

Insulation resistance testers above 2.5 kV

Megger[®]





Why Diagnostic Insulation Testing?

Electrical insulation degrades over a period of time because of various stresses which are imposed upon it during its normal working life. The insulation has been designed to withstand these stresses for a period of years, which would be regarded as the working life of that insulation. This often runs into decades.

Abnormal stresses can bring about an increase in this natural aging process that can severely shorten the working life of the insulation. For this reason it is good practice to perform regular testing to identify whether increased aging is taking place and, if possible, to identify whether the effects may be reversible or not.

The purpose of diagnostic insulation testing is:

- **To identify increased aging.**
- **To identify the cause of this aging.**
- **To identify, if possible, the most appropriate actions to correct the situation.**

While there are cases where the drop in insulation resistance can be sudden, such as when equipment is flooded, it usually drops gradually, giving plenty of warning if tested periodically. These regular checks permit planned reconditioning prior to service failure and/or a shock condition. Without a periodic testing program all failures will come as a surprise, unplanned, inconvenient and quite possibly very expensive in time and resources and, therefore, money to rectify.

There are various types of diagnostic insulation tests:

- 1 Spot Reading Test (IR) (IR(t)):** The simplest of all insulation tests and the one most associated with lower voltage insulation testers; the test voltage is applied for a short, specific period of time and a reading is then taken. The reading can then be compared to the minimum installation specifications. Unless the result is catastrophically low, it is best used when trended against previously obtained values.
- 2**
- 3 Time vs. Resistance Test (DAR):** The concept of the time resistance test is to take successive readings at specified times during a single test. It is based on the relative magnitudes of leakage and absorption currents in clean, dry insulation compared to that of moist or contaminated insulation. Good insulation shows a continual increase in resistance over time. With contaminated insulation, the leakage current is much larger and the effects of the absorption current are, therefore, much less apparent.
- 4 Polarization Index Test (PI):** The simplest implementation of the time resistance test for solid insulation, the PI Test requires only two readings followed by a simple division; the one-minute reading is divided into the ten-minute reading to provide a ratio. With "good" insulation, leakage current is relatively small and resistance rises continually as current decreases from the effects of charging and dielectric absorption. In general, a low ratio indicates little change, hence poor insulation, while a high ratio indicates the opposite.
- 5 Dielectric Discharge Test (DD):** While the other methods mentioned measure the currents flowing during the charging process, the DD test measures the current that flows during discharge of the test sample. As such, it is not a pure insulation resistance test but rather an adjunct to traditional insulation tests. Insulation in high voltage equipment often consists of layers, each having its own capacitance and associated leakage resistance. When a layer is faulty between good layers, its leakage resistance will decrease while capacitance is likely to remain the same. A standard insulation test will be determined by the good layers, and not likely to reveal this condition. But during dielectric discharge, the time constant of the faulty layer will mismatch the others to yield a higher DD value.

Each diagnostic insulation test can point to different problems in the insulation. As mentioned, the DD test helps identify problems in a single layer of multilayer insulation. The PI test is particularly valuable in revealing moisture ingress, oil soaks, and similar pervasive contamination. Localized physical damage like pinholes or dry, brittle insulation in aged equipment can be revealed by the SV test.
- 6 Step Voltage Test (SV):** Since good insulation is resistive, an increase in test voltage will lead to an increase in current with a result that the resistance remains constant. Any deviation from this could signify defective insulation. At lower test voltages, say 500 V or 1000 V, it is quite possible that these defects might be unobserved, but as the voltage rises we reach a point where ionization can take place within cracks or cavities, resulting in an increase in current, and therefore a reduction in the insulation resistance. A recognized standard procedure is to increase voltage in five equal steps at one-minute increments and record the final insulation resistance at each level.
- 7 Ramped Voltage Test:** The ramped voltage test is endorsed in IEEE95-2002 as part of the recommended practice for insulation testing of AC electric machinery (2300 V and above) with high direct voltage. When using this test method, the test voltage is gradually increased (ramped) at a set rate to a final level, which results in an increase in the current. Any variations in current compared to the increase in applied test voltage can provide useful diagnostic information about the condition of the insulation.



For more information on these diagnostic tests, please see the Megger booklet "A Guide to Diagnostic Insulation Testing above 1 kV".

Why Megger Diagnostic Insulation Testers?

Diagnostic insulation tester users have told Megger what they want:

- Make it lighter and smaller.
- Make it easier to use/more intuitive.
- Make sure it is safe to use.
- Make the battery better.
- Make sure the readings are accurate and repeatable.
- Make it versatile (work where I work).

Following are just a few of the capabilities of Megger's diagnostic insulation testers (some specifications may vary with the model). Each one addresses what end users need and want.

- Only 4.5 kg.
- Rotary switches for operation rather than complicated menu structures.
- Unique dual-case construction allows for inner case fire retardant protection while maintaining the ruggedness of the outer case.
- Locking test leads with non-removable test clips prevent any accidental unplugging that could cause a dangerous situation.

- CATIV 600 V safety rating on all terminals with 1000 V protection between terminals.
- CAT rating maintained to 3000 m.
- Lithium-ion battery charges fully from being dead in 2.5 hours. A user can test for an hour with only a 30 minute charge. Up to 6 hours continuous usage from a single charge.
- 5% accuracy up to 1 T Ω (at 5 kV), 2 T Ω (at 10 kV) and 3 T Ω (at 15 kV).
- The best guard terminal performance (2% error guarding 500 k Ω leakage with a 100 M Ω load) of any instrument available.
- Delivery of the chosen test voltage even with the guard terminal in use.
- Industry best IP65 rating.
- Up to 6 mA short circuit current.
- Up to 8 mA noise immunity for operation in electrically noisy environments.



15 kV heavy duty diagnostic insulation tester

MIT1525

Offering test voltages up to 15 kV and a maximum insulation resistance reading of 30 TΩ the MIT1525 extends the users' ability to monitor the aging of insulation. Diagnostic tests available include IR, timed IR, polarization index (PI), dielectric absorption

ratio (DAR), step voltage, dielectric discharge and ramp testing as automatic tests. The results are time and date stamped and stored on board or they can be downloaded in real time.

- **15 kV test voltage – increases test current, helping to avoid negative current when testing high resistance insulation.**
- **CATIV 1000 V safety on all test terminals to 3000 m.**
- **Rapid charge of capacitive loads such as HV power cables.**
- **Always ready to test with Li-ion fast charge battery or from an AC source.**
- **Designed to be durable and survive in the harshest of environments.**
- **High noise immunity 6 mA.**
- **High 3 mA short circuit current.**
- **Download/stream results.**
- **2 year warranty.**



5 and 10 kV diagnostic insulation resistance testers

FEATURES

- Industry best guard terminal accuracy.
- Compact and lightweight for easy transport and use.
- PI, DAR, DD, SV and ramp test.
- Unique dual case design provides additional user protection.
- Lithium-ion battery - extended capacity, rapid charge.
- Advanced memory with time/date stamp.
- CATIV 600 V safety rating on all terminals.



5 kV heavy duty diagnostic insulation resistance tester

MIT525

The MIT525 performs all the insulation tests offered by MIT515 and extends the testing capabilities to include step voltage, dielectric discharge and ramp testing. Test data can be downloaded in real time using the 10 kV isolated

USB port, or stored in the instrument's advanced memory. Smaller and lighter than its predecessors, these new testers are easier to store on a van, fit in an overhead locker on an aircraft and are more convenient to carry to the job.

10 kV heavy duty diagnostic insulation resistance tester

MIT1025

The MIT1025 tests insulation to 20 TΩ at test voltages up to 10 kV. It has increased diagnostic potential over its predecessors by offering IR, timed IR, polarization index (PI), dielectric absorption ratio (DAR), step voltage, dielectric

discharge and ramp testing as automatic tests. The results are time and date stamped and stored on board or they can be downloaded in real time.



5 kV heavy duty diagnostic insulation resistance tester

MIT515

Offering CATIV safety and Megger's unique dual case design, MIT515 is an easy to operate insulation resistance tester that is very tough.

Measuring up to 10 TΩ, it allows IR, timed IR, polarization index (PI) and dielectric absorption ratio (DAR) to be measured automatically.

5, 10 and 15 kV utility insulation resistance testers

FEATURES

- Resistance range up to 35 TΩ.
- 8 mA noise rejection plus 4 filters.
- Safety up to CATIV 1000V to 4000 m.
- Rapid charge Li-ion battery – meets IEC62133.
- Operate with dead battery from an AC source.
- Tough dual case design.



5 kV utility insulation resistance tester

S1-568

With exceptionally high noise rejection, the fast charging S1-568 offers the full gamut of automatic insulation tests with 8 mA of noise rejection, IR, timed IR, polarization index (PI), dielectric absorption ratio (DAR), programmable step voltage (SS), dielectric discharge (DD) and ramp. The S1-568 allows the operator to control the test remotely

from a computer using the 10 kV isolated USB port, to store the date and time stamped results on board or to download them in real time using Bluetooth. This is the perfect tester for the itinerant contractor as it will give results in any electrical environment.

10 kV utility insulation resistance tester

S1-1068

With a full 8 mA of noise rejection and 4 levels of filtering the fast charging S1-1068 obtains meaningful results in extremely hostile environments. Offering the full gamut of automatic insulation tests, IR, timed IR, polarization index (PI), dielectric absorption ratio (DAR), step voltage, dielectric discharge and ramp, the S1-1068 allows the

operator to control the test remotely from a computer using the 10 kV isolated USB port, to store the date and time stamped results on board or to download them in real time using Bluetooth. This is the perfect tester for the itinerant contractor as it will give results in any electrical environment.



15 kV utility insulation resistance tester

S1-1568

A maximum resistance measurement of 35 TΩ and 15 kV test voltage are additional features of this instrument, which displays the same exceptionally high noise rejection as the other testers in the series. Diagnostic tests available include IR, timed IR, polarization index

(PI), dielectric absorption ratio (DAR), step voltage, dielectric discharge and ramp testing as automatic tests. The results are time and date stamped and stored on board or they can be downloaded in real time.

Selection guide for the 5, 10 and 15 kV insulation testers

Selection guide for the 5, 10 and 15 kV insulation testers								
		MIT515	MIT525	MIT1025	MIT1525	S1-568	S1-1068	S1-1568
Test voltage	15.0 kV				■			■
	10.0 kV			■	■		■	■
	5.0 kV	■	■	■	■	■	■	■
	2.5 kV	■	■	■	■	■	■	■
	1.0 kV	■	■	■	■	■	■	■
	500 V	■	■	■		■	■	
	250 V	■	■			■		
	100 V to 1 kV in 10 V steps	■	■	■	■			
	1 kV to max test voltage in 25 V steps	■	■	■	■	■	■	■
	40 V to 1 kV in 10 V steps					■	■	■
Measurement	Max reading	10 TΩ	10 TΩ	20 TΩ	30 TΩ	35 TΩ	30 TΩ	35 TΩ
	Min reading	10 kΩ	10 kΩ	10 kΩ	10 kΩ	10 kΩ	10 kΩ	10 kΩ
	Voltage	■	■	■	■	■	■	■
	Capacitance	■	■	■	■	■	■	■
	Leakage current	■	■	■	■	■	■	■
	Test types	Timed insulation resistance	■	■	■	■	■	■
Polarization index		■	■	■	■	■	■	■
Dielectric absorption index		■	■	■	■	■	■	■
step voltage			■	■	■	■	■	■
dielectric discharge			■	■	■	■	■	■
Ramp			■	■	■	■	■	■
Other feature	Other feature Analogue and digital display	■	■	■	■	■	■	■
	Short circuit current	3 mA	3 mA	3 mA	3 mA	6 mA	6 mA	6 mA
	Rechargeable	■	■	■	■	■	■	■
	Timer control and display	■	■	■	■	■	■	■
	Max noise rejection	3 mA	3 mA	3 mA	6 mA	8 mA	8 mA	8 mA
	Remote control via USB port					■	■	■
	USB output		■	■	■	■	■	■
	Bluetooth output					■	■	■
Software	Software PowerDB Lite	■	■	■	■	■	■	■

5 kV insulation resistance tester

BM5200

Megger BM5200 is a battery powered insulation tester with digital and analog arc display, designed for high voltage insulation resistance testing in the maintenance and servicing of cables, rotating plant machinery, transformers, switchgear and industrial applications.



DC insulation tests are performed at 250 V, 500 V, 1000 V, 2500 V, 5000 V. Insulation resistance measuring range is 100 k Ω to 1000 G Ω . Automatic discharge for capacitive circuits under test is provided and decaying voltage displayed.

- 1 T Ω , 1.4 mA, 5 kV digital insulation tester with digital and analog display.
- Five test ranges; 250 V, 500 V, 1000 V, 2500 V and 5000 V.
- Insulation, Polarization Index (PI) and variable timed test (t) modes.
- Selectable DC or AC (including frequency) voltmeter functions.
- Guard terminal to shunt surface leakage currents.
- CATIII 600 V safety rating.

5 kV analog insulation resistance testers



The BM15 and MJ15 are compact 5-kV insulation testers. They are very simple to use and provide a quick and accurate reading of insulation resistance. The instruments use an analog display with a maximum reading of 20 G Ω . The BM15 is powered by batteries. The MJ15 has an additional hand-cranked generator.

BM15, MJ15

- Four test voltages to 5 kV
- Dual power supply option
- Resilient mounted analogue scale for robustness
- Voltage range to 600 V indicates auto discharge
- Pass/fail overlays for rapid testing
- Single scale for insulation values to avoid operator error
- CAT III, 300 V safety rating

The instrument operation is extremely simple. A voltage range enables measurement of a.c. or d.c. conductor potential. Four test voltages are available at 500 V, 1 kV, 2.5 kV and 5 kV. A choice of push buttons is supplied; a locking button simplifies long term testing, or a nonlocking version is preferred for maximum safety.

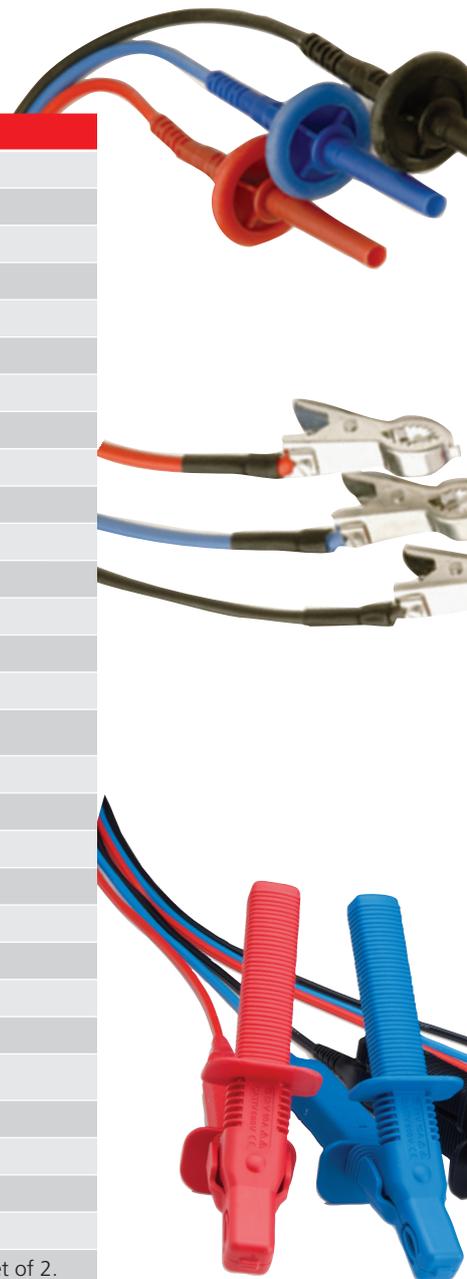
5, 10 and 15 kV test leads

Megger provides a range of lead sets and clips of different sizes and electrical characteristics for use with Megger 5,10 and15 kV insulation resistance testers, enabling the user to choose the most applicable set for the work at hand.

These leads are designed in full compliance with IEC61010-031:2008 which requires a fully insulated clip design.

For more information on our variety of test leads, visit our website megger.com.

Cat. No.	Description
1008-022	3m (10ft), 6 kV MEDIUM insulated clip, set of 3
1002-641	5m (16ft), 6 kV MEDIUM insulated clip, set of 3
1002-642	8m (26ft), 6 kV MEDIUM insulated clip, set of 3
1002-643	10m (33ft), 6 kV MEDIUM insulated clip, set of 3
1002-644	15m (50ft), 6 kV MEDIUM insulated clip, set of 3
1005-262	3m leadset (x 3, red, blue, black) , medium insulated clips
1005-263	10m leadset (x 3, red, blue, black) , medium insulated clips
1007-311	3m (10ft), 10 kV LARGE insulated clip, set of 3
1002-645	5m (16ft), 10 kV LARGE insulated clip, set of 3
1002-646	8m (26ft), 10 kV LARGE insulated clip, set of 3
1002-647	10m (33ft), 10 kV LARGE insulated clip, set of 3
1002-648	15m (50ft), 10 kV LARGE insulated clip, set of 3
1005-259	5m leadset (x 3, red, blue, black) , large insulated clips
1005-260	10m leadset (x 3, red, blue, black) , large insulated clips
1005-261	15m leadset (x 3, red, blue, black) , large insulated clips
8101-181	3m (10ft), BARE COMPACT clip, set of 3
8101-182	8m (26ft), BARE COMPACT clip, set of 3
8101-183	15m (50ft), BARE COMPACT clip, set of 3
6220-835	3m (10ft), BARE COMPACT clip, 5 kV SCREENED black lead, 3 clips, 2 leads
6311-080	15m (50ft), BARE COMPACT clip, 5 kV SCREENED black lead, 3 clips, 2 leads
6220-834	3m (10ft), BARE COMPACT clip, 10 kV SCREENED black lead, 3 clips, 2 leads
6220-861	10m (33ft), BARE COMPACT clip, 10 kV SCREENED black lead, 3 clips, 2 leads
6220-833	15m (50ft), BARE COMPACT clip, 10 kV SCREENED black lead, 3 clips, 2 leads
1005-266	3m (9.8ft) Leadset, 15kV Screened, large insulated clips
1005-267	10m (33ft) Leadset, 15kV Screened, large insulated clips
1005-268	15m (49ft) Leadset, 15kV Screened, large insulated clips
1005-269	20m (66ft) Leadset, 15kV Screened, large insulated clips
6220-822	3m (10ft), 1kV insulated probe and clip set for CONTROL CIRCUIT TESTING, set of 2
1005-264	3m (10ft), 1kV insulated probe and clip set for CONTROL CIRCUIT TESTING, set of 2
1002-913	1.25m (4ft) 1kV insulated FUSED probe and clip set for <1 kV voltage measurements, set of 2.
1005-265	1.25m (4ft) 1kV insulated FUSED probe and clip set for <1 kV voltage measurements, set of 2.





The world leader

Megger 5-kV, 10-kV and 15 kV insulation testers are designed for industrial and utility applications. All Megger insulation testers are robust and reliable for high performance use. They offer up to CAT IV 1000 V safety rating on all terminals and are housed in a rugged polypropylene case with full protection to IP65 when being transported. A unique dual case design on all units allows for fire-retardant protection while maintaining ruggedness.

The 10 kV instruments offer full compliance with the IEEE 43-2000 standard "Recommended Practice for Testing Insulation Resistance of Rotating Machinery". This allows the user to effectively test any existing engine. The 15 kV instruments offer full compliance with NETA requirements for testing equipment rated above 35 kV.

Why a 10-kV Insulation Tester?

Megger invented insulation testing before the beginning of the 20th century and has continued to lead the market in innovation and technological advancement. So, why did we develop a 10 kV model when all other suppliers stopped at 5 kV? The answer is in the IEEE standards. Megger developed a 10-kV unit to meet the new testing recommendations outlined by the IEEE. Megger has offered a 10-kV insulation resistance tester since 2001.

In March 2000, The IEEE-SA Standards Board approved a revision to IEEE Std 43-1974. The "IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery," Std 43-2000, emphasizes the need for upgrading current practices to accommodate changes and improvements in insulating materials and the value of higher voltage testing that reveals otherwise hidden flaws.

Following is a brief summary of the highlights of the standard:

- **Test voltages up to 10 kV are recommended for windings rated greater than 12 kV.**
- **Both the Insulation Resistance test and the Polarization Index test are recommended.**
- **Test results should be compared to historical values to identify changes.**
- **In lieu of historical records, minimum acceptable values (based on the type of equipment) for both tests are indicated.**
- **Depending on the machine rating, the readings for one or both tests should exceed the minimum acceptable values.**
- **If the readings are below the minimum acceptable values, the winding is not recommended for an over voltage test or for operation.**

The world leader

IEEE Std 43-2000 recommends a procedure for measuring insulation resistance of armature and field windings in rotating machines rated 1 hp, 750 W or greater and applies to synchronous machines, induction machines, dc machines and synchronous condensers. It does not apply to fractional horsepower machines. It also recommends the insulation test voltage (based on winding rating) and minimum acceptable values of insulation resistance for ac and dc rotating machine windings.

For more information on the IEEE Standard, please refer to our booklet "A Guide to Diagnostic Testing Above 1 kV" on our website at megger.com.

Why a 15 kV Insulation Tester?

15 kV insulation testers are now in demand as engineers experience earlier degradation detection and better fault detection on high voltage equipment. Many power utilities in South America have already incorporated 15 kV testing into their procedures and this trend is now spreading into Europe, the Middle East and Asia. In the US NETA standards specify 15 kV test voltage. The NETA Pearl reconditioning standard / NETA MTS-1997 specifies 15 kV testing on equipment with a maximum voltage rating of 35 kV and above. Motors tested to NETA ATS 2007 with 34,500 V or above on their nameplate also require testing at 15 kV.





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Above2_5kv_InsulationTestBrochure_BR_EN_V01b

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