Review: Smart Tweezers ST5 R-L-C Meter
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Surface mount device (SMD) components are inexpensive and small, and lend themselves well to modern automatic manufacturing processes. And meanwhile leaded components are becoming more expensive and even obsolete. So as much as I dislike working with SMD components, more and more projects seem to require them – even some kits that are currently available.

When I work with SMD components, I have to be extremely careful to keep the parts properly sorted. If I accidentally mix the parts, I have to measure multiple components in order to make sure I don't install the wrong part. Unfortunately, measuring these tiny parts is extremely difficult with the typical ham's component-measuring capability. Enter the Siborg Systems Inc (www.smarttweezers.us) ST5 Smart Tweezers - a compact, highly accurate L-C-R meter that is especially made for measuring SMD components.

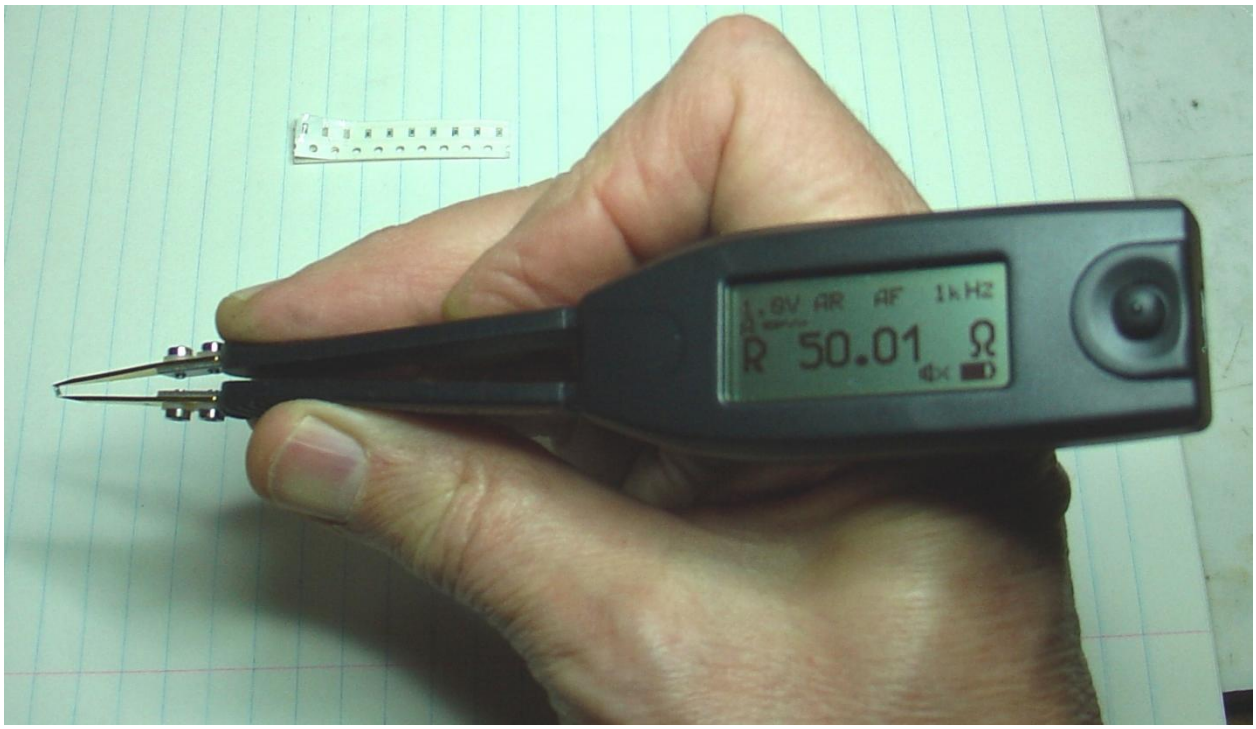

Figure 1: ST5 measuring a precision 0201 50-ohm SMD resistor

The ST5 is a precision instrument with a basic accuracy of ±0.2% and supplied with a NIST-traceable calibration certificate. Its gold plated tweezer tips can easily hold SMD components down to 0201-size. And besides measuring inductance, capacitance and resistance, the ST5 also displays Q, ESR, and impedance. It also performs diode and continuity tests, and provides a selectable component tolerance offset test. The ST5 specifications are given in Table 1.

Table 1: ST5 Specifications
Measurement rate: 1-sample/second
Continuity and diode test
Tolerance offset: 1-, 5-, 10-, and 20%, selectable for automatic component sorting

Measuring Frequencies: 100 Hz, 120 Hz, 1 kHz, 10 kHz
Test signal levels: 0.2-, 0.5- and 1-Volt rms sine wave
Resistance: 0.05Ω-9.9MΩ, ±0.2% from 100Ω-10KΩ, ±0.5% from 1Ω-1MΩ
Capacitance: 0.5pF to 4999µF, ±0.2% from 10nF-10µF, ±0.5% from 100pF-1mF
Inductance: 0.5µH to 999mH, ±0.2% from 10mH-100mH, ±0.5% from 100µH to 999mH
Dissipation Factor: 0.001 to 1000 (Q = 1/D: 1000-0.001)
Semi-automatic offset subtraction
Automatic best range selection (measuring frequency and test signal level)
Component sorting: Settable to 1-, 5-, 10- or 20% tolerance.
Weight: 52 grams (less than 2 oz)
The ST5 includes a carrying case, an internal Lithium-Ion battery and a USB cable and charger.

Using the ST5

When you open the ST5 package you might think there is a computer interface as you'll find a USB A/Micro-USB A cable. However, this cable is only used for charging the internal Li-Ion battery from your computer's USB port, or with the supplied USB charger. Charging time is approximately 2.5 hours for a fully discharged battery.

The ST5 is turned on by momentarily pressing the navigation button, after which the last selected measuring function is displayed. The navigation button may be rocked to select different measuring parameters and test functions. Rock the button up cycles through test signals levels of 0.25-, 0.5- or 1.0-Vrms (default). Rock the button left to select the device type to be measured: R, L, C, |Z|, ESR, diode test, Rdc (DC resistance) and AUTO. Rocking the button down selects one of three test ranges or AUTO. Finally, rocking the button right selects one of four test frequencies, or AUTO. The ST5 automatically powers off after 30 seconds (default) of inactivity. The power off time is settable from 10-200 seconds.

When in AUTO mode, AM shows in the bottom left of the display. For most uses the AUTO mode works well as the ST5 will determine the component type and best measuring range and frequency at the default signal level of 1Vrms. The 1.0 Vrms signal level provides the best accuracy for most resistors, capacitors and inductors. However lower signal levels may be better for very low value high-Q inductors. And some ceramic capacitor data sheets specify lower test voltages depending on the capacitor voltage rating. According to the manual the AUTO mode is accurate when measuring capacitance from 3pf-199uf, and inductance from 5uHy to 500mHy. Outside of these ranges the frequency can be manually changed for better accuracy (lower frequency for higher inductance and higher frequency for lower capacitance). I checked a few parts outside of the auto range to see how the ST5 would do in the auto mode. The results are shown in Table 2.

Table 2: Auto vs Manual frequency measurement

Component Marking	Meas. Value/Auto Mode & Freq	Meas. Value/Manual Entry
2pf ±5%	2.1pf/10kHz	-
1000uf ±20%	916uf/100Hz	-
1uHy ±5%	675mΩ/1kHz	1.03uHy @ 10kHz, Selected L

As you can see, the auto mode worked well even for capacitors out of the auto range. It correctly selected the highest test frequency for the 2pf capacitor, and the lowest test frequency for the 1000uf capacitor. However, the 1uHy inductor measured as a low value resistor in the auto mode. But when I manually selected "L" as the component type the ST5 automatically selected a 10KHz measuring frequency and accurately displayed the inductance.

The ST5 fits your hand well and is very easy to use. Besides easily picking up virtually any size SMD component for measuring, the ST5 tweezer tips are perfect for measuring a SMD component mounted on a pc board, probing nearby pads on a pc board, and even measuring leaded components on a pc board. Once you touch the ST5 tweezer tips to a component, the component type and value is instantly determined, along with loss shown as a series or shunt resistor on the display. For highest accuracy you can set the ST5 to automatically subtract out the tweezer's residual resistance (typically 30 milliohms), stray capacitance (typically 0.5-1.2pf), or stray inductance (typically 0.1uHy). And incidentally, the ST5 "knows" when a component is being measured and will not power off until after the component is no longer being measured.

Finally, the tolerance sorting feature may be of interest to hams designing active filters. Often the actual component-to-component variation is just as important as the calculated component value, especially in multi-section filters. Or perhaps you need to sort 5- or 10 percent resistors to find some within 1% for a critical project. Using the tolerance sorting capability, you can quickly sort parts to be within the desired tolerance from a reference component. The ST5 beeps once when a component is within the tolerance specified, and three times if it is out of tolerance.

Most of my components are still leaded, thru-hole components and the ST5 is a little clumsy to use when measuring these components. Therefore, I soldered two pairs of alligator clips (Mouser 534-5033) together so as to make a leaded-component adapter as shown in Figure 2.

Figure 2: Leaded component adapter

As you can see in Figure 2, a 20pf silver-mica capacitor is being measured in the auto mode. Besides the capacitor value, the parallel shunt resistance is also displayed along with the measuring frequency and signal level.

Conclusion

The ST5 is a very nice multi-function hand-held device that is perfect for surface mount component measurement and evaluation. While pricey, you do get a precision instrument that is applicable for both tight manufacturing process control, as well as home lab measurements. For those who can tolerate a unit with a bit less accuracy, the LCR-Reader is a lower-cost ($200) version of the ST5. The LCR-Reader has a basic accuracy of 1%, a fixed 0.5Vrms test signal, and does not come with a NIST-traceable calibration certificate.