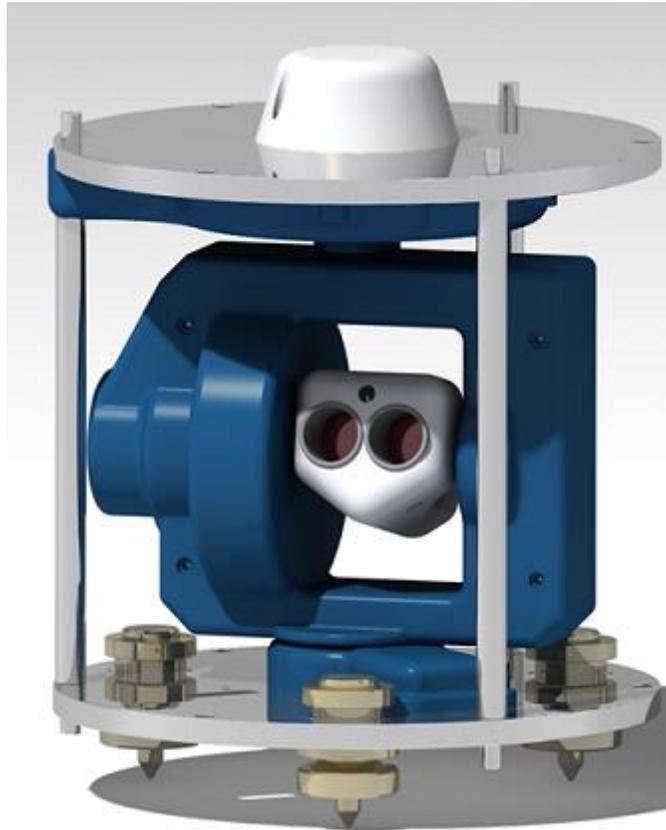


# AutoDIF MKII

## User Manual



*Royal Meteorological Institute of Belgium  
Centre de Physique du Globe  
rue du centre de physique 1  
5670 Dourbes (Belgium)  
[www.meteo.be](http://www.meteo.be)*

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## WARNING

AutoDIF is equipped with a 650 nm (red) class IIIa laser (< 5 mW).

The owner is responsible for safe use.

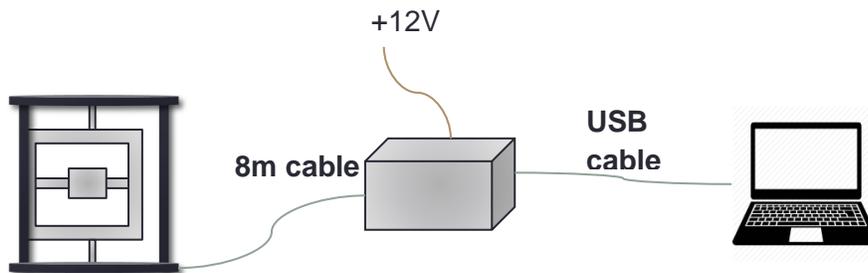
DO NOT LOOK DIRECTLY INTO THE BEAM.

Laser specifications are presented in Appendix I

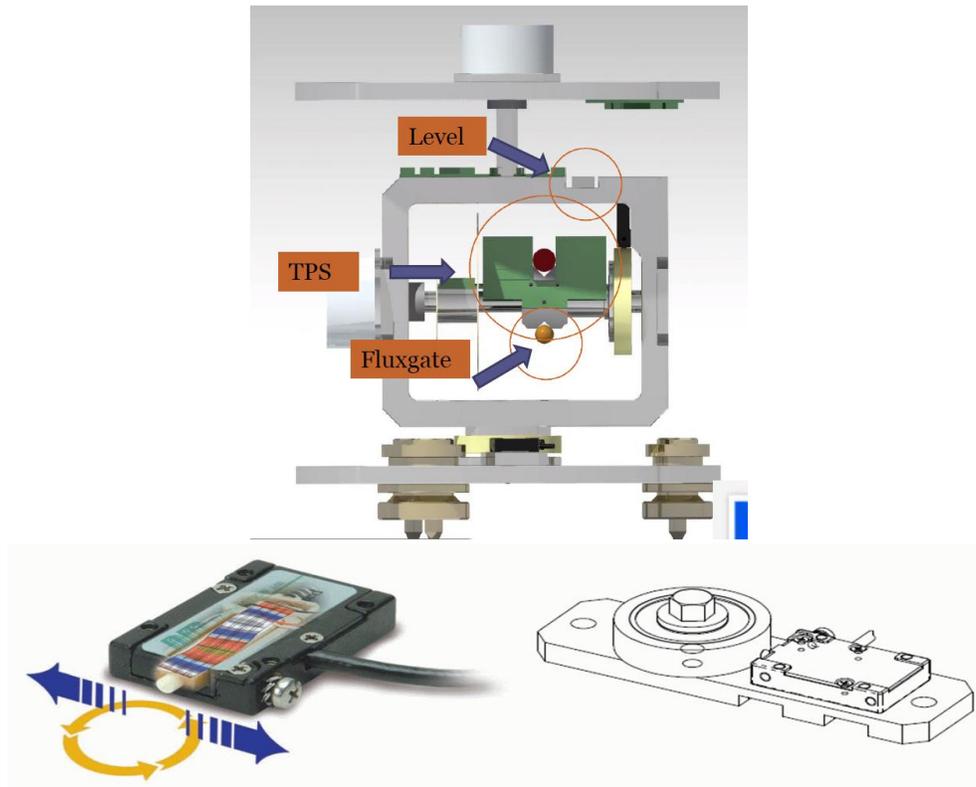
## INSTRUMENT DESCRIPTION

AutoDIF MKII is a non-magnetic robotized DIFlux used to measure the earth magnetic declination and inclination. The system is composed 3 major parts:

- A non-magnetic robotized theodolite able to orientate a magnetic sensor (fluxgate type) according any direction.
- An electronic box sending and receiving electrical power and signals from/to the theodolite. This box is connected to the acquisition system through a USB (A-B type) cable.
- An acquisition system (laptop or fit-PC) containing the Windows software and recording the measurements in files.



The theodolite structure is similar to conventional theodolites used in magnetic observatories. 2 orthogonal axes allow a probe-holder to be oriented according any direction. Electronic encoders are present on each axis in order to read angular directions (they are the electronic version of the theodolite circles). The motion is ensured by means of non-magnetic piezoelectric motors.

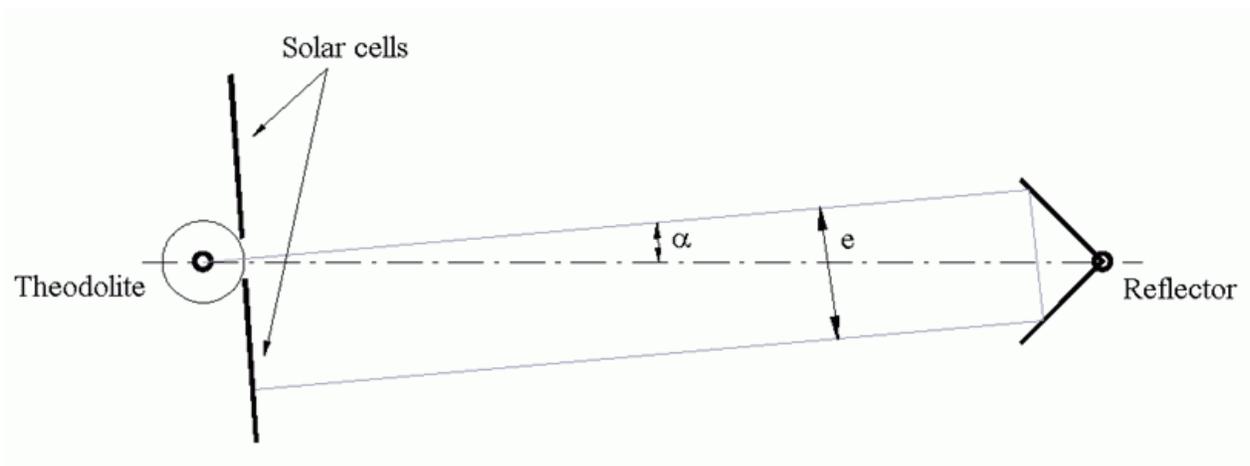
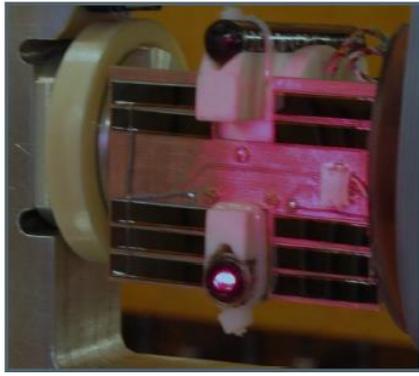


The leveling error is not compensated by hardware like in Zeiss-010 theodolite (or equivalent) but an electrolytic level records the deviation of levelling. This value is used in the declination and inclination measurement to compensate the tilt by software:

$$D_{err} = \tan(I) * Tilt_{err}$$

$$I_{err} = Tilt_{err}$$

The method of measurement is the conventional method used in most Intermagnet Magnetic Observatories. Therefore, a target is needed to determine the geographic north (True North) and the magnetic declination. AutoDIF target system is slightly different from an optical theodolite. The human eye is replaced by a laser coupled with photocells. Both are mounted on the probe holder (in the same referential as the fluxgate sensor). The laser points a corner cube (retroreflector) while the photocells receive the returning beam. Two photocells groups are present in both left and right sight of the laser. When the incident beam points the center of the corner cube, both photocells groups receive the same amount of light.

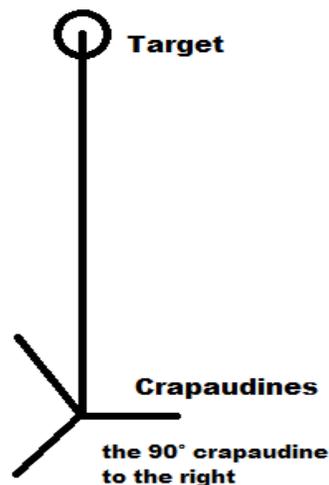


## INSTRUMENT SETUP

### PLACING

The instrument is supposed to be installed in a magnetic observatory. A pillar should be dedicated in the absolute house or in any other non-magnetic building. The corner-cube must be visible from the pillar. The laser can shot through a window (refraction may be taken into account).

Due to its mechanical structure, “crapaudines” (v-groove) must be placed so that laser beam is not disturbed by the instrument itself (AutoDIF has 3 vertical studs). A good layout is presented below (the configuration is relative to the target, not to the north):



Even if it is possible to point a close target, it is better to put it at least at 50m from the AutoDIF. A 120m distance has already been realized. The optical path should be as horizontal as possible. The target azimuth must be determined by any method.

### SWITCH ON

Once the instrument is placed on the pillar and all parts connected together, the system may be switch on. USB icon should appear green on the main screen (see GUI section). In debug mode, USB activity should be visible. If the icon is red (and no received packed), restart the USB driver (see restart USB driver section). Then encoders may be initialized. Initialization is required to determine the encoders (circles) index. When installing AutoDIF for the first time, it is strongly recommended to perform a manual initialization. Pay attention to keep enough rotation range because the race is limited. So if an axis encounters “stiffness”, it may be necessary to counterturn by 360°. The “manual init” procedure is described later.

## LEVELING

The next step consists of leveling the instrument. It is recommended to use a conventional leveling procedure consisting of turning two foot-screws in opposite direction and then, the third one. The electronic level output is used as a bubble level. Like any sensor, it may present an offset. So the goal is not to have a zero value but a constant value in any direction of the vertical axis. Before turning the 2 opposite or the single third foot-screws, the operator has to turn the axis in order to present the sensitive axis of the level according to the tilt direction. The level axis is perpendicular to the frame.

## TARGET POINTING SETUP

Target pointing setup is certainly the most difficult part of the setup and may require some experience. The idea is to switch on the laser and turn manually the axes until pointing roughly the target. Operator may use some tips such as reducing the window frame by obstructing it or making marks... The easiest way is to point the target during the night. Once the laser is pointing, photocells receive significant signal. The pointing range mainly depends on the target distance. Typically a 100m target allows  $\pm 0.01^\circ$  range.

The operator records the angle values (both vertical and horizontal) in “parameters/settings/star positions” (see below). The protocol requires a pointing fluxgate UP the horizontal axis and fluxgate DOWN the horizontal axis. The operator should then repeat the operation for the second configuration.

When performing a measurement, the system starts by pointing an operator-defined direction used to calibrate the photocells. This direction should be chosen close to the target pointing Fluxgate UP direction. The operator will pay attention not to point a reflective material in order to avoid an artificial offset.

## MAGNETIC SETUP

The magnetic setup is easier because the fluxgate sensor saturates positively or negatively. The algorithm takes advantage of it and allows therefore a  $\pm 5^\circ$  range.

The first declination direction is the East fluxgate Up (UE). The horizontal axis is placed at  $90^\circ$  by means of a “goto” command (see later) then, the operator turns the vertical axis in order to point roughly the magnetic east. This value is then recorded in “parameters/settings/star positions”. The three others are directly derived: the second is the same and the last 2 directions are at  $180^\circ$  from this one.

A similar procedure is made for the 4 inclination directions. It is possible to perform a “declination program” before the inclination setup in order to automatically determine the magnetic meridian. The system sequence is (in the north hemisphere):

- (1) sensor UP South corresponding to  $180^\circ$ -I
- (2) sensor DOWN North corresponding to  $360^\circ$ -I

- (3)sensor DOWN South corresponding to  $I+180^\circ$
- (4)sensor UP North corresponding to I

**!!! The procedure requires to have a first declination UE at an angle bigger than  $180^\circ$ . If it is not the case, it is possible to turn the instrument by  $120^\circ$  (changing foot-screws and crapaudines) and restart at the levelling procedure. Another solution is to close the program and open the “config file” (see later) and change the V angle offset until obtaining the correct declination UE value. In this case, there is no need to restart previous setup but only add the offset difference in the already setup “parameters/settings/star positions”. If anyway the operator want to keep a declination UE lower than  $180^\circ$ , the inclination sequence should be adapted: (1)&(2) become (3) &(4). The operator will have to keep in mind that step names will not be correct but the measurement will be performed.**

Once all “start positions” are determined, annual means and observatory settings have to be filled.

Then, it is possible to start a complete measurement sequence (complete program). The value of each step is displayed in the lower right part of the screen. In order to make the next measurements quicker, it is recommended to update the declination and inclination start positions.

## SCHEDULER

The last setup step is the scheduler allowing performing measurement at regular interval. See “scheduler section”.

## MAIN WINDOW

The Main Screens pops up with five info panels:

- **Schedule Info** Panel displays the Info of the next scheduled measurement.
- **Axes** panel displays the current angle measurements around each axes in decimal degrees. Warning! Angle around the Vertical Axis is called VAngle and corresponds to conventional Hcircle reading. Angle around the Horizontal Axis is called HAngle and corresponds to conventional Vcircle reading.
- **Probes** panel displays the current measurements of the three probes : Fluxgate, Laser and Level
- **Last measurements** panel displays the last correct executed measurements on each measurement position: Declination, Inclination, Target, Meridian (Angle around vertical axis towards the magnetic north). Meridian is automatically computed.
- **Measurement Steps** shows for each of the different measurements all last records. Intermediate recording are also displayed even if they aren't directly useful information. Nevertheless they can help when problems occur.

The screenshot displays the following panels:

- Schedule Info:** No Measurements Scheduled
- Axes:**

Axis V	Axis H
80,0001 °	40,0003 °
- Measurement Steps:** Declination 1 (dropdown menu). Table with columns: Time, Horizontal Axis, Vertical Axis, Level, Laser, Fluxgate.
- Probes:**

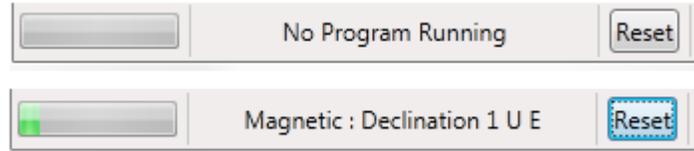
Fluxgate	Laser	Level
200,6 nT	26	0,2719 [°]
FINE	OFF	FINE
- Last Measurements:**

Declination		Inclination	
0,0000	0,0000	0,0000	0,0000
0,0000	0,0000	0,0000	0,0000
Target		Meridian	
0,0000	0,0000	139,4188	319,4188
0,0000	0,0000		

Rq. : Most of the Info Panels have tooltips to explain in more detail what exactly is shown.

## TOOLBAR

The toolbar provides the instrument status information.



Left side part toolbar indicates which action is running. When no action is performing (i.e. in standby state) the toolbar indicates “no program running”. The Progress bar shows a relative evolution on the current program running. As more operations have been executed the progressbar fills up. The name of the program and the current executed operation are shown.

The **Reset** button is very useful if an operator would like to stop a measurement before the end of it or in case of problems. It resets the current action and stops sending commands to the device. The reset button should always be handled with care because abrupt stopping of the program can cause flaws in the current measurements.

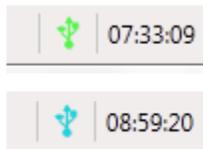
On the right side are three indicators: power indicator, USB status and UTC Time.

Power indicator is of interest when software is installed on a laptop. In this case, the system checks if a battery charger is plugged or if the laptop works on its own battery. When no charger is plugged, the scheduler set in pause state.



USB icon has three states:

- **red** : If no connection with the device could be made via USB.
- **green** when the connection could be made and the device is in an Idle (standby) state.
- **blue** : when the device is busy executing a command.



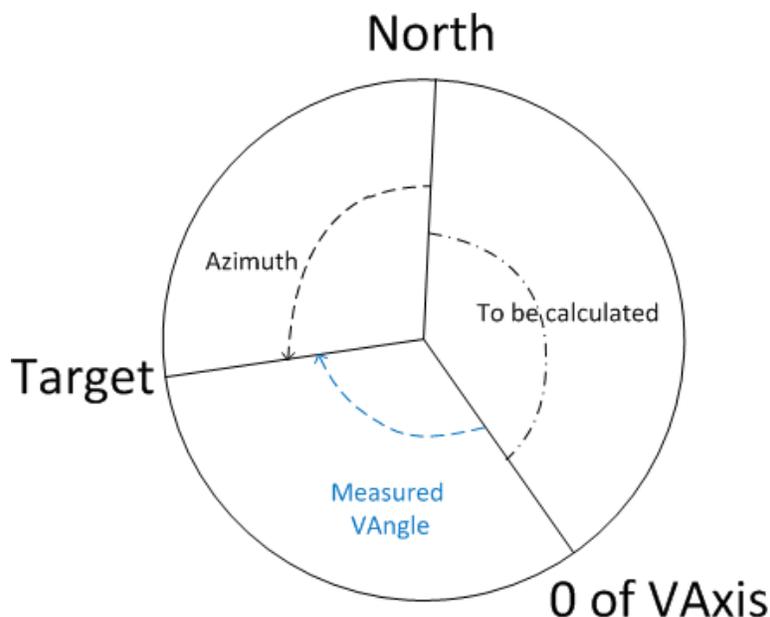
Beside the USB Status clock is displayed. The time indicated is the UTC, which is the standard time used to register the measurements.

## PROGRAMS

A Program is a group of operations that can be executed in one click. During an operation different commands are sent to the instrument in order to execute the operation. Five different programs are predefined and can be executed by selecting them in the program menu.

### AZIMUTH PROGRAM

The azimuth program has as main goal to measure the VAngle (around vertical axis) towards a target with a known azimuth. This measured VAngle can be used later on to determine the angle between true north and the index position of the V Axis.



The AutoDIF target is a corner cube (retroreflector) whose azimuth is determined a priori by means of a third method. A laser embedded on AutoDIF points this target. The device tunes the position in order to detect the center of the cube corresponding to the target direction. Two positions close to the center are recorded and interpolated to find the exact center. The initial rough position must be set in the settings during the instrument setup.

The program consists of following operations:

- Switch the Laser ON.
- Position the instrument in a predefined orientation close to the target but not on it and calibrate the optical sensor.

- Point the target with the fluxgate Probe Up and record the angle. (always two correct measurement will be taken and registered).
- Point the target with the fluxgate Probe Down and record the angle. (angle has 180° difference with previous measurements).
- Switch the Laser OFF.

The measurement steps info panel shows all consecutive measurement attempts to find the target. If no correct measurement is found after 30 attempts the measurements stops and the program executes the following operation. When this happens the initial parameters need to be reset.

If measurement was correct 4 angle measurements (2 fluxgate\_probe up and 2 fluxgate\_probe down) will be registered in the raw data file while the two interpolated values will be recorded in the calculated file.

## DECLINATION PROGRAM

The Declination Program applies to the first part of the standard DIFlux measurement protocol where 4 VAngle measurements are to be registered to be able to accurately measure the magnetic declination. In this case Autodif is in a configuration so that the fluxgate lies in a horizontal plan and oriented orthogonally to the H component of the field. Similar to the target measurement two angles are recorded as well as fluxgate output (also called residue) in order to interpolate and determine the exact perpendicular position (zero method).

This program consists of 4 Operations:

- Declination 1: Telescope towards the east and the fluxgate probe up.
- Declination 2: Telescope towards the west and the fluxgate probe down.
- Declination 3: Telescope towards the east and the fluxgate probe down.
- Declination 4: Telescope towards the west and the fluxgate probe up.

The initial rough position needs to be setup. Then, the instrument converges to the correct position within a range of  $\pm 5^\circ$ . A measurement is correct when the fluxgate is not saturating (i.e. when output value is less than 1700 samples or about 150nT). In this case, AutoDIF can move directly close to the zero position by using H component annual mean that operator presets in the software.

For each step it is possible to speed up the convergence by setup the initial rough position close to the “zero-output” position in the parameter settings .

The measurement steps info panel shows all consecutive measurement attempts to find a correct fluxgate measurement. If no correct measurement is found after 3 attempts the measurements will stop and the next operation is executed. In this case the initial parameters need to be redefined.

If the program is correctly executed 8 angle measurements (2 for each declination operation) are registered in the raw data file and the 4 interpolations in the calculated file.

## INCLINATION PROGRAM

The Inclination Program applies to the second part of the standard DIFlux measurement protocol where 4 HAngle measurements are to be registered to be able to accurately measure the magnetic inclination. In this case Autodif is in a configuration so that the fluxgate lies in the magnetic meridian and oriented orthogonally to the F component of the field. Similar to the target and declination measurement two angles are recorded as well as fluxgate output in order to interpolate and determine the exact perpendicular position (zero method).

This program consists of 4:

- Inclination 1: Telescope towards the south and the fluxgate probe up.
- Inclination 2: Telescope towards the north and the fluxgate probe down.
- Inclination 3: Telescope towards the south and the fluxgate probe down.
- Inclination 4: Telescope towards the north and the fluxgate probe up.

The magnetic meridian is automatically computed during the declination program.

The measurement steps info panel shows all consecutive measurement attempts to find a correct fluxgate measurement. If no correct measurement is found after 3 attempts the measurements stops and the next operation is executed. In this case the initial parameters need to be reset.

If the program is correctly executed 8 angle measurements (2 for each inclination operation) are registered in the raw data file and the 4 interpolations in the calculated file.

## MAGNETIC PROGRAM

The Magnetic Program combines the Declination and Inclination Programs. Therefore 8 operations are executed starting by the 4 Declination Operations.

## COMPLETE PROGRAM

The complete program executes:

- Azimuth Program
- Declination Program
- Azimuth Program
- Inclination Program.

A successful execution results in a registration of a complete autodif measurement set consisting of 24 measurements:

- 4 Laser Measurements ( 2 Probe Up , 2 Probe Down)
- 8 Declination Measurements ( 2 for each declination operation)
- 4 Laser Measurements ( 2 Probe Up , 2 Probe Down)
- 8 Inclination Measurements ( 2 for each inclination operation)

## COMMANDS

A Command is a Single Operation Program that does elementary tasks. In general the programs are using single commands to execute a coarse grained action.

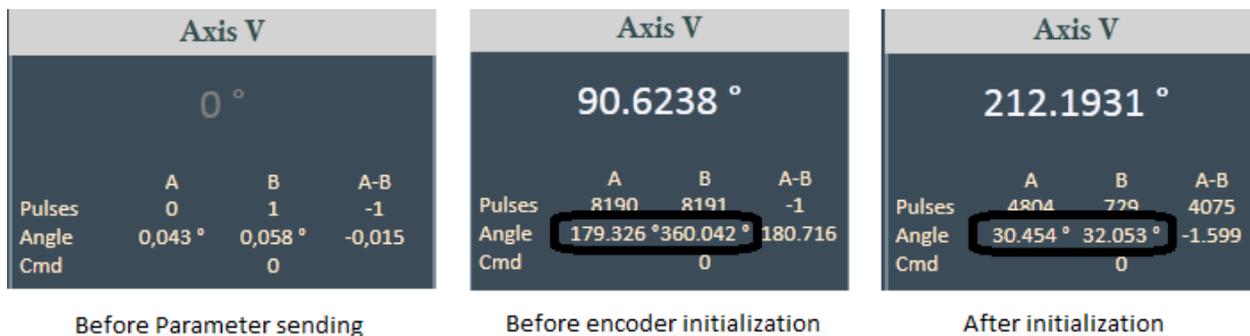
## BASIC COMMANDS

### INITIALIZATION

Autodif encoders (angle reading sensor) are relative devices that need to be initialized before trying to read any angle. This command is executed after each switch-on beforehand any other operation. It consists of:

- Sending Initial Setup parameters: initial setup data like angle offsets and PID coefficients are send to the device.
- Execute a rotation around the two axes to find the zero's of the encoders.
- Save the current registered angle values.

The figure below shows the vertical axes before and after each step.



Before initializing the angle are greyed out zero indicating that the initial parameters are not send yet. After receiving the parameters the greyed out zero's disappear and an angle value is displayed.

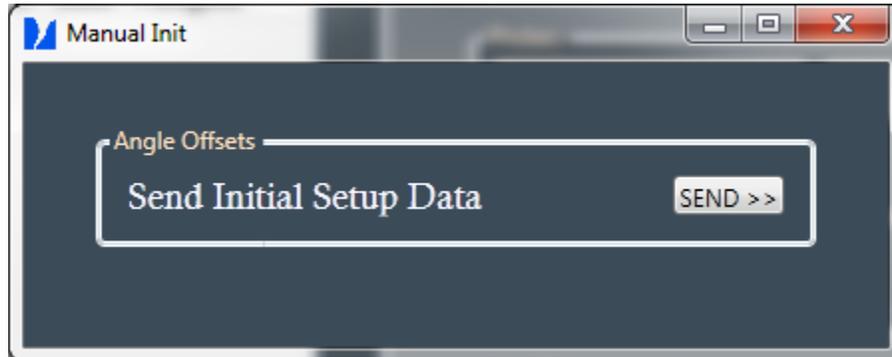
When switching to debug mode detailed angles are shown. In particular, the two readers (A and B) are clearly different before initialization. After initialization the angle values of the two sensors should give similar angle results. These values are also checked during execution of a program and reinitialization is automatically performed if necessary.

### AUTOMATIC INITIALIZATION

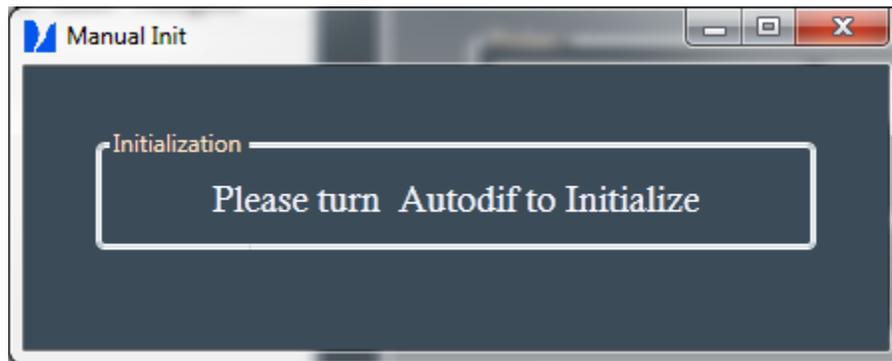
The automatic initialization performs the initialization automatically. However last position has to be saved. Typically this is used after a power failure or a restart of the software. AutoDIF software automatically records the position after each correct movement and on completion of an initialization.

## MANUAL INITIALIZATION

The above described steps are normally executed automatically after detection of none initialization. However it is possible to do that manually by choosing it in the command menu. Popups guides the operator during these steps.



Pressing the button send the initial needed setup data to the device. The greyed out zero's disappears after synchronization and the second screen appears.



During this step operator need to turn AutoDIF axes until the zero's are found and the next screen is displayed.

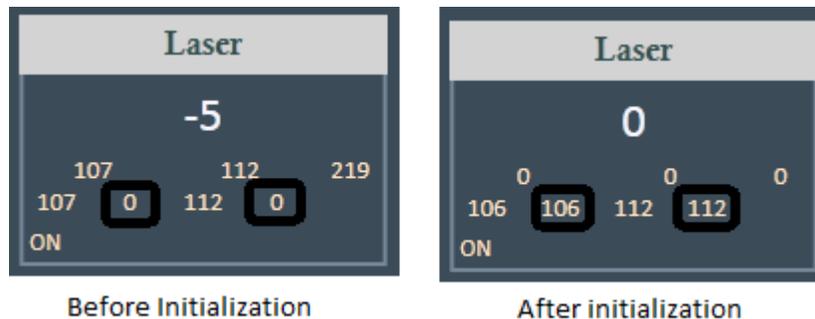


Press the save button to register the position and complete the manual initialization.

## INIT LASER

The first step of the azimuth program consists of initializing the embedded optical sensor by pointing an operator-predefined direction. The sensor is composed by two photocells whose offsets are cancelled during this step. It is evident that the predefined direction should not coincide with a direction allowing a beam reflection to the optical sensor. This direction should also be as close as possible to the target location (fluxgate up) in order to minimize the motion during an azimuth or complete program.

It is possible to visualize offsets, sum and differences of the sensors values when switched in debug mode.



## SWITCH LASER, FLUXGATE OR LEVEL

With three single switch commands we can :

- Put the Laser On and Off (also used in azimuth measurements)
- Switch the measurement scale of the fluxgate sensor from fine-grained to coarse-grained
- Switch the measurement scale of the level sensor from fine-grained to coarse-grained

The current settings can be seen on the Probe Info Panel in yellow.



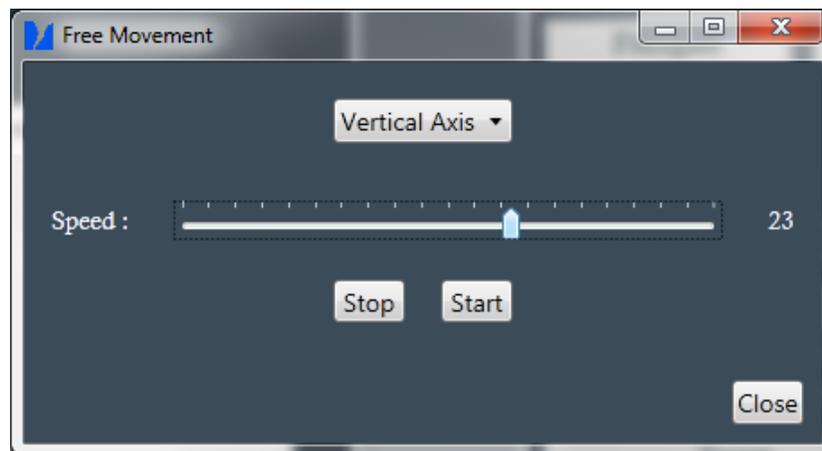
## BASIC MOTION

Basic motions are Single Commands that allow the user to execute a specific rotation. They are often used during the setup to facilitate levelling or to find initial positions of targets ,etc.

There are three type of rotation: free, pulsed and regulated.

## FREE MOTION

The Free Motion is an open loop rotation in which the selected axis turns at a ratio of its nominal speed. This ratio can be ether positive or negative depending on the desired direction of rotation.

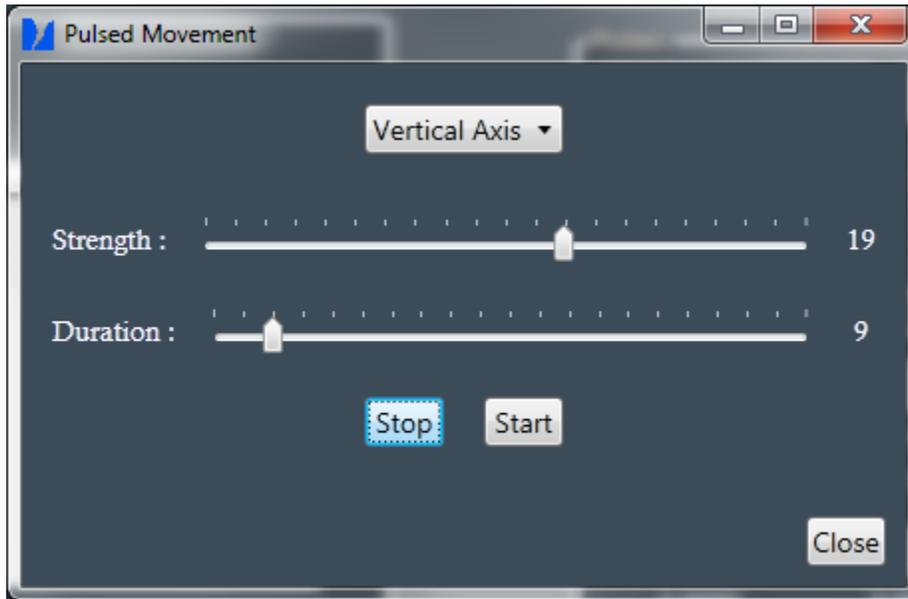


After selection of the axis and ratio, the operator starts a continuous motion by pressing the start button. The speed can be changed in real-time between a relative value of -100 or +100. The movement needs to be stopped by pressing the stop button (leaving the window will also cause a stop of the movement). Stop button must be pressed to change the Axis.

**This should always be handled with care because rapid movement can cause the cables to block.**

## PULSED MOTION

The Pulsed Motion allows executing a very small and brief motion (a pulse). It can be useful when tuning a position in particular when setup the target pointing. Two parameters can affect the pulse: strength as well as for free motion and the duration of the pulse.



A pulsed movement needs therefore three inputs :

- The axis of the pulsed movement.
- The strength of the pulse between -100 and 100 the sign indicates the direction.
- The duration of the pulse which is a relative number between 0 and 100.

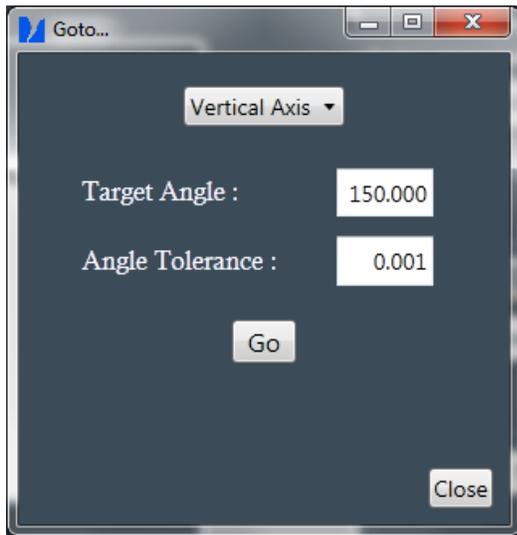
A single pulse is an open-loop motion. Its effect strongly varies with instruments so that operator should get familiar with its own instrument and use this command by slowly increasing the strength and duration values. Depending on the selected values, the motion may range from  $0.001^\circ$  to several degrees.

If the duration is big enough, the pulse can be stopped by pressing the stop button (leaving the window will also cause a stop of the movement). Axis can't be changed during a pulse.

---

## GOTO POSITION

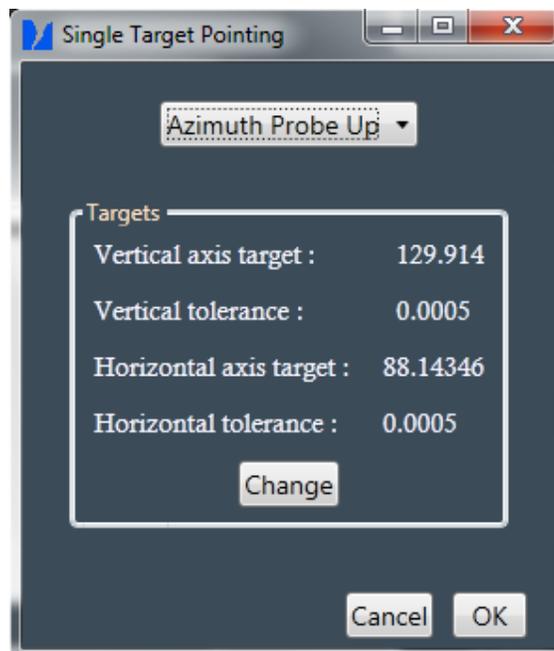
The Goto Position Command is a closed-loop motion that turn an axis according a given angle. Commands can be given for HAngles and VAngles.



After selecting the Axis, Angle and Tolerance you can execute the goto command. AutoDIF moves in the desired position. The window stays open until the close button is pressed. This makes possible to execute a sequence of goto commands, typically needed during levelling of the instrument. The last executed goto command is shown in the label. Pressing the close button does not stop the movement (operator needs to press the reset button in the toolbar).

## SINGLE MEASUREMENT

### TARGET POINTING MEASUREMENT



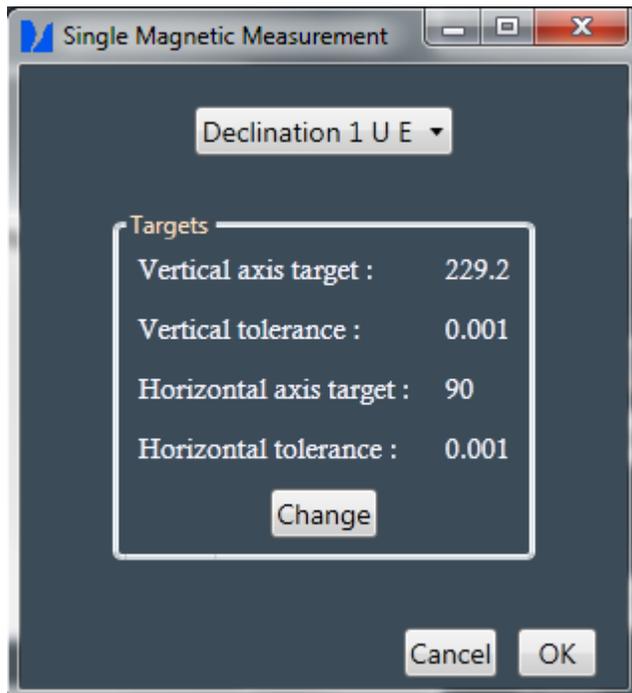
The Target Pointing Measurement lets operator to execute a single measurements of the Azimuth Program.

The dropdown allows selecting between Fluxgate Probe Up or Down. The targets bullet indicates the setup values of the measurement that will be used during command execution. These values can be changed via the parameter settings by clicking on the change button.

---

## SINGLE MAGNETIC MEASUREMENT

The Single Magnetic Measurement lets to execute a single step of the Magnetic Program .



The dropdown allows selecting between the 8 possible magnetic measurements. The targets bullet indicates the values of the initial angles and tolerances corresponding to the selected step. These values can be changed via the parameter settings by clicking on the change button.

## SETTINGS

The settings menu contains all the items that are needed to configuration the instrument. It also has possibilities to adapt the view panels.

## PARAMETERS

The parameters window let the operator to change most of the configurable items in the AutoDIF software. It is organized in three tabs:

- The Start Positions Tab which contains initial angles and there accepted tolerance.
- Advanced Settings Tab that contains more advanced parameters used during initialization and angle corrections in the used algorithms.
- Observatory Settings Tab containing general info of the current observatory. This info is used to construct the header of the Calculated File.

Parameter values are stored in two binary files `globalsettings.osl` and `initialdata.osl`. Changes are recorded when button ok is pressed. These two files need to be copied if operator wants to setup a second computer with same parameter values.

---

## START POSITIONS

Each step of Azimuth or Magnetic measurement starts by going to a predefined V/H angle. These positions are setup in the Start Positions Tab.

For best working of automatic measurements these start positions should be chosen close to the assumed definitive position. In particular the azimuth positions need to be chosen with care.  $\pm 5^\circ$  range is possible for magnetic steps positions. In the case of inclination, the V axes values are automatically updated after declination measurements.




---

## ADVANCED SETTINGS

The Advanced Settings contain:

- Annual Mean Values of the horizontal magnetic field component H and the Magnetic Field total strength F.
- Unit Conversion Factors that convert the samples into meaningful units measurements.
- Laser Initialize Position which is the position that will be used to remove photocells offsets.
- Sign of Corrections are the signs of the eventual corrections that will be added or subtracted to the current position during fluxgate algorithm. This sign should be checked in particular if the operator decides to change the sequence order (in this case, declination 1 may not remain “Up East” even if one can read “UE” beside it).

---

## ANNUAL MEAN VALUES

The annual mean values is used during a magnetic measurement in order to converge to a position corresponding to a zero output of the fluxgate sensor. The following residue to angle conversions are computed:

For the calculation of the declination correction:

$$A_{\sin} \left( \frac{\text{Sample} * \text{Factor}}{H_m} \right)$$

Where “sample” is the fluxgate digital sample, “factor” the conversion factor to convert the digit samples into nTesla and  $H_m$  the annual mean of the magnetic H component.

For the calculation of the inclination correction:

$$A_{\sin} \left( \frac{\text{Sample} * \text{Factor}}{F_m} \right)$$

Where  $F_m$  the annual mean of the magnetic F component.

---

## UNIT CONVERSION

The unit conversion factors are used to convert digital samples into physical units.

The Fluxgate Conversion Factor is used to convert samples into nanoTesla and appears in the above equations to calculate needed corrections.



The image shows a screenshot of a configuration window titled "Fluxgate Parameters". It contains three settings:

Parameter	Value
FluxGate Conversion Factor	0.098000
Sign of Correction for D1 and D3	1
Sign of Correction for I1 and I4	-1

The Level Conversion Factor is used to convert the level samples into degrees and display them in a human readable form. Positive and negative value may slightly differ. Values are factory determined and should be changed only in case of change of the level sensor. The sign of correction may be changed in case of change in the sequence order.

Level Parameters	
Level Constant for + values	-3.2214E-05
Level Constant for - values	-3.2752E-05
Sign of Correction for D1 and D2	1 ▾

---

## LASER INITIALIZE POSITION

The laser initialize position is the HAngle and VAngle with tolerance of the position that will be used to execute and Initialize Laser command.

Laser Initialize Position		
Vertical Angle and Tolerance	80,000	0,001
Horizontal Angle and Tolerance	40,000	0,001

The position should point beside the target ( not on the target ) where the reflection is normally zero. It will then be used to determine the photocells offsets.

---

## OBSERVATORY SETTINGS

The Observatory Settings contain all info that is needed to identify the position of the autodif installation:

- The Observatory Name is a logical name that identifies the current observatory.
- The Iaga Code is the unique code that IAGA has given to this observatory.
- Pillar ID is the unique identifier of the pillar upon which AutoDIF is placed.
- Target ID is the unique identifier for the target used by AutoDIF.
- Target Azimuth is the azimuth in decimal degrees of the target.

Global parameters of the observatory

Observatory Name	Dourbes
Iaga Code	DOU
Pillar ID	DO1
Target ID	TDO1
Target Azimuth	0.00000
Longitude	4.60000
Latitude	50.10000

These parameters are used to create the header of the Calculated File.

## SCHEDULER

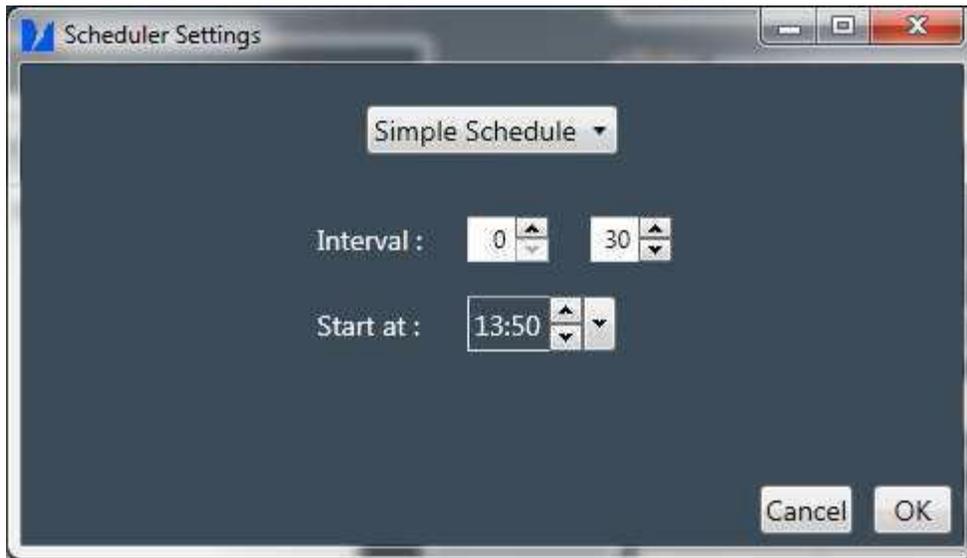
The Scheduler allows planning an execution of a Complete Program at regular points in time.

- Simple Schedule: allows scheduling a complete program at a predefined interval.
- Mixed schedule: allows scheduling a program at a predefined interval. The program to execute can be complete or just magnetic one.

All introduced schedule parameters are saved and AutoDIF can be configured to automatically restart the schedule when program gets restarted.

### SIMPLE SCHEDULE

Simple schedule only require start time and interval in hours and minutes. Interval is limited at 168 hours (7 days) . The start time is UTC and limited at the current day. Once the schedule parameters are determined and Ok button is pressed the schedule parameters are saved (in the Globalsettings.osl) and the Schedule Info Panel gets updated.

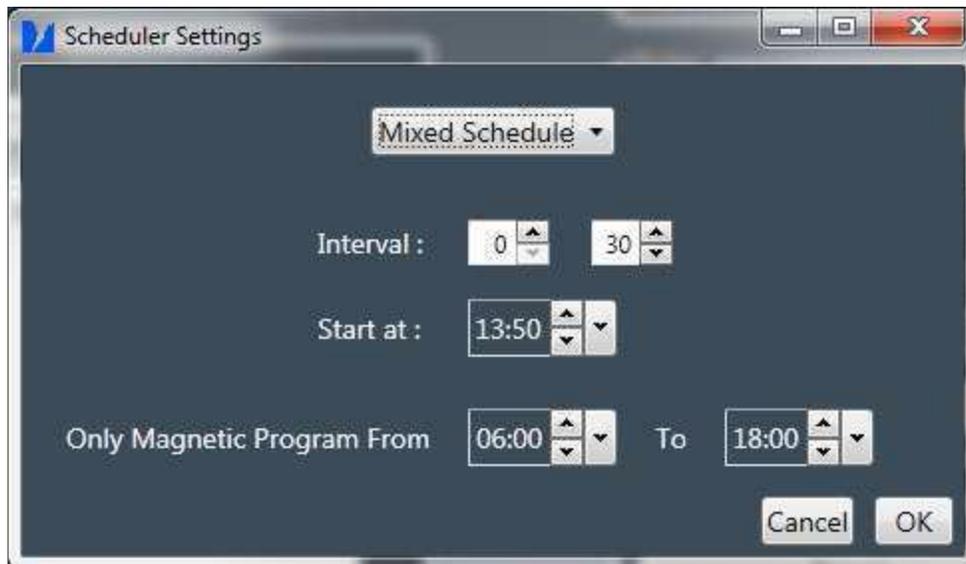


Advisable at least 15 minute interval needs to be respected.



---

## MIXED SCHEDULE



Mixed schedule requires the same parameters as the simple scheduler (start time and interval). On top of that it is possible to introduce a time period within only a magnetic program needs to be run instead of a complete. It can be useful if the optical path between instrument and target is periodically disturbed (e.g. due to thermal effect). Once the schedule parameters are determined

and Ok button is pressed the schedule parameters are saved (in the Globalsettings.osl) and the Schedule Info Panel gets updated.



## SCHEDULER ON HOLD

In case of power failure the program detects that it falls back on battery and the next scheduled program is placed on hold.



When the program detects that there is again a power supply the on hold is removed and the next program is executed as planned.

This particularity is only used with a laptop.

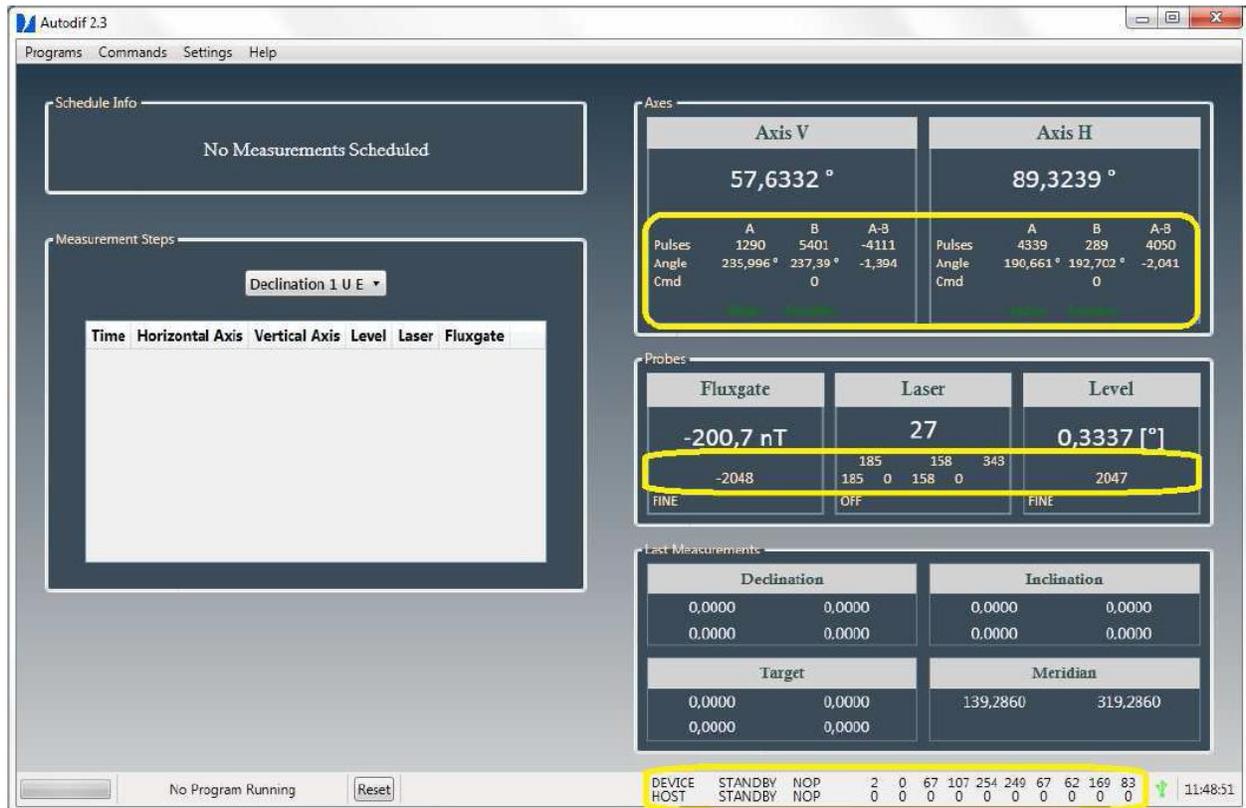
## DISPLAY MODE

The Display Mode let operator switching between Debug Mode and User Mode. When Debug Mode is set extra infos are displayed. Usually these info are only needed when autodif encounter problems or during installation.

The extra debug zones are indicated with a yellow ellipse. In total there are three zones.

The first one is in the Axes view panel. Each angle is capture by two sensors (A and B) and the sample values plus angle measurements are displayed in this extra info. Another extra info is the encoder and motor which are displayed in green when the microcontroller has connection to them and red when connection to them failed.

A second one is located on the probes view panel it permits to view the actual measured samples of Fluxgate and Level. For the laser you have extra info of the two sensors that are used. In the debug view, you can see the actual laser samples, the calculated offsets and corrected samples (original - offset). As extra the sum of the two samples are displayed. (sum and differences are used during azimuth algorithm to position the laser exactly on the target). Tooltips indicate which field is what.



In the status bar there is an extra double line. The line above shows the 12 bytes that are continuously send and updated from the device to the computer. They are essentially used to send the data needed to update the info panels.

The second one are the 12 bytes that are used to send commands from the computer to the device. During program execution you can notice that these are changing.

Remark: the first three bytes of each line are replaced by human understandable words to simplify debugging.

## RESET USB

The reset USB MenuItem can be used to restart the Windows USB driver. When you notice the usb device is not found (red USB symbol) although everything seems to be correctly connected, restarting the USB driver can fix the problem.

It will result in restarting the USB Device USBXpress that you can find in the Windows Device Manager.

Disabling/Enabling it from within the Windows Device Manager has the same effect.



## HIDE MEASUREMENT STEPS

This action just hides/unhides the Measurement Steps Info Panel. Hiding it also stops the timer thread needed to update this panel.

## ADD NOTE

The add notes is a small utility to make it possible to log certain special conditions in a logbook. When you click this menuitem you have the possibility to register string messages in a database or a file notes.txt with the time of logging. Depending of the boolean DB autodif will use a DB or the textfile.

## CONFIGURATION FILE

Autodif software comes with a startup file that makes it possible to change some startup parameters. The file is an xml file called autodif.exe. All these parameters should only be setup during initialization and handled with care ! When changed the autodif software needs to be restarted to pick up the changes. It will not automatically load the changes.

The **DevConFile** parameter contains the location of the devcon.exe file, a utility needed to be able to restart the USB Driver. This parameter should not be changed.

The **DriverPattern** parameter is the pattern that corresponds to the USBDriver that is needed to find the correct driver. This parameter should not be changed.

The **VersionNumber** parameter is the current installed version. DO NOT change this.

The **Debug** parameter is a boolean. When put to True autodif will startup with the debug info panels enabled else it starts up in user mode.

The **FluxAcceptableMeasurement** parameter is a short. It indicates the upper limit of the fluxgate sample value that is considered as an acceptable fluxgate measurement.

The **LaserSumAcceptableMeasurement** parameter is a short . It indicates the lower limit of the Laser Sample Sum that will be considered as a useful laser measurement.

The **LaserStep** parameter is a float . It indicates the the corrective angle in decimal degrees that will be used during the azimuth algorithm that calculates needed correction.

The **Calculated File** parameter is a boolean . If true autodif will generate a daily file in a directory "calculate" which contains calculated and easy to use data for baseline calculations. The file corresponds with the one that would be noted by a manually executed procedure.

The **DB** parameter is a boolean. If true autodif will send the calculated data to a DB to add a measurement record in the DB ( as alternative to file usage: all parameters beginning with DB are used to establish connection to the DB). Only Mongo DB is supported.

This File also contains all initial Offsets and PIDFactors that are send to the Autodif device during initialization. These need to be handled with care and determined during first setup and installation.

## RESULT FILE

The result file is an ASCII File that is created in a subdirectory Data. It is a daily rolling file with a name structure YYYYMMDD.txt. Every entry is tab separated and a newline is indicate with Carriage Return LineFeed (0D0A). For each correctly executed measurement it registers one line :

MeasureID | YYYY-MM-DD | HH:MM:SS | Laser | Fluxgate | Level | Haxis | VAxis

resulting in for example a Declination measurement :

Declination 1 2013-04-26 09:48:25 0.1489 -217 837 89.9994 291.4992

A complete program results in 24 entries in this file.

## CALCULATED FILE

The Calculated File is an ASCII File that is created in a subdirectory Calculated when the boolean CalculatedFile is set to True. It is a daily rolling file with a name structure YYYYMMDD.txt. A Calculated File has a header containing all the observatory info. All other entries are tab separated and a newline is indicated with Carriage Return LineFeed (0D0A). The Calculated File is a reduced and more useful form of the result file. A Complete Program or Magnetic Program results in a record in this File. :

ID | YYYY-MM-DD | HH:MM:SS | Value (Corresponding Angle in decimal Degrees)

resulting in for example a Declination measurement :

Decl1UE 2013-04-05 03:37:35 291.4741

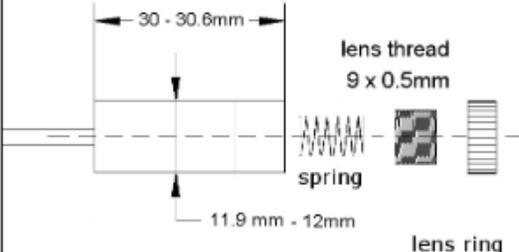
A complete program results in 4 Declination Measurements, 4 Inclination Measurements and 4 Target Laser Measurements.

## RECORDED FILES

Recorded Files are binary recorded behind the scenes files that need to be there to guarantee persistency of certain values. In total three recorded files can be distinguished :

- InitialData.osl containing the [initial positions and their tolerances](#) for each different type of measurement.
- GlobalSettings.osl containing the last configured schedule parameters, the parameters configured in the [Advanced Settings](#) and [Observatory Settings](#)
- reinit.dat containing the two last angles around VAxis and HAxis that are needed during [reinitialization](#). This file is constantly updated after a Theodolite movement.

## HLM1230 5mW RED LASER MODULE

<p style="text-align: center;">650 nm</p> <p style="text-align: center;">5mW</p> <p style="text-align: center;">RED LASER MODULE</p> <p style="text-align: center;">FOCUSABLE ACRYLIC LENS</p>	 <p style="text-align: center; font-size: small;">&lt; 5mW 650nm FOCUSABLE LASER MODULE</p>																																						
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