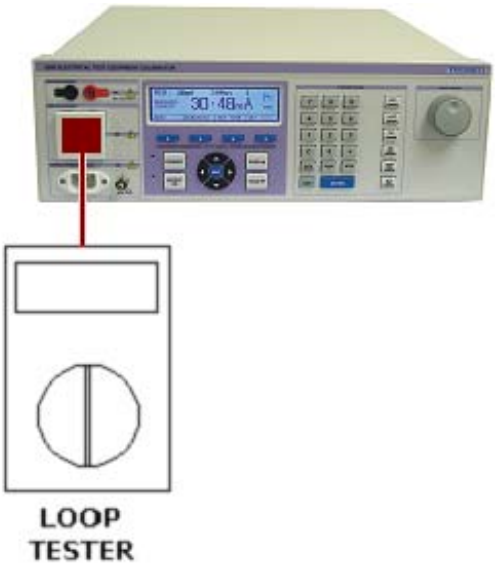
Introduction to Calibrating Loop Testers



Loop Testers measure the resistance of the mains supply at a power outlet socket. They do this by measuring the voltage drop when an internal load is applied. The resistance is then calculated and displayed in Ohms. All loop testers work this way, some loop testers will measure only the resistance of the live to earth loop and have only one load current, usually 26 Amps, others can also measure the Live to Neutral Phase and also display PSCC.
Some have ranges which use much smaller load currents or only apply the load for a short period to avoid tripping circuit protection devices.

What is the loop ?

When an appliance is connected to the mains supply a circuit is made. It completes a **loop** for current to flow round, from the power station to the appliance and then back to the power station. Voltage is dropped around the **loop** due to the resistance of the cables etc. in which the current is flowing.

What is PSCC and why is loop resistance important?

Using ohms law the loop resistance will determine the maximum current that can possibly flow round a circuit, as an example if the loop resistance is 1 ohm and the supply voltage 230 Volts using ohms law where

VOLTAGE / RESISTANCE =CURRENT
(230 V / 1Ohm) = 230 Amps

It can be seen that the maximum current that could flow would be 230 Amps even if the appliance was a dead short circuit. It can be clearly seen that a fuse or protection device lower than 230 amps would be needed to protect this circuit. It should be noted that some testers take the lowest loop, either live/neutral or live/phase to calculate the PSCC while other will use only the live/earth loop resistance.

Why is it normal to get large variations in PSCC measurements ?

PSCC is calculated by dividing the mains voltage by loop by the loop resistance. Loop resistance's are often very low, 0.1 to 0.4 ohms and the accuracy , resolution & repeatability possible when measuring loop resistance will give rise to large variation in PSCC as the supply voltage is being divided by a number approaching zero.

Supply Requirements For Calibrating Loop testers

As loop testers pass current from live phase to earth they will 'blow' any earth fault protection device's in the line, it is therefore necessary to have a supply **without an earth leakage trip / protection device**. An isolation transformer can be used but this will add resistance to the loop. Alternatively if no other option exists it is possible to rewire the 3200 to take the earth return to the neutral. This obviously presents a electrical shook hazard and should only be used by qualified engineer's

Interface Isolation of the 3200

Special consideration has been given to the design of the 3200 when connecting to a computer. The RS232 Interface on the 3200 in opto-isolated and the socket is plastic avoiding the outer shell of the RS232 connector grounding the case of the 3200 which would cause multiple earth paths resulting in current passing back to the computer and causing potential damage and / or inconsistent calibration results.

Calibrating Loop Testers

Loop testers normally have 2 or 3 ranges, example 1.999 ohm, 19.99 ohms & 199.9 ohms. It is necessary to calibrate the lowest range at a series of points across its span to confirm linearity. The higher ranges can then be calibrated at just one or two points at least at or higher than 50% of the scale to confirm range accuracy.

The method used is to switch in additional known (calibrated) resistance values in the supply loop, which increases the loop resistance by a known

amount. The additional resistance is normally added in the earth line.

It is important to understand that this only adds resistance to the existing supply loop, values below the supply loop resistance cannot be obtained This is the reason for requiring a supply socket with as low as loop resistance as possible.

A loop tester could be calibrated by simply recording the differences from one value to the next. It is much better however if the resistance of the supply loop is known which can then be added to the additional resistance values used for calibration.

Correcting For Supply Loop

One of the advantages of the 3200 is the **AUTO-LOOP** option which measures the supply loop resistance very accurately and automatically adds this to the displayed reading so that the reading on the tester can be compared directly with that displayed.
It is important to measure the supply loop as accurately as possible as all other values are based on this reading.

Measuring the Supply Loop Accurately

The 3200 has been very carefully designed to measure supply loop resistance very accurately. By using its internal high speed/high accuracy A/D converter it digitises each ½ cycle of the mains wave form in real time taking peak / RMS values of each. An internal 4Amp load is repeatedly switched on & off. The high performance A/D in the 3200 allows a smaller load to be used than in a loop tester, this therefore reduces load variation due to self heating and allows a larger number of measurement to be made. Advanced firmware discards cycles containing spike or noise.

From the drop in mains voltage under load the 3200 can calculate the loop resistance and then adds in the calibrated resistance of the adapter test socket to give the true value at the socket which is displayed. The value displayed by the 3200 is not the loop resistance of the socket into which the 3200 is powered from, but the loop resistance at the test socket.

If the auto loop option is not fitted then the resistance at the test socket can be manual entered.
When running with the ProCal calibration software the loop value from the display is read back to the PC and used as the calibration value. Procedures should be written to perform the 'AUTO-LOOP' correction at the start of calibration.

To Calibrate a PSCC range it is necessary to put the resistance in the neutral return. This is easily accomplished by making a special adapter socket rewired to take both earth and neutral to the earth pin on the 3200. Then using the formula shown previously in this application note PSCC can be calculated.

Some Loop testers also can display mains voltage which can be easily calibrated by comparing with the supply voltage displayed on the 3200.

Automating Calibration With ProCal

ProCal can fully control all operations of the 3200 via an optically isolated RS232 connection. Using the built in procedure wizards, procedures can be rapidly created. For installation testers, a combination of tests can be added together to create a comprehensive procedure.