ALPHALAB INC.

DC Gaussmeter Model GM 1-ST Instructions

The Gaussmeter Model GM 1-ST measures the field of even the strongest magnet (to 20kG) down to fine resolution (0.1G).

Operation:

Turn the meter on by pressing "Power" for at least 1 second. Note that the last few millimeters at the (black) end of the probe has a square bulge on one side; the gray cable is marked black on this side the other side is flat. The center of that square bulge is the location of the Hall-Effect sensor, which is very small (0.2 x 0.2 mm). Place the flat side of the probe end (not the side with a black mark) against the surface to be measured. A negative sign indicates that the probe is touching the south pole of a magnet. A north pole will read positive ("positive" is indicated by the absence of a polarity sign on the display). The actual center of the sensor is 0.75 mm above the flat surface or 0.6mm below the top of the square bulge) and is centered in the center of the square bulge.

Below 10 gauss, only two digits (such as "3.7") will be displayed. For stronger fields, more digits will appear. For fields stronger than +/- 9999.9 gauss, the extreme left digit will display. (It is a "1"). Very few magnet assemblies have a field this strong, which is usually found only in the gap between two rare earth magnets or in a high-power electromagnet. If the field is stronger than +/- 19,999.9 gauss, the display will read "1- - - -.-"if positive over range, or it will read "-1- - - -.-" if negative over range. These high fields will not harm the meter, although some styles of batteries may malfunction if exposed to such high fields. (However, this malfunction would only occur if the battery itself is in the high-field region). If the display reads "LO BATT", there is about one hour of battery life remaining. Remove the soft bumper (the "boot") if the bumper is present, and then slide off the battery door on the back side. Replace with a common 9-volt rectangular battery. Alkaline is preferred. Current drain is 8ma and the LOBATT reads if battery voltage remains below 7V for at least one minute. (Accuracy errors will occur below 5.8V). You may need to press "Power" twice the first time with a new battery. MAKE SURE THE METER TURNS ON AFTER REPLACING THE BATTERY.

Offset Adjustment (only necessary if measuring weak fields):

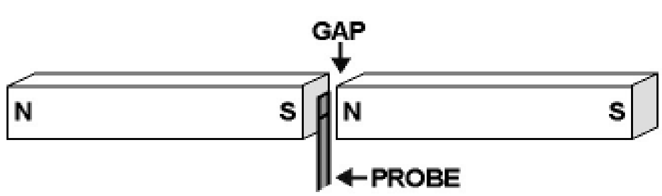
The offset controls allow you to add or subtract any field to or from the displayed number of gauss. This feature is used if you are holding the sensor in a certain orientation in space, and you want the display to show "zero", even though some field is present. Press "Auto Zero" to do this. Then you bring in a magnetized object to measure. This is the magnetic equivalent of adjusting the "tare" weight of a weight scale, because there may be an ambient magnetic field that you'll want to subtract out. When turned on, the display will read approximately zero in zero field, but you can perfectly adjust the offset to zero if you do one of two things, either:

1) Place the sensor in a "zero gauss chamber" (not supplied with this meter) and press "Auto Zero". (However, a "zero gauss chamber" is sometimes accidentally magnetized, so it is not always reliable. Unless the chamber also has a degausser.)

2) Place the sensor end flat on a non-magnetic table or desk with the black mark facing up. In this orientation, the meter will read the upward-pointing component of the magnetic field. (If the field is instead downward-pointing there, the meter should then read a negative number.) Note the number on the display. Then flip the sensor so the square bulge is facing down. This 2nd reading should be the negative of the 1st reading. That is, if the 1st reading was –0.4 (gauss), then the 2nd should be 0.4 (gauss). If the two readings are not the negative of each other, then the offset is not adjusted perfectly for a zero reading in zero field. For example, if the 1st reading is 1.0, and the 2nd reading is 0.0, then the offset is off by 0.5 gauss (the average of the two readings). Generally, this fine level of adjustment is not necessary, because it makes a difference of only a fraction of a gauss when measuring a multi-thousand gauss magnet. This method however, is more reliable than using a "zero gauss chamber". Offset is adjusted by pressing the "+" or "-" buttons. If you hold one button down, the offset amount will count up or down faster. The meter offset will return to factory reset when power is turned off. You can change the factory reset by removing the 4 screws in back and taking off the front cover. Turn the small round potentiometer below (nearest the battery) that says "internal offset".

Measuring Magnets:

Most magnet materials have a published "remnant magnetization" or "internal flux density". This is typically as high as about 5000 gauss for ceramic magnets and up to about 14,000 gauss for some rare earth magnets. The actual field (technically, "flux density") on the surface of a single magnet is at most half this number, and it's only that high if the magnet is long compared to its diameter. A stubby magnet, such as a disk or pill-shaped magnet will have a surface flux density that is even lower than half the published remnant magnetization. You'll see the highest number of gauss (for a given type of magnetic material) in the gap between two long, thin magnets if the poles of each magnet are well-separated from each other, but the north of one magnet is almost touching the south of the other, as illustrated.



If the gap spacing is much less than the diameter of the magnets, and the length of each magnet is much greater than the diameter, then the reading in the gap (with the thin dimension of the probe slipped into the gap) should be almost as high as the published remnant magnetization.

Magnets produce an additive field in general. This fact can be demonstrated from the gap magnet setup illustrated. If the meter reads 13,000 gauss in the gap, and then one of the magnets is taken away, the new reading will be about 6500 gauss, or half as much. The field from each permanent magnet adds to the total, because the two magnets do not alter each other's field. (If iron or steel is used as part of a magnetic structure, then it's a different story, because the permanent magnets in the structure do magnetize the iron or steel.

Magnets may lose strength because of overheating (100°C will demagnetize some types of FeNdB magnets, but over 800°C is required to demagnetize some types of ceramic magnets). They may also partially demagnetize if struck hard or exposed to a sufficiently strong reversed magnetic field, either from coils that carry electric current (as in a permanent magnet electric motor) or from another strong permanent magnet. In any case, it's easy to detect demagnetization: when a new magnet comes in, measure the number of gauss in one or more critical spots and record this. Then compare these to later measurements. There is one warning: all magnets have a slightly lower field when they're warm than when they're cool, so try to standardize the temperature at which you measure. Each type of magnetic material has a published %/°C temperature sensitivity. Note that magnets are not permanently demagnetized by going through repeated warming and cooling cycles. They only permanently demagnetize if heated above their maximum allowed operating temperature.

Measurement of Residual Magnetism or the Earth Field:

This type of meter is also used to check residual (accidental) magnetization of parts. In general, this accidental magnetization is perpendicular to the surface of the part, so the probe can be placed flat against the part, and this is the correct direction for detection of that field. You may need to scan the probe across the surface to find the highest number. This highest reading is usually found at the ends or sharpest points of the part.

There are some peculiarities of measuring residual magnetization. Long, thin steel parts will often "amplify" the Earth field by a factor of 10 or so, at the ends of the part. If the long-axis of the part is pointed east-west, or perpendicular to the local indoor field, this is not a problem. The strength of the Earth field is about 0.5 gauss, so you may see up to about +/-5 gauss at the end of a properly demagnetized steel rod if the rod is pointed in the direction of the Earth field. The north pole of the earth is not horizontal in most locations. In most of Asia the magnetic field direction is within about +/-20° of horizontal. In North America if you face north and then look downward from horizontal 20° (Central Mexico) to 55° (Northern US) to as much as 90° down in parts of Canada, that is the direction of magnetic North Pole. You can detect the field strength and direction with the meter. Note that with the bulge in the probe pointing toward the Earth north, you will read a positive number, because it's pointing toward the south pole of a magnet. If you flip the sensor 180° so that the flat part is facing Earth north, you will read a negative number, of course.

When scanning the surface of parts, if you want to measure with a resolution of less than five gauss, it's recommended that you keep the probe end stationary with its thin axis (magnetic sensitivity direction) pointed perpendicular to the local magnetic field direction, and with offset adjusted so the display usually reads zero. (You'll know it's perpendicular to the local field direction if when you flip the probe end 180°, the display continues to read zero. Then scan the part along the flat surface of the probe and look for the highest number (either positive or negative).

SPECIFICATIONS: 1-axis DC Gaussmeter GM1-ST	
Range/Resolution:	19,999.9 G/0.1 G; with polarity indicator
Accuracy:	+/- 1% of reading (16° to 29°C); +/- 2% (-4° to 65°C)
Offset:	Auto-Zero. Also fine offset (0.1 gauss resolution)
Probe (non-detachable):	1.5 (thick) x 4.3 x 24 mm
Meter Size:	5.2 x 3.6 x 1.6 inches; 132 x 91 x 41 mm
Weight:	8 oz
Battery:	9 volt alkaline (~ 40 hour life) / "Low Battery" indicator