Stray Voltage Testing Made Easy With U1272A

Application Note

Introduction

Stray voltage, sometimes referred to as ghost voltage, is a voltage that appears in an electrical conductor such as a wire, even though the wire is disconnected from an electrical circuit. Electricians and technicians frequently encounter stray voltages in electrical systems when measuring the AC voltage in electrical circuits that have been disconnected. Measuring the circuit using a high-impedance handheld digital multimeter can make it difficult to differentiate stray voltages from legitimate readings. In this situation, identifying and resolving the source of the stray voltage can cost time, effort, and money.

This application note presents an alternative tool for identifying the presence of stray voltages: the Agilent U1272A handheld digital multimeter (HH DMM.) This paper also explains how the U1272A's Z_{Low} feature makes it easy for technicians and electricians of every skill level to identify the presence of stray voltage in all types of electrical installations. To illustrate the differences in voltage measurement tools, this application note uses an actual situation in which stray voltage was identified.

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Finding Stray Voltage

As Figure 1 illustrates, an electrician is installing low voltage lighting in a warehouse office. The warehouse is equipped with two wires running in parallel to the conduit. One is for light A, which is ON, and the other pair of wires will be used by the electrician to install a new light using a new expansion cable that is running parallel with light A. Before beginning the installation, he checks the voltage on the wire using his high-impedance handheld multimeter (shown in blue in the illustration.) He obtains a reading of 40 V, even though the line is disconnected from the main switch. He suspects that touching conductors have formed a short circuit, causing voltage to leak through the conductor's insulation. However, after a thoroughly investigation, he finds no short circuit to ground.

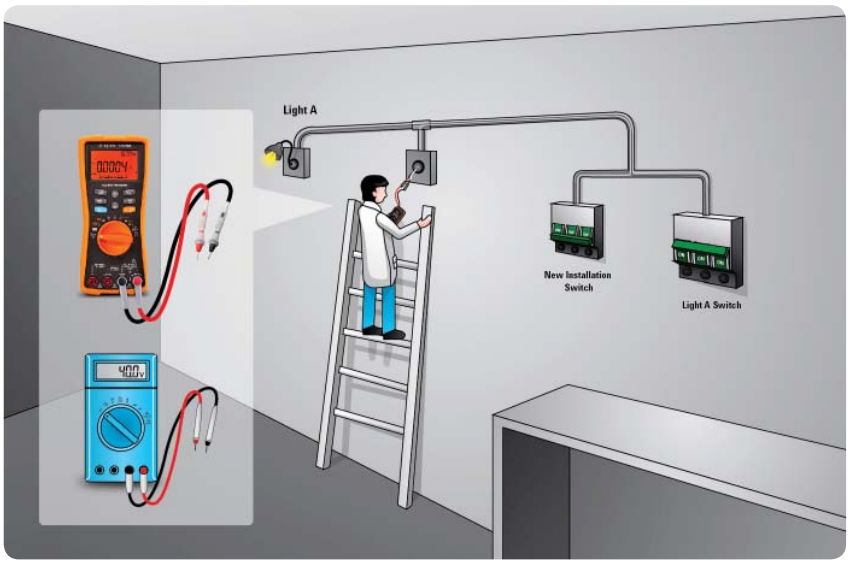

Figure 1. Electrician detects stray voltage on the unused connection with high input impedance multimeter (shown in blue).

Stray Voltage Causes

Stray voltage readings, such as the one found by the electrician in our example above, can be caused by capacitive coupling of the energized conductors with unused wire that is running parallel and in close proximity. This capacitance increases as the length of the conductor increases. The longer the wire, the easier it is to detect stray voltage. Current in the active circuit can also trigger a stray voltage reading; the higher the current in the active circuit, the higher the stray voltage. Stray voltage readings caused by active circuits can range from a few volts to as high as the voltage of the adjacent conductors.

It should be noted that according to Underwriters Laboratories Inc. (UL), stray voltage is not real voltage and it cannot cause physical harm to a person. UL also states that care must be taken to ensure that the voltage reading is a stray voltage and not a result of a cable defect or improper installation; as such a situation may result to a shock hazard.

Impedance versus Measurement Accuracy

Most handheld digital multimeters have high input impedance as compared to the impedance of the circuit being measured. These HH DMMs are designed to place very little load on the circuit under test and because of this, stray voltage is measured by the DMM. Typically these types of handheld multimeters have input impedance that is greater than 1 M-Ohm, and the input impedance varies depending on the DMM's design.

For working with electrical systems, low input impedance testers, such as a solenoid tester or the Wiggington tester, are preferred because they do not pick up stray voltage like some of the high impedance digital meters. However, with sensitive electronics, low input impedance will affect the current flowing through the circuit and can actually damage the components being tested or change the measurement reading.

If a low input impedance multimeter had been used to perform the AC voltage measurement in our example, the electrician would have found virtually zero stray voltage. This is because stray voltage is a physical phenomenon involving very small values of capacitance, it cannot energize a load.

The Hybrid Solution

However, it is impractical and not cost-effective for electricians to carry both a high input impedance and low input impedance multimeter in order to identify stray voltage. Agilent's U1272A, with its unique Z_{Low} function, is a solution that allows users to switch from high input impedance mode to low input impedance mode to check for the presence of stray voltage.

The Z_{Low} function acts like a backup voltage indicator and eliminates the need to carry additional tools for troubleshooting. In the event that real voltage is measured using the U1272A's Z_{Low} function, the positive temperature coefficient (PTC) thermistor that is designed as an over current protection will ensure the multimeter always operates in high input impedance.

Summary

As electrical and electronic systems become increasingly sophisticated, electricians and technicians tend to opt for more accurate and easy-to-use digital multimeters to efficiently and effectively perform their daily tasks. They want their tasks to be done safely, conveniently, and with reliable measurements. The Agilent U1272A is the right tool and is equipped with all the functionality and protection required in an industrial environment.

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Revised: July 8, 2010

Product specifications and descriptions in this document subject to change without notice.

Printed in USA, October 13, 2010
5990-6517EN

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