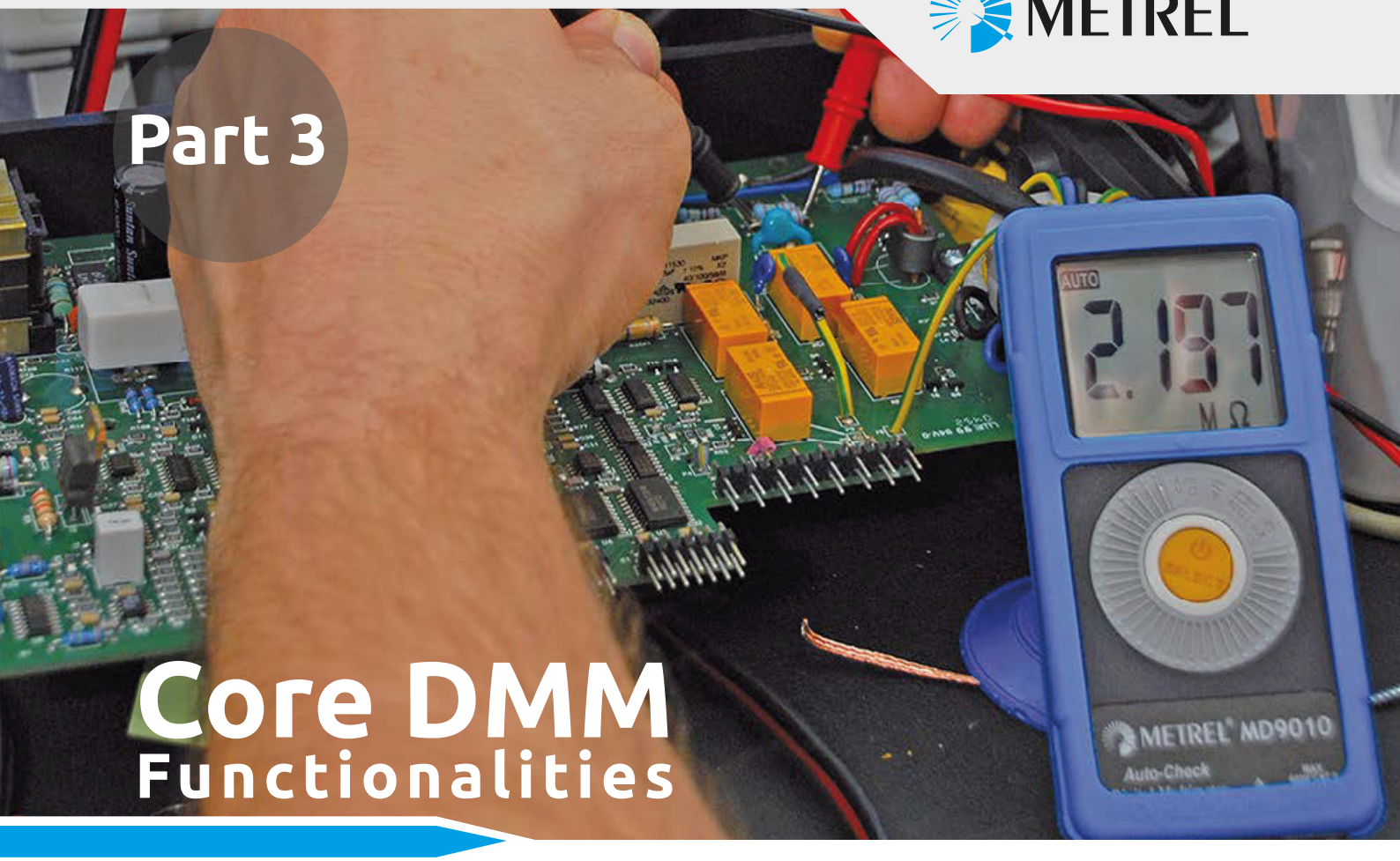


Part 3

Core DMM Functionalities

Digital Multimeter Functions & Properties 101

There are many different types of handheld digital multimeters with a myriad of different functions and features, some for more general measuring applications, while others for more specialized, niche applications. Amongst those are multimeters like ours MD 9035 Automotive multimeter, which can measure a number of car/motor vehicle-specific quantities, besides more standard ones that will be presented in this newsletter.

Voltage

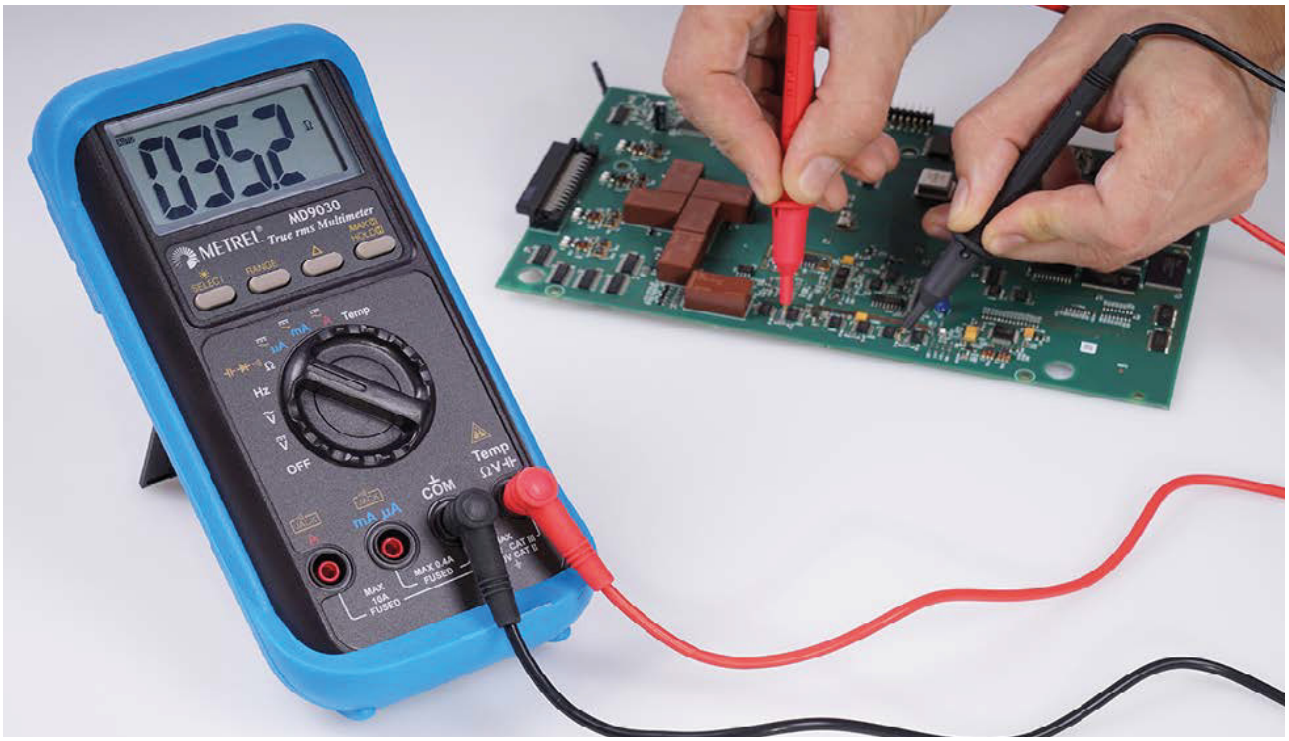
AC and DC voltages are the very core measurements anyone expects of a multimeter. Presence of voltage on power supply is also the very first test when troubleshooting a device. DC voltages are normally found on batteries or battery-powered devices and in devices with rectifiers in the supply line. AC voltage is present on mains and anything powered directly from them. Other shapes can appear unpredictably, either on a special device or as result of distortion. Again, one needs to consider whether the value shown is true RMS or not.

Current

To measure current, the meter needs to be put in series with the element of interest. This may not be possible, as it normally requires taking the circuit apart and including the instrument in it. Special leads are available to avoid this, e.g. current clamps that measure current through induction or the Hall effect. To measure current, the leads are put into different terminals than for voltage measurement and have to be exchanged again before measuring voltage again – or damage to instrument can occur as voltage is applied over (very) low shunt on current input. Normally, there is a fuse in place to prevent or mitigate such an occurrence.

Frequency

Multimeters can usually give the frequency of a base component in the signal. However, certain signals can give them trouble with high harmonic content or unusual shape. The best known is output from variable frequency drives for electric motors, a pulse-width modulated signal. Motors only respond to the base component. Multimeters that don't take high harmonic content and noise into account will show a much higher value than motor's internal indicator. Filters need to be applied to the signal before the reading can become meaningful. On the other edge of the spectrum one can find multimeters with bandwidth up to 100 kHz



Resistance, continuity and diode

Resistance is the most basic material electric property. It ranges from a few milliohms of contact resistance to hundreds of gigaohms of insulation resistance. It is measured by introducing a voltage through lead tips and measuring the current between them. Therefore, the object undergoing a resistance measurement must be off and isolated from power, or damage may occur. For low resistance measurements, the resistance of test leads is an important source of error and should be subtracted.

Continuity is a check of connection between two points in the circuit. It is different from resistance in intent – one is not looking for exact resistance value, only that it is low enough. Most multimeters will give a beep when that happens, so that not even a look to the screen is needed. Diode test measures voltage drop over a silicone junction. It should read less than 0.7 V for forward direction and open circuit for reverse. If the instrument uses voltage lower than 0.6 V to measure resistance, it can be used to test resistors that would normally be isolated by silicone elements.

Capacitance

Capacitance is another common troubleshooting measurement. Capacitors can fall out of tolerance without looking damaged on the outside and sometimes, there is no other option but to check them one by one. It is however painstakingly slow if using only the test leads, and most multimeters cannot successfully measure values higher than a few milifarads, while being really accurate when measuring much lower values.

Temperature

Special probes are needed, most commonly thermocouples. The probes give out a voltage in proportion to the measured temperature. The accuracy is quite poor (usually worse than ±1 °C), but a wide range of temperatures can be measured.