Concorso 2020N28

colloquio - testo 1

1. Si descriva la procedura di misura di una resistenza mediante ponte di Wheatstone.

2. Si supponga di dover approvvigionare il laboratorio di misure elettriche con dei resistori aventi valore nominale di 100 ohm. Sono previsti due principali impieghi:
   - in alcuni circuiti di base con amplificatori operazionali
   - quali carichi per verificare il funzionamento di regolatori domestici di luci alogene

   Si descrivano quali sono le specifiche con cui dovranno essere scelti tali resistori.

3. Dopo aver eseguito delle misure su una resistenza, si deve redigere una relazione tecnica che illustri i risultati ottenuti. Si descriva con quali strumenti e con quali modalità si ritiene opportuno redigere tale relazione.

4. Si traduca dall'inglese il testo allegato.

Renato Gobbo

Stefan Pirro

FLUKE®

ABCs of multimeter safety

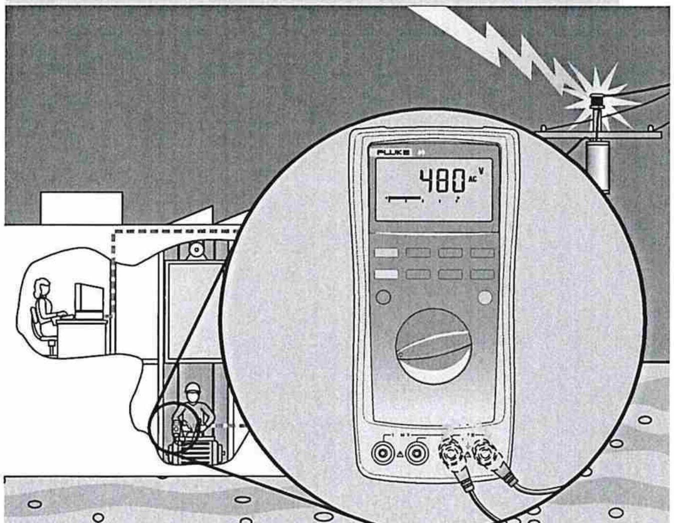
Multimeter safety and you

Application Note

Don't overlook safety—your life may depend on it

Where safety is a concern, choosing a multimeter is like choosing a motorcycle helmet—if you have a "ten dollar" head, choose a "ten dollar" helmet. If you value your head, get a safe helmet. The hazards of motorcycle riding are obvious, but what's the issue with multimeters? As long as you choose a multimeter with a high enough voltage rating, aren't you safe? Voltage is voltage, isn't it?

Not exactly. Engineers who analyze multimeter safety often discover that failed units were subjected to a much higher voltage than the user thought he was measuring. There are the occasional accidents when the meter, rated for low voltage (1000 V or less), was used to measure medium voltage, such as 4160 V. Just as common, the knock-out blow had nothing to do with misuse—it was a momentary *high-voltage spike or transient* that hit the multimeter input without warning.



Voltage spikes—an unavoidable hazard

As distribution systems and loads become more complex, the possibilities of transient overvoltages increase. Motors, capacitors and power conversion equipment, such as variable speed drives, can be prime generators of spikes. Lightning strikes on outdoor transmission lines also cause extremely hazardous high-energy transients. If you're taking measurements on electrical systems, these transients are "invisible" and largely unavoidable hazards. They occur regularly on low-voltage power circuits, and can reach peak values in the many thousands of volts. In these cases, you're dependent for protection on the safety margin already built into your meter. **The voltage rating alone will not tell you how well that meter was designed to survive high transient impulses.**

Early clues about the safety hazard posed by spikes came from applications involving measurements on the supply bus of electric commuter railroads. The nominal bus voltage was only 600 V, but multi-meters rated at 1000 V lasted only a few minutes when taking measurements while the train was operating. A close look revealed that the train stopping and starting generated 10,000 V spikes. These transients had no mercy on early multimeter input circuits. The lessons learned through this investigation led to significant improvements in multimeter input protection circuits.

Test tool safety standards

To protect you against transients, safety must be built into the test equipment. What performance specification should you look for, especially if you know that you could be working on high-energy circuits? The task of defining safety standards for test equipment is addressed by the International Electrotechnical Commission (IEC). This organization develops international safety standards for electrical test equipment.

Meters have been used for years by technicians and electricians yet the fact is that meters designed to the IEC 1010 standard offer a significantly higher level of safety. Let's see how this is accomplished.

Concorso 2020N28

colloquio - testo 2

1. Si descrivano brevemente i principali impieghi degli amplificatori operazionali.

2. Si supponga di dover eseguire la misura della tensione nel punto di consegna in bassa tensione di un ente di distribuzione. Si descriva quale strumentazione sia necessaria e quali siano le caratteristiche che la strumentazione deve avere per effettuare una misura affidabile e sicura.

3. Si deve organizzare una prova termica nella quale si vuole monitorare la temperatura rilevata da alcune sonde installate in un motore elettrico. Si prevede che la prova duri alcune ore. Si descriva con quali strumenti (anche informatici) e con quali modalità si ritiene di organizzare la misura, anche allo scopo di automatizzare la procedura e redigere una relazione tecnica che raccolga i risultati della misura.

4. Si traduca dall'inglese il testo allegato.

5.6 Test Instruments

There are three basic kinds of capacitance, tan δ and power factor test instruments in use.

Although the high accuracy Schering Bridge must be balanced manually and the balance observed on a null indicator, it has been widely sold and used for decades. The capacitance and dissipation factor can be calculated by reading the position of the balance elements.

The automatically balanced C tan δ measuring instrument performs measurement by the differential transformer method. The automatic balancing makes operation very easy.

The double vector-meter method is essentially an improvement of the differential transformer method. The MIDAS micro 2883 incorporates the double vector-meter method.

All three methods are in current use for accurate and repeatable measurements of C tan δ on various test objects. The differences basically lie in the resolution and accuracy. Different instruments are generally developed specially for field or laboratory measurement.

Field instruments are specially constructed for rugged field requirements and are equipped with a mobile high voltage source. In addition, such instruments provide noise suppression for onsite use.

Laboratory instruments have been constructed for indoor use where high accuracy specifications are required. These test systems are built in a modular construction for higher Test Levels. The systems may be used for daily routine testing, for high precision long duration tests or for acceptance tests.

5.7 Evaluation of Test Results

5.7.1 Significance of Capacitance and Dissipation Factor

A large percentage of electrical apparatus failures are due to a deteriorated condition of the insulation. Many of these failures can be anticipated by regular application of simple tests and with timely maintenance indicated by the tests. An insulation system or apparatus should not be condemned until it has been completely isolated, cleaned, or serviced. The correct interpretation of capacitance and dissipation factor tests generally requires knowledge of the apparatus construction and the characteristics of the types of insulation used.

Changes in the normal capacitance of insulation indicate such abnormal conditions as the presence of a moisture layer, short circuits, or open circuits in the capacitance network. Dissipation factor measurements indicate the following conditions in the insulation of a wide range of electrical apparatus:

- Chemical deterioration due to time and temperature, including certain eases of acute deterioration caused by local overheating.
- Contamination by water, carbon deposits, bad oil, dirt and other chemicals.
- Severe leakage through cracks and over surfaces.
- Ionization.
- The interpretation of measurements is usually based on experience, recommendations of the manufacturer of the equipment being tested, and by observing these differences:
- Between measurements on the same unit after successive intervals of time.
- Between measurements on duplicate units or a similar part of one unit, tested under the same conditions around the same time, e.g., several identical transformers or one winding of a three phase transformer tested separately.
- Between measurements made at different test levels on one part of a unit; an increase in slop (tip-up) of a dissipation factor versus voltage curve at a given voltage is an indication of ionization commencing at that voltage.

Concorso 2020N28

colloquio - testo 3

1. Si descriva la caratteristica meccanica di un motore asincrono trifase.

2. In un laboratorio didattico di misure elettriche ci sono 24 postazioni di lavoro. Si supponga di dover organizzare una prova didattica per 40 studenti al fine di eseguire una misura volt-amperometrica di una resistenza. Si descriva come si procederebbe all'organizzazione in sicurezza dell'attività, descrivendo la strumentazione ed il materiale necessario per la lezione.

3. E' stata eseguita in laboratorio la misura di un'impedenza in corrente alternata ad una data tensione. Si sono ricavate numerose letture dalla strumentazione che devono essere elaborate. Si descrivano gli strumenti conosciuti per l'elaborazione sistematica e la visualizzazione dei risultati ottenuti.

4. Si traduca dall'inglese il testo allegato.

5 Theory

5.1 Why is Insulation Tested?

All transformers, high voltage switchgear, motors and electrical equipment accessories have a high voltage lifespan. From the first day of use the equipment is subject to thermal and mechanical stresses, foreign particle ingress and variations in temperature and humidity. All of these influences raise the working temperature of the equipment when switched on. This heating accelerates chemical reactions in the electrical insulation, which result in a degradation of the dielectric characteristics. This process has an avalanche character i.e. the changing electrical characteristics of the insulation increase the loss factor and produce heating which further degrades the insulation. If the loss factor of the insulation is periodically monitored and recorded, it is possible to predict and / or avoid catastrophic failure of the electrical equipment.

At the beginning of the public electricity supply industry, methods and processes were sought to avoid unexpected losses caused by equipment defects. One method that provided repeatable data and offered simple on-site measurement was the measurement of capacitance and loss factor (power factor) of the equipment insulation.

In cases where loss factor tests were regularly carried out, and the relevant test results compared with earlier results, the deterioration of the insulation was noted and necessary preventative measures were carried out. Based on this groundwork, a series of test procedures were developed and described in various IEEE, ANSI and IEC documents and standards to specify the insulation quality for various types of electrical equipment.

In this way the degradation of the insulation characteristics over a specified period of time can be determined. With the test result history an experienced engineer is able to take the necessary maintenance actions based upon changes in the value of loss factor.

5.2 What is Loss Factor?

Loss factor is the total energy that will be used by the equipment during normal service. In particular, the insulation loss factor is any energy that is taken by the flow of current through the resistive component of the insulation. The earth path varies according to the type of electrical equipment. For example, switchgear will probably develop tracking to earth at right angles to the floor connections. In transformers paths can develop in the insulation resistance between the windings or between the windings and housing (tank). In all cases the result is a loss factor in the form of heating.

Note: In this text loss factor (losses, watts) is referred to, in contrast with total loss factor. Total loss factor is normally used to describe the total losses of the transformer under load and should not be confused with the energy that is lost due to degradation of the insulation.

5.3 What is Dissipation Factor tan δ?

To specify the insulation loss factor, the test object must be considered in the test arrangement as a capacitor. Consider all test objects e.g. transformers, bushings, bus bars, generators, motors, high voltage switchgear etc. are constructed from metal and insulation, and therefore possess associated capacitive properties. Every test object consists of various capacitances together with the insulation and the internal capacitance to earth. The figure shows the components that comprise a capacitance and the diagram for a simple disc capacitor.