

This is in regards to calibrating the Carlson CR+ instrument.

After powering on your Carlson CR+ you will need to double-tap the “Geomax Toolkit” icon then tap on “4. Apps” and “2. Calibrate”.

6.2 Calibration

6.2.1 Overview

Description	GeoMax instruments are manufactured, assembled and adjusted to the best possible quality. Quick temperature changes, shock or stress can cause deviations and decrease the instrument accuracy. It is therefore recommended to check and adjust the instrument from time to time. This check and adjust can be done in the field by running through specific measurement procedures. The procedures are guided and must be followed carefully and precisely as described in the following chapters. Some other instrument errors and mechanical parts can be adjusted mechanically.										
Electronic adjustment	<p>The following instrument errors can be checked and adjusted electronically:</p> <table><tr><td>l, t</td><td>Compensator longitudinal and transversal index errors</td></tr><tr><td>i</td><td>Vertical index error, related to the standing axis</td></tr><tr><td>c</td><td>Horizontal collimation error, also called line of sight error</td></tr><tr><td>a</td><td>Tilting axis error</td></tr><tr><td>AiM</td><td>AiM zero point error for Hz and V - option</td></tr></table> <p>If the compensator and the horizontal corrections are activated in the instrument configuration, every angle measured in the daily work is corrected automatically. The results are displayed as errors but used with the opposite sign as corrections when applied to measurements.</p>	l, t	Compensator longitudinal and transversal index errors	i	Vertical index error, related to the standing axis	c	Horizontal collimation error, also called line of sight error	a	Tilting axis error	AiM	AiM zero point error for Hz and V - option
l, t	Compensator longitudinal and transversal index errors										
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AiM	AiM zero point error for Hz and V - option										
View current adjustment errors	To view the adjustment errors currently used, select MAIN MENU: Apps\Calib\ViewAdjustment Data .										
Mechanical Adjustment	<p>The following instrument parts can be adjusted mechanically:</p> <ul style="list-style-type: none">• Circular level on instrument and tribrach• Optical plummet - option on tribrach• Allen screws on tripod										

Precise Measurements

To get precise measurements in the daily work, it is important:

- To check and adjust the instrument from time to time.
- To take high precision measurements during the check and adjust procedures.
- To measure targets in two faces. Some of the instrument errors are eliminated by averaging the angles from both faces.



During the manufacturing process, the instrument errors are carefully determined and set to zero. As mentioned above, these errors can change and it is highly recommended to redetermine them in the following situations:

- Before the first use
- Before every high precision survey
- After rough or long transportation
- After long working periods
- After long storage periods
- If the temperature difference between current environment and the temperature at the last calibration is more than 20°C

Summary of errors to be adjusted electronically

Instrument error	Effects Hz	Effects V	Elimination with two face measurement	Automatically corrected with proper adjustment
c - Line of sight error	✓	-	✓	✓
a - Tilting axis error	✓	-	✓	✓
l - Compensator index error	-	✓	✓	✓
t - Compensator index error	✓	-	✓	✓
i - Vertical index error	-	✓	✓	✓
AiM Collimation error	✓	✓	-	✓

6.2.2

Preparation



Before determining the instrument errors, the instrument has to be levelled using the electronic level. The tribrach, the tripod and the underground should be stable and secure from vibrations or other disturbances.



The instrument should be protected from direct sunlight to avoid thermal warming. It is also recommended to avoid strong heat shimmer and air turbulence. The best conditions are early in the morning or with overcast sky.



Before starting to work, the instrument has to become acclimatised to the ambient temperature. Approximately two minutes per °C of temperature difference from storage to working environment, but at least 15 min, should be taken into account.




Even after adjustment of the AiM, the crosshairs may not be positioned exactly on the centre of the prism after an AiM measurement has been completed. This outcome is a normal effect. To speed up the AiM measurement, the telescope is normally not positioned exactly on the centre of the prism. These small deviations/AiM offsets, are calculated individually for each measurement and corrected electronically. This means that the horizontal and vertical angles are corrected twice: first by the determined AiM errors for Hz and V, and then by the individual small deviations of the current aiming.

6.2.3 Calibrate (a, l, t, i, c and AiM)

Description


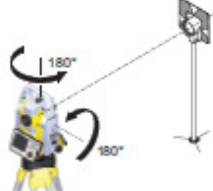
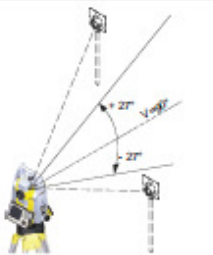
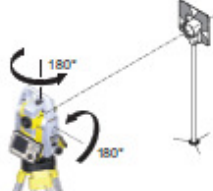
The calibration procedure determines the following instrument errors in one process:

a	Tilting axis error.
l, t	Compensator longitudinal and transversal index errors.
i	Vertical index error, related to the standing axis.
c	Horizontal collimation error, also called line of sight error.
AiM Hz	AiM zero point error for horizontal angle.
AiM V	AiM zero point error for vertical angle.

 AiM Hz and AiM V are excluded from calibration if you choose the "Calibrate without AiM" procedure. AiM Hz and AiM V are included if you choose the "Calibrate All" procedure.

Calibrate step-by-step

The following table explains the most common settings.

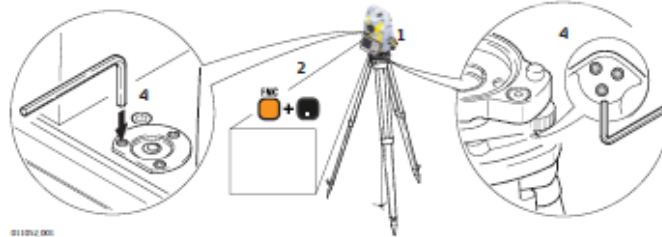
Step	Description
1.	MAIN MENU: Apps\Calib\Calibrate All or Calibrate without AiM.
2.	Level the instrument and press OK.
3.	 <p>Aim the telescope accurately at a target at about 100 m distance. The target must be positioned within $\pm 9^\circ / \pm 10$ gon of the horizontal plane.</p>
4.	Press OK to measure and continue to the next step.
5.	 <p>Motorised instruments change automatically to the other face. It is recommended carefully fine-point to the target manually.</p>
6.	Press OK to measure and continue to the next step.
7.	Repeat steps 3,4,5 and 6 for the second set. Continue with step 8.
8.	 <p>Aim the telescope accurately at a target at about 100 m distance or less if not possible. The target must be positioned at least $27^\circ / 30$gon above or beneath the horizontal plane.</p>
9.	Press OK to measure and continue to the next step.
10.	 <p>Motorised instruments change automatically to the other face. It is recommended carefully fine-point to the target manually.</p>
11.	Press OK to measure and continue to the next step.


Step	Description
12.	Repeat steps 8,9,10 and 11 for the second set. Continue with step 13.
13.	The results are shown on the screen. If the values are okay, press OK to store or press ESC to decline.

6.2.4

Adjusting the Circular Level of the Instrument and Tribrach

Adjusting the circular level step-by-step




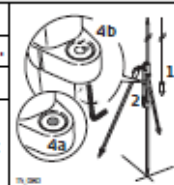
Step	Description
1.	Place and secure the instrument into the tribrach and onto a tripod.
2.	Using the tribrach footscrews, level the instrument with the electronic level.
3.	Access the electronic level and laser plummet by using the key-combination <FNC>+<, > or by starting GeoMax Toolkit and go to MAIN MENU screen and select Level .
4.	Check the position of the circular level on the instrument and tribrach.
5.	a) If both circular levels are centred, no adjustments are necessary b) If one or both circular levels are not centred, adjust as follows:
	Instrument: If it extends beyond the circle, use the supplied allen key to centre it with the adjustment screws. Turn the instrument by 200 gon (180°). Repeat the adjustment procedure if the circular level does not stay centred.
	Tribrach: If it extends beyond the circle, use the supplied allen key to centre it with the adjustment screws.
	After the adjustments, all adjusting screws must have the same tightening tension and no adjusting screw should be loose.

6.2.5

Adjusting the Circular Level of the Prism Pole

Adjusting the Circular Level Step-by-Step

Step	Description
1.	Suspend a plumb line.
2.	Use a pole bipod, to align the prism pole parallel to the plumb line.
3.	Check the position of the circular level on the prism pole.
4.	a) If the circular level is centred, no adjustment is necessary. b) If the circular level is not centred, use an allen key to centre it with the adjustment screws.
	After the adjustments, all adjusting screws must have the same tightening tension and no adjusting screw should be loose.



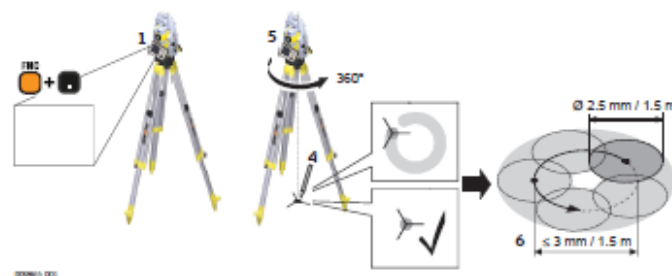
6.2.6

Inspecting the Laser Plummet of the Instrument




The laser plummet is located in the vertical axis of the instrument. Under normal conditions of use, the laser plummet does not need adjusting. If an adjustment is necessary due to external influences, return the instrument to any GeoMax authorised service workshop.

Inspecting the laser plummet step-by-step



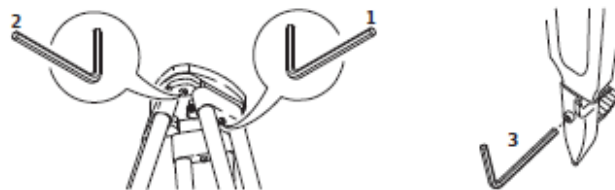
The following table explains the most common settings.


Step	Description
1.	Place and secure the instrument into the tribrach and onto a tripod.
2.	Using the tribrach footscrews, level the instrument with the electronic level.
3.	Access the electronic level and laser plummet by using the key-combination <FNC>+<.,> or by starting GeoMax Toolkit and go to MAIN MENU screen and select Level .
4.	The laser plummet is switched on automatically when the Level up screen is entered. Adjust the laser plummet intensity. Inspection of the laser plummet should be carried out on a bright, smooth and horizontal surface, like a sheet of paper.
5.	Mark the centre of the red dot on the ground.
6.	Turn the instrument through 360° slowly, carefully observing the movement of the red laser dot.
	The maximum diameter of the circular movement described by the centre of the laser point must not exceed 3 mm at a distance of 1.5 m.
7.	If the centre of the laser dot describes a perceptible circular movement, or moves more than 3 mm away from the point which was first marked, an adjustment may be required. Inform your nearest GeoMax authorised service workshop. Depending on brightness and surface, the diameter of the laser dot can vary. At 1.5 m, it is about 2.5 mm.

6.2.7

Servicing the Tripod

Service the tripod step-by-step



 The connections between metal and timber components must always be firm and tight.

- 1) Tighten the leg cap screws moderately with the allen key supplied.
- 2) Tighten the articulated joints on the tripod head just enough to keep the tripod legs open when lifting the tripod off the ground.
- 3) Tighten the screws of the tripod legs.