

Appendix B

B.1 Equipment Specification

B.1.1 2400 Source Meter and Multiplexer Card

The Keithley 2400 programmable device source meter acts as a meter for voltage and current and also as a sink (resistance), shown in figure B.1.1.1. This model combines a precise, highly stable DC power supply with a low noise, highly repeatable, high impedance millimetre (Anon, 2001m). The basic features of this model are:

- Source voltage from $5\mu\text{V}$ to 210 V and measure voltage from $1\mu\text{V}$ to 220 V.
- Source current from 50 pA to 1.05 A and measure current from 10 pA to 1.1 A.
- 22W, 4-quadrant source and sink operation.

The source meter is a bi-polar programmable device for sourcing and sinking both voltage and current.



Figure B.1.1.1 Model 2400 Keithley source meter for sourcing and sinking voltage/current for the test device.

B.1.2 IEEE488 Interface to a PC

The general purpose interface bus (GPIB) transfers information between devices when the devices are configured to send data in the proper order and according to the proper protocol (Anon, 2001o). In this experimental characterisation, the PC is interfaced by a IEEE488 interface with each measuring

instrument. The IEEE488 transfers the data at up to 1M bytes/second between the individual devices. When communication occurs between devices, addresses are used to make sure that the desired devices receive the information and that other devices ignore it. In this way IEEE488 helps the source meter in sourcing voltage and sinking, whereas the data acquisition system is able to measure the required data from the test device. All data stored on a PC.

B.1.3 Keithley 2700 Data Acquisition System and Channel Card Configuration

Model 2700 is a 6.5-digit high-performance multimeter/data acquisition system as shown in figure B.1.3.1. It can measure voltage (DC and AC), current (DC and AC), resistance (2-wire and 4-wire), temperature (thermocouple, thermostat, and 4-wire RTD), frequency and period and test continuity. The model has two slots that will accommodate Keithley Model 7700 series switching modules. Each channel of a switching module that is closed or scanned is measured by the Model 2700. For scanning, each model has its unique set up i.e. function, range, and digits.



Figure B.1.3.1 Model 2700 Keithley data acquisition system.

B.2 Sensor Used in the Experiments

Apart from I-V measurements, temperature and solar radiation were measured for the indoor experimental characterisation. Thermocouples were used to measure the temperature and Kipp & Zenon pyranometer was used to measure solar radiation.

B.2.1 The Thermocouples Used for Temperature Sensing

Temperature is one of the most measured of the physical quantities. Crucial factors such as cable used or raw material usage, product specification, yield and quality can be affected by the precision and frequency with which temperature is measured. To measure the temperature as accurately as possible 1/0.2 type T type thermocouples were used in this experiment (Anon, 2001p).

B.2.2 Solar Radiation Sensor

The measuring instrument for global (beam and diffuse) solar radiation is referred to as pyranometer (Duffie and Beckman, 1991). The Kipp & Zonen Delft pyranometer was used for conducting this experiment. The pyranometer CM 11 is designed to measuring the irradiance on a plane surface, which results from the direct solar radiation and from the diffuse radiation incident from the hemisphere above.