Resistance multiplier option

5320A model can generate directly high resistance values in range from 10 kOhm to 10 Gohm with 41/2 digit resolution and single value 100 GOhm with maximal applied voltage to 1575 Vpk.

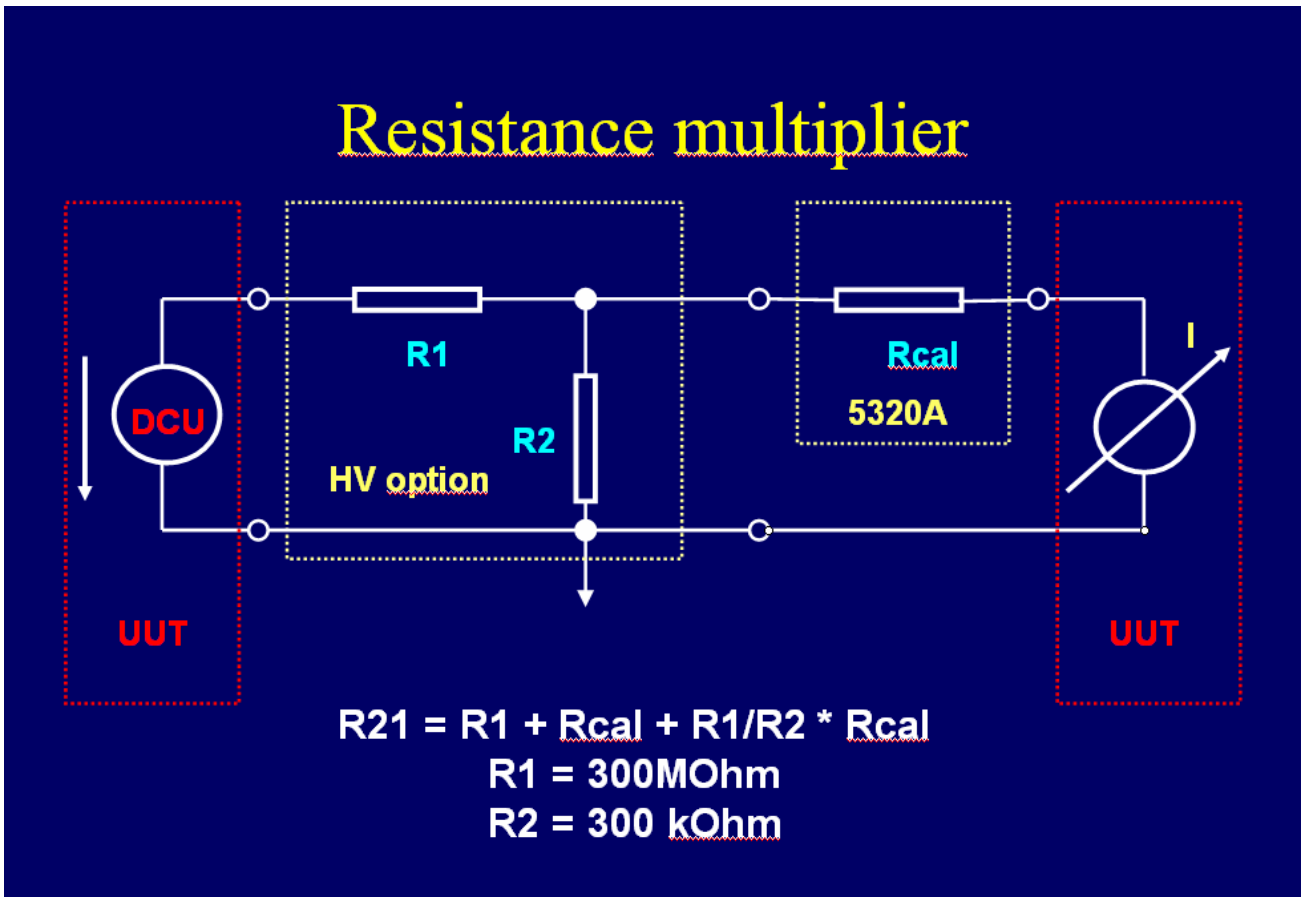
For insulation meters calibrations sometimes higher resistance range and higher test voltage is requested. 5320A offers for this purpose combined HVprobe / Resistance multiplier option. The option can increase high resistance range up to 10 TΩ with applicable DC test voltage up to 10 kV. For calibrations using resistance multiplier option some limitations resulting from the option principle has to be taken into consideration.

Principle of operation

Resistance multiplier function is based on passive T type resistance network which defines four-pole parameter

$$R21 = U1 / I2 \quad \text{under condition } U2=0 \qquad (1)$$

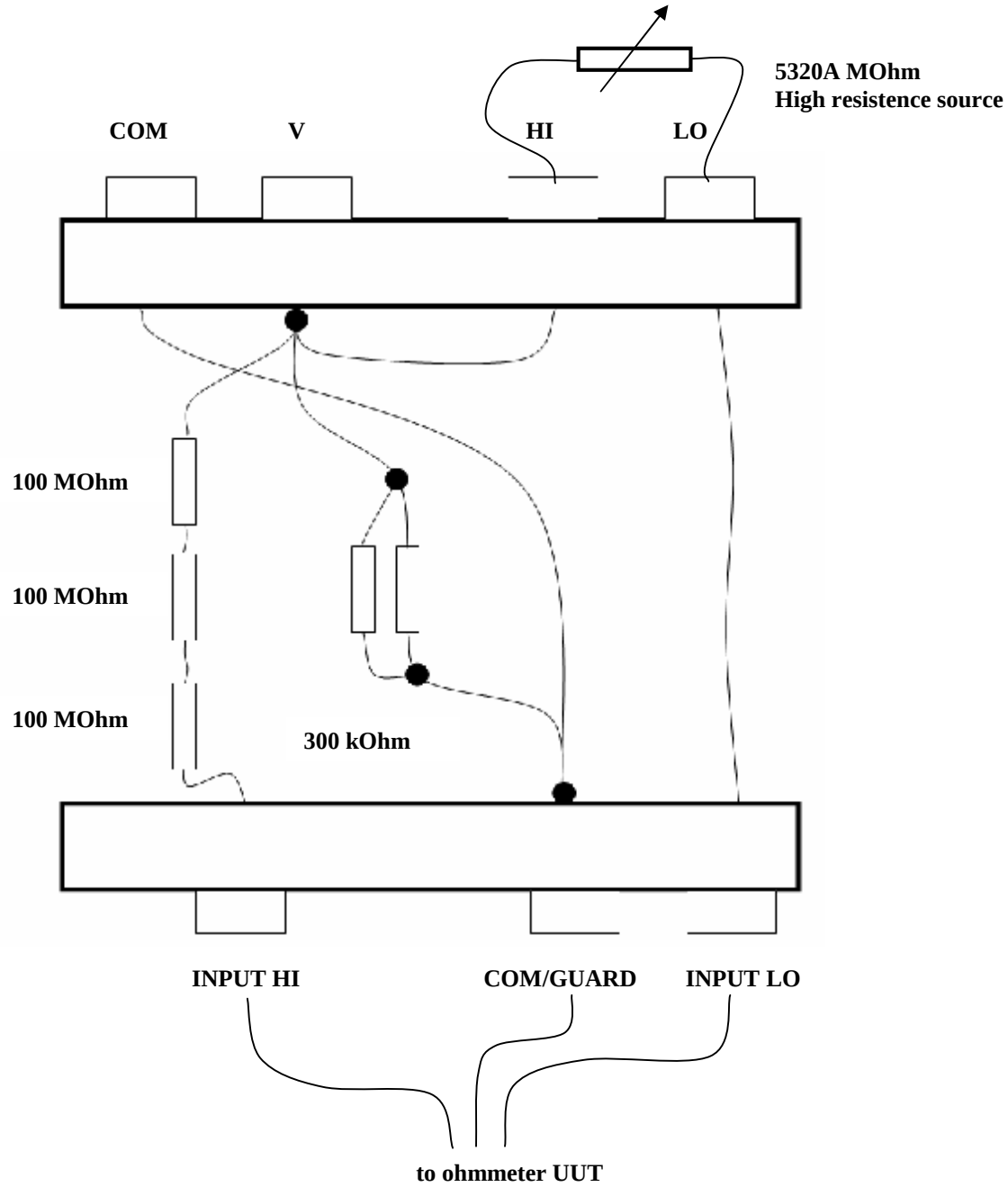
5320A High resistance source is used as one of parts of the resistance network Rcal. Next two resistors R1 and R2 creating T network are part of the Resistance multiplier option. Nominal multiplication coefficient of the option is 1000.



The applied multiplying principle has some limitations in application. Resistance multiplier is in fact three-pole simulator of high resistance. It can be applied successfully for such meters which low sense terminal sinks test current created by HV source of test voltage in UUT attached to the resistance multiplier. To meet conditions of the equation (1) UUT low (sense) terminal has to work as virtual zero point.

Resistance multiplier option connection

Resistance multiplier option combines both 10kV DC/AC voltage divider with dividing ratio 1:1000 and Resistance multiplier. Internal connection of the option is shown bellow



In the drawing there is shown position of 5320A High resistance source used as the third resistor in T resistance network. Because 5320A resistance can be set with 41/2 digit resolution also multiplied resistance can be set with the same resolution. The lower limit of the multiplied range is given by 3x 100MOhm resistors in the option, practically it limited from 350 MOhm is in 5320A.

Types of megaohmmeters

From principle of function point of view megaohmmeters can be sorted as follows:

a. Two terminal meters. They are equipped with two single sense terminals measuring usually resistance ratio against internal range resistor. The meters request two pole resistance standards for calibration. They can be calibrated with 5320A up to 100 GOhm but not in extended range with Resistance multiplier option. Typical examples are models Fluke 1653, all hand-held ohmmeters and multimeters.

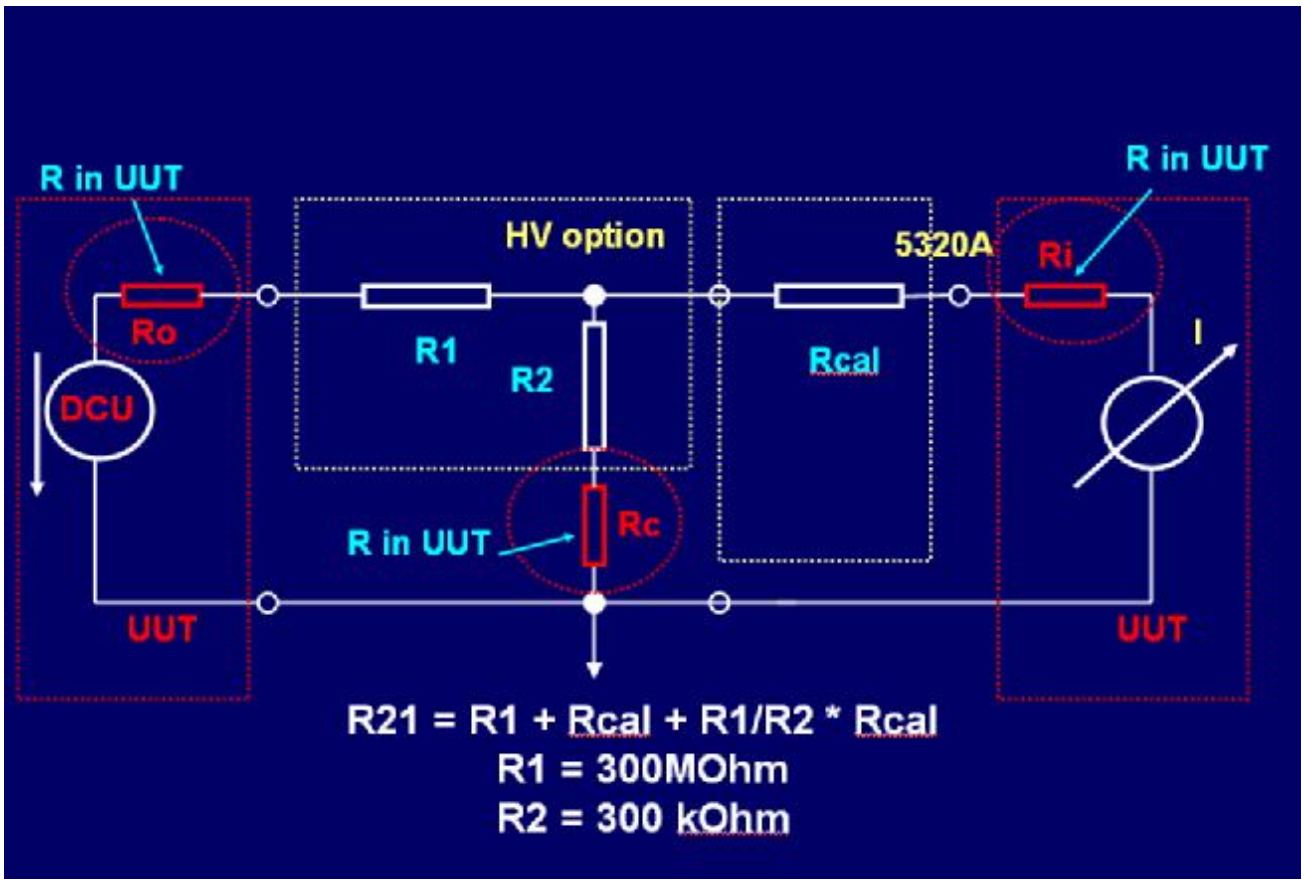
b. Two terminal meters with third Guard terminal. The guard terminal is mostly used for electrostatic shielding to avoid spurious leakage currents flowing along surface of the objects. They can be calibrated with 5320A up to 100 GOhm but not in extended range with Resistance multiplier option.

c. Three terminal meters with right third terminal (COM or GUARD or GROUND) and with virtual uA-meter in low sense terminal. The COM terminal is used as common terminal of the source of test voltage and sense uA-meter. The meters can be calibrated both with alone standing 5320A and in connection with Resistance multiplier.

d. Three terminal meters with right third terminal (COM or GUARD or GROUND) and with uA-meter with fix input resistance in low sense terminal. The COM terminal is again used as common terminal of the source of test voltage and sense uA-meter. The meters can be calibrated both with alone standing 5320A and in connection with Resistance multiplier. Input resistance in low meter terminal must be known and entered as correction in 5320A SETUP menu, item High resistance source / R multiplier input. The meter input resistance is usually specified in operation manual.

Sources of mistakes

Some of three terminal megaohmmeters use a protective resistance in sense L terminal, source H terminal or in COM/GUARD terminal. Discussion of their effect is shown bellow.



a. Resistance Ri is connected in series with Rcal resistor. It fully influences accuracy of calibration. However, effect of the Ri resistance can be corrected by above described correction constant in 5320A SETUP menu.

b. Ro resistance is output resistance of meter test source. If the output resistance is higher than approx. 1 MOhm it can significantly influence result of calibration. Fortunately, typical UUT output resistance is in order of kOhm.

c. Any protective resistor Rc in the UUT fully influences result of calibration. In test circuit it becomes a part of R2 resistor which determines multiplying coefficient. UUT with Rc resistor higher than 300 Ohm cannot be directly calibrated with Resistance multiplier option.

When using Resistance multiplier option for insulation meters calibration, rules for high resistance measurements should be taken into consideration.

- 5320A doesnot scan test voltage when resistance multiplier is connected. Don’t exceed maximal peak value 10 kV on the option input terminals.
- 5320A High resistance source connected to the resistance multiplier grounding should be set to OFF in SETUP menu.
- From safety reasons the Resistance multiplier option housing must be connected with protection earth potential.
- Some megaohmmeters may request swapping wiring from HI and LO 5320A terminals to HI and LO terminals on the Resistance multiplier.
- System of input terminal grounding must be considered in meters with power line supplying (not floating) to avoid damage either the meter or 5320A. 5320A LO terminal potential should not exceed 20Vpk against protective earth.