Detailed guide and description

DE712-02 Demo multimeter 02 'inno'

General description

This multimeter is a universal analogue device for taking current and voltage measurements in demonstration classes. It can be fixed (vertically) anywhere, attaches magnetically to suitable metal panels and can also be mounted horizontally with an overhead projector for displaying the measurement results to a larger audience. The unusually sensitive measurement ranges offered also enable the quantitative analysis of tests at low voltages and currents, for which expensive and complicated measuring amplifiers typically had to be used previously. The centring of the pointer's zero point to the middle of the scale simplifies measurements using dipolar sources. Clearly marked slot-in scales and digital, human-readable displays in all ranges ensure error-free readings. The novel, servo-powered measuring element is rugged and offers a high level of precision plus electrostatic shielding, regardless of device orientation. Compared to other mechanical measuring elements, it is also much faster at showing the final value without first oscillating around it – which is critical for dynamic readings. An automatic switch-off feature guarantees a long battery life. An AC power adapter can also be used as an alternative power supply.

Technical data:

Measurement ranges 1 V/3 V/10 V/30 V DC:
- Accuracy higher than ±2%
- Input impedance 100 kΩ/V

Measurement range 1 mV DC:
- Accuracy higher than ±2%
- Input impedance 10 kΩ
- (for special measurement tasks, this range can therefore also be interpreted as a 100 nA current measurement range)

Measurement ranges 1 V/3 V/10 V/30 V AC:
- Accuracy higher than ±3%
- Input impedance 100 kΩ/V
- Frequency range 20 Hz … 20 kHz, the -3 dB point lies beyond 60 kHz.
- Note: since a corrected arithmetic mean measurement is used for rectification, the values stated for accuracy and frequency range apply for pure sinusoidal signals only.

The accuracy of the 1 mV AC range is not specified. However, usage should be confined to frequencies below 500 Hz, in order to obtain reasonably meaningful results.

Measurement ranges 100 µA/10 mA/30 mA/100 mA/300 mA/1 A/3 A/10 A DC:
- accuracy higher than ±2%, except ±5% for 3 A range.

Measurement ranges 100 µA/10 mA/30 mA/100 mA/300 mA/1 A/3 A/10 A AC:
- Accuracy higher than 3%, except ±6% for 3 A range.
- Note: since a corrected arithmetic mean measurement is used for rectification, the values stated for accuracy and frequency range apply for pure sinusoidal signals only.

Connections

The signals for all voltage/current measurement ranges are fed into the instrument using three safety sockets on the device front. These are insulated, rigid 4 mm sockets that are designed to accept spring-loaded 4 mm plugs with spring-loaded or rigid insulating sleeves or without insulating sleeves.
All measurement signals, with the exception of the 10 A range, are fed into the device with the correct polarity using the V/A and COM pair of sockets.
In the 10 A range, the 10 A and COM pair of sockets are used (observe polarity). When a plug is inserted into the 10 A socket, the display switches automatically to 'A'. The position of the measurement range switch is ignored in the 10 A range.

Overload protection

The current measurement ranges are equipped with ceramic fuse elements that automatically return to the conducting operating mode once the error state no longer applies. This not only avoids the familiar logistic problems with thermal fuses but also the dreaded issues affecting connections in sensitive measurement ranges. The LED displays − clearly visible even from a distance − also show if overcurrent devices have tripped.

Notes on accuracy

Details of accuracy include final reading errors, linearity errors and hysteresis errors. Correct setting to zero or the midpoint is assumed. The accuracies stated are the limits of intrinsic deviations under reference conditions according to DIN EN 60051. Limits may be exceeded if operating conditions deviate considerably from the reference conditions, such as when temperatures are significantly higher or lower, or the device is used in the presence of strong magnetic or electric fields. However, these conditions are unlikely to occur in a classroom situation. DC refers to direct voltages or direct currents with no pulsation. Measurement of alternating voltages that have only been rectified but insufficiently filtered can occasionally result in clearly audible disruptions to the display and unexpected readings.

In the 100 µA range, internal consumption of up to 100 mV must be accounted for. Although typical for digital measuring devices, it may be confusing in isolated cases. Conversely, 100 mV measurements − but using an internal impedance of 1 kΩ − are also possible and useful in the 100 µA range.

In the 1 mV range, some skill in testing work will be required to ensure measurements can be completed without problems. Lastly, thermoelectric voltages of a few kelvins and moving measuring cables past magnets will also produce significant readings. When longer cables are used, the induction of the earth's magnetic field can even be detected with a certain amount of trial and error.

With the exception of the 3 A range, the device therefore satisfies the requirements of accuracy class 2 for DC zero point and accuracy class 3 for AC and for DC zero midpoint.

Safety

The maximum guaranteed holding current is 5 A at 20 °C and 4.15 A at +40 °C. Continuous measurements > 5 A are therefore not possible. At 20 °C and 10 A the unit interrupts the measurement within about 30 seconds, at 20 A within about 4 - 12 seconds. The maximum voltage is 30Vrms. The short-term maximum current is 100 A.

The device must not be connected to mains power: this will destroy the device. Without further specifications, the device is therefore equivalent to category CAT I (IEC 61010-1, Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use) – i.e. devices for measuring electrical circuits not connected directly to mains power.

Protection classes define measures protecting against voltages that cause electric shock (EN 61140). With this device, any voltage that could cause electric shock must not be connected to the signal voltage sockets or to the supply voltage sockets. This also applies to single pole-only connections. The device therefore has no protection class.

Power supply

The device is typically powered using a set of 4 AA alkaline batteries that are installed in the compartment on the back of the device. The typical service life of a set of alkaline batteries is around 20 hours of operation, depending on device usage and battery quality. Powering the device with zinc-carbon batteries with acid electrolytes is not recommended and can lead to irregularities during operation.

The last position of the measurement type switch displays the relative battery voltage, independently of the position of the measurement range switch or any input voltages. The usability of the batteries or the connected AC adapter can be identified from the display by consulting the arch labelled 'BAT' that is printed onto the front panel.

The batteries should be removed from the battery compartment when the device will not be used for some time. Damage caused by battery leakage is not covered by the warranty!

To conserve battery power, the device switches off automatically after one hour. Changing the measurement type can trigger an earlier automatic shut-off. In either case, the device can be switched back on by turning the measurement type switch to zero and then to the required position.

The device can also be powered by using an AC adapter. The device requires stabilised direct current of 6 V with a load bearing capacity of at least 500 mA via a 5.5 / 2.5 mm DC plug. The pin is positive and the outer sleeve negative. If substandard switching adapters are used that have a high level of interference, this can impair the quality of the measurements – especially in sensitive DC ranges as well as in all AC ranges. The device features semiconductors and ceramic fuse elements to protect it from supply voltages >7 V and from supply voltages with the wrong polarity. The device will therefore be unusable if power supply equipment with these kinds of voltages is connected.