Hipot Testing: Ensuring Connection with OSC

When performing a hipot test (high potential, also known as dielectric withstand test), it is important to ensure the connection between the hipot tester and the device under test (DUT). A hipot test can produce a false pass if the high voltage cable between the DUT and tester is broken or unconnected.

Manufacturers have added safeguards to try and ensure their product is attached. When performing AC Hipot, a low limit can be set so that the leakage current reaches a minimum value. Determining whether a product is attached during a DC Hipot test is more challenging. Often the leakage from a DC hipot is zero or in the microAmps. Setting a low limit is not feasible. One solution has been to perform a low voltage AC Hipot test to measure the current, use a low limit to ensure the connection, and then perform the DC Hipot. But for multiple connections, these safeguards may not be enough.

QuadTech understands the difficulty in being certain that devices are properly connected when performing dielectric withstand test (hipot). The QuadTech Sentry Plus series, Hybrid 2000, and the Guardian 1000 series, 6000 Plus series, and 6100 Plus series of instruments contain a test mode called OSC (Open and Short Circuit Check), which is programmed to check the integrity of the connection(s) prior to the hipot test and the application of high voltage. This function not only makes certain the product is properly connected; it also verifies that the product does not contain a short circuit. If the product is shorted, there is no need to perform hipot, it will have failed during OSC.

The Challenge

A medical device manufacturer wants to be certain of the Patient connection, Nurse Call connection, and Comm connection before they perform a hipot test with all of three connections tied together, testing the leakage to ground. The problem is, if one of the connections is not made, there is no significant difference in the leakage current to catch the disconnect even with a low limit. Using the Guardian 1030S 8-channel hipot tester and OSC, the manufacturer can check and verify each connection to the product and the hipot tester.

How OSC works

The device under test contains some capacitance (C_x), from tens to thousands of pF. The QuadTech tester measures the capacitive load of the DUT to determine whether the connection is good.
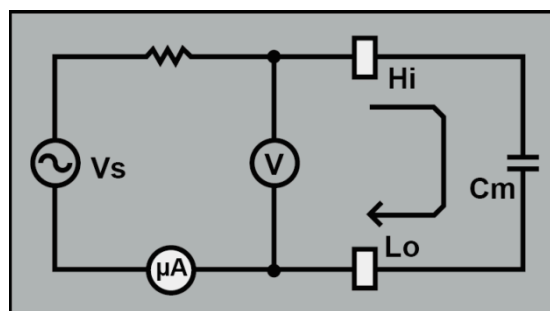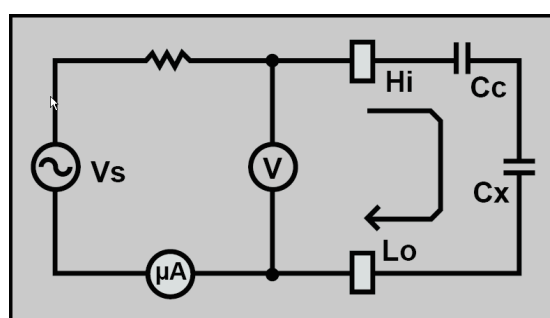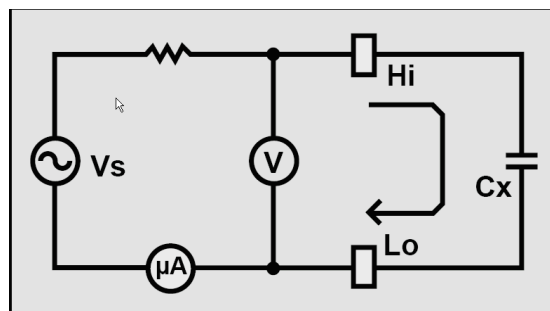
Open Circuit Detection

If the connection is open, additional capacitance (C_c) will be measured (C_m) and the total capacitive load will be < the capacitance of the product under test, resulting in an Open Circuit Fail.

$$C_m = C_c*C_x/(C_c +C_x)<<C_x$$

Short Circuit Detection

If the insulation of the device contains a short circuit, the total capacitance measured (C_m) will be much higher than normal, resulting in a Short Circuit Fail.

$$C_m>>C_x$$

Programming the Test

Select the **OSC** test mode in the program menu on any of the QuadTech instruments that contain the OSC function. (Contact QuadTech Sales for more information on the specific products at sales@quadtech.com)

Open Chk parameter sets the judgment test result (Pass/Fail condition) to the open circuit condition (compares the test reading [C_m] with the product standard capacitance value [C_x]). Default for Open Chk is 50%. If the measured C_m is within 50% of the learned C_x value, the result is a Pass. The Open Chk value can be programmed from 10% to 100% to account for variance among DUTs.

STEP SETTING				
01. Test Step	:	1		
02. Test Mode	:	OSC		
03. Open Chk.	:	50%		
04. Short Chk.	:	300%		
05. CHAN (H-L)	:	OFF		
10% - 100%		Remote	Lock	Offset	Error

Short Chk parameter sets the judgment test result to short circuit condition (compares the test reading [C_m] with the learned product standard capacitance value [C_x]). Default for Short Chk is 300%.

STEP SETTING				
01. Test Step	:	1		
02. Test Mode	:	OSC		
03. Open Chk.	:	50%		
04. Short Chk.	:	300%		
05. CHAN (H-L)	:	OFF		
0, 100% - 500%; 0 = OFF		Remote	Lock	Offset	Error

If measured C_m is < 300% of learned C_x, the result is Pass. If measured C_m is > 300% of learned C_x, the result is Fail.

Once step 1 has been programmed for OSC, continue programming the tester for hipot, insulation resistance, or other desired safety tests.

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Learning the C_x Value

Once the test is programmed, get the C_x.

1. Attach the DUT.

2. Press **Get C$_s$** (C_x).

The tester will learn the C_x value for that product. Once the C_x value is learned, save the test in the memory of the unit. The C_x value will be saved with the test program.

Example

Let's say the tester learned that C_x is 0.241nF. Therefore 0.241nF will be the reference value for all future tests. The Open Chk value was set to 50%. 50% of 0.241nF is approx 0.121nF.

If measured C_m is > 0.121nF the result is Pass,

If measured C_m is < 0.121nF the result is Open Fail.

The Short Chk value was set to the default value of 300%. 300% of 0.241nF is approx 0.723nF. If the measured C_m is > 0.723nF the result is a Short Circuit Fail.

Once the OSC test is performed, the tester continues onto the programmed tests, which can be ground continuity, ground bond test, hipot test, leakage current test, insulation resistance, functional checks, etc.