

Ammeter calibration using M-140/M-142 multifunction calibrator

Summary range of current function in M-140/M-140i multifunction calibrator covers 0 to 20 A for DC current and 1 μ A až 20 A for AC current. Range of the current function of M-142/M-142i model is 0 to 30 A for DC current and 1 μ A to 30 A for AC current. Some phenomena which limit applications are discussed below.

1. Test leads

1.1. Quality of test leads

When M-140/M-142 calibrators are applied for UUT current function calibrations on range above 1 A special care should be taken to the applied of test leads. The test leads with minimal length should be applied. Voltage drop on the test leads should not cross over approx. 500 mV. When current 30 A is applied resistance of each test lead should not be higher than 12 m Ω . The test lead terminals have to be kept clean with well springing contacts. The banana ends have to be inserted into calibrator front panel terminals fully to decrease contact resistance. High contact resistance can cause heat emission in the terminal 20 to 30 W without calibrator recognising it as application fault. The heat can damage output terminals.

More, high contact resistance acts as non-linear resistance on high currents causing in this way additional distortion of output current which is out of specified limits. The additional distortion influence negatively calibration uncertainty.

1.2. Recommendations

Following principles should be taken into consideration for calibrations over 1 A:

- Not to disconnect test leads when output terminals are ON.
- To ground LO terminal in one point, either on calibrator side using SETUP menu or on UUT side.
- To keep clean and springy contacts of test lead ends.
- Avoid applications with high quality inductance load or capacitance load which are out of calibration specification.

2. Load impedance and calibrator output oscillation

Multifunction calibrator current output is formed by power amplifier with current feedback. For the amplifier short on output terminals is standard native condition. Real UUTs have non-zero input resistance, formed usually by low resistance current shunt or by sensing transformer. Multifunction calibrators M-140/M-142 can drive both these UUTs.

However, when UUT has input impedance with dominated inductive character like current transformers with high number of turns, UUT input resistance can cause oscillations in connection with non-ideal output resistance of the calibrator. When the oscillations exceed approx. 3 V, calibrator can recognise them and disconnects output terminals. If the oscillations are of lower amplitude, calibrator cannot recognise them. Output current can be inaccurate under this condition. Typical sign of parasitic oscillation is non-stable reading on UUT display. The oscillation can be often treated by inserting low value resistor in series with the output terminals. The resistor should be of such value the oscillations already disappear and calibrator output is not overloaded.

3. Time limitation of current output

Multifunction calibrator can supply UUT with continuous AC/DC current up to 10 A. In range 10 to 20 (or 30) A is the calibrator equipped with time limiting procedure who protects internal circuits against thermal overloading. Maximal time interval for 20 (30) A is 30 s, when lower current is set time interval is appropriately prolonged. Full loading is available again after elapsing relaxing time. The length of the relaxing time is controlled by the calibrator and cannot be influenced by user. Time information is shown of the front panel display.

4. Current coil application

4.1. Frequency range

Current coil can be applied for clamp ammeter calibration only. Multiplying coefficient at delivered coil Option 140-50 is either 25 or 50. Manufacturer guarantee capability of calibration using the current coil up to 20 A and on frequency 40 to 60 Hz. However, the current output can be typically applied also on higher frequencies to 80 or 100 Hz. Real frequency range depends on specified load feature of UUT.

4.2. UUT versus current coil position

When clamp ammeter is calibrated, mutual position of current coil column and UUT clamps is very important. Plane of UUT clamps must be rectangular to current coil column axis. It is good the tested clamp ammeters to place symmetrically to compensate influence of current coil magnetic field non-homogeneity. Additional uncertainty due to this effect is 0.3 %.