

INSULATION TESTING SOLUTIONS

By Jeff Jowett, Megger



Insulation testing is faster, easier and safer with the Megger MIT400 Series

Introduction

Insulation testers come in a variety of packages, from basic megohm resistance and continuity measurements to full-featured models that incorporate many of the functions performed by multimeters. With such a range of selection available, how does the electrician, repair technician, or engineer decide upon the best instrument for a particular application or set of applications?

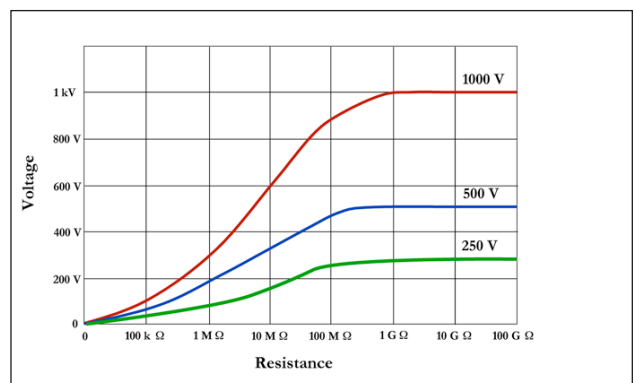
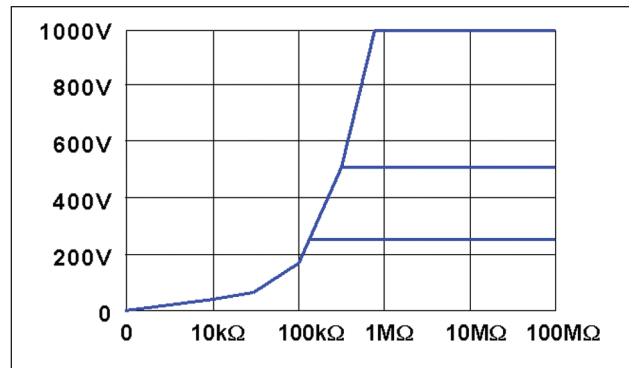
Megger® is eponymous with insulation testing. The inventor, prime innovator and leading manufacturer of insulation testers (a/k/a megohmmeters), Megger has organized their range of products into convenient family groupings, from basic function to full-featured models, and then across each family with increasing numbers of features. The top of the line is the MIT400 Series. The prospective operator can easily decide what level of instrumentation the job requires, and then select the model with the necessary or preferred features. The most basic questions to be decided are voltage range and intended purpose. After that, individual preferences largely finish the selection process.

Specialized Insulation Testing Equipment

Most equipment operating from building wiring can be tested with a handheld 1 kV tester. Single-voltage models are useful for highly specific applications where accidental use of the wrong test voltage could present a problem. They are also handy where semi-skilled or apprentice personnel may be using the tester, for essentially the same reason. Many electricians need only a 500 V megohmmeter for building-wiring applications. But more often, it is convenient and practical to have multi-voltage selection. Typical settings are 250, 500, and 1000 volt tests. This enables the user to craft his technique more closely to the rated voltage of the equipment being tested, as well as to observe the response of the insulation to different voltages. A test at 1 kV is useful for troubleshooting because it will pick up faults that a lower-voltage test may have missed, such as by drawing an arc from a pinhole.

Voltage Selection

Voltage selection doesn't stop there, however. More sensitive circuits, such as telecom, datacom and control circuitry, may require testing at lower voltages, 50 V and 100 V being typical. But while it is convenient to have both power and telecom capabilities in a single unit, additional test voltages add incrementally to the cost of the model. Megger's broad range of products effectively addresses this consideration by offering models with power voltages only (MIT400) and telecom voltages only (MIT480). The latter not only reduces cost but at the same time affords thorough protection against the possibility of exposing sensitive circuitry to potentially damaging voltages through human error. Five other models offer the full range of selection, from 50 V to 1 kV.



Typical load graphs: rapid voltage rise (top) vs. slow rise (bottom)

Flexibility doesn't stop there. In addition, specialized applications like military, avionics, maritime, battery-powered equipment and the like specify test voltages that aren't typically found outside of that technology. For these demands, the MIT40X provides voltage selection in 1 V increments from 10 to 100 V.

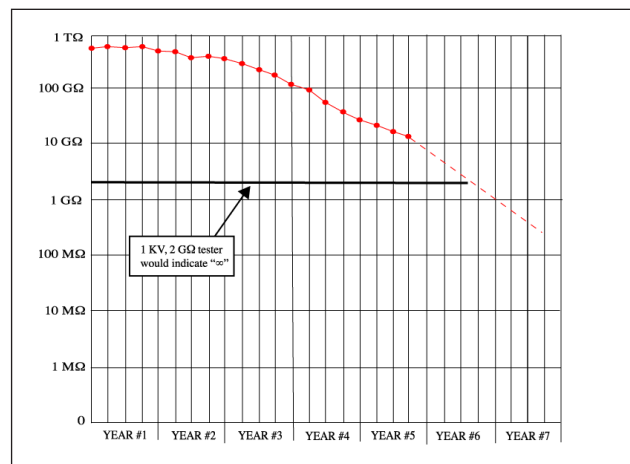
Finally, an instrument should also be evaluated on the basis of the quality of the voltage output. Loosely designed (and therefore low cost) instruments may deliver the stated test voltage only nominally. That is, at some level, typically many megohms, the load resistance is high enough to support the selected test voltage. However, on the lower end of the insulation range, voltage decay will occur because the tester cannot output enough current to support the test voltage against the applied resistance. To evaluate this specification, look for a load graph that shows voltage rise against increasing resistance of the item under test. All insulation testers have a limit on output current. This should be specified. For one, it is the manner in which high test voltage is obtained from on-board batteries. For another, current limitation protects the test item if it is in a badly deteriorated, yet possibly reclaimable, condition. Water-soaked equipment fits this parameter. Well designed instruments will show a fast voltage rise to 1 megohm (the popular "1 Megohm Rule"), above which full selected voltage is applied. Poorly designed testers will show a markedly slower rise, so that over the most critical resistance range...the lower end of the spectrum where decisions must be made as to the continuing serviceability of the equipment...the item is not being tested as thought and measurements are a less reliable indicator.

Interpretation of the Infinity Reading

The next most important selection criterion is the goal of testing. The possibilities break down into pass/fail, go/no-go, and troubleshooting applications on one hand, and continuing predictive/preventive maintenance on the other. As with number of voltage selections, this distinction also separates relatively inexpensive from high-end testers. The principle determinant in this case is range of measurement. Megger's MIT400 family offers the highest range in a handheld unit on the market.

Industry-standard testers typically measure to 1000 or 2000 Megohms (1 or 2 Gigohms). On old analog units, this is what was considered "infinity" (∞). The MIT400 Series measures to 200 G Ω ! (A G Ω is 1000 M Ω .) What's the purpose? This is where the two

basic types of testing goal diverge. Pass/fail, go/no-go, and troubleshooting tests are concerned with the lower end of range. The operator is determining if the test item meets a minimum standard, is in acceptable condition to continue in operation, or exhibits a problem or failure. Nothing is "bad" at two thousand Megohms, so a basic-range model is adequate. This type of testing is being done on the fringe of operation, to determine what works from what doesn't, and misses much of the value that an insulation tester can provide. A full range of resistance measurement enables new equipment to be more precisely evaluated as to condition, and subsequent measurements to be plotted so as to establish a time line and an idea of where the item is on its life cycle. Routine deterioration can be anticipated, maintenance scheduled, and equipment kept in service longer and more dependably. Basic-range models give most of their data when equipment is in the twilight of its operation or approaching the possibility of breakdown. High-range models extend this capability over the entire life of the item.



Interpretation of test results: high range vs. standard range

Personal Preferences

Having decided on test voltages and resistance range, the operator can now focus on what he or she needs or would like. Do not overlook the kilohm range. This is a measurement function between the continuity and insulation ranges. It closes the gap between ohms and Megohms. It is most useful in drying-out and troubleshooting applications, where the operator is working with badly deteriorated insulation, and also for testing components and sub-assemblies, whose insulation requirements are often less demanding than isolation from ground.



Megger is the only manufacturer that offers a genuine digital/analog electronic display. An electronic pointer travels against a logarithmic arc with the time signature familiar to well-seasoned technicians who value pointer travel as much or more than actual measurement. When it stops, a high-accuracy digital reading appears, eliminating parallax and affording the best elements of both types of measurement.

Another feature that both saves time and insures against error is the ability to set alarm limits on both the continuity and Megohm ranges, at any value across the range. Just set the desired value and listen for the buzzer. This feature is an added advantage when using semi-skilled personnel who might be prone to misinterpretation of results. The adjustable continuity alarm is a feature of all models, while the MIT420 and MIT430 extend this capability to the insulation resistance range. In addition, the continuity function has a fast buzzer that will soon be appreciated when performing rapid-repeat tests.

Choose Your Tests

The operator can also select a variety of additional tests. The MIT400 family offers voltage measurement, leakage current, capacitance and frequency, depending on model. Acting as a voltmeter, all models measure True RMS and dc to 600 V. Leakage current, the reciprocal of the Megohm measurement, is offered on all but basic-function models, and affords added insight into the response of the insulating material as well as being the more popular measurement in some industries. Moreover, an added capability of selecting various combinations of dual measurements simultaneously displayed saves time and aggravation, making it easier for the operator to instantly evaluate results and draw appropriate conclusions. Four models measure capacitance from 0.1 nF to 10 μ F, while MIT481 and MIT485 compare

the reading to an internal library of selectable wire types and automatically convert the measurement to length. All but the basic-function models also offer automated tests that need only be selected and engaged. These include the familiar industry-standard Polarization Index (PI) test, a Dielectric Absorption Ratio (DAR) test, and a selectable timed test. The tester will perform any of these automatically while the operator can focus attention elsewhere. In addition to saving time, PI and DAR also aid in evaluating test item condition by providing an industry-accepted result.

Storage and downloading of test results, once a luxury, have now become industry standard. This capability is an enormous time-saver where maintenance records are being kept, and eliminates human error from interpretation of results and subsequent discussion with third parties. MIT420, MIT430, MIT481 and MIT485 store in excess of 1000 results, and MIT430 and MIT485 add Bluetooth® downloading. Software is provided at no additional charge.

Interpretation of test results: high range vs. standard range

Safety First

Just as important as operational features are intangibles like convenience and, especially, safety. Megger products are designed for maximum safety. The tester itself cannot cause harm, but the test item can! Accordingly, MIT400s are safety rated against IEC 61010-1 for arc flash protection to CAT IV 600V. In addition, an entire package of redundant safety features protects the operator from static charge that can build on the test item during testing. The voltmeter is a default that engages automatically when voltage is detected on the test item after conclusion of a test, issuing both visible and high-speed buzzer alarms. The test item is then safely discharged through the tester, and the progress visibly monitored. If the protective fuse fails, it is immediately indicated; no need to test manually. When switching from insulation to continuity ranges, the high input protection of the high-voltage circuit remains in place until both leads are properly connected, thereby preventing a free probe from becoming live in the event of a system fault. If extraneous voltage is applied during a test, as by someone closing a switch, testing will be automatically inhibited, thereby protecting both

the operator and the instrument. This protection occurs above 50 V for power models, so that low levels of harmless noise will not inhibit testing. In telecom models, the limit is raised to 75 V in order to accommodate normal cross-talk.

And There's More

All models are protected against ingress of dirt and moisture to the high level of IP54. This protection greatly extends the life of testers, especially in difficult environments like quarries, mines, cement plants, paper and textile mills. The testers are ergonomically designed for comfortable handheld use. Remember, picking something up at a trade show isn't the same as working with it all day. All models come with a protective rubber boot that will keep the unit working through normal dropping. And do not overlook leads. Many "economical" testers cut corners to cut costs, and leads are expendable. A cheap set of leads can defeat the whole purpose of testing by allowing considerable leakage, which is then reflected in the measurement. MIT400s come with high-quality silicone leads. A remote switch probe is also provided on six models, freeing the operator's hands in challenging environments by engaging the display from the probe without having to press the TEST button.

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