

White Paper

Contact disturbance measurements using CONtester™

Newson NV, Dijkstraat 84, 9200 Dendermonde, Belgium

The automotive industry has strict requirements regarding the quality of components such as sockets, plugs, contacts and switches. Therefore, it is necessary to have the ability to detect contact disturbances such that contact quality can be guaranteed under the influence of external factors such as temperature, vibration and acceleration.

CONtester™ is a highly accurate, modular measurement system capable of measuring impedance variations under the influence of such external factors. The contact disturbance module "CT 2G-CD" is capable of measuring disturbances on a time-scale down to 100 ns. All measurements are stored in log files which in turn can be exported in Microsoft Excel format or in graph format for subsequent analysis.

The communications between the various contact modules and the PC is controlled by the CONtester™ CPU card and runs over an electrically isolated USB interface.

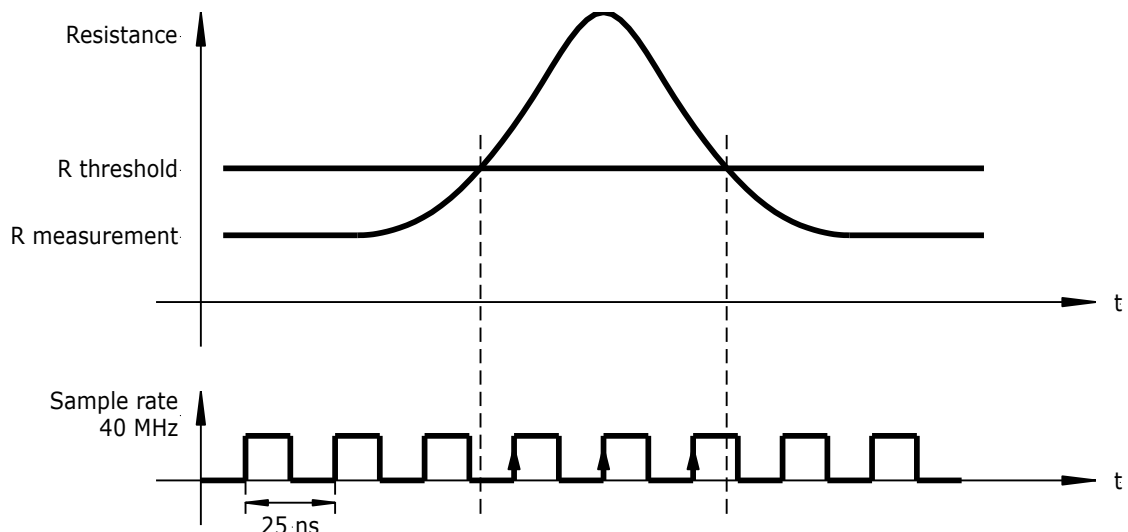
Contact disturbances: detection, sample rate, accuracy

Contact disturbances are measured using a threshold value. More specifically, resistance values are measured repeatedly and compared to a pre-defined threshold value. If the resistance rises above, and, consequently drops below this threshold within a time of 10 ms a contact disturbance occurred. The resistance values to be measured are chosen by the user in the range of 1-600 Ohm.

Resistance measurements are sampled at a rate of 40 MHz. The contact disturbance time is established by counting the number of samples during which the measured resistance is greater than the threshold resistance.

$$\text{disturbance time} = (\text{no samples} + 1) \times 25\text{ns}$$

example: when three rising edges are counted the contact disturbance time lies within the range of 50-100 ns.





All detected contact disturbances are saved to a cache on the "CT 2G-CD" module. Its bandwidth allows consecutive measurements at a rate of up to 100 ns.

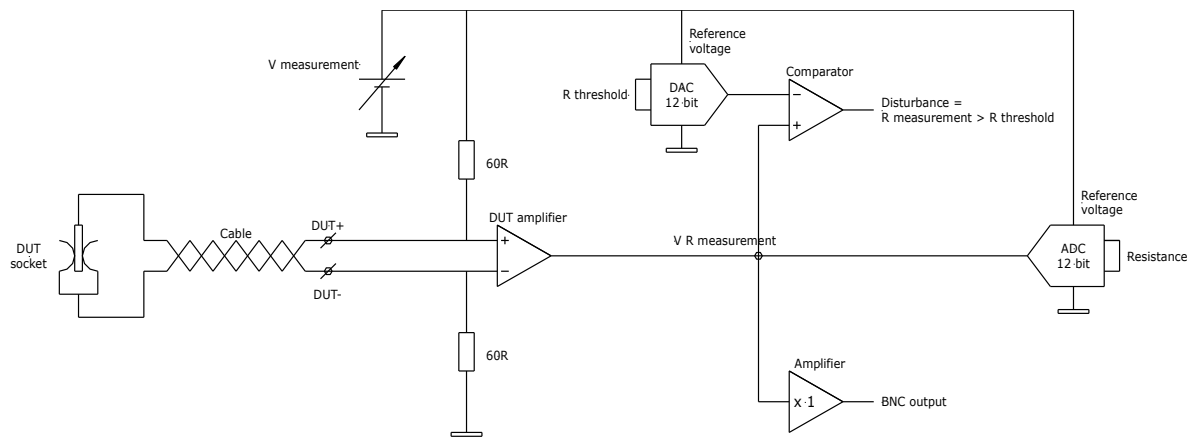
Contact disturbance times are classified as follows:

- ≥ 100 nsec < 200 nsec
- ≥ 200 nsec < 300 nsec
- ≥ 300 nsec < 400 nsec
- ...
- ≥ 900 nsec < 1 µsec
- ≥ 1 µsec < 2 µsec
- ...
- ≥ 9 µsec < 10 µsec
- ≥ 10 µsec < 20 µsec
- ≥ 20 µsec < 30 µsec
- ...
- ≥ 90 µsec < 100 µsec
- ≥ 100 µsec < 200 µsec
- ≥ 200 µsec < 300 µsec
- ...
- ≥ 900 µsec < 1 msec
- ≥ 1 msec < 2 msec
- ≥ 2 msec < 3 msec
- ...
- ≥ 8 msec < 9 msec
- ≥ 9 msec

Finally, all measurements are logged and transferred to a pc where they can be further analysed in graphical format (using the viewer software) or in Microsoft Excel format.

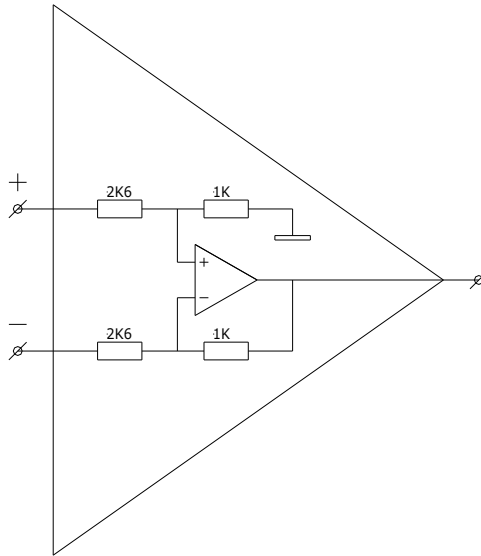
Simplified diagram for contact disturbance

The following figure shows a simplified diagram of the contact disturbance module.



The measurement voltage can be chosen freely in the range of 10-13 V. It is important to note that the measurement voltage also serves as a reference voltage for the ADC converters thus eliminating the effect of small supply voltage variations on the measurements. This also applies to the chosen reference voltage.

Simplified diagram of the contact disturbance amplifier Vdut



The amplifier output can be measured manually by connecting an oscilloscope to the CONtester™, however, any impedance mismatches must be taken into account when interpreting the results.

The influence of the internal amplifier resistance, R_i , on the measurement voltage, V_{dut} , is compensated in software. A relatively low resistance value was chosen to allow for high-bandwidth and low noise measurements.

Conditions regarding temperature, vibrations and acceleration

The CONtester™ has a connection for dual thermocouple element (typ K) allowing temperature measurements in the range -30 to +100 °C. The internal hardware can compensate the « cold solder temperature » and the software calculates the temperature in °Celsius.

Vibration and acceleration are measured using external low-impedance piezoelectric sensors which are connected to the CONtester™ using a BNC connector. The user can freely choose the sensitivity in the range from 5-1000 mV/G.