MGPBox Manual

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Introduction

Thank you for purchasing MGPBox (short for Meteo-, GPS- and Power Box) a small, self-contained device that delivers positional information, barometric pressure, temperature, humidity and dew point information with high accuracy.

Sophisticated telescope mounts usually allow the creation of models to minimize inaccuracies in pointing and tracking that can result from mechanical tolerances, atmospheric refraction and other factors. In order for this model to be of the highest quality, the mount computer or controlling software can use the data that MGPBox provides and thus improve the accuracy in their calculations.

Because of the small size of MGPBox, it can be used in both mobile astronomy as well as stationary setups inside an observatory.

MGPBox is self-declared CE conform according to EN 301489-1 Class B and EN 61000-6-3 Class B
MGPBox is also ROHS compliant.

Overview
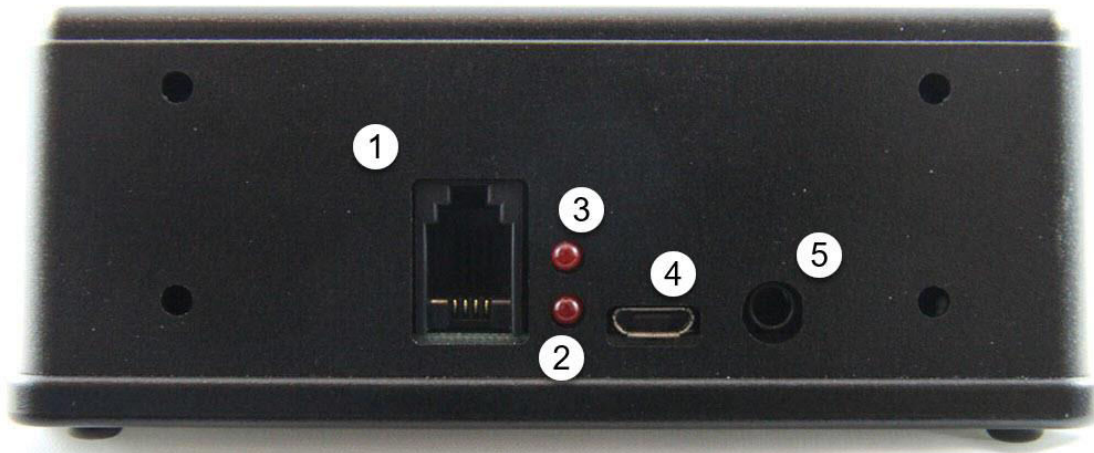
1 – RJ10 Port

2 – GPS Status LED

- LED blinks in 1 second interval if no GPS Fix is acquired
- LED remains off once a valid GPS Fix is achieved

3 – Mount Status LED

- Only relevant for the 10Micron specific Firmware
- Indicates if communication with the mount has been established. If the LED is on, MGPBox and the mount are not communicating with each other.

4 – Micro USB Connector

5 – Socket for Power-Control Cable

System Requirements

MGPBox was tested on WindowsXP, Windows 7 and Windows 10 in a mix of 32-bit and 64-bit versions. It is assumed that the Windows OS is updated to the latest patches and updates.

General Requirements

Windows Operating Systems

- Windows 10
- Windows 8 / 8.1
- Windows 7
  - No further requirements, in case the FTDI Driver is missing or overwritten by the Windows update process, please reinstall the one from the FTDI website (http://www.ftdichip.com/Drivers/VCP.htm)
- WindowsXP
  - Service Pack 3
  - .Net Framework 4.0
  - FTDI Driver (http://www.ftdichip.com/Drivers/VCP.htm)

Other Operating Systems

Although untested, MGPBox should work on Mac or Linux operating Systems. It may be necessary to install the proper driver that is available from FTDI (see link above). For a description of the command protocol please refer to Section Application Interface.

ASCOM Connections

For connections thru ASCOM the following needs to be installed:

- ASCOM Platform 6.2 or later
- Astromi.ch MGPBox Driver

MGPBox usage

MGPBox can either be used with or without a computer.
If you use the RJ10 interface of MGPBox, please check the pinout of your mount's computer before hookup. We take no responsibility for possible damages resulting from improper configurations! Please see Chapter "RJ10 Interface" for details

Usage with computer
- Connect MGPBox to your computer using the supplied USB-Cable and launch the application. MGPBox will be recognized by Windows as a new Com-Port
- It is recommended to do this at least once to in order to configure the behavior of the RJ10 Port.
- On older Windows Versions or other Operating Systems, it might be necessary to install the proper FTDI Driver before the device becomes available.

Usage without computer
- MGPBox can also be connected to your mount using the supplied RJ10 cable. The RJ10-Port is configured similar to a serial port and MGPBox can draw power either thru the USB-Port or from the RJ10-Port.
- Using just the RJ10 Port makes MGPBox operate in stand-alone mode where it just keeps sending data according to its configuration.

Note: For 10Micron Mounts, if the mount is powered off but the mount's power source remains on, MGPBox will continue to receive power from the mount.

Windows Application

Please consult the respective manual for a description of the windows application.

Firmware Versions

There are two versions of Firmware available for MGPBox which are described here.

Standard Firmware

The standard Firmware is pre-flashed onto the microprocessor. It sends both positional and meteorological data to the computer and the RJ10 port, if configured.

10Micron specific Firmware

Operating a high-end telescope mount can have some pitfalls. There are quite a few things that can go wrong and ruin the experience the mount is capable of providing.
Just to name a few:

- Wrong refractive data / time during model creation
- Update of critical parameters during tracking / exposure
- Multiple sources that sync (different values) with the mount (e.g. time)
- Etc.

In order to reduce this complexity, a 10Micron specific Firmware is available. The goal is to have one device that is "plug and forget" and does all of the above automatically and therefore reduce complexity for the user.

Installation and Configuration

Please download the Firmware from the astromi.ch website and install it using the MGPBox application and the procedure described in chapter "Windows Application – Setup and Close buttons" of this manual.
The application recognizes the firmware automatically after reconnection and automatically enables additional features.

Configure the Mount's GPS-Port to be a serial port. Details about this can be found in the 10Micron Manual.

Once these prerequisites are met and you have verified the pinout of your mount's computer, you can connect MGPBox to your mount using the supplied RJ10 cable.

Note: If you want to use MGPBox as the "one-and-only" data source, please ensure that no other software or driver also synchronizes data as this could lead to unpredictable results.

Differences in Windows Application

Because this Firmware features additional functionality, the Windows application also needs to be slightly different to take advantage of these features. The additional functionality described below is enabled automatically when the software detects the 10Micron specific Firmware.

Main Window
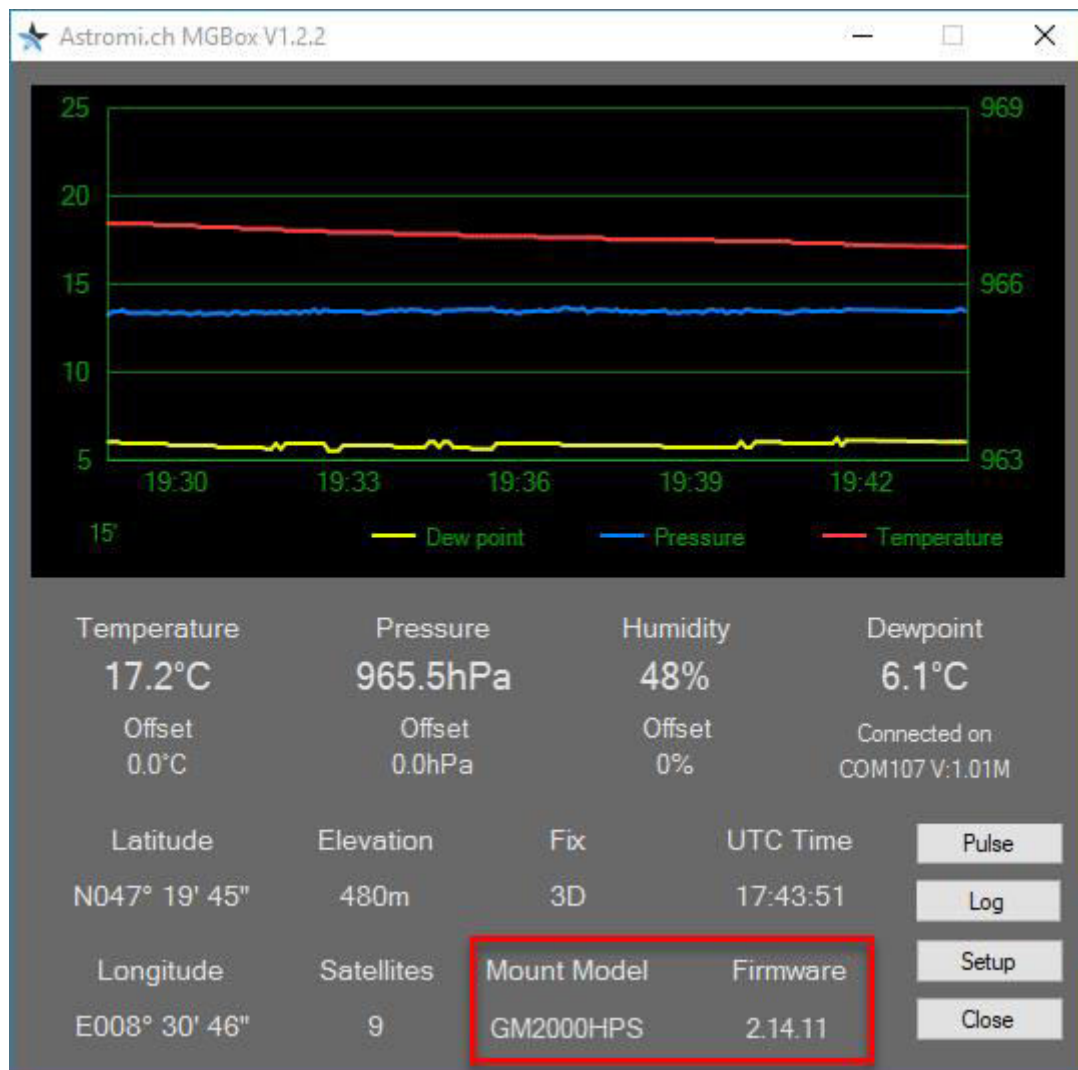
Mount Model and Firmware Information
Once MGPBox and your Mount communicate with each other, information about the Mount Model and the installed Firmware is displayed.

Setup Window
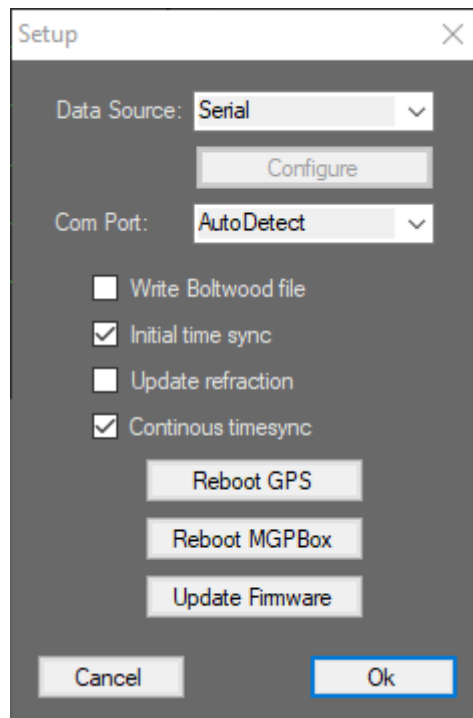
Initial time sync
Updates the mount's time to the time received from the GPS Module. This will only happen once when MGPBox and your mount establish communication. No further updates will happen after that.

Update refraction
Sends updated temperature and pressure information to the mount.

Continuous timesync
This option will continuously update the mounts time, depending on the tracking state as further explained below.

More Details

When MGPBox is plugged into the mount it will boot up and constantly query the mount for various information. As soon as a valid reply is received for a specific command, the main processes start.

Tracking state
MGPBox queries the mount for its tracking status at frequent intervals. Any updates to time or refraction parameters will only happen if the status is anything but tracking.

Location

Once the GPS Module reports valid data, the mount's latitude, longitude and elevation is updated to reflect the GPS data. This happens one time after MGPBox establishes communication with the mount and is irrespective of the tracking state.

Refraction and Time updates

The positional data from the GPS Module includes very accurate timestamps. To further increase that accuracy, MGPBox also makes use of the 1PPS signal that the GPS-Module provides. This time information, together with the UTC Offset and daylight savings defined via the hand controller of the mount, the current local time is calculated and compared to the time the mount reports.

The difference between "Mount-Time" and GPS-Time is computed every 5 seconds and the difference stored in the RAM of MGPBox. Every two minutes, and only of the mount is not tracking:

- MGPBox calculates the average of all time errors collected. If it is more than one second, the actual time is set directly. If the error is less than one second, the mount's time is nudged by the difference.
- Refraction data is updated

If MGPBox misses an update to the mount (e.g. because the mount has been tracking for the last 15 minutes), it will update the mount as soon as the tracking state is anything but tracking.

Note: If either of the two options is enabled, MGPBox will sync time / refraction once irrespective of tracking state. After the initial sync, updates will only happen if the mount is not tracking.

Note: For time synch to be available, the GPS Module needs to have a 3D-Fix (tracking four or more satellites).

LED

The top LED is used to indicate the current state of the communication with the mount.
The following is a breakdown of the different states:

- LED Constantly on
  - No communication with the mount
- LED blinking once a second
  - Communication with Mount established, update of location, refraction parameters and time ongoing (if configured)
- LED off
  - All mount parameters are updated according to the configuration. Time sync, if enabled, is considered complete when the GPS- and mount time do not have a delta of more than 100ms.
  - The LED flashes every time an update to refraction and / or time is done.

Hardware information

MGPBox uses a Bosch Sensortec BME280 Sensor that delivers pressure, temperature and Humidity with very high accuracy. The following is an excerpt from the specifications of the sensor depicting its tolerances and operating limits:

Pressure Sensor

Parameter	Min	Typical	Max	Unit
Operating temperature range	-40	25	+85	°C
Operating pressure range	300		1100	hPa
Absolute accuracy pressure		+- 1.0		hPa
Relative accuracy pressure		+-0.12		hPa

Temperature Sensor

Parameter	Min	Typical	Max	Unit
Operating range	-40	25	+85	°C
Absolute accuracy temperature		+- 1.0		°C

Humidity Sensor

Parameter	Min	Typical	Max	Unit
Operating Temperature Range	-40	25	+85	+C
Absolute accuracy tolerance		+- 3.0		%RH

Microprocessor

The "heart" of MGPBox is an Atmel ATmega2560V microprocessor that interfaces with the Sensor over the I^{2}C protocol. It features 256KB of flash memory, 4KB of EEPROM, 8Kbytes of internal SRAM and 86 general-purpose I/O lines.

The ATmega2560 runs at 8Mhz using and external ceramic resonator.

GPS Module

MGPBox uses a GlobalTop PA6C GPS Module. The Module utilizes the MT3339 Chipset from MediaTek. It features high sensitivity (-165dBm) and low power consumption. The patch antenna is built in and the module can track up to 22 satellites.
The quick Time-to-First Fix of this module makes the use of a backup battery unnecessary, which in turn removes the hassle of replacing batteries and at the same time not causing additional pollution.

RJ10 Interface

The RJ10 Interface works almost like a typical RS-232 Interface with the exception that only V+, GND, TX and RX are used.
The following picture illustrates the pinout:
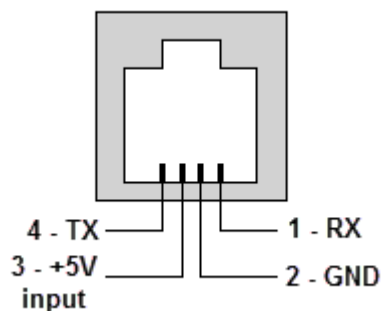
Conversion from TTL to RS-232 is done by a Max3232ESE+ IC.

The supplied cable is a standard RJ10 cable and the pinout is as follows (colors may vary):

 Important: Please consult your mount manual before connecting MGPBox to it.
We will not take responsibility for possible damages resulting from wrong connections!

Application Interface

This section provides information about how to interface with MGPBox from your own application or script.

Serial Port settings

Use the following settings to connect to MGPBox and start receiving data:

Baud: 38400
Data-Bits: 8
Stop-Bits: 1
Parity: None

Serial Port settings RJ10

With the following settings you can receive data from the RJ10 Serial Port:

Baud: 9600
Data-Bits: 8
Stop-Bits: 1
Parity: None

Protocol

MGPBox uses, for compatibility reasons, the NMEA 0183 Protocol that is used by various navigation devices.

MGPBox sends data from the sensor in the following format:

$PXDR,P,96276.0,P,0,C,31.8,C,1,H,40.8,P,2,C,16.8,C,3,0.8*39<cr><lf>

This breaks down into the following, more readable format:

$	Start of sentence
P	Proprietary sentence
XDR	Transducer type
P	Sensor type, pressure
96276.0	Sensor value
P	Sensor units, pascal
0	Sensor ID
C	Sensor type, temperature
31.8	Sensor value
C	Sensor units, °C
1	Sensor ID
H	Sensor type, humidity
40.8	Sensor value
P	Sensor units, percent
2	Sensor ID
C	Sensor type, temperature
16.8	Sensor value
C	Sensor units, °C
3	Sensor ID
0.8(M)	MGPBox firmware version (an "M" indicates that the 10Micron specific Firmware is running)
*39	Checksum

Additionally, MGPBox can also send information about calibration values stored in the EEPROM.

Standard Firmware:

$PCAL,P,0,T,0,H,0,MM,1,MG,0*69<cr><lf>

10Micron specific Firmware:

$PCAL,P,0,T,0,H,0,UR,0,UT,0,CUT,0*16<cr><lf>

$	Start of sentence
P	Proprietary sentence
CAL	Calibration data
P	Sensor type, pressure
20	Calibration value multiplied by 10, e.g. 2.0 hPa
T	Sensor type, temperature
50	Calibration value multiplied by 10, e.g. 5.0 °C
H	Sensory type, humidity
-10	Calibration value multiplied by 10, e.g. -1.0 %RH
MM / UR	MM: Send Meteo-Data to mount UR: Update mount's refraction data
1	Yes (0 = No)
MG / UT	MG: Send GPS-Data to mount UT: Initially synchronize mount's time
0	Disabled (1 = Enabled)
CUT	Continuously synchronize mount's time
0	Disabled (1 = Enabled)
*69 / *16E	Checksum

Setting, resetting, receiving Calibration data and other commands

In order to set, reset or query calibration data from the MGPBox, similar formatted sentences can be sent to the device:

Setting pressure calibration

:calp,50*

:calp	Set calibration value for pressure
50	Calibration value multiplied by 10, e.g. 5.0 °C
*	End of message indicator

Setting temperature calibration

:calt,22*

:calt	Set calibration value for temperature
22	Calibration value multiplied by 10, e.g. 2.2 hPa
*	End of message indicator

Setting humidity calibration

:calh,50*

:calh	Set calibration value for pressure
50	Calibration value multiplied by 10, e.g. 5.0°C
*	End of message indicator

Resetting calibration values

:calreset*

:calreset	Resets all calibration values
*	End of message indicator

Getting calibration values

:calget*

:calget	Resets all calibration values
*	End of message indicator

Send GPS-Data to Mount (Standard Firmware only)

:mg,1*

:mg	Set's if GPS-Data should be sent to the Mount
1	Enable sending (0 = disabled)
*	End of message indicator

Send Meteo-Data to Mount (Standard Firmware only)

:mm,1*

:mm	Set's if Meteo-Data should be sent to the Mount
1	Enable sending (0 = disabled)
*	End of message indicator

Update Mount refraction data (10Micron specific Firmware only)

:ur,1*

:ur	Set's if the mount's refraction data should be updated periodically
1	Enable sending (0 = disabled)
*	End of message indicator

Update Mount time initially (10Micron specific Firmware only)

:ut,1*

:ut	Set's if the mount's time should be updated initially
1	Enable sending (0 = disabled)
*	End of message indicator

Update Mount time continuously (10Micron specific Firmware only)

:cut,1*

:cut	Set's if the mount's time should be updated continously
1	Enable sending (0 = disabled)
*	End of message indicator

Getting Mount Model (10Micron specific Firmware only)

:mmget*

:mmget	Returns the Mount Model if MGPBox has this information
*	End of message indicator

Getting Mount Firmware Version (10Micron specific Firmware only)

:mfget*

:mfget	Returns the Mount's Firmware if MGPBox has this information
*	End of message indicator

Rebooting the GPS-Module

:rebootgps*

:rebootgps	Reboots the GPS-Module
*	End of message indicator

Rebooting MGPBox

:reboot*

:reboot	Reboots MGPBox
*	End of message indicator

Turning GPS Module On

:gpson*

:gpson	Enables Power to the GPS Module
*	End of message indicator

Turning GPS Module Off

:gpsoff*

:gpsoff	Removes Power to the GPS Module
*	End of message indicator

Activating the relay

:pulse,1500*

:pulse	Starts a pluse of the relay
1500	Pulse length, 1.5 seconds
*	End of message indicator

Query Device type

:devicetype*

:devicetype	Queries the Type of the Device connected
*	End of message indicator

Query status of timesync (10Micron specific Firmware only)

:tsget*

:tsget	Queries the status of the initial time sync
*	End of message indicator

Troubleshooting

If your MGPBox does not work as expected, please check the following:

- Verify in Device Manager the FTDI Serial Port shows up. Install / reinstall the driver if necessary (http://www.ftdichip.com/Drivers/VCP.htm)
- If configuring ASCOM Connection and it appears that nothing happens when you click the "Configure" button, look in your task bar for an additional window. Sometimes the ASCOM Setup-Dialog ends up behind the other windows and is therefore not apparently visible.