# AutoDIF MKII - Specifications & Installation Requirements



Figure 1: AutoDIF MKII installed at Conrad Observatory (WIC - Austria)

## Description

AutoDIF MKII is an automated DIflux, providing absolute measurements of geomagnetic Declination & Inclination. Those measurements are used in geomagnetic observatories to calibrate variometers. As an automated instrument, Autodif continuously works without any human support. An Autodif measurement sequence follows the same protocol as a conventional "manual" DIFlux measurement sequence:

- Horizontal direction Referencing: 2 target pointing (sensor up and sensor down)

- 4 declination measurements: east-up, west-down, east-down and west-up.

- Horizontal direction Referencing: 2 target measurement  (to check the mechanical stability)

- 4 inclination measurements: south-up, north-down, south-down and north-up

Combined with a scalar instrument (e.g. proton precession magnetometer), the AutoDIF MKII absolutely measures the geomagnetic field vector in orientation and in size, and can determine variometer baselines (e.g.X0, Y0 & Z0).

Mechanical part of the instrument consists of a non-magnetic platform having two major degrees-of-freedom in rotation (a vertical and a horizontal axis). The motion is ensured by non-magnetic ultrasonic motors. Each axis is equipped with non-magnetic angular encoders providing angle readings with 1arcsec (1/3600°) resolution. A single axis magnetic sensor (fluxgate sensor) is mounted on the horizontal axis in order to determine the different positions perpendicular to the magnetic field. Levelling the instrument can be performed by turning the three foot-screws and checking the electrolytic level (electronic version of the usual bubble level).

Referencing uses a laser beam and a corner cube (retroreflector) as target. The center of the corner cube corresponds to the center of the target. The reflected beam is detected by a couple of photocells mounted on the instrument.
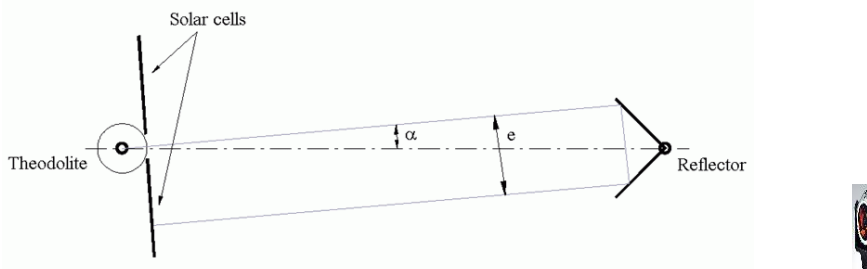


Figure 2: Target pointing principle

Autodif signals are transmitted to its electronic box through an 8m cable and data from electronic box to a laptop through USB cable.
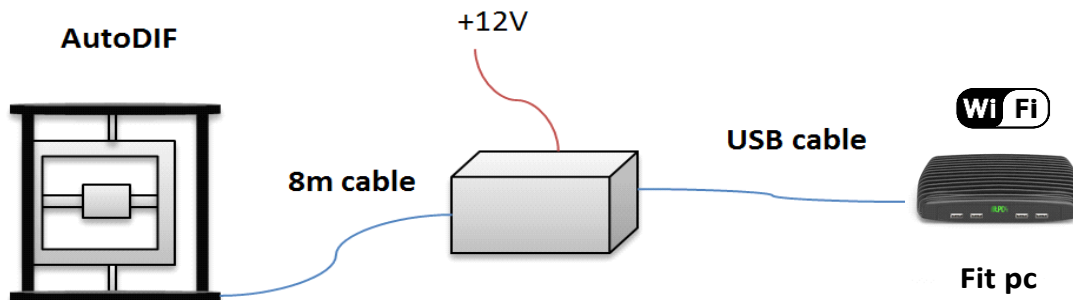


Figure 3: Cabling

## Main characteristics

| | |
|---|---|
| Angle reading resolution | Better than 1'' |
| Angle absolute accuracy (ISO 17-123): | Better than 6" |
| Motor resolution | 0.001° |
| Fluxgate sensor resolution | 0.1nT |
| Electrolytic level resolution | <0.2'' |
| Vertical Index level compensation range (by software) | +/- 2' |
| Clock | From local time server or by internet |
| Target pointing resolution | < 1'' |
| Laser beam wavelength | 650 nm (visible red) |
| Power requirement | AC 100-230V 50/60Hz 2A |
| Autodif - electronic box cable length | 8m |
| Electronic box magnetic signature | < 1nT at 1m |
| Measurement duration | < 10min |
| Max measurement rate | > 6 sequences/hour |
| Autodif dimensions | 230mm (external diameter) x 350mm (height) |
| Footscrews spacing | 120° on 24 cm diameter underplate |

| Control Computer reference<br>Note: no screen nor keyboard/mouse included. | Compulab fitlet 2 or similar |
|---|---|
| Remote desktop connection | through LAN or wireless router (reference TPlink TL-MR3020 or similar) |
| Target (corner cube) reference | Geo Fennel prism set A4 or similar |
| Battery reference | YUASA REC 10-12 (12V, 10.0 Ah) cyclic application (or similar) |

## Files format

AutoDIF records data in txt files. There is one file per day. The name has the following structure: yyyymmdd.txt

All data are written in the daily file. The first line of a measurement specifies if the sequence is complete or magnetic only (without target). Then the lines correspond to a step of measurement:

- Target pointing fluxgate UP

- Target pointing fluxgate DOWN

- First declination fluxgate UP EAST

- Second declination fluxgate DOWN WEST

- Third declination fluxgate DOWN EAST

- Fourth declination fluxgate UP WEST

- Target pointing fluxgate UP

- Target pointing fluxgate DOWN

- First inclination fluxgate UP SOUTH

- Second inclination fluxgate DOWN NORTH

- Third inclination fluxgate DOWN SOUTH

- Fourth inclination fluxgate UP NORTH

The structure of each line is TAB SEPARATED: *Measurement step      date    time    value*

```
AUTODIF001    2015-09-02

STATION NAME : Dourbes
IAGA CODE    : DOU
PILLAR ID    : DO2
TARGET ID    : TDO2
TARGET AZ    : -007.94667


ID       YYYY-MM-DD   HH:MM:SS       VALUE
```

```
RecTime    2015-09-02    00:01:32        COMPLETE
LaserPU    2015-09-02    00:00:35        192.8610
LaserPD    2015-09-02    00:01:20        013.6043
Decl1UE    2015-09-02    00:01:38        292.2522
Decl2DW    2015-09-02    00:01:54        291.8539
Decl3DE    2015-09-02    00:02:17        111.4910
Decl4UW    2015-09-02    00:02:31        112.4979
LaserPU    2015-09-02    00:02:47        192.8611
LaserPD    2015-09-02    00:03:27        013.6044
Incl1US    2015-09-02    00:03:42        114.5193
Incl2DN    2015-09-02    00:03:58        294.4002
Incl3DS    2015-09-02    00:04:13        245.4439
Incl4UN    2015-09-02    00:04:27        065.5682
RecTime    2015-09-02    01:01:45        COMPLETE
LaserPU    2015-09-02    01:00:40        192.8613
LaserPD    2015-09-02    01:01:33        013.6047
Decl1UE    2015-09-02    01:01:51        292.2892
Decl2DW    2015-09-02    01:02:07        291.8635
Decl3DE    2015-09-02    01:02:20        111.5007
Decl4UW    2015-09-02    01:02:35        112.5054
LaserPU    2015-09-02    01:02:57        192.8613
LaserPD    2015-09-02    01:03:22        013.6047
Incl1US    2015-09-02    01:03:39        114.5164
Incl2DN    2015-09-02    01:03:55        294.3971
Incl3DS    2015-09-02    01:04:09        245.4465
Incl4UN    2015-09-02    01:04:23        065.5705
```

## Installation Requirements

AutoDIF is an indoor instrument requiring a dedicated pillar in an absolute house.

| | |
|---|---|
| Temperature & humidity operating range | 10 – 30 °C  &  20 – 80% relative humidity |
| Recommended Autodif/ target distance | 50-100m (line of sight must be within 10 degrees to horizontal and free from any obstacle) |
| Distance Autodif / electronic box | Minimum 3m<br>Note: Minimum cable (Autodif to electronic box)  bend radius is 50cm |
| Recommended Pillar layout for Autodif | Non-magnetic Indoor pillar<br>Top Surface: min.25cm x min 25cm<br>Height: 0,5m to 1,5m |
| Recommended target support | Outdoor dedicated pillar with 5/8" screw<br>A small roof is strongly recommended (weather protection) |
| Power availability | AC 100-230V 50/60Hz 2A (2 plugs) |
| Internet availability | Internet availability is needed for remote troubleshooting assistance and Autodif data control. If no time server is available, internet is required for clock synchronisation. |

# FAQ

**What happens if the target is not visible?**

During a standard session, the instrument always tries to aim at the target a few times (max 30x). When it is not visible (e.g. fog or snow), the instrument forsakes the target reading and continues the procedure by measuring declination and inclination. The recorded results are flagged "without target". It is then possible to use the last target recording as current geographic north reference.

**What happens if the corner cube rotates around its vertical axis?**

The centre of the corner cube (i.e. the back corner of the prism) is the "mark" whose azimuth is known. Therefore, this particular part should be aligned with a possible vertical axis in order to avoid any rotation effect. The same case is encountered with a conventional DIFlux target presenting a lateral motion.

**Can we shoot the target through a glass window pane?**

Once again, shooting through a window will provide the same effects as pointing a target with a DIFlux. So the offset due to the beam refraction when pointing across double or triple-pane should be taken into account. The more perpendicular the bean is the less the offset is present.

**What kind of footpads should we install & how to orient the footpads?**

Footpads are included in the set of Autodif accessories (underplate) and will be installed by ourselves