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Type starts around here

Carlson CR Robotic/Reflectorless Total Station

Calibration Overview

Congratulations on your purchase of the Carlson CR Robotic/Reflectorless Total Station (RTS)! This high-precision instrument is designed to give years of reliable and accurate service under regular operating conditions. Like any precision instrument, periodic cleaning and calibration will help ensure the best possible results.

The instructions that follow have been extracted for your convenience from the digital documentation that accompanies each RTS instrument. For complete care and operational instructions of this RTS instrument, please refer to the documentation that accompanied this instrument or contact your Carlson RTS dealer.

4 Check & Adjust

4.1 Overview

Description

GeoMax instruments are manufactured, assembled and adjusted to a high quality. Quick temperature changes, shock or stress can cause deviations and decrease the instrument accuracy. It is therefore recommended to calibrate the instrument from time to time. This can be done in the field by running through specific measurement procedures. The procedures are guided and have to be followed carefully and precisely as described in the following chapters. Some other instrument errors and mechanical parts can be adjusted mechanically.

Electronic adjustment

The following instrument errors can be checked and adjusted electronically:

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
Aim360	Aim360 zero point error for Hz and V - option

Every angle measured in the daily work is corrected automatically if the compensator and the Hz-corrections are activated in the instrument configuration. Select **Main Menu: Config...\Instrument Settings...\Compensator** to check the settings.

View current adjustment errors

The currently used adjustment errors can be viewed under **Main Menu: Tools...\Check & Adjust...\Current Values.**

Mechanical adjustment

The following instrument parts can be adjusted mechanically:
- Circular level on instrument and tribrach
- Laser plummet
- 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.
- Refer to "4.2 Preparation" to find more important points.

☞

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	---	✓	✓	✓
Aim360 Collimation error	✓	✓	---	✓

4.2 Preparation

Before determining the instrument errors, the instrument has to be levelled using the electronic level. **SHIFT (F12)** to access **STATUS Level & Laser Plummet**, **Level** page.
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 Aim360, the crosshairs may not be positioned exactly on the centre of the prism after an Aim360 measurement has been completed. This outcome is a normal effect. The telescope is not normally positioned exactly on the centre of the prism, to speed up the Aim360 measurement. These small deviations/Aim360 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 Aim360 errors for Hz and V, and then by the individual small deviations of the current aiming.

Next step

IF the task is to	THEN
adjust a combination of instrument errors	Refer to "4.3 Combined Adjustment (l, t, i, c and Aim360)".
adjust the tilting axis	Refer to "4.4 Tilting Axis Adjustment (a)".
adjust the circular level	Refer to "4.5 Adjusting the Circular Level of the Instrument and Tribrach".
adjust the laser/optical plummet	Refer to "4.7 Inspecting the Laser Plummet of the Instrument".
adjust the tripod	Refer to "4.8 Servicing the Tripod".

4.3 Combined Adjustment (l, t, i, c and Aim360)

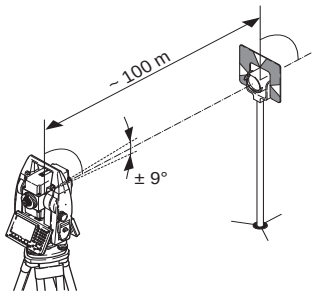
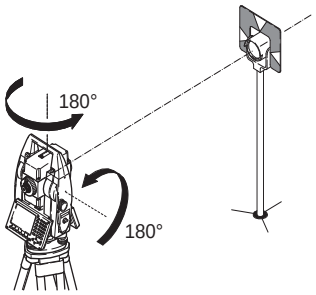
Description

The combined adjustment procedure determines the following instrument errors in one process:

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
Aim360 Hz	Aim360 zero point error for horizontal angle option
Aim360 V	Aim360 zero point error for vertical angle option

Combined adjustment procedure step-by-step

The following table explains the most common settings.

Step	Description
1.	**Main Menu: Tools...\Check & Adjust...**
2.	**TOOLS Check & Adjust Menu**
	Select the option: **Combined (l,t,i,c,Aim)**
3.	**TOOLS Combined I**
	<Aim Adjust: On> Includes the determination of the Aim360 Hz and V adjustment errors. ☞ It is recommended to use a clean GeoMax circular prism as target. Do not use a 360° prism.
4.	 Aim the telescope accurately at a target at about 100 m distant. The target must be positioned within ± 9°/± 10 gon of the horizontal plane. The procedure can be started in any telescope face.
5.	**MEAS (F1)** to measure and to continue to the next screen.  Instruments change automatically to the other face. ☞ The fine pointing has to be performed manually in both faces.
6.	**TOOLS Combined II**
	MEAS (F1) to measure the same target in the other face and to calculate the instrument errors.
☞	If one or more errors are bigger than the predefined limits, the procedure has to be repeated. All measurements of the current run are rejected and none of them is averaged with the results from previous runs.
7.	**TOOLS Adjustment Accuracy** **<No.of Meas:>** Shows the number of runs executed. One run consists of a measurement in face I and face II. **<σ l Comp:>** and similar lines show the standard deviations of the determined adjustment errors. The standard deviations can be calculated from the second run onwards.
☞	It is recommended to measure at least two runs.
8.	**MEAS (F5)** if more runs have to be added. Continue with step 3. OR **CONT (F1)** to accept the measurements and to proceed to **TOOLS Adjustment Results**. No more runs can be added later.

Next step

IF the results are	THEN
to be stored	**CONT (F1)** overwrites the old adjustment errors with the new ones, if the **Use** status is set to **Yes**.
to be determined again	**REDO (F2)** rejects all new determined adjustment errors and repeats the whole procedure. Refer to step 3. of paragraph "Combined adjustment procedure step-by-step".

4.4 Tilting Axis Adjustment (a)

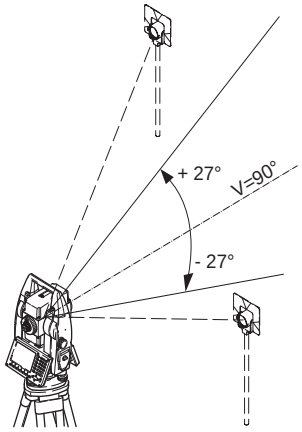
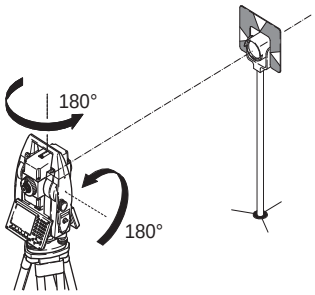
Description

This adjustment procedure determines the following instrument error:

a Tilting axis error

Determination of tilting axis error step-by-step

The following table explains the most common settings.

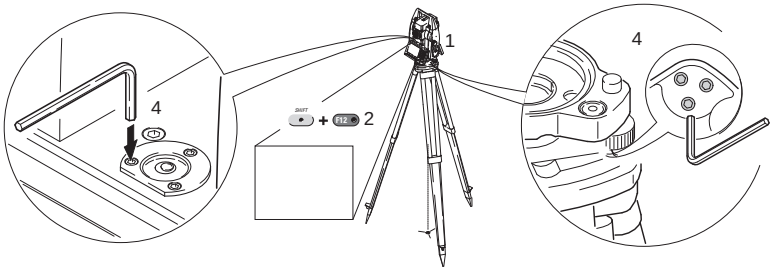
Step	Description
☞	The Hz collimation error (c) has to be determined before starting this procedure.
1.	**Main Menu: Tools...\Check & Adjust...**
2.	**TOOLS Check & Adjust Menu** Select the option: **Tilting Axis (a)**
3.	**TOOLS Tilting-Axis Adjustment I**  Aim the telescope accurately at a target at about 100 m distance or less if not possible. The target must be positioned at least 27°/30 gon above or beneath the horizontal plane. The procedure can be started in any telescope face.
4.	**MEAS (F1)** to measure and to continue to the next screen.  Instruments change automatically to the other face. ☞ The fine pointing has to be performed manually in both faces.
5.	**TOOLS Tilting-Axis Adjustment II** **MEAS (F1)** to measure the same target in the other face and to calculate the tilting axis error.
☞	If the error is bigger than the predefined limit, the procedure has to be repeated. The tilting axis measurements of the current run are then rejected and not averaged with the results from previous runs.
6.	**TOOLS T-Axis Adjustment Accuracy** **<No.of Meas:>** Shows the number of runs executed. One run consists of a measurement in face I and face II. **<σ a T-axis:>** shows the standard deviation of the determined tilting axis error. The standard deviation can be calculated from the second run onwards.
☞	It is recommended to measure at least two runs.
7.	**MEAS (F5)** if more runs have to be added. Continue with step 3. OR **CONT (F1)** to accept the measurements and to proceed to **TOOLS T-Axis Adjustment Result**. No more runs can be added later.

Next step

IF the results are	THEN
to be stored	**CONT (F1)** overwrites the old tilting axis error with the new one.
to be determined again	**REDO (F2)** rejects the new determined tilting axis error and repeats the whole procedure. Refer to step of paragraph "Determination of tilting axis error step-by-step".

4.5 Adjusting the Circular Level of the Instrument and Tribrach

Adjusting the circular level step-by-step

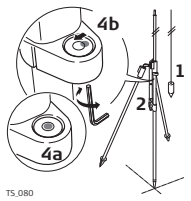


Step	Description
1.	Place and secure the instrument into the tribrach and onto a tripod.
2.	Using the tribrach footscrews, level the instrument with the electronic level. **SHIFT (F12)** to access **STATUS Level & Laser Plummet**.
3.	Check the position of the circular level on the instrument and tribrach.
4.	a) If both circular levels are centered, no adjustments are necessary. b) If one or both circular levels are not centered, 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 centered. **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 should have the same tightening tension and no adjusting screw shall be loose.

4.6 Adjusting the Circular Level of the Prism Pole

Adjusting the circular level step-by-step

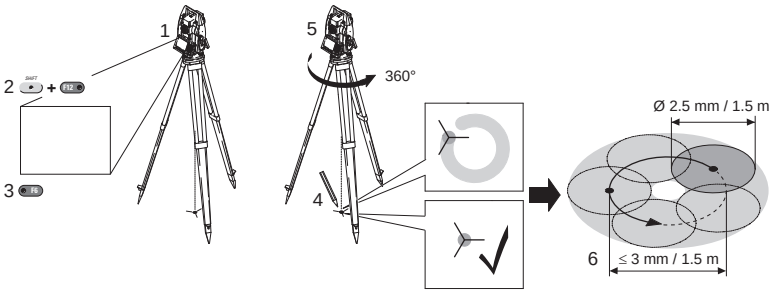
Step	Description
1.	Suspend a plumb line.
2.	Use a pole bipod, to align the prism pole parallel to the plumb line.
3.	Check the position of the circular level on the prism pole.
4.	a) If the circular level is centred, no adjustment is necessary.
	b) If the circular level is not centred, use an allen 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.



4.7 Inspecting the Laser Plummet of the Instrument

The laser plummet is integrated into 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, the instrument has to be returned to a GeoMax service workshop.

Inspecting the laser plummet step-by-step

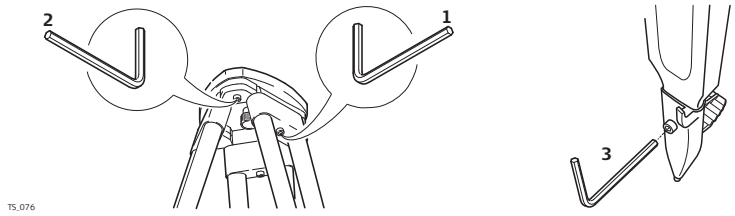


The following table explains the most common settings.

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. **SHIFT (F12)** to access **STATUS Level & Laser Plummet**.
3.	**PAGE (F6)** to access the **Laser Plummet** page. Switch on the laser plummet. Inspection of the laser plummet should be carried out on a bright, smooth and horizontal surface, like a sheet of paper.
4.	Mark the centre of the red dot on the ground.
5.	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 should not exceed 3 mm at a distance of 1.5 m.
6.	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.

4.8 Servicing the Tripod

Servicing the tripod step-by-step



The following table explains the most common settings.

Step	Description
☞	The connections between metal and timber components must always be firm and tight.
1.	Tighten the leg cap screws moderately, with the supplied allen key.
2.	Tighten the articulated joints on the tripod head enough to keep the tripod legs open when lifting the tripod off the ground.
3.	Tighten the allen screws of the tripod legs.