

AN 19—Diagnosing Instrument Operation

Introduction

Occasionally it may be necessary for a user to test either the LT-451 Dielectric Cure Monitor or the LTF-631 High Speed Dielectric Cure Monitor for proper operation. It is important to investigate the various parts of the system to establish that a component is working as expected, or to determine that a component is faulty. The main, accessible links in the signal chain are:

- Computer to instrument connection
- Instrument to sensor or instrument to extension cable connection
- Sensor

This application note will show the proper connections at these various points and discuss how to test for proper operation.

Connecting to the Instrument

The CureView software interfaces to the LT-451 and LTF-631 through a single RS-232 serial port on the PC using a null-modem cable provided with the instrument. If desired, or if the PC has no RS-232 port, the PC may connect to an instrument through a USB port using a USB to RS-232 converter also provided with the instrument.

To confirm correct connection between the instrument and computer:

- Refer to Figure 1.a. or Figure 1.b. for the locations of connectors.
- Connect the RS-232 null modem cable from the instrument RS-232 port to the computer.
- If the computer uses a USB port, then connect the supplied RS-232 to USB converter between the null modem cable and the computer

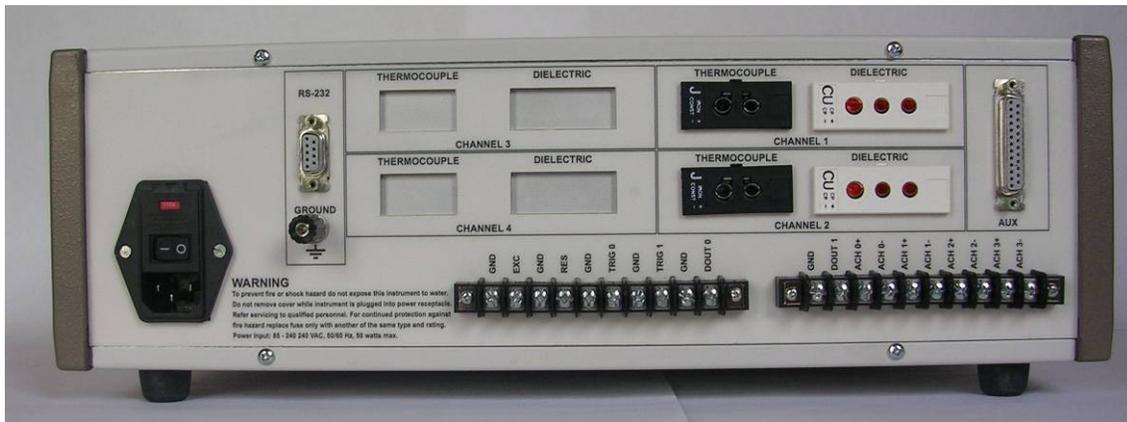


Figure 1.a.
LT-451 rear panel



Figure 1.b.
LTF-631 rear panel

Start the CureView software. CureView will automatically test each serial port on the PC, look for an instrument and indicate the connection status as shown on the following window:

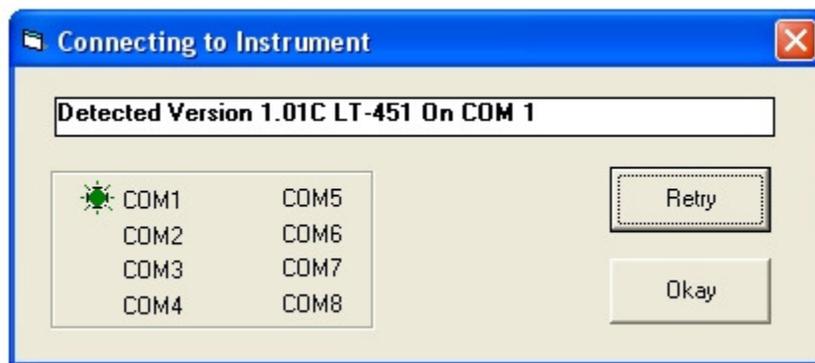


Figure 2
Serial port connection window

Click **Okay** to accept the connection. If no instrument is found, make sure the instrument is powered and ready and that the serial cable is connected correctly. Click **Retry** and CureView will look again for an instrument attached to the PC.

After CureView has found an instrument and the user has clicked **Okay**, CureView will initialize and display the Main Window.

Connecting Sensors and Extension Cables

Dielectric sensors with leads are connected to a dielectric sensor connector as shown in Figure 3.

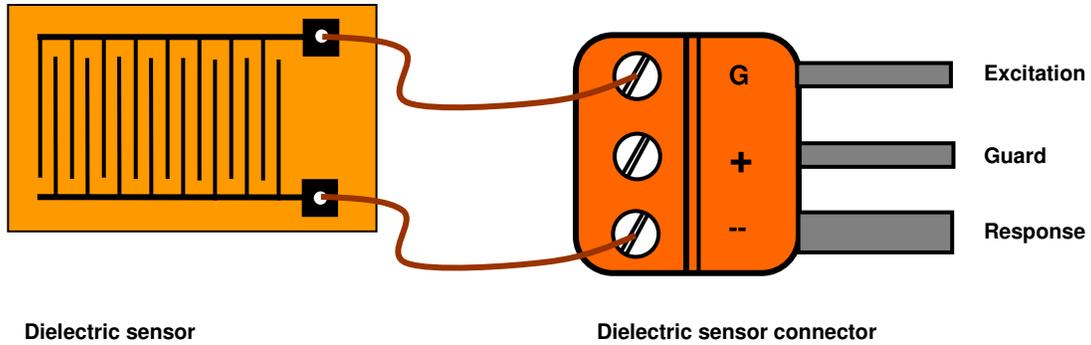


Figure 3
Connecting dielectric sensors with leads

Sensors with leads are connected as follows:

- One lead is connected the screw terminal labeled "G."
- The other lead is connected to the screw terminal labeled "-" or "E."

Note that terminals "G" and "-" or "E" are the outermost terminals of the dielectric sensor connector. The center terminal is for the guard signal, which is used with extension cables to reduce noise on the response line.

Dielectric sensors may be connected to a dielectric extension cable to allow placement of the sensor up to 20 feet away from the instrument. A sensor is connected to an extension cable as shown in Figure 4.

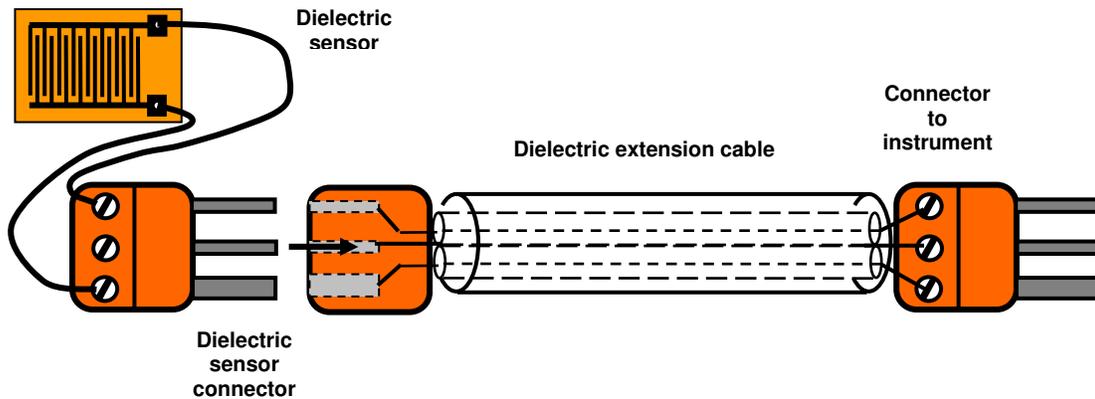


Figure 4
Connecting a dielectric sensor to the extension cable

The maximum recommended length of shielded extension cables is 20 feet. Note that phase error in the response signal increases at high frequencies with long cables. This phase error decreases the accuracy of dielectric measurements at frequencies above 10 KHz for cables longer than about five feet.

To confirm correct connection between the sensor and the end of the dielectric sensor connector or the extension cable:

- Use an ohmmeter to check for electrical continuity from electrode "A" of the sensor to pin "G" on the dielectric sensor connector.
- Check for electrical continuity from electrode "B" of the sensor to pin "G" on the dielectric sensor connector.
- Note that dielectric sensors have symmetric electrodes. It is unimportant which electrode is connected to pin "A" or pin "G."

Check to make sure there is no short circuit between pins "A" and "G" on the dielectric sensor connector.

Connecting Sensors to an Instrument

Dielectric sensors or sensors with extension cables may be plugged into an instrument as shown in Figure 5.

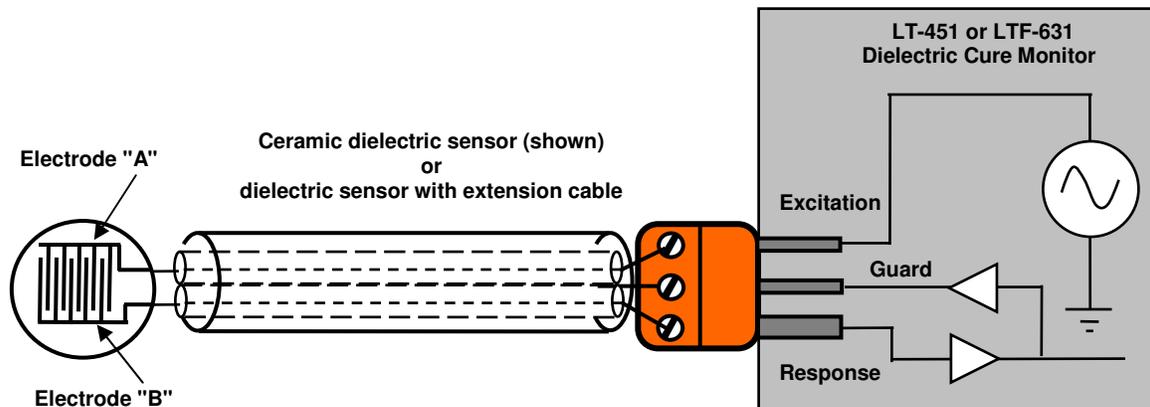


Figure 5
Connecting a dielectric sensor to an instrument

Note: Dielectric sensors may be connected to the LT-451 or LTF-631 dielectric cure monitors with unshielded leads, but data at low signal levels or at the end of cure may be noisy due to electrical interference. To reduce noise, the sensor leads should be shielded and connected to the instrument guard drive whenever possible.

Testing System Operation with Supplied Test Circuits

After confirming that all connections are correct and secure, the entire measurement system may be tested for proper operation. The instrument comes with a Dielectric Test Plug, which is a 20 pF mica capacitor wired into a Dielectric Sensor Connector as shown in Figure 6.

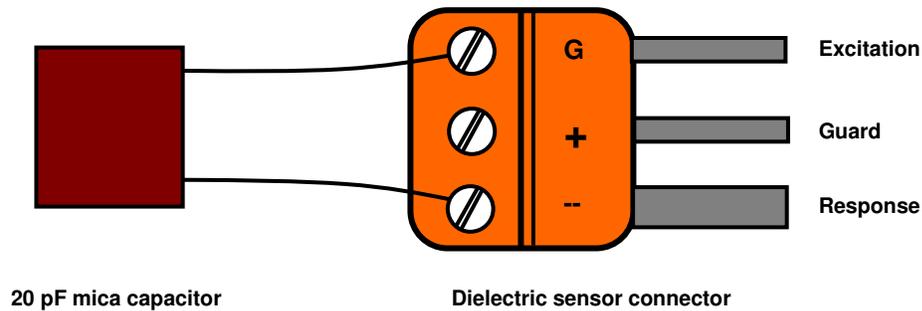


Figure 6.
Test Plug with 20 pF mica capacitor

The instrument also comes with a Thermocouple Test Plug, which is a thermocouple plug with a small value resistor to simulate a thermocouple at approximately ambient temperature.

Figure 7 shows the CureView Main window toolbar.



Figure 7
Main window toolbar

Toolbar icon buttons allow easy execution of CureView functions. Click on the  icon to make a single measurement. To test system operation:

- Insert the Dielectric Test Plug into the dielectric channel selected for testing.
- Insert the Thermocouple Test Plug into corresponding thermocouple Channel.
- Make single measurements at:
 - 1Hz, 10Hz 100 Hz, 1 KHz, 10 KHz and 100 KHz for the LT-451.
 - 10Hz 100 Hz, 1 KHz and 10 KHz for the LTF-631.

For the LT-451/LTF-631 typical results are shown below in Table 1:

Table 1
Typical gain-phase results with Dielectric Test Circuit

| Freq (Hz) | Subtraction mode (default) Gain (dB) | Non-Subtraction mode Gain (dB) | Phase (deg) |
|-----------|--------------------------------------|--------------------------------|-------------|
| 1 | -36 to -38 | -39 to -41 | -10 to +10 |
| 10 | -36 to -38 | -39 to -41 | -4 to +4 |
| 100 | -36 to -38 | -39 to -41 | -4 to +4 |
| 1 K | -36 to -38 | -39 to -41 | -4 to +4 |
| 10 K | -36 to -38 | -39 to -41 | -4 to +4 |
| 100 K | -36 to -38 | -39 to -41 | -4 to +4 |

Exact results may vary due to use of cabling and connectors.

Subtraction mode is the default configuration with shipment of an instrument. For more details, please refer to the LT-451/LTF-631 manual, *Chapter 7--Mid-conductivity Measurement Modes*.

The Thermocouple Test Plug connects the two contacts of the thermocouple input and produces a measurement of approximately room temperature (~20 °C). Exact results of the thermocouple measurement will vary and tend to be around 30 °C.

Test System Operation with 100 Kohm, 1% Resistor

A high value resistor may be used to perform a more detailed test of instrument operation. To do such a test, first make a test circuit with a 100 Kohm, 1% resistor wired into a dielectric sensor connector as shown in Figure 8.

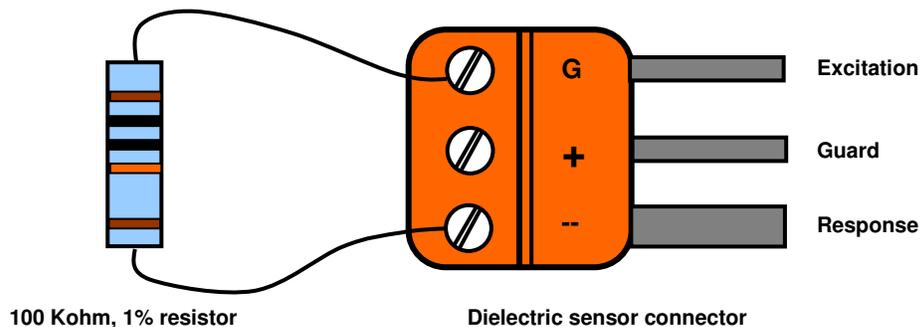


Figure 8.
Test circuit with 100 Kohm, 1% resistor

The Dielectric Test Plug included with the instrument is useful for testing low signal operation, when the expected gain is about -40 dB and the expected phase is approximately 0° for all frequencies. Use of a 100 Kohm, 1% resistor tests the gain and phase measurement over a broader range and therefore provides added information about the system.

To test system operation:

- Insert the 100 Kohm, 1% resistor into the dielectric channel selected for testing.
- Insert the Thermocouple Test Plug into the corresponding thermocouple channel.
- Make test measurements at:
 - 1Hz, 10Hz 100 Hz, 1 KHz, 10 KHz and 100 KHz for the LT-451.
 - 10Hz 100 Hz, 1 KHz and 10 KHz for the LTF-631.

For the LT-451/LTF-631 typical results are shown below in Table 2:

Table 2
Typical gain-phase results with 100 Kohm, 1% resistor

| Freq (Hz) | Subtraction mode Gain (dB) | Non-Subtraction mode Gain (dB) | Phase (deg) |
|----------------------|---------------------------------------|---|------------------------|
| 1 | -0.00 | -0.0 | -0.0 |
| 10 | -0.00 | -0.0 | -0.7 |
| 100 | -0.06 | -0.06 | -7.2 |
| 1 K | -4.21 | -4.21 | -51.7 |
| 10 K | -22.11 | -22.11 | -82.5 |
| 100 K | -41.18 | -41.18 | -63.4 |

Conclusion

If the results of the described tests deviate substantially from normal performance, please contact Lambient Technologies for support and assistance.