part of the articulation which extends above the pivot pin.



Guide to equipment pin positions used to determine height

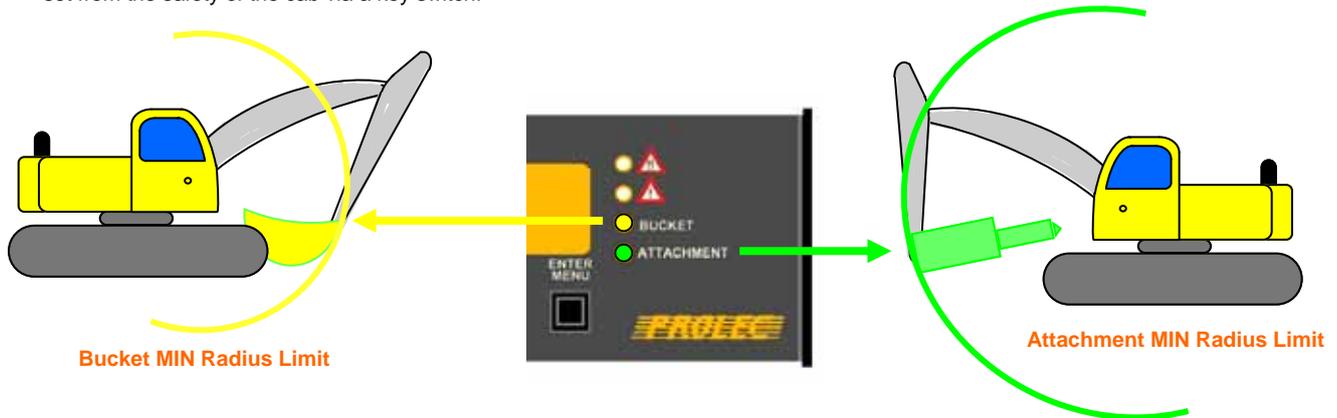
- Artic = Artic Pin
- Arm = Arm Pin
- Bucket = Bucket Pin
- R = Residual height

1.3 MIN Radius Limiting (Cab Protection)

The Min Radius Limit limits the bucket pin from entering one of two predefined minimum radii. EA Heightmaster + uses a COMBI BOX (see section 2.0) which allows the system to interface with hydraulic solenoid valves on the pilot control circuits to physically prevent the Min Radius Limit from being exceeded. The Min Radii Limits are stored in the memory each time it is set. When the system is switched on, the last Min Radius Limit selected will become operative. The yellow LED on the display is lit when the bucket radius is selected and the green LED is lit when the attachment radius is selected. This function cannot be cancelled or adjusted by the operator. True Height and radius are given with telescopic section equipped machines.

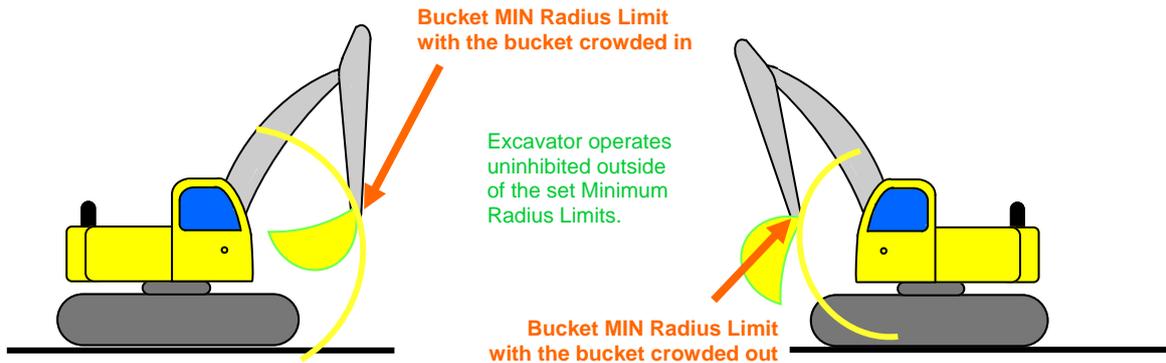
The EA Heightmaster+ :

1. Constantly monitors the bucket pivot pin radius
2. Motion is cut to prevent equipment from entering excluded zones
3. Provides the user with a clear display of alarm conditions.
4. Allows two preset Min Radii Limits (Bucket and Attachment) to be set from the safety of the cab via a key switch.



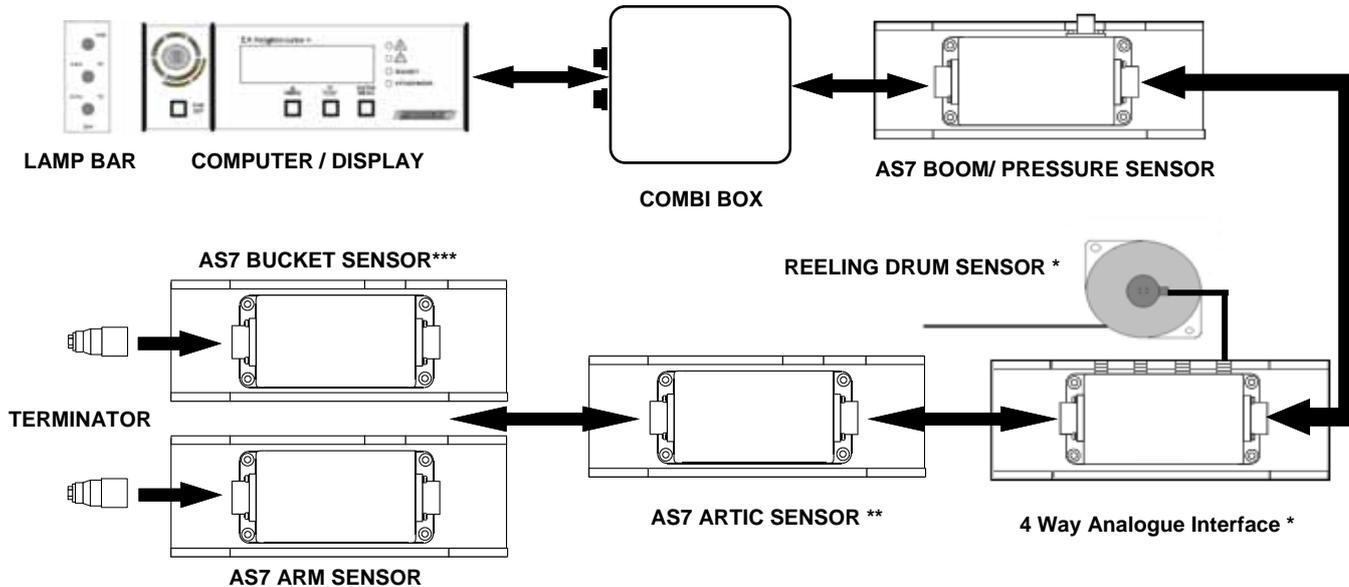
1.3.1 Dual Redundancy Bucket System (Optional)

As an option, EA Heightmaster + can monitor the position of the bucket / attachment (Bucket shown in example) and automatically adjust the current Cab Protection Limit by a preset distance. There are two states, crowded in and crowded out. This allows the bucket pivot pin to come in closer to the cab if the bucket is crowded out.



When the bucket pivot pin reaches the set radius limit, depending on the attitude of the bucket, it will either cause the visual and audible alarms will activate and the corresponding equipment motion to be cut at the inner limit or the outer limit.

2.0 System Components



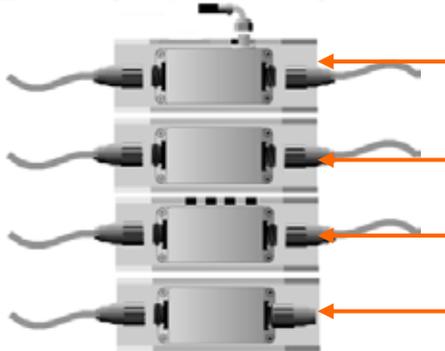
The EA Heightmaster+ uses CAN2.0B communication technology. A single cable run connects all the system components. Power from an ignition switched source is connected to the LCD/Computer. All the cables have 6-way screw type connectors. These have a common pin-out, and are polarised, allowing any cable to be plugged into any device or sensor without causing damage.

*Telescopic sections only **Triple articulation machines only – secondary boom sensor ***Additional arm sensor labelled bucket angle sensor

2.0 System Components - Continued



Cab mounted combined Computer/LCD display unit with lamp bar. Rear mounting plate carries sockets for connection to DC power, lamp bar and the CAN system.



AS7 boom angle/ pressure sensor (or primary boom sensor on hydraulically adjustable booms). This sensor is usually mounted on the OFFSIDE of the boom. The sensor is connected to the Combi Box and to either the arm sensor on monoboomb machines, or the secondary boom sensor on hydraulically adjustable booms.

[OPTIONAL] Secondary boom angle sensor (AS7 Artic sensor) for hydraulically adjustable booms. This sensor is usually mounted on the OFFSIDE of the secondary boom. The sensor is connected to the primary boom sensor and arm sensor.

[OPTIONAL] 4-way Interface box. This is fitted to machines with telescopic section. It will be located in an appropriate location in the CAN line near to the reeling drum.

AS7 Arm/ Bucket [OPTIONAL] angle sensor usually mounted on the NEARSIDE of the arm near the pivot pin. The sensor is connected to the boom sensor. The bucket sensor is fitted to any extra arms that are supplied with the machine. This sensor has a special 'Terminator' plug fitted. This is required for correct system operation.

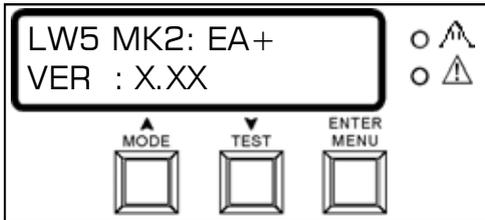


4 way Combi Box provides the interface to solenoid valves which control the motion of the machine equipment.



[OPTIONAL] Reeling drum only fitted to telescopic booms. This can be mounted on the side or top at the base of the boom. The reel will extend and retract with the boom.

3.0 System Operation



3.1 Power On

EA Heightmaster+ will only operate when it is switched on.

To activate the EA Heightmaster+ turn the key switch to any position other than OFF. The System title and software version will be momentarily displayed before proceeding to the selected mode. See section 3.3.

3.2 Initialisation

Once activated, EA Heightmaster+ will perform an initialisation procedure. This will take three to four seconds, during which time all sensors and auxiliary components are checked for correct operation. If all checks are successfully completed, operation will commence. The next screen displayed is dependant on the position of the key switch. If problems are detected during initialisation, relevant warning message(s) will be issued.

See section 10 for further information on error conditions.

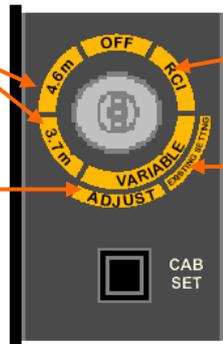
3.3 key Switch Positions

3.7m and 4.6m Fixed Height

With the key switch in the 3.7m or 4.6m position, the predefined height limits are selected. See section 4.0 for further details.

Variable Adjust

With the key switch in the Variable Adjust position, three functions can be accessed; variable height limit setting, selecting minimum radius limits and No Protection Transport Mode. See section 3.5 for further details. See section for more information.



RCI

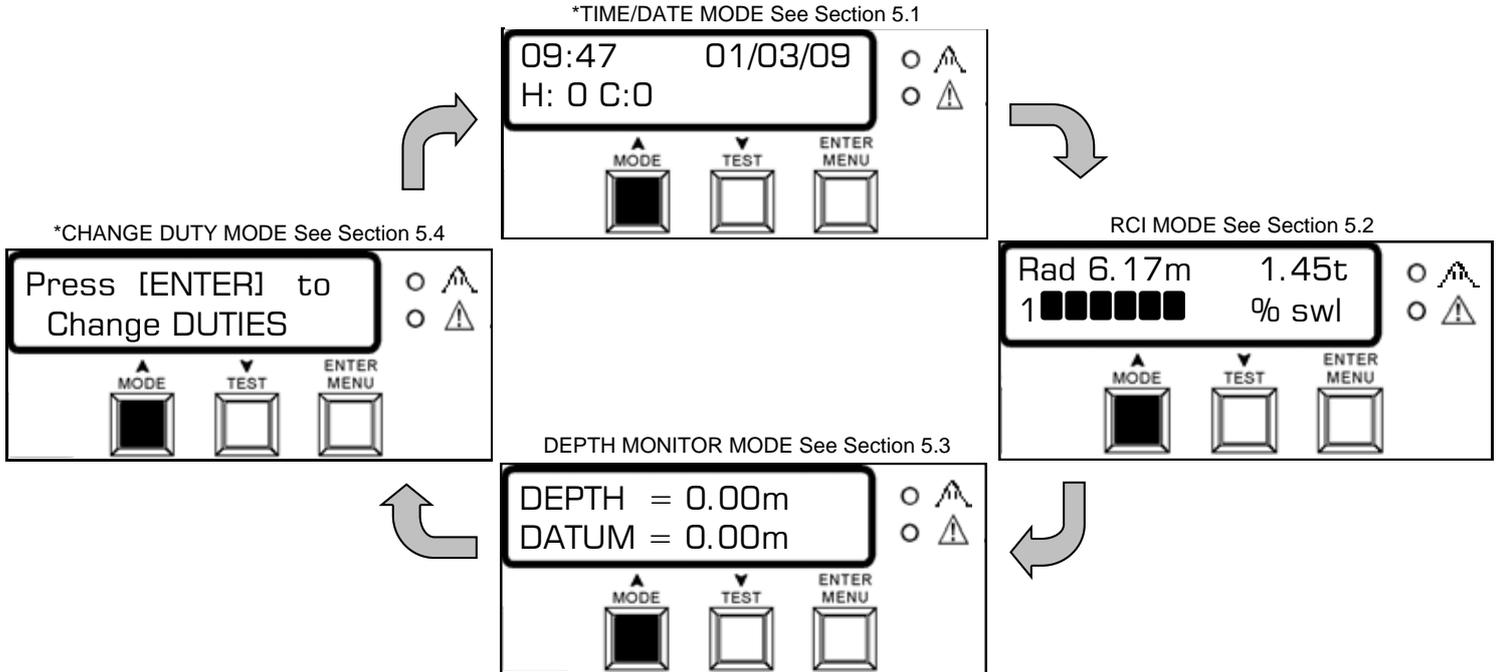
With the key switch in the RCI position, RCI mode and duty selection can be accessed. See section 3.4 for further details.

Variable Existing Setting

With the key switch in the Variable Existing Setting position, the variable height monitoring will be activated. See section 6.0 for further details.

3.4 Key Switch in RCI Position

Pressing the MODE button will cycle the EA Heightmaster+ through the four available operational modes as shown below with the key in the RCI position.

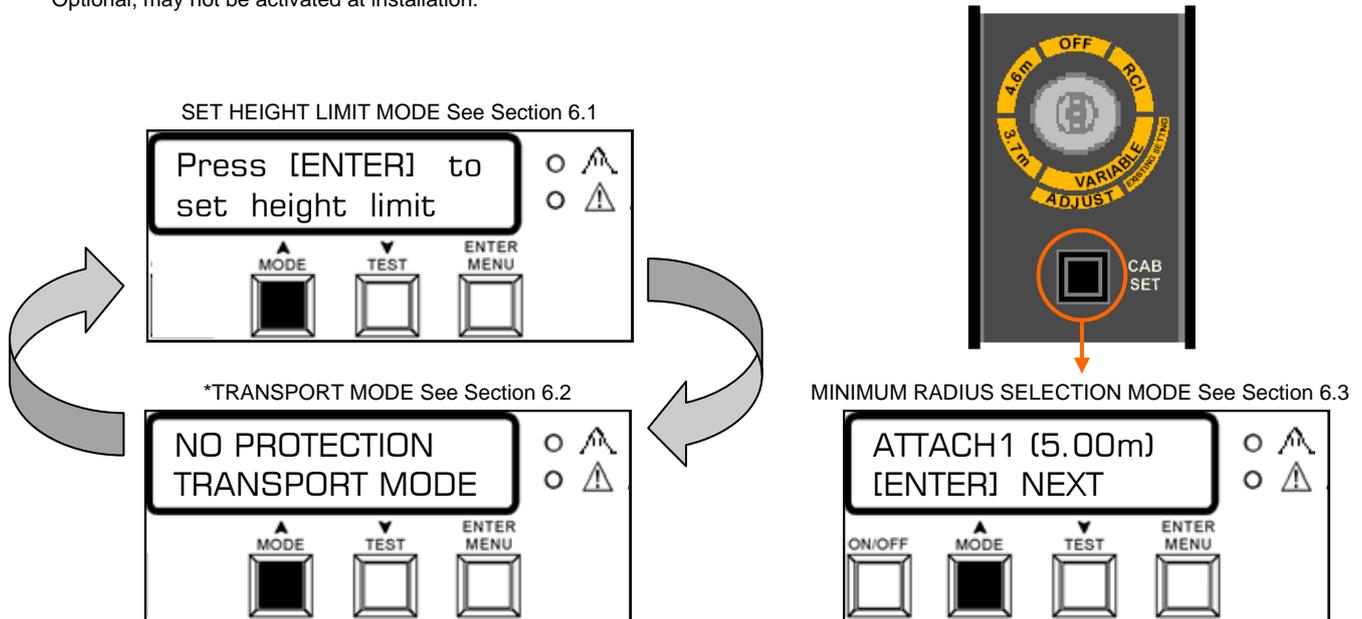


* Optional, may not be activated at installation.

3.5 Key Switch in VARIABLE ADJUST Position

Pressing the MODE button will cycle the EA Heightmaster+ through the two possible operational modes as shown below with the key in the VARIABLE ADJUST position. Additionally, pressing the Cab Set button below the key switch allows access to select the preset minimum radius limits.

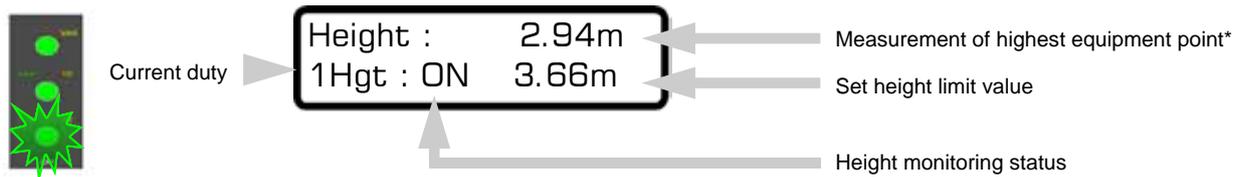
* Optional, may not be activated at installation.



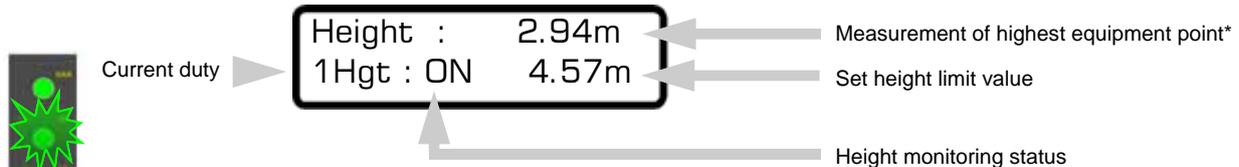
4.0 Key Switch in 3.7m and 4.6m positions - Fixed Height Limits

With the Key switch in either the 3.7m or 4.6m positions, the screen displays the following information for each position. Also, the 3.7m or the 4.6m lamp will be lit. The system will alarm and motion will be cut if the either preset height limit is reached. If the variable height limit has been previously set, it will be deactivated and the VAR lamp will no longer be illuminated.

KEY SWITCH IN 3.7m POSITION



KEY SWITCH IN 4.6m POSITION

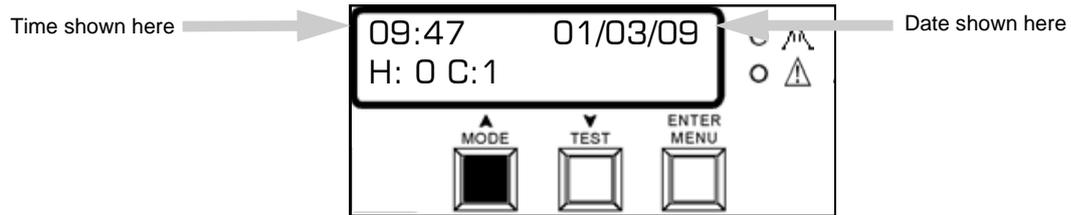


All heights are referred to equipment pins plus, and where applicable will include the residual height – Triple articulation machine shown in the example

5.0 Functions of the RCI Key Switch Position

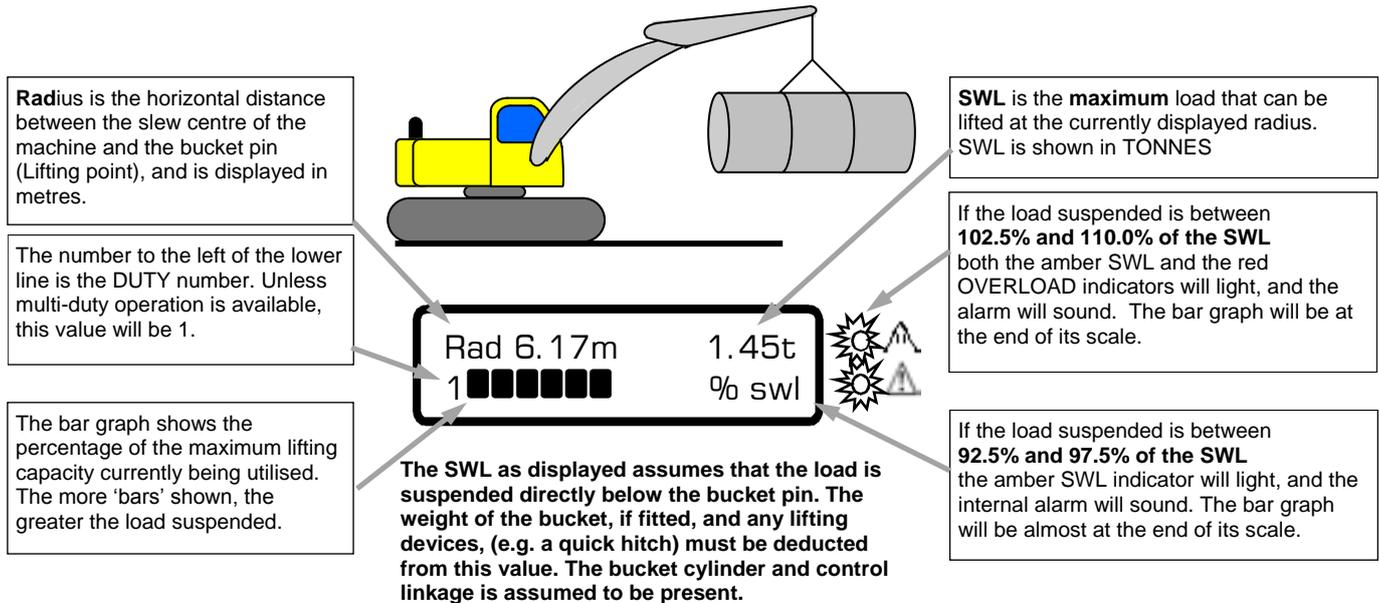
5.1 Time/ Date Mode

In this mode the system will display the current time, date and Height and Cab Limit monitoring status. *This mode is optional and may not have been activated at installation.



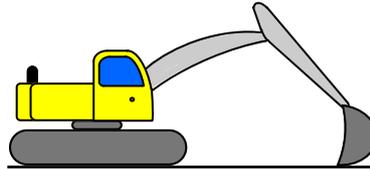
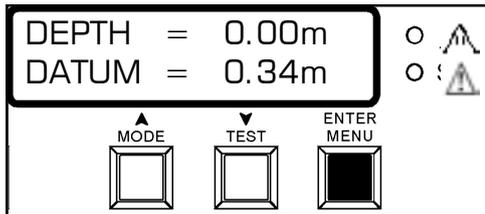
5.2 Rated Capacity Indicator Mode

In the RCI MODE the top line will display the current bucket pin radius and the maximum safe working load at that radius. The bar graph on the lower line will indicate the proximity of the current load to the maximum available safe working load. Approach to SWL and OVERLOAD are indicated by audible and visual indicators.

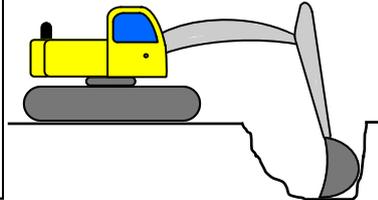
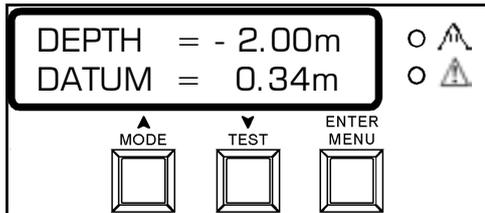


5.3 Dig Depth Monitoring Mode

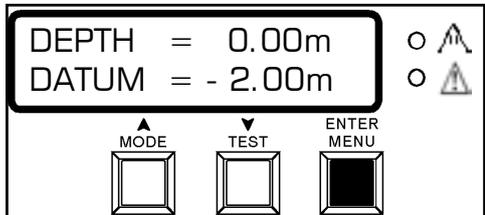
As the EA Heightmaster + system has equipment-mounted angle sensors, it has the capability to measure bucket tooth depth. Although a bucket angle sensor is not a standard feature, careful operation and control of bucket attitude can produce accurate trenching and basement excavations. Use the MODE button to scroll through the options until the display shown below appears. The operation sequence described here gives an example of how the system can be used.



A. Position the bucket on the ground at the start of the excavation, with the bucket in the attitude shown in the diagram. Correct depth will only be displayed when measurements are taken with the bucket in this attitude. This is because EA Heightmaster+ does not have a bucket angle sensor. Press ENTER to set the datum at this elevation. At this point the DEPTH value will change to 0.00, and the new DATUM will become the current ground level.

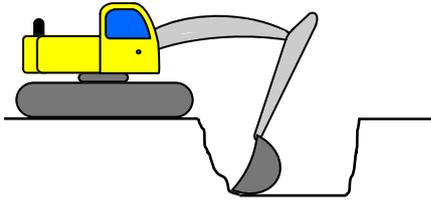


B. Dig to the required depth using the DEPTH value on the top line (remembering that the bucket must be in the attitude described above to measure accurately). In this example the basement depth is 2.00m (or -2.00m below the initial DATUM). NOTE: because the current depth is BELOW the current DATUM, the 'TOO LOW' internal alarm will sound.

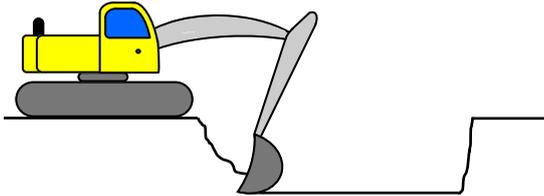


C. Place the bucket (in the attitude described in 1) in the bottom of the trench at the target depth, and press the ENTER button to re-reference the system. The current DEPTH will change to 0.00m (i.e. the distance to the target datum), and DATUM will change to -2.00m (i.e. target depth). The system is now fully referenced and ready for use.

5.3 Dig Depth Monitoring Mode - Continued



D. The basement/trench can now be extended at will. To extend, move the machine to the new position, place the bucket at the base of the initial excavation, and press the ENTER button to re-reference the position. The excavation can now be continued without the need to watch the display. When the correct depth is achieved (or exceeded) the 'TOO LOW' internal alarm will sound. As the system has been referenced to the bottom of the initial excavation (and not to the track base of the machine) the position/height of the actual excavator is not important.



5.4 Change Duty Mode

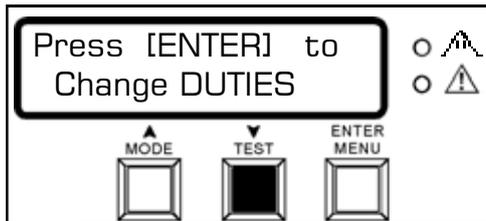
The Change Duty mode can only be accessed with the key switch in the RCI position cycle and if manual duty selection has been activated (This forms part of the calibration and set-up of the unit, which is not accessible during normal operation). Multiple duties allow the machine to have more than one lifting duty. On tracked machines this may be used to allow both 360° and OVER FRONT/ REAR lifting sectors for increased lifting capacity, or on wheeled machines it could be used for any combination of sector, support blade and stabiliser usage. Automatic duty switching is available via the combi box, reeling drum or by sensor identification, and can be used in conjunction with manual duty switching.

If idle, this mode will time out and return to RCI mode after 15 seconds.

Automatic duty changing will be via the following:

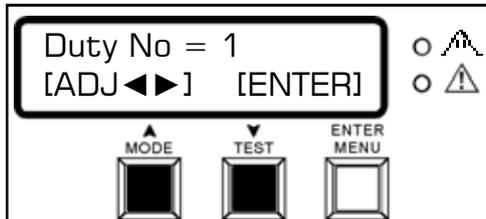
Reeling drum mounted on a telescopic section

Additional arm with bucket sensor attached



A. Use the mode button to cycle through the available modes until the 'change duty' option is displayed. Pressing ENTER will allow adjustment of the current lifting duty. Pressing MODE will continue the mode cycle leaving the current setting unaltered.

If ENTER is pressed, the display shown below will appear.

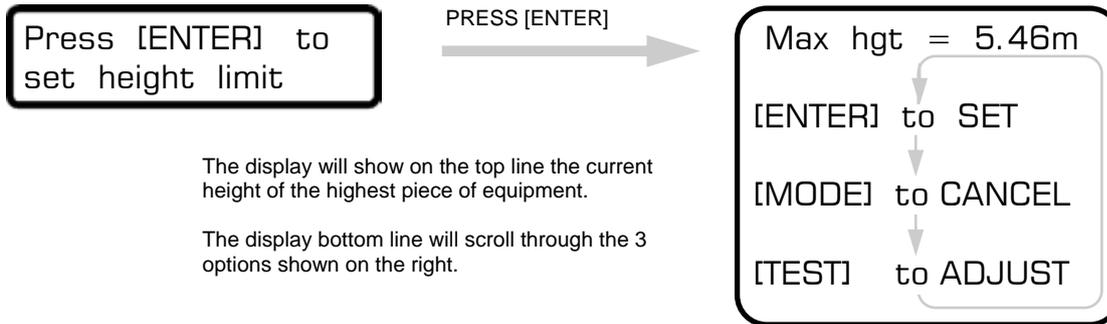


B. Use the UP & DOWN keys to select the required duty. The load chart issued with the EA Heightmaster+ system will list all available lifting duties. There is a maximum of 8 possible duty selections. Press ENTER to confirm the selection. After duty changes are made, control always returns to the Rated Capacity Indicator mode. The new duty number will appear in the lower left of the display.

6.0 Functions of the VARIABLE ADJUST Key Switch Position

6.1.0 Setting the height limit at an operator derived equipment position

Turn the key switch to the Variable Adjust position and press [ENTER] to access the set height limit display.

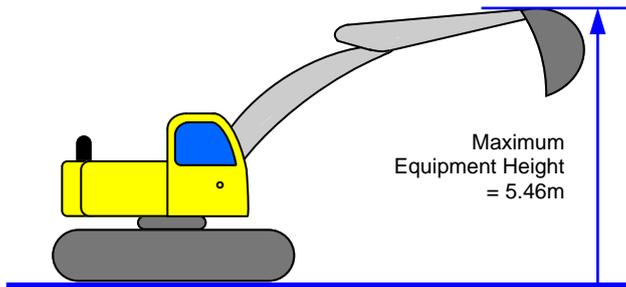


The display will show on the top line the current height of the highest piece of equipment.

The display bottom line will scroll through the 3 options shown on the right.

Continued overleaf

6.1.0 Setting the height limit at an operator derived equipment position - Continued



In this example the maximum equipment height is referred to the bucket pin.

Max hgt = 5.46m
[ENTER] to SET

The display will show the current height, move the equipment to the desired new maximum height.

PRESS
[ENTER]

<<<<LIMIT>>>>
! ARM TOO HIGH

The system will be in alarm mode until the equipment is lowered from the SET height. The VAR lamp will now be lit.

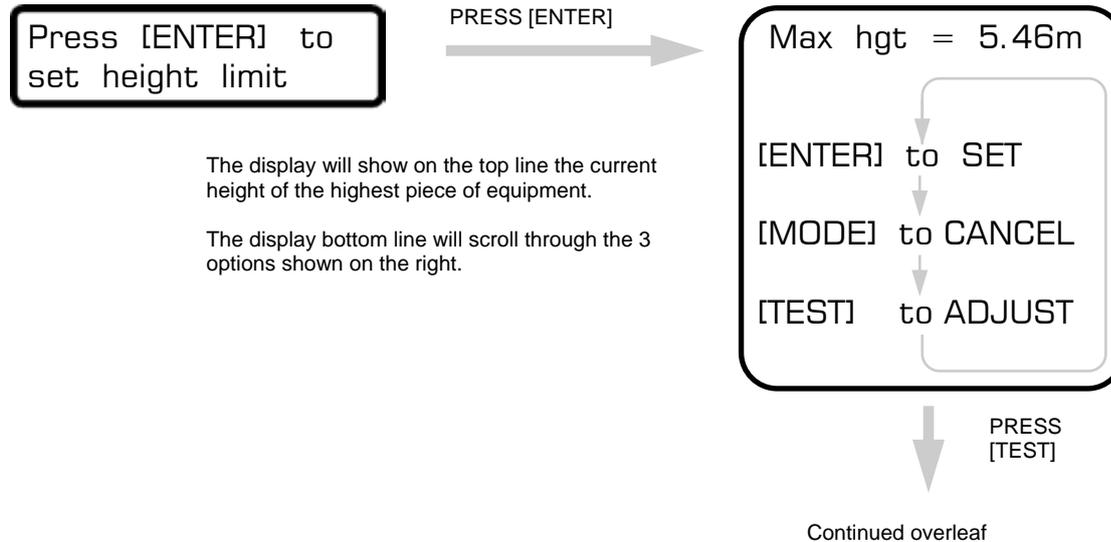
Press [ENTER] to
set height limit

The system will return to the height setting screen if the machine is not in an alarm condition or if the equipment is lowered out of an alarm condition.

The Height monitoring mode is now active, any piece of equipment which intrudes into the set Height Limit will cause the relevant alarm and motion cut condition to occur. Variable height limit is not active with key switch in 3.7m or 4.7m positions.

6.1.1 Setting the Height Limit to a Known Height

Turn the key switch to the Variable Adjust position and press [ENTER] to access the set height limit



6.1.1 Setting the Height Limit to a Known Height - Continued

THE display will show the current set height Limit.

Use the ◀ (MODE) and ▶ (TEST) buttons to adjust the set height to the required value.

Hgt MAX = 5.46
[ADJ◀▶] [ENTER]

PRESS
[ENTER]

<<<<LIMIT>>>>
! ARM TOO HIGH

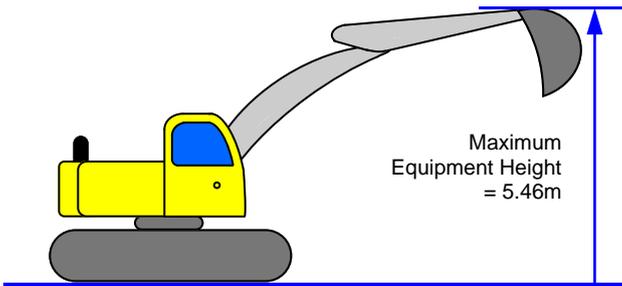
Press [ENTER] to
set height limit



Lamp Bar

The system may be in alarm mode until the equipment is lowered from the SET height. The VAR lamp will now be lit on the lamp bar.

The system will return to the height setting screen if the machine is not in an alarm condition or if the equipment is lowered out of an alarm condition.



In this example the maximum equipment height is referred to the bucket pin.

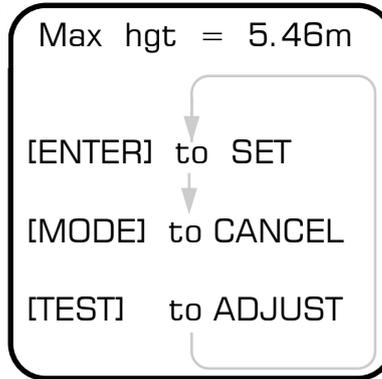
The Height monitoring mode is now active, any piece of equipment which intrudes into the set Height Limit will cause the relevant alarm and motion cut condition to occur. Variable height limit is not active with key switch in 3.7m or 4.7m positions. Ensure that the correct limit is selected and that it alarms correctly.

6.1.2 Switching OFF Height Monitoring

Turn the key switch to the Variable Adjust position and press [ENTER] to access the set height limit display.

Press [ENTER] to set height limit

PRESS [ENTER]



The display will show on the top line the current height of the highest piece of equipment.

The display bottom line will scroll through the 3 options shown on the left.

PRESS [MODE]

Press [ENTER] to set height limit

The operator set height limit will now be off. The VAR lamp on the lamp bar will no longer be lit with the key switch in the RCI, Variable Existing Setting and Variable Adjust positions.



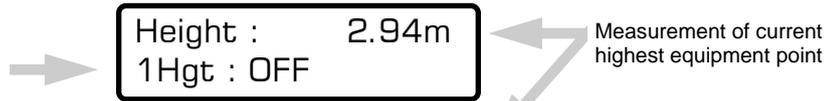
Lamp Bar VAR light not lit when variable height is off.

6.1.3 Variable Height Limit Active Indicators

To determine if a variable height limit is active and too what value it is set to will depend on the keyswitch position and the current mode.

Key Switch in Variable Existing Setting position

Hgt : OFF indicates height Limiting is off.



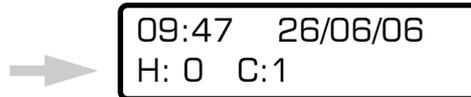
Hgt : ON indicates height Limiting is on.



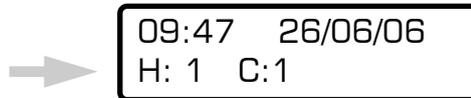
With Key switch in RCI position

In Time/ Date Mode:

Height monitoring status H:0 indicates height Limiting off.



Height monitoring status H:1 indicates height Limiting on.



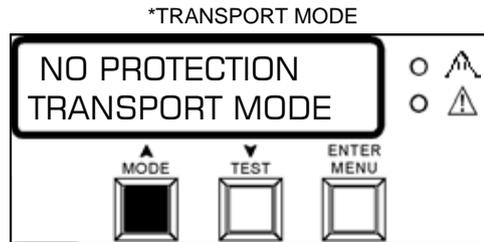
Lamp Bar VAR light lit when variable height is on.

6.2 No Protection Transport Mode

With NO PROTECTION TRANSPORT MODE selected, the SWL is not monitored, any height limit set will not be monitored and CAB protection is not operational.

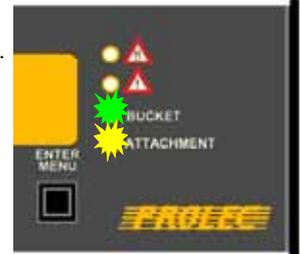
The alarm will sound every four seconds in this mode.

*This mode is optional and may not have been activated at installation.



6.3 MIN Radius Limiting (Cab Protection)

EA Heightmaster+ has *two minimum radius limits, bucket and attachment, which are selectable via the key switch. One of the two minimum radii limits will be active at all times regardless of key switch position (Cab Protection will not be active when in selection mode) and cannot be cancelled or deactivated. To identify which limit is active, either the Bucket LED or the Attachment LED will be lit. To switch between limits, position the key switch in Variable Adjust and press and hold the CAB button. See section 1.3.

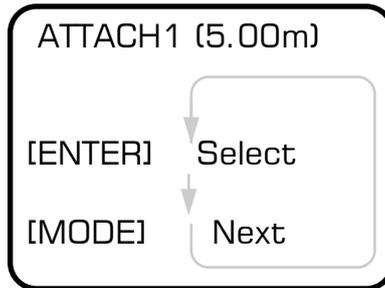


6.3.1 Selecting the MIN Radius limits (Bucket or Attachment) (Cab Protection)

Position the key switch to the Variable Adjust position and press and hold [Cab Set] to access the select MIN Radius Limit display.

The display will show on the top line the currently selected radius (ATTACH1 or BUCKET).

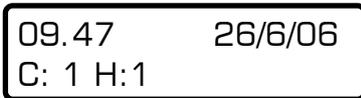
The display bottom line will scroll through the 2 options shown on the right.



Press [ENTER] to select the displayed limit

Press [NEXT] to select the alternative limit

Once a radius limit is selected, the position of the machine may activate the alarm mode until the equipment is moved from the limit. Ensure that the correct limit is selected and that it alarms correctly.



With the key switch in the RCI position, in the Time/ Date Mode, 'C' will always equal 1 to show a MIN Radius Limit is set.

* Some systems have been calibrated with more than two minimum radius limits, see cab sticker supplied.



6.3.2 MIN Radius Limiting (Cab Protection) Dual redundancy Bucket System

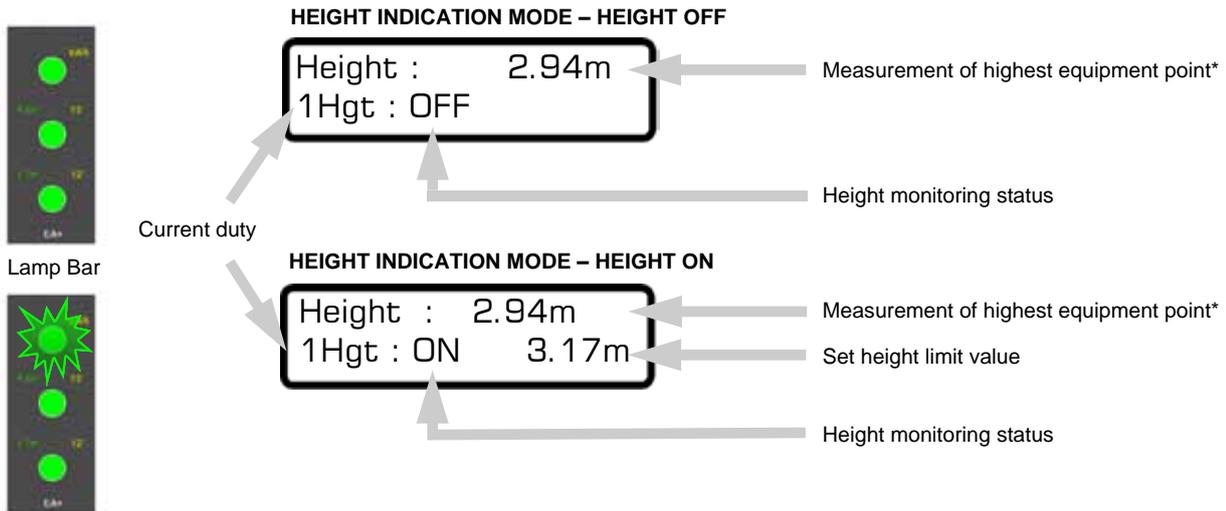
If the dual redundancy bucket system is fitted, the position of the bucket, crowded in or crowded out will automatically affect the minimum radius limit.

If the bucket is crowded in then the radius limit will be increased by a predetermined value. If the bucket is crowded out then the radius limit will decrease the a predetermined limit.

7.0 Variable Height Limit - Key Switch in Variable Existing Setting Position

With the Key switch in the Variable Existing Setting position, the screen displays the following information dependant upon the Variable Height monitoring being ON or OFF.

If the variable height limit is set, the VAR lamp will be lit, it will alarm and motion will be cut with the key switch in the RCI, Variable Existing Setting and Variable Adjust positions.



8.0 Height Alarm Conditions

When the machine equipment reaches a set height limit the EA Heightmaster + will go into alarm mode. The operator will be alerted visually, audibly and operationally of the condition.



The display will inform the user which piece of equipment is too high. The RED LED will illuminate. The internal and external alarms will sound.

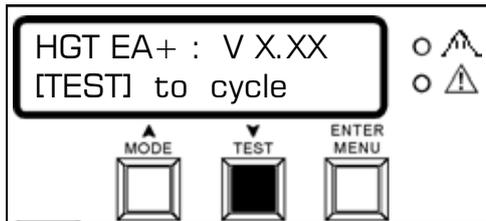
Depending on the piece of equipment causing the alarm condition, it will have its motion cut such that it cannot intrude into the set height limit any further. If the Arm is causing the alarm condition, motion to the Boom and Artic (If fitted) will be cut.

In the case of triple articulation machines both base boom and secondary boom (boom and artic) will be restricted from raising should either a "BOOM TOO HIGH" or "ARTIC TOO HIGH" condition occur.

The alarm condition will be cleared on lowering the equipment from the set height limit.

9.0 System Test

The EA Heightmaster+ has a comprehensive built-in test function that allows the operator to check all aspects of the system and its set-up. This function can be accessed at any time with the key switch in the VARIABLE ADJUST position by pressing the TEST button. Once this mode is accessed, pressing TEST will cycle the options available and pressing MODE will cancel the function and return to the previous operational mode. RCI, Height and radius monitoring and motions cuts are not active in TEST mode.



The initial test display is shown here. All information is displayed on the upper line. The lower line contains a scrolling message that says '[TEST] to cycle [MODE] to exit'. This will be present throughout the test procedure.

Current duty = 1

Current duty number

This displays the current operational duty selected.

Boom len = 5.20

Boom length

This is the straight line distance between the boom pivot pin and arm pivot pin, and is given in

Artic len = 3.70

Artic length

This is the length of the secondary boom section on an hydraulically adjustable boom. If the system is configured for monoboam equipment, this display will not appear. The length is the straight line distance between the secondary boom pivot pin and the arm pivot pin, and is given in metres.

9.0 System Test - continued

Arm len = 2.80

Arm length

This is the straight line distance between the arm pivot pin and bucket pivot pin, and is given in metres.

Alarm ON check

External alarm check

If the system has a Combi Box with external alarm this test will activate the external alarm.

Buzzer ON check

Internal alarm check

This test will activate the internal alarm which is mounted on the rear of the display housing.

Amber ON check

Amber alarm check

This test will activate the amber LED on the display front.

Red LED check

Red alarm check

This test will activate the red LED on the display front.

Green LED check

Green alarm check

This test will activate the yellow LED on the display front.

Yellow LED check

Yellow alarm check

This test will activate the green LED on the display front.

9.0 System Test - continued

Pressure= 125.2

Pressure check

This test will display the current pressure (bar) measured in the PISTON SIDE of the boom lift cylinder(s).

Boom Ang= 32.1°

Boom angle check

This test displays the current boom angle on monoboom machines, or the first boom section angle on hydraulically adjustable boom machines. The angle given is for the imaginary line connecting the two pivot pins. As the boom moves up the value should increase: as the boom moves down the value should decrease. When the two pins are in the same horizontal plane, the value should be zero.

Arm Ang= 90.6°

Arm angle check

This test displays the current arm angle in degrees. The angle given is for the imaginary line connecting the two pivot pins. As the arm moves out the value should decrease: as the arm moves in the value should increase. When the two pins are in same vertical plane, the value should be 90.

Artic Ang= 12.8°

Artic angle check

This test displays the current secondary boom angle on hydraulically adjustable boom machines. The angle given is for the imaginary line connecting the two pivot pins. As the secondary boom moves up the value should increase: as the secondary boom moves down the value should decrease. When the two pins are in same horizontal plane, the value should be zero. This option will not appear on monoboom machines.

Buck Opto = 0 1

Proximity switch Test

If a dual redundancy system is fitted to the bucket linkage this option this test function will be displayed. If the proximity switches are covered, 0 1 will be displayed and if uncovered, 1 0 will be displayed. 0 0 and 1 1 can be displayed if the proximity switches are not activated simultaneously. This will cause false error messages in normal use.

15:53 26/06/08

Calibration time and date

The final test option displays the calibration time and date. This value is updated when the passcode protected Calibration menu is accessed.

10.0 Error Conditions

EA Heightmaster+ software constantly checks for the presence of all attached sensors and if they are not detected then the display indicates the problem component. This will indicate if the sensor is missing, damaged, or that there is a fault with interconnecting CAN bus cable. If an error condition is displayed halt any operation, seek service immediately and do not continue operation until the fault has been remedied. The failure message is shown on the lower line of the current active display. If more than one sensor fails then the Fail messages will scroll.

Height = 6.07m
BOOM FAIL!

Boom sensor not detected.

Height = 6.07m
ARTIC FAIL!

Artic sensor not detected.

Height = 6.07m
ARM FAIL!

Arm sensor not detected.

Height = 6.07m
COMBI FAIL!

Combi Box not detected.

Height = 6.07m
RELAY SUPPLY!

Power not detected to Combi Box relays.

Height = 6.07m
PROX FAIL!

Proximity switch failure or proximity switch mismatch. See test section 1.3.1 for further information



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