Common CR+ / Zoom 90 Robot Issues and Questions

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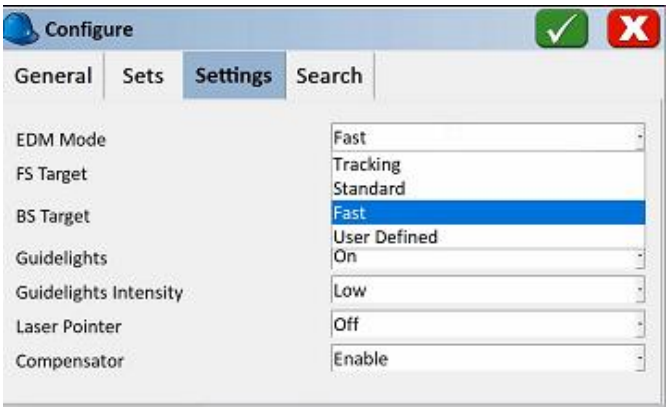
EDM Mode

In Carlson under 'Configure on the Settings tab there is a setting for 'EDM Mode':



The default mode is 'Standard'. If you handhold the prism rod close (less than 50 feet from the robot) to the gun, the robot will lose sight of prism if you wobble the prism while the EDM is fired. (Because tracking is turned off in Standard mode when the EDM fires.)

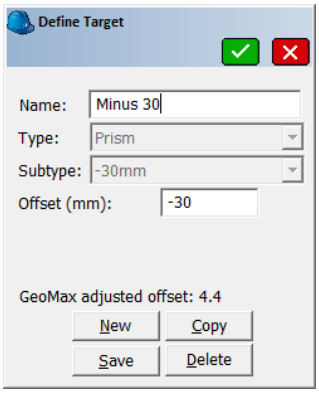
Change the 'EDM Mode' to Fast if you are working at close range without a bi-pod. The 'EDM Mode' affects the EDM accuracy:

EDM measuring mode	std. dev. ISO 17123-4, standard prism	std. dev. ISO 17123-4, tape	Measurement time, typical [s]
Standard	1 mm + 1.5 ppm	3 mm + 2 ppm	2.4
Fast	2 mm + 1.5 ppm	3 mm + 2 ppm	0.8
Tracking	3 mm + 1.5 ppm	3 mm + 2 ppm	< 0.15

However, for hand-held shots the difference should be negligible.

Leica (GeoMax) Prism Constants

SurvCE makes prism constant entry simple, however you need to be aware that the Zoom 90 adheres to the Leica prism constant offset methodology.



When a prism is entered in SurvCE, the standard Absolute offset is entered. SurvCE computes the GeoMax (Leica) adjusted offset as

GeoMax/Leica Offset = Standard Offset + 34.4 mm

What is going on?

Prism Offsets Explained

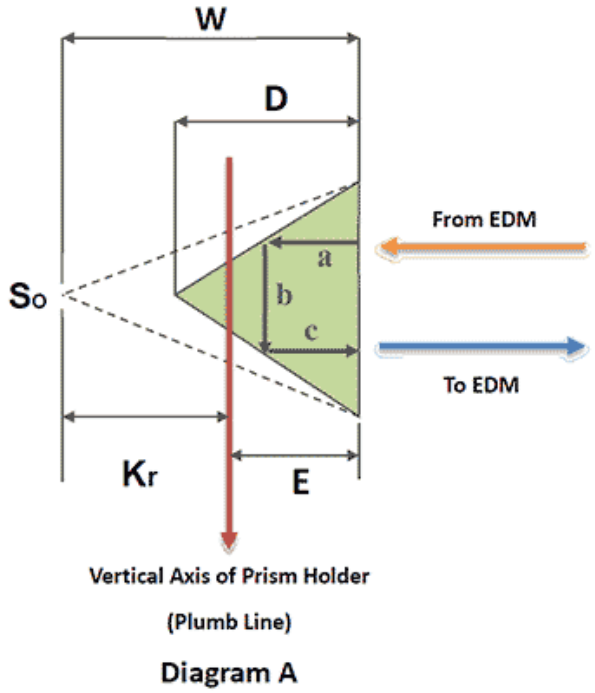


Diagram A

The distance that we want to measure is the distance from the instrument center (vertical axis) to the vertical axis (plumb line, Diagram A) of the prism holder.

However, the path of the beam includes the distance the beam must travel through the prism (distance a+b+c, Diagram A) and must be corrected for this “extra” distance and the effect on the speed of light when the beam travels through the glass instead of air.

This value is Kr: the absolute offset (also known as the manufacturers offset) and in most circumstances the absolute offset is what is printed on the prism.

Except for prism's manufactured by Leica Geosystems and some GeoMax prisms.

Every other manufacturer defines the prism constant as a correction that is directly applied to the measured distance.

The magnitude of the prism constant is determined by the distance between the vertical axis of the prism holder and target point (Diagram A) and the theoretical turning point (So) of the measuring beam, which is behind the glass. If the vertical axis is situated right at point (So, Diagram A), then the Prism Constant equals 0. In other commercially available prisms the vertical axis is always in front of the point (So). The measured distance will then be too long and the corresponding correction (prism constant Kr, Diagram A) will be negative.

If the vertical axis runs through the center of the prism (commonly referred to as the nodal point), the prism distance won't change when tilted. This minimizes errors due to misalignment. Prism sets that follow these design principles are known as nodal prism sets.

The GeoMax / Leica Prism Offset

GeoMax/Leica uses a different prism offset method than other manufacturers (and they are the only companies to do so). The difference between a Leica prism quoted offset and all other prism offsets is the way the Kr value is handled. Leica's prism constant system is defined with reference to its standard prism sets (the GPH1 + GPR1) which has a Kr value equal to -34.4 mm.

A Note of Caution

The GeoMax 360 prism has a Leica constant printed on the label.

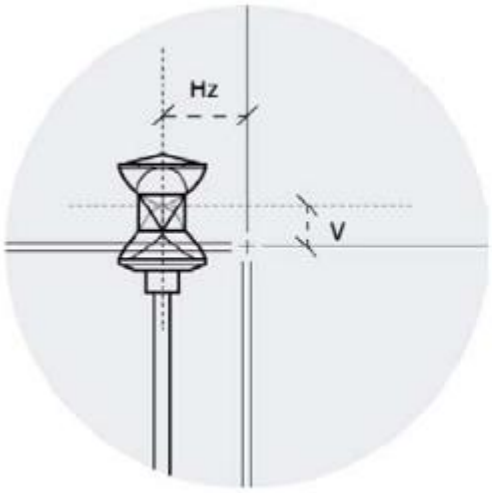
Some GeoMax branded prisms have Absolute embossed on them.

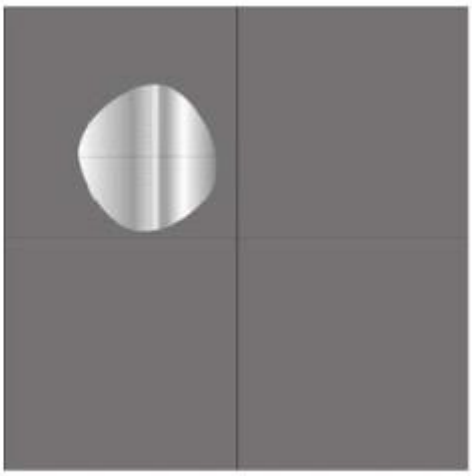
Be VERY careful with GeoMax branded prisms and the appropriate constant!

AiM

The GeoMax robots use 'AiM' technology to measure the prism position, adjust for prism tilt and prism skew without directly placing the robot crosshairs on the prism center. This method is MUCH more accurate than you can do manually by adjusting the crosshairs so you should not try to out-smart it!

The robots have a high-resolution CCD (CMOS) array. A laser beam is transmitted through the telescope towards the prism and the reflected beam is visible on the CCD array. The computer uses the image to compute the delta-Hz / delta-V of the computed and adjusted prism center from the robot measurement center:





This saves positioning time, battery drive power, drive motor wear and results in a more accurate position than you could do by hand.

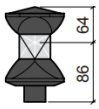
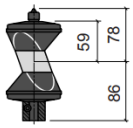
However, it also results in the crosshairs NOT aligning with the prism center when a robotic measurement is made. **Again, the robot will rarely align the prism with the telescope crosshairs** when targeting a prism closer than 1,000 meters. Do not be concerned, the **computed** prism center is within 1" (Hz and V).

AiM works to 3,280 feet.

360 Prism (ZPR1) Vertical Height

The GeoMax ZPR1 prism is identical to the Leica GRZ4 prism.

The vertical center of the ZPR1 360 prism is 86 mm (0.2822') above the bottom of the prism:

360° prism GRZ4 ZPR1	GeoMax / Leica +23.1 Absolute - 11.3	
360° prism GRZ122	+23.1	

The lightweight GeoMax ZPC105 button-snap-lock pole is 1.965 m extended to the long position, 1.465 m extended to the bottom position so with the 360 prism:

1.965 m + 0.086 m = 2.051 m = 6.729 ' (nominally this would be 2.05 meters)

1.465 m + 0.086 m = 1.551 m = 5.089' (nominally this would be 1.55 meters)

The SECO 5501-11 pole includes a TLV adapter at the top which nominally allows the prism pole to direct read the prism center height.

Adjacent Faces on ZPR1 360 Prism have a ~5mm Vertical Offset

There is a 0.005 meter (5 mm, 0.016 foot) vertical offset between adjacent prism faces on the ZPR1 360 prism.

If you are preforming an 'accurate' elevation survey, you should hold the prism so that a face with a 'Yellow Arrow' is always pointing back to the robot when you fire a shot.

If you are performing a 'very accurate' elevation survey, you should probably consider using a high-quality round prism:

765608	**ZPR100** Circular prism and holder (Constants - GeoMax 0.0; Absolute -34.4)	$288

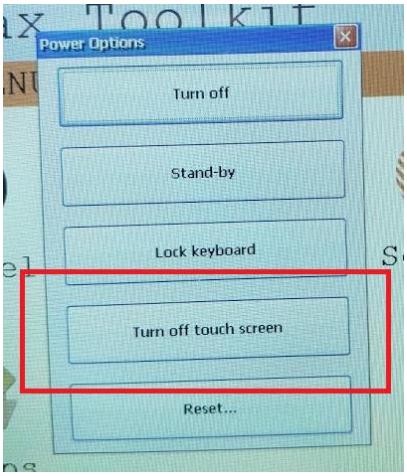
The GRZ122 High Accuracy 360 Prism:

754384	**GRZ122** High accuracy 360° Prism with 5/8" screw for GNSS antenna (Constants - GeoMax +23.1; Absolute -11.3)	$1,700

does not have this limitation, the GRZ122 is substantially more expensive than the ZPR1 prism.

Locking and Unlocking the Touchscreen on the Primary Face

You can lock and unlock the touchscreen. Usually it is locked accidentally. To unlock, press and hold the ON/OFF button for 2 seconds:



The next-to-bottom button toggles the touchscreen on and off.

Display Backlight Warning

Do NOT set the display backlight to the lowest setting (which is off or nearly off). It is very difficult to reset the backlight to turn it on. (You must manually edit the device registry via a cable connected tool!)

So DO NOT turn off the backlight!

Long Distance Measurement Errors

For some reason, we often are confronted with elevation measurement error questions along the line of:

> *"I setup on a known benchmark and shoot the elevation of a remote benchmark 2,600 feet distant. The remote elevation is in error by around 7 hundredths of a foot!"*

Of course, if you are making a long measurement you want to make sure that:

Compensator is enabled

Level is nearly perfect

EDM mode is Standard

The elevation is nearly correct

The absolute pressure is correctly entered

Refraction Coefficient is enabled

However, the most important consideration is at 2,500 feet with a 5-second gun the estimated error is:

sin(5 / 3600) * 2500 feet = 0.061 feet

Because of the way the 5” and 2” guns are manufactured, it statistically is probable that they will NOT exceed the nameplate accuracy. So you should expect the robot to be as accurate as the nameplate and not much better.

Do a Field Calibration at the First Sign of Trouble

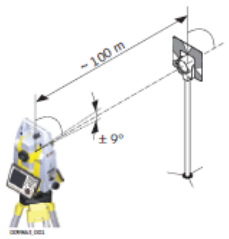
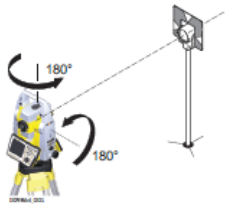
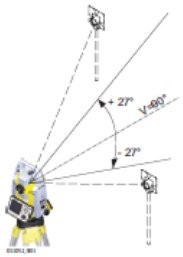
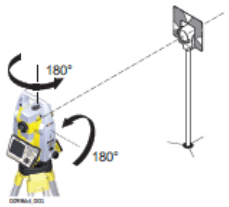
In addition to the **factory recommended** situations where a field calibration is warranted:

- 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

If your robot is having a difficult time **Power-Searching** (turns to prism, then can’t find prism when looking up and down), or your **robot won’t shoot a prism even when locked** or **ANY OTHER pointing or measuring anomaly** then you should do a field calibration.

The instructions are in the User Manual on page 38.

A summary of the User Manual follows:

Step	Description
1.	**MAIN MENU: Apps\Calib\Calibrate All** or **Calibrate without AiM.**
2.	Level the instrument and press **OK**.
3.	 Aim the telescope accurately at a target at about 100 m distance. The target must be positioned within ±9°/±10 gon of the horizontal plane.
4.	Press **OK** to measure and continue to the next step.
5.	 Motorised instruments change automatically to the other face. It is recommended carefully fine-point to the target manually.
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.	 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°/30gon above or beneath the horizontal plane.
9.	Press **OK** to measure and continue to the next step.
10.	 Motorised instruments change automatically to the other face. It is recommended carefully fine-point to the target manually.
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.

On step 8, it is usually difficult to find a target 27 deg above the horizon, 100 meters distant (that would be > 150 feet tall at a distance of 350 feet.) It is okay to use a nut on the top of a power pole or a building corner.

Battery Charger LED Meanings

The battery charger comes with a small graphic instruction page. This page is written in 'Ikea' like icons that don't make any sense.

The following summary is thought to be an accurate English translation of the page:

Indoor Use Only. Don't get it wet.
If the charger is damaged, don't plug it into power.
Don't open the charger.

The fuse should be replaced with a 5 Amp fuse.
Use charger in moderate temperatures (32 deg F to 122 deg F).
It should take 2 to 4 hours to charge from 20% to 80%.
Don't charge Ni-Cd or Ni-MH with this charger.
Only charge GeoMax Batteries with this charger.
Plug charger into power prior to inserting battery.

P — Power is applied to charger when the left LED is lit green.

L R — L solid when charging or fully charged.

L R — L sold and R solid when charging and battery is over 80% full.

L R — L flashes and R solid when battery is full.

L R — L solid red, R off, battery damaged.

L R — L and R solid red, charger is damaged.

L R — L off, R solid red, battery is too hot (or cold) to charge

Scout, TRack, AiM Range

Scout:	Power Search	985 feet
TRack:	Continuously track and follow prism	2,600 feet
AiM:	Compute the actual center of a prism	3,280 feet

Traverse Closing Issues

If you are having traverse closing issues, here are some things to consider:

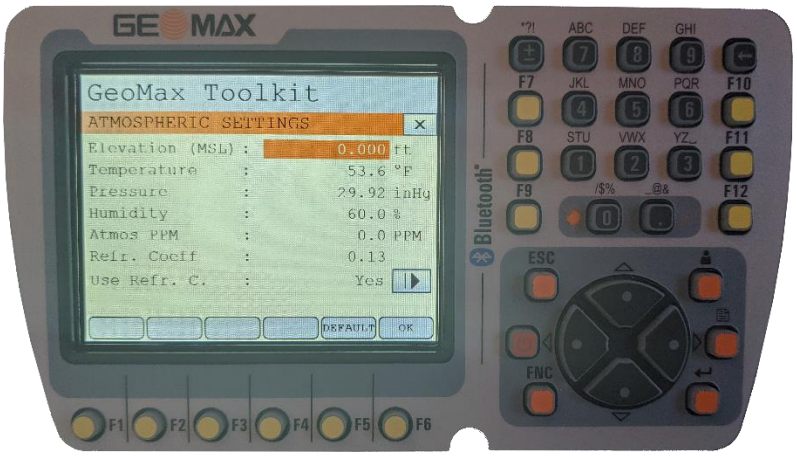
1. Have you recently done a field calibration? The factory basically recommends doing one every day.
2. **Check your tripod**:
    a. are the legs loose?
    b. clean sliding surfaces?
    c. loose feet/shoes on the legs, make sure the foot points are screwed in tight.
    d. are you firmly setting the instrument screw?
    e. Are the feet firmly set in the ground?
    f. Is anyone touching the instrument or legs after setup?
    g. Is the station settling in asphalt?
    h. Is the robot level at the beginning and end of the observations?
3. Check the EDM mode: is it "Standard" or "Fast"? (Standard is preferred) "Fast" means it won't update the angle with ATR after the first shot. Only the EDM distance is re-shot. With Fast you are not really checking the centering process, just the distance. The "Fast" mode also has a slightly looser spec for distance.

Setting the EDM mode to “Standard” will preclude the use of close handheld shots, however you really should not be using them to close traverses.

4. Check the prism pole bubbles. Have the foresight and backsight tribrachs been checked/adjusted recently?
5. Check prism constants? (See the section “*Leica (GeoMax) Prism Constants*” above.)
6. Is the atmospheric temperature, pressure, elevation correctly entered? This is especially important if you have any long observations.
7. Are you allowing the robot to acclimate when pulling from truck to job? Direct heating can be a big issue. Heating the instrument unevenly, as in the case of the Sun hitting only one side can be a really big issue. Consider setting up an umbrella.
8. The Robotic Total Station must be located at a location that does not vibrate as the compensators are very susceptible to vibration. Thus, bridges with active traffic are to be avoided.
9. Make sure the compensator is enabled.
10. If you are using the 360-prism, make sure you are using the faces with arrows (or without arrows) exclusively. (See “*Adjacent Faces on ZPR1 360 Prism have a ~5mm Vertical Offset*” above.)
11. Are your backsight or foresight shots handheld or on high-stakes? (That won’t close well!)
12. Are your foresights and backsights balanced?
13. Are you inverting the scope? Doubling angles?
14. Long shots with heat waves / shimmer will have significant angular errors.

‘Atmospheric Corrections’

From the primary display face on the robot, you can click on ‘GeoMax Toolkit’ then ‘3 Settings’ and finally ‘4 Atmos.’ To reach the ‘ATMOSPHERIC SETTINGS’ page:



The purpose of this screen is to compute an Atmospheric PPM correction and enable/disable compensation for refraction.

Customers are often confused by this screen because if you enter an elevation, then the pressure is modified; if you enter a pressure then the elevation is modified. You cannot specify **both** elevation and pressure.

Determining an accurate ‘Absolute Station Pressure’ is difficult because devices that directly measure absolute pressure are highly temperature dependent. We recommend entering the robot Elevation, ambient Temperature and approximate Humidity.

The easiest method is to:

1. Enter the Elevation of the Robot within 20 feet.
2. Enter the Temperature.
3. Skip over the Pressure.
4. Enter the Humidity.

The robot will automatically compute the station pressure based on these values.

If you choose to enter the 'Pressure' you need to enter the 'Absolute Station Pressure' not the 'Sea Level Corrected Pressure". The pressure published by the National Weather Service for Airports are very accurate, however they are 'Sea Level Compensated Pressures'.

This equation will aproximently convert 'Sea Level Pressure' to 'Absolute Station Pressure':

$$StationPressure = SeaLevelPressure \cdot e^{-\frac{Elevation}{Temp*29.263}}$$

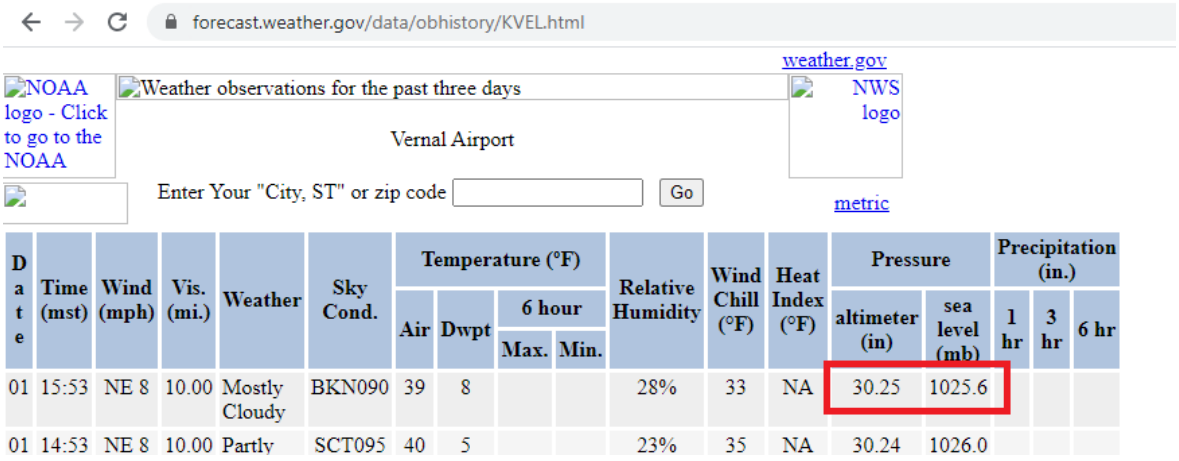
Where:

Elevation is in Meters	ElevM = ElevF * 0.3048
Temp is in degrees Kelvin	degK = degC + 273.15

Pressure Example

Many users prefer to use the pressure from the nearest airport to estimate 'Absolute Station Pressure' for a jobsite. Unless you are very close to an airport this may not be a reasonable method. For many rural applications this will be totally inappropriate.

For example, let's consider my current location. The elevation is 5653 ft and the temperature is 24 deg F. The nearest airport is Vernal Utah which is 35 miles to the southeast. The elevation of the Vernal airport is 5280 feet (1609.3m). Using the current online weather forecast for the airport:


forecast.weather.gov/data/obhistory/KVEL.html

weather.gov

NOAA logo - Click to go to the NOAA

Weather observations for the past three days

NWS logo

Vernal Airport

Enter Your "City, ST" or zip code Go

metric

Date	Time (mst)	Wind (mph)	Vis. (mi.)	Weather	Sky Cond.	Temperature (°F)				Relative Humidity	Wind Chill (°F)	Heat Index (°F)	Pressure		Precipitation (in.)		
						Air	Dwpt	6 hour Max.	6 hour Min.				altimeter (in)	sea level (mb)	1 hr	3 hr	6 hr
01	15:53	NE 8	10.00	Mostly Cloudy	BKN090	39	8			28%	33	NA	30.25	1025.6			
01	14:53	NE 8	10.00	Partly	SCT095	40	5			23%	35	NA	30.24	1026.0			

The current temperature at the airport is 39 degrees F (277.04K) and the 'Sea Level Adjusted Pressure' is 30.25 inHg.

Converting to 'Absolute Station Pressure' = 24.80 inHg.

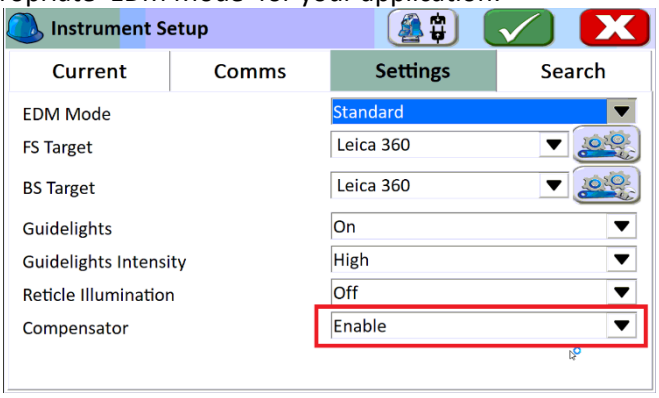
Entering 24.80 into the Settings page on the robot with the correct Temperature and Humidity results in a PPM of 34.2 PPM.

Using the Elevation (5653) results in a PPM of 41.2 PPM. The 7.0 PPM difference results in a measurement change of 0.04 feet per mile.

Because there is a significant difference in elevation and temperature between the airport and the robot's location, the Elevation method is probably far more accurate than the Pressure method.

Conclusion

1. Do a 'Field Calibration' at the beginning of the day.
2. Set the Atmospheric settings: use correct Elevation (not Pressure), Temperature and Humidity.
3. Enable 'Use Refraction Coefficient' on the Robot. The default refraction coefficient is 0.13 and is appropriate for most jobs. Other common values are 0.142 and 0.2.
4. In Carlson SurvPC/CE on the 'Instrument Setup' screen, make sure the 'Compensator' is enabled; choose the appropriate 'EDM Mode' for your application:



5. In Carlson SurvPC/CE on the 'Equip: Localization: TS (tab)', make sure that 'Curvature & Refraction' and 'Sea Level Correction' are both checked: