Application Notes:
Interfacing AG-132 GPS with G-858 Magnetometer
25430-AM Rev.A

Operation Manual

GEOMETRICS, INC.
2190 Fortune Drive, San Jose, Ca 95131 USA
Phone: (408) 954-0522
Fax: (408) 954-0902
EMAIL: SALES@MAIL.GEOMETRICS.COM

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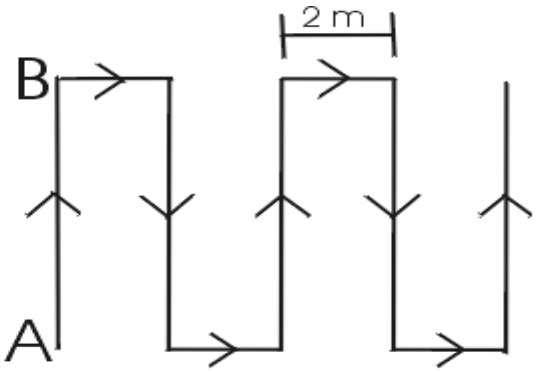
Instructions for setup and basic survey using G-858 magnetometer and Ag-132 non-magnetic GPS:

Introduction

This tutorial will provide you with the information you need to set up a basic survey on the Trimble AG-132 GPS. This survey will assume that you will predefine and walk one line, and from there, you will use this line as a base line for the rest of the survey. Your final pattern should look like:



Hardware Setup:

Needed Equipment:

1) G-858 magnetometer console
2) Battery pack
3) "Y" cable with connector to battery pack
4) Magnetometer sensor
5) Ag-132 receiver (yellow box)
6) Ag-132 antenna
7) Light bar
8) Handheld keypad
9) Dual power and data cable (yellow cable with two 12 pin connectors, and one power connector)
10) Light bar and keypad data cable (yellow cable with three identical 12-pin connectors
11) Antenna cable (black)
12) Cable with 9-pin female connector and RS-232 858 Data connector.
13) Male/Male null modem
14) Backpack
15) Magnetometer staff sections
16) GPS pouch

Recommended Setup:

Please refer to wiring diagram located in back of manual for more details:

1) Screw the antenna into the top of the threaded staff section on the backpack.
2) Attach the antenna cable from the Ag-132 receiver to the antenna (See Trimble manual for drawings)
3) Attach the dual power and data cable to port A of the Ag-132 receiver. (See Trimble manual.)
4) Mount the light bar arm onto the backpack.
5) Attach the light bar and keypad data cable to the light bar, keypad, and port B of the Ag-132 receiver. (See Trimble manual.)
6) Use one end of the Y cable to plug into the battery pack, and the other two ends to plug into the Ag-132 power connector, and the G-858 power connector. The GPS and light bar should automatically turn on at this stage. Note: if the light bar does not turn on, it means that you need to configure it (discussed later).
7) Plug one end of the male/male null modem into the Ag-132 data cable.
8) Use the 9-pin female serial cable/RS-232 Data cable to connect the G-858 console with the Ag-132 data cable. – if all configurations are correct, you should be able to test for proper communications by going into "Chat mode" on the G-858 (see "Magnetometer / Ag-132 Communication").
9) Assemble the magnetometer staff. (See G-858 manual)
10) Attach the magnetometer sensor to the staff, and plug the cable into the G-858 console.
11) Put Ag-132 receiver in the GPS pouch on backpack.
12) Put on backpack.

13) Put battery pack around backpack, fitting it into the top tray on the backpack if necessary, and fastening it around your waist. This is so that you can mount the G-858 console.
14) Mount the G-858 console on waist. (See G-858 manual).

Note: sometimes it is easier to hold off attaching power and data cables to the G-858 console until the backpack is on. Once you are familiar with the setup this is probably the easiest way.

Specifications:

Magnetic measurements of the Ag-132 components show that you need to keep the following distance specifications to get GPS induced magnetic errors of less than 1 Gamma:

- Ag-132 console needs to be at least 4 feet away from the magnetometer sensor.
- The antenna needs to be at least 2 feet away from the magnetometer sensor.
- The light bar should be at least 2.5 feet away from the magnetometer sensor.

Note: Values are based on degaussed components. Keep all magnetic devices such as magnetized screw drivers away from any of the components of the system, or the GPS induced magnetic errors could be significantly higher.

Degaussing can be performed using commercially available degaussing equipment such as a bulk tape eraser. Please contact Geometrics for more information.

GPS-Magnetometer Software Setup:

Hardware configurations:

Light bar:

a) The light bar can be set up from the Ag-132 console. From the main menu, use the ">" key to select: "**Config Port B**".
b) Then, use the "v" key to select "**Port-B In**".
c) Use ">" to go into change mode, and the arrow keys to select "**LBAR**" for the first field.
d) Now go to "**Port-B Out**" by hitting ">" and then "v".
e) Follow the procedure described in *c*.

You should now see the light bar power up.

Magnetometer/Ag-132 Communication:

Magnetometer:

1) Set the baud rate:
   As a default, you can set the baud rate in the magnetometer as 9600. To do this, go to:
   a) **SYSTEM SETUP**
   b) Use the left and right arrow keys to set the *baud rate* to **9600.**
2) Set the transfer protocol:
   a) Under "*Use serial port as:* " option on the "*System Setup*" screen, select "**Data Logger**"

GPS:

1) Set the Data-in parameters:
   a) Use the arrows to navigate through the available options to where you have: **"Config Port A"**. Use the down arrow key to enter the options.
   b) Under **"Port A In:"**, press **">"** and then use the down arrow key to select **"NONE"**. This will tell the GPS not to expect any incoming data.
2) Set the Data-Out parameters:
   a) You can then use the arrows to navigate to the next screen: **"Port A Out"**.
   b) From here, use > to select the field you would like to edit, and use the arrow keys to make sure that the first column says **"NMEA"**, and the second column matches the baud rate you selected for the magnetometer. Set the following NMEA output parameters: **9600 N-8-1**. If this is not set correctly, the GGA messages will not be seen by the magnetometer.
   c) The rest of the default values should work okay.

   Note: Magmap 96 currently interprets the GGA stream, so if you wish to use Magmap as a data interpreter, you need to use some of the following screens to disable other outputs. You can refer to the Trimble manual for more details. It is OK to turn off all the NMEA messages that are not needed. To turn off a NMEA message, move the cursor to that

message and press up or down to change the letters to lower case. Make sure you leave the GGA message in upper case.

Check the results:

You can check your results by hooking up the serial cable between the magnetometer and the GPS. From the magnetometer's **"***System Setup***"** screen, select **"EXTERNAL RS232 & FIELD NOTE SETUP**". Then select **"Chat Mode"**. You may get a warning, which you can easily clear, and from this screen, you should be able to see data streams coming into the magnetometer.

If you do not see the proper NMEA data stream at this point STOP! Check the cable/port connections and the setup port parameters on the GPS receiver. Do not proceed any further until you verify that the GGA messages are displayed on the Magnetometer.

Survey Configurations:

The first four options are set from within the "*Config Guidance*" screen on the Ag-132, which can be accessed from the main menu.

1) You need to specify the units you will be using.
   The first option in "*Config Guidance*" will be "**Guidance Units**". For the purpose of our survey, this is "**meters**". As a general rule, you can use the right arrow to select a parameter to change and then use the up and down arrow keys to toggle between selections. Use the Back Arrow (ENTER) key to enter your selection
2) You need to specify the spacing between adjacent lines -- swath width.
   The next option in the menu should be "**Swath width**". From here, you can use "**>**" to enter into change mode, and then use the up and down arrow keys select the distance. For this survey, we use: "**02.00 meters**".
3) You need to set whether lines will be generated from the left, or right of your first line.
   Scroll down, until you get to : "**Create Swaths**"
   From here, you can use "**>**" to go into change mode, and use "**v**" to scroll through the different options until you see: "**Right of AB**".
4) You need to tell the GPS that you want lines of a fixed distance calculated from your first line – Headland type:
   Scroll down until you get to "**Headland Type**"
   Use "**>**" to go into change mode, and use "**v**" to select "**AB EndZones**"

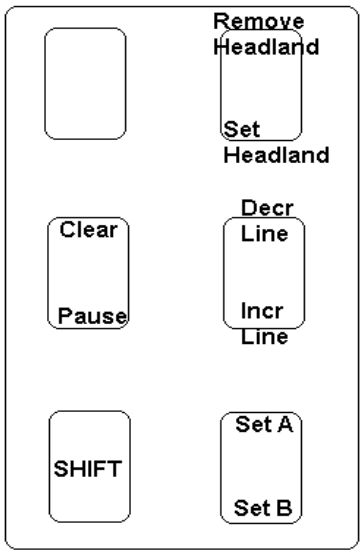
The next options are set from within the "*Config Lightbar*" screen which can also be accessed from the main menu:

5) You want to specify how much of a warning the light bar will give when you are at the end of the line – Indicator LED sensitivity
   Scroll down until you get to "**Indicator LED Sensitivity**".
   Use ">" to go into change mode, and use the right and left arrow keys to select the number you wish to use. For the purposes of this survey, we use "**002m**". This means that the large center light should turn orange 2 meters before the end of the line and red when the end of line is reached.
6) You want to specify the sensitivity of the LED to offline excursions – e.g. how much the LED will react when you go off line.

Scroll down until you get to "**LED Spacing**".
Use ">" to go into change mode, and use the right and left arrow keys to adjust the first number. Choose the highest sensitivity that is possible (0.16 meters.) The number "End" should adjust itself to reflect the total offline width the LED will display. E.g. in the case where I use "**00.61m**", End displays "**0010m**" which means that when you are 10 meters off line (and greater), you should see the last LED lit. If the sensitivity is set to 0.16 meters the end will be 3 meters. This high sensitivity is useful when a 2 meter swath width is chosen.

Notes on the keypad:

After you have set all the options, and you have your equipment connected, you are ready to begin your survey. Most of the GPS options can be accessed remotely from the keypad which is attached to the light bar. The diagram below describes some of the features of the buttons on the keypad , and how you can access different options:



Definitions of selected keys:

1) **Shift**: Allows you to access options listed on the top of each key.
2) **Set A/Set B:** Allows you to set A and B points needed for most surveys.
3) **Pause:** Puts GPS in pause mode, which will normally have light bar display distance from paused point.
4) **Clear:** Clears survey options such as headland points and A and B position points.
5) **Increment/Decrement Line:** Increments or decrements current line. For the purposes of this survey, this will be used to tell the light bar to give you directions to the next adjacent line. Note: This will not decrement below 0!
6) **Set Headland Point/Remove Headland Point:** This will set and remove headland points. In this example, this will not be necessary because the type of headlands used assumes that A and B are the headland points.

Note: when you select an option on the keypad, you should be able to see a description of the action on the lightbar.

Starting the survey:

With all your equipment on, navigate to your first point. If you only know your point by latitude and longitude, you may need to take the GPS out of the backpack and use this to navigate to your first and second points. The light bar is only useful after you have set up these two points.

1) Turn on the magnetometer and set it up to take a simple survey. Your magnetometer manual should describe how to do this.
2) Set your initial points:
   When you are at Point A, make sure that all options are cleared by pressing "**Clear**". If you are getting 3D GPS, your light bar should read: "*Need Point A*". Press "**Shift A**" on the keypad. You should now see "*Point A Set*", followed by "*Need Point B*".
   If you wish to take measurements this first line, press the "**Mark**" key on the magnetometer to begin recording data.
   Navigate to point B, and then press "**B**" on the key pad, and "**End of Line**" on the magnetometer. You should now see "*Line AB okay*". This should confirm that you have correctly entered your two position points.
3) Go to the next line:
   From point B, you can now press "**Increment Line**" to go to your next line. You should see the display change from "*0R*" to "*1R*", and the lights on the light bar should immediately change to guide you to the next line. When you are ready to begin taking data again, you should press "**Mark**" to clear the display, and then press it again to begin taking data. A common mistake is to only press it once, and then get to the end of the line and notice that no data was taken. As a check, you should hear the magnetometer, and you should also see the line increment and see a changing visual display.
   As a general rule of thumb, the lights on the light bar should point in the direction you need to go. As the lights get further away from the center, that means you are further away from where you need to be.

   The large center light on the light bar gives a measure of where you are on your line. Normally, it should be green. When you approach the end of the line, you should see it turn from green to yellow. The center of the yellow transition should occur exactly on the end of your line. We recommend that you stop when the light turns from yellow to red (in this example, it should occur one meter beyond the end of line) for consistency. Conversely, when you begin your line, you should begin on the red-yellow transition.
4) Repeat part three until you are done. Check your battery gauge and memory available periodically through the survey. There is a possibility of losing your data if you lose power in the middle of surveying so be careful! The battery gauge (located on the magnetometer) is a measure of voltage available, so this will fall off very fast when you are almost out of power. If you find this gauge empty, you should immediately exit the survey, turn off the magnetometer, and replace the battery pack. You can continue from where you left off later.

Survey guidelines:

1) **Confusing directions**: If you get a lot of confusing directions, this could mean that you have lost differential correction. When DGPS is lost, you should see the LEDs on the end of the lightbar light up, and you will lose guidance information. If you are not sure, you can take the GPS out of the your backpack and see if it says that you have 3D GPS. If you haven't lost differential correction, your best bet is probably to stop, and move slowly to get back on line. You can also try to correct your course by using 45 degree steps to get quickly back on line (e.g. walk forward in a direction slanted towards the line).
2) **Bad data on a line**: Sometimes it is useful to go over a line again. The "Decrement Line" option is useful for this case. If you know the line you would like to go back to, you can press this until you are at the line you need. The light bar will then steer you to the appropriate line, and you can begin again. Conversely, you can skip over lines by using "Increment Line". Note: this only resets the GPS line. You will have to refer to the magnetometer manual for instructions on how to erase a magnetometer line.
3) **Interfacing with magnetometer:** The magnetometer does not take data while it is paused, or at the end of the line. This is useful when you are using the GPS to guide you to your next line. If you find out you are off line, this is also okay, because your magnetometer is still recording the position sent by the GPS. Your survey will reflect the excursion off the line, but the magnetometer/position data will still be accurate.
4) **Loss of differential correction:** Differential correction can sometimes be lost when you go under trees, or when you are near buildings or other structures. If this happens, try to steer yourself as accurately as you can until you get your differential correction back. The light bar will then steer you back on line.
5) **Difficulty staying on line: Light bar gives confusing directions steering off line, and incrementing line number automatically.** The guidance system has an option called "Snap to swath" which can be enabled from within *Configure Guidance->Create Swaths*. It can be quite confusing when it is not expected. It divides the distance between two adjacent lines by two and it will increment (and give directions to) the next line when the GPS is over half the distance to the next line. This can cause problems when differential correction is lost because the user may inadvertently wander to another line and then be guided to the nearest line, thus skipping quite a few lines. If you think that this is the problem, you can check it out by walking one line over and looking at the light bar display. You should see it automatically increment. It is recommended to manually increment the lines by selecting *Configure Guidance->Create Swaths -> Right of AB*.

Hints:

- Do not stare at the light bar constantly while doing the survey. Watch the ground in front of you for hazards, glancing about every five seconds to the light bar for confirmation of your path. It is easier to walk a straight line if you look forward to a landmark on the horizon.

- Remember to press mark twice while on simple survey. It is easy to walk an entire line, and realize that no data was taken due to the second mark not being pressed. It is useful to glance at the magnetometer display periodically during the survey to make sure you are recording data and also to make sure that you have enough batteries and memory.

- It is easy to miss the green-orange-red "End of Line" transition while actively surveying. Train yourself to look first at the small end-of-line indicator to make sure you have not reached the end of the line. If you overshoot, stop the magnetometer, increment the line, and navigate to the beginning of the next line position. It also helps to drop a marker at the end of the line for when you return. This is a good way of judging where your previous end of line was.

- Start the magnetometer and GPS off on the same line number. This is useful later on to insure that you increment correctly. If you forget to increment one, or the other, the two numbers will no longer match. This can also be used as an indicator of what you have missed. If your magnetometer line number is higher than the GPS line number, it probably means that you have surveyed one line twice, which will be reflected when you later analyze your data. If the GPS line number is higher than the magnetometer's line number, you have probably skipped a line. It is advisable to decrement the GPS to the line number that you missed, and re-survey the line. After you are done surveying, make sure that the magnetometer and GPS line numbers again match.

- If you are planning on doing a gradiometer survey, you should purchase an extra battery pack and charger. A typical battery pack will give about four hours of survey time for a single magnetometer and GPS system. It should last about 2 ½ hours for a dual sensor system.