HOW TO ADJUST FOR MINIMUM VARIATION OF OFFSET WITH METER MOVEMENT BY HALL SENSOR BALANCING.

N.B.- Only matters in 2A DC range, everything below is done in that range.

The adjustment process takes longer to read about than to actually do - but
it does require some explanation if you are coming at it from cold...

This procedure should in theory work globally, except for both polar regions.
It will work better the nearer you are to the equator.

This balance adjustment does not seem (in my 2 meters) to affect previous calibration much
(<0.5%). The small variation in current readings with position of wire in jaws seems actually
to have improved with balancing - by about 0.2% in my case.
Your meter may act differently !! It depends how out of balance your meter is to start with.

-Ensure that the jaws of your meter are closing together as closely as they can - excess plastic
flashing around the jaw tips can be taken off with a knife - you want the jaw gap
to be as small as intended by design, AND the same with each closing - this can make a lot of difference.
The plastic bulge with the sensor inside it should be the only part of the fixed jaw tip
touching the moving jaw tip, and that contact is with the shiny iron surface, not the plastic
surrounding it.

-Before taking the back off, go through section (A) once to check if your meter even
needs any adjustment. (and also just to get a 'before' adjustment reference.)
-If it does, you'll need to run meter with the back off somehow.
EG:- a set of AAA batts in a holder soldered onto the two small pads marked + and -.
(not far away from the main battery pads).
OR:- you can use the meter's own batteries and back - leave switch in 2A DC, adjust VR4,
hold the back in place and allow the meter to start up, keeping it pressed together
it's possible to hold it down on your compass card (see below) and rotate it for
the test in section (A). If you let go, it will power down of course. Adjusting the
final power-on offset value in section (C) is more tricky without a permanent
external power source - you have to adjust VR+/VR- pots a bit, then put the
back on to see what the new offset is at power on. It's possible with care.
(I have tried this method and it worked fine for me)
This method of powering the meter has the advantage that when doing rotation test,
the meter is always level - with a temp. battery box it may not be so stable.
(meter doesn't need to be absolutely level for rotation - just stable and
repeatable between each attempt at rotation test in (A) below. Level is better)

-Let the meter temperature stabilise in the place where testing is going to happen,
since the offsets are quite temperature sensitive.

-Do it in a place where there isn't any iron or steel or nickel nearby. No steel structure
in your building. No nearby steel tools.
-Mark a piece of cardboard with North, South, East and West around a circle of about 8"
or 20cm diameter. Mark some intermediate angles, such as every 30 or 45 degrees.
-Use a compass to orient this card on the table correctly, and stick it down with tape.
-Use magnetic north not true north for your location of course.
-The table you take readings on must not have a steel structure. No steel screws, etc underneath
within about 30cm or 1 foot of the meter jaws. These WILL affect the adjustment.

-Demagnetise the jaws using a degausser, or with care, a permanent magnet. This will give the lowest possible zero offset as a starting point.
-Use a trimming tool which is either all plastic, or plastic with a small metal tip. If you only have a screwdriver, use one with a plastic handle, not metal.

NOTE :-
Only VR4, the balance pot, is going to be adjusted firstly. VR4 is near the flexi connector.
DO NOT touch VR+ or VR- until stage (C) below. These two pots are for setting the final offset value around zero. They are together, and the only other pots on the pcb.
Leaving these where they are until the end means that you can get VR4 back to its original position if you want to abort the VR4 adjustment. (to abort adj., adjust VR4 until the offset readings in 2A DC FROM POWER-ON are back to somewhere near zero, or where they were before you started, at least.)

VR4 balances the two Hall sensors against each other approx. at its mid-point (6 o'clock, where 12 o'clock is nearest the meter jaws), as a guide.
My two meters after adjustment ended up with VR4 at about 5.30 on a clock face.
The flat on the pot adjuster ring is opposite the actual wiper position, for all 3 pots.

<u>METER ADJUSTMENT PROCEDURE</u>

Turn on to 2A DC range, use zero button (just to put the readings somewhere around zero)

- Section A) METER ROTATION TEST.

Put meter on your marked up compass circle card on the table.
(meter directions mean the direction the jaws are pointing)

- Rotate meter from W to S to E and look for the highest positive reading. The peak is quite flat-topped, so swing either side until the readings drop by the same amount, then the centre of peak will be half way between these two points.
  The actual value of the readings does not matter, we are only trying to locate the meter position for the middle of the offset reading peak.
- If this position is with the jaws pointing South (+/- 10 deg), then your meter is probably fairly well balanced already, and you won't gain much by adjusting further.
  (From my testing, on a sample of two meters, the better centred on South this peak is, the lowerthe offset stability with movement is)
- If this position is further away from South than +/- 10 degrees, either East or West of it, the meter is not as well balanced as it could be, continue with section (B) below.

- Section B) BALANCE POT VR4 ADJUSTMENT
  Remove meter back and set up your external power arrangement.
  Adjust VR4 a very small amount- the aim is to adjust the position of the meter at which this maximum positive offset reading occurs:-
  when jaws were pointing South (+/- 10 deg) at peak reading, in a sample of two tested meters, it was found that the offset variation with movement was at a minimum.

If the max offset position in (A) needs to move clockwise to be at South, then VR4 also needs to be turned clockwise, when looking directly at the pot.
And the reverse for anti-clockwise.

As you approach the ideal adjustment of VR4, the adjustments to VR4 will be VERY small.
Handy tip: put trimming tool in pot, turn whole thing over so you can read display,
put turning pressure on the tool until the reading just changes a bit, you may not
even feel that the pot is moving, but if the reading is changing, then it IS !

Each time you adjust VR4, there will be a new offset reading on the display, either
+ve or -ve.
Treat each pass through section (A), after each VR4 adjustment, as separate from the
previous one, ie don't compare absolute readings between each pass of section (A), only
max. offset differences with a rotation of the meter matter.
Readings can be zeroed at any time using the button if you like, but it's not necessary, you are
just looking for that max positive reading in (A) above, after each VR4 change.

- Repeat A and B above until you get the max offset position in (A) to be in the South.
Adjustment of VR4 is very sensitive, that is the most difficult part of this whole process.
Continue to section (C) below when this has been achieved.

- Section C) FINAL OFFSET ADJUSTMENT VR+ AND VR-.

Turn meter off and on again to 2A DC, to get the new offset reading from power on.
Adjust one of either VR+ or VR- (whichever is not near an endstop) so that max and min
readings (when ,meter is rotated) are roughly either side of zero.
This will vary with temperature anyway, so it's not a critical adjustment.
In my sample of two meters (both UT210E), I reduced the offset variation with rotation
from +/- 25mA down to about +/- 12mA after balance adjustment. At least one other
owner has found that his meter did not seem to want to go below about +/- 27mA, so
your results could be better or worse than the figures given here.
Re-assemble the meter and check all is working.

- Notes:-
It seems that final offset adjustment is provided by two pots, rather than one, simply
to be able to get the range (+ or -) required - I have tried different combinations of
position for VR+ and VR-, each with similar final offset results, however, note that
it is likely that your meter calibration could be shifted by up to approx. 0.5% by
these adjustments.

As of Oct 2020, a version of the circuit diagram (schematic) for this meter is here:-
https://elektrotanya.com/uni-t_ut210e_schematic.pdf/download.html (I have NO connection with site)

NB- the diff amp range gains, and the analogue reg voltages, shown on this diagram,
from the above source, all seem to be incorrect - values calculated from component values, and also
measurements made on one of my ut210e meters, both show this. I have annotated a version with
more accurate values, if anyone wants it.