Grupa 5211

Colocviu MEE 25.05.2018

1. The absolute voltage standard
2. The constant resistance compensator
3. The dual slope integrating analog to digital converter (electric diagram, working principle, waveforms)
4. A voltmeter V (c=1, Un=3V) is verified by comparing with a another voltmeter with higher accuracy.

There are available 2 instruments:

- V1 – Un=10V, c=0.2
- V2 – Un=4V, +- 0.5% +-4digit (4000 counts)

Find out

- Which is the better instrument+
- Draw the error graph for the voltmeter V2

Solution for subject 4:

The volmeter V: the accuracy class is expressed by referenced error ⇒ c=(ΔU/Un)*100 ⇒ the absolute error is ΔU=(c*Un)/100 ⇒ the relative error is εr=(ΔU/U)*100=c*Un/U=1*3/U=3/U.

The voltmeter V1: the accuracy class is expressed by referenced error ⇒ c=(ΔU/Un)*100 ⇒ the absolute error is ΔU=(c*Un)/100 ⇒ the relative error is εr=(ΔU/U)*100=c*Un/U=0.2*10/U=2/U.

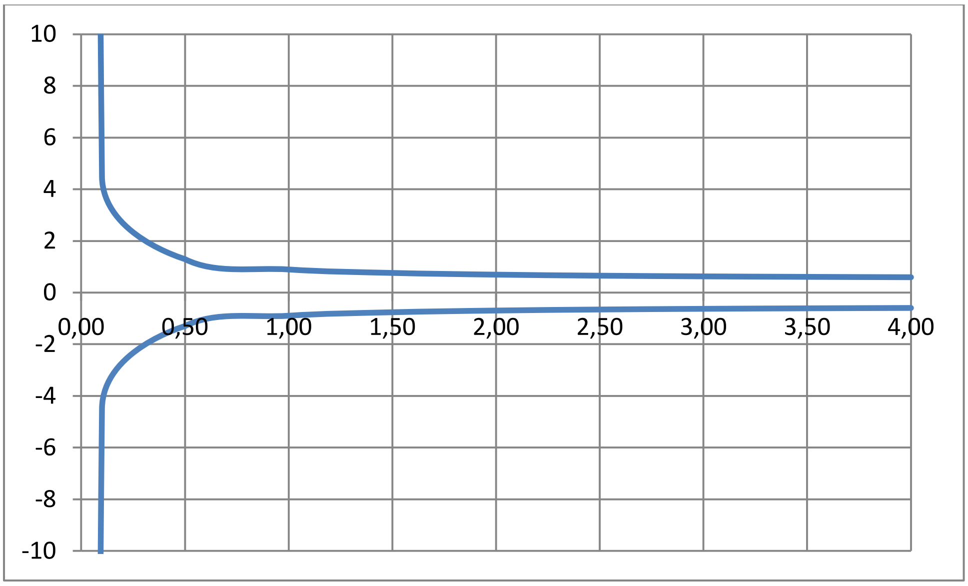
The voltmeter V2: the accuracy class is expressed by combination of relative and referenced error ⇒ ΔU=0.5*U/100+(4V/4000)*4=U/200+0.004 ⇒ the relative error is εr=(ΔU/U)*100=((U/200+0.004)/U)*100

Replacing the voltage values below in the equations above for the 3 voltmeters we get:

for U=1V - V: εr=3% V1: εr=2% V2: εr=0.9%
for U=2V - V: εr=1.5% V1: εr=1% V2: εr=0.7%
for U=3V - V: εr=1% V1: εr=0.66% V2: εr=0.63%

The best accuracy is given by the voltmeter V2, but it has to have an accuracy of at least 3 times better than V on the whole measuring range. For U=2V and 3V this is not realized even for V2.

b) We reprezent in the graph the error given by εr=±(U/200+0.004)/U)*100



Grupa 5212

Colocviu MEE 25.05.2018

1. The conservation voltage standard: the Zenner diode based standard
2. The Feussner compensator
3. The successive approximation AD converter
4. There are available 2 voltmeters V1 and V2 with the following characteristics:

- V1 – Un=10V, 20V, 50V, 100V, c=0.2
- V2 – Un=10V, 30V, 100V, 300V, +- 0.5%read+-0.5%fs

Find out

- The voltmeter that measure 45V with better accuracy
- Draw the error graph for the voltmeter V2

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a) The voltmeter V1 is used on the scale Un=100V: the accuracy class is given through a referenced error c=(ΔU/Un)*100 ⇒ the absolute error is ΔU=(c*Un)/100 ⇒ the relative error is εr=(ΔU/U)*100=c*Un/U= =0.2*50/U=10/U ⇒ εr=10/45=0.202%

The voltmeter V2 is used on the range of 50V: accuracy class is given through combination of relative and referenced error ⇒ the absolute error is ΔU=0.5*U/100+(0.5*50V)/100=U/200+0.25 ⇒ the relative error is εr=(ΔU/U)*100=((U/200+0.25)/U)*100=1.05%

The error of the 1st voltmeter is 0.202% and of the second voltmeter is 1.05%. The best voltmeter is V1.

b) The absolute error of the voltmeter V2 is ΔU=(0.5*U)/100+(0.5*Un)/100=(U/2+Un/2)/100

The relative error of the voltmeter V2 is εr=(ΔU/U)*100=(U/2+Un/2)/U

For the scale Un=10V - 0<U<10: εr=(ΔU/U)*100=(U/2+10V/2)/U=(U/2+5)/U=0.5+5/U

For the scale Un=30V - 10<U<30: εr=(ΔU/U)*100=(U/2+30V/2)/U=(U/2+15)/U=0.5+15/U

For the scale Un=100V - 30<U<100: εr=(ΔU/U)*100=(U/2+100V/2)/U=(U/2+50)/U=0.5+50/U

For the scale Un=300V - 100<U<300: εr=(ΔU/U)*100=(U/2+300V/2)/U=(U/2+150)/U=0.5+150/U