Meeting the Challenges of Testing Filtered Connectors

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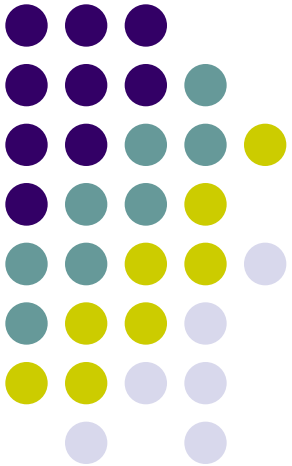

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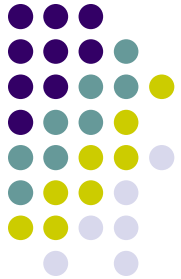
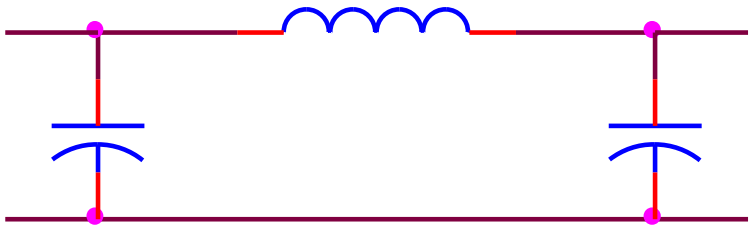
Filtered connectors – increasingly important.



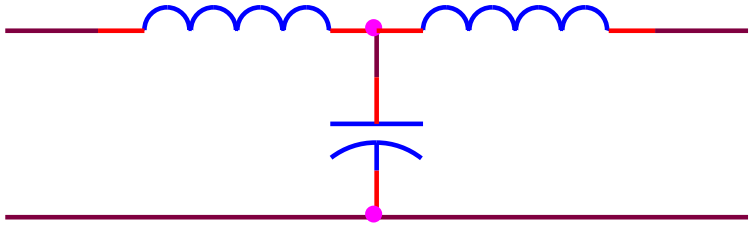
- A filtered connector is any type of connector that contains additional components to attenuate the passage of unwanted signals through it.
- Increasingly used to protect ‘mission critical’ electronic systems against EMI such as lightning discharges and unwanted RF transmissions - inward or outward!
- Market sector likely to increase further as use of composite housing or airframe materials increases.
- Filtered connectors are an example of a ‘complex passive’ – apparently simple to test yet requiring careful attention to test solutions. Correct testing of these parts is not trivial.
- A solution is presented for meeting and exceeding these test challenges.

A typical filtered connector internal circuit.

- Two main types of filter exist – ‘Pi’ and ‘T’.
- The common connection may be the shell of the connector or common to one of several logical groups (e.g. a data bus).
- Pins may also contain over-voltage protection devices such as zeners or varistors connected in various configurations.

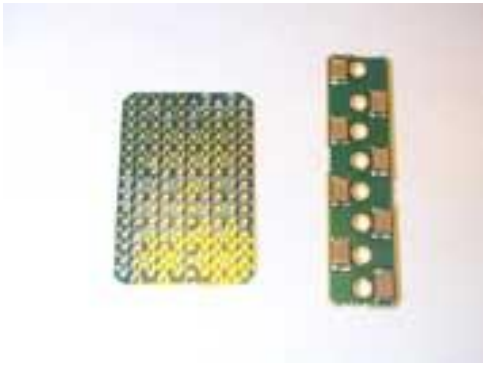


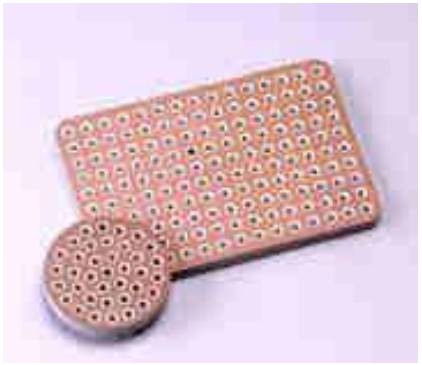
'Pi' Filter



'T' Filter

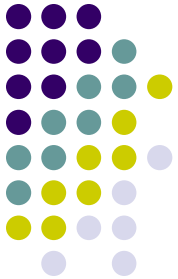
Physical construction is becoming more integrated.





- Early filtered connectors were made using PCB-mounted discrete components – difficult to assembe and less reliable in use.
- Capacitor arrays improved integration and filter performance.
- Combination of capacitor and varistor array is the most highly integrated.

The need for a dedicated filter connector test system.

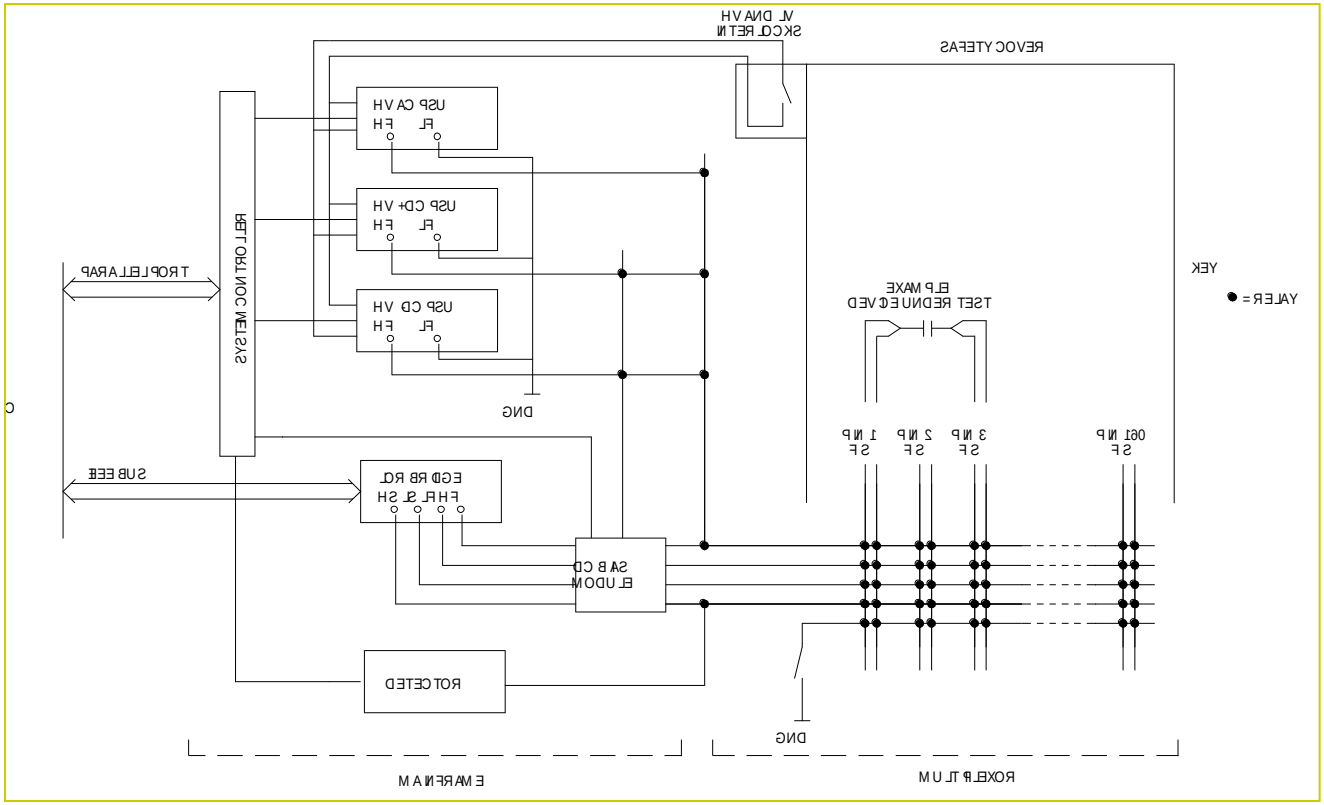


- The basic tests are simple - Capacitance, IR and DWV - relatively easy to measure with discrete equipment - BUT..
- Need to measure these same parameters over many test routes.
- Measurements are required between pins of the filtered connector in many different ways.
- Capacitance must be measured accurately to ensure valid construction and filter performance.
- Test connection to the device can introduce measurement errors.
- Use of a standard cable test system can seem attractive but parametric measurement quality is usually insufficient.

The Reflex 950 – a dedicated filter connector test system.

- Has up to 160 4-wire device connections.
- Test voltage up to 2100V peak, DC or 50-400Hz AC.
- Measures Cap and DF using LCR meter (e.g. Agilent) at elevated voltage.
- Measures insulation resistance (leakage current).
- Measures DWV (breakdown) using pulse capture and level.
- Measures through pin resistance (milliohms)
- Measures clamp voltage (zener, varistor).

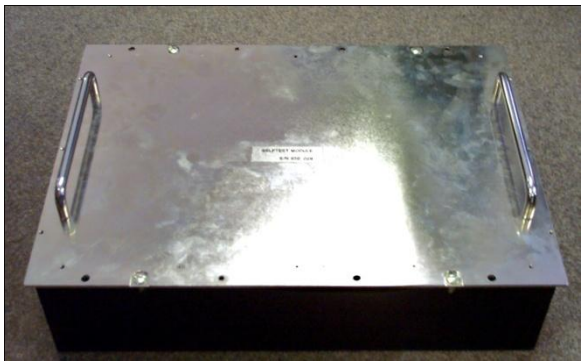
Tester electrical architecture.

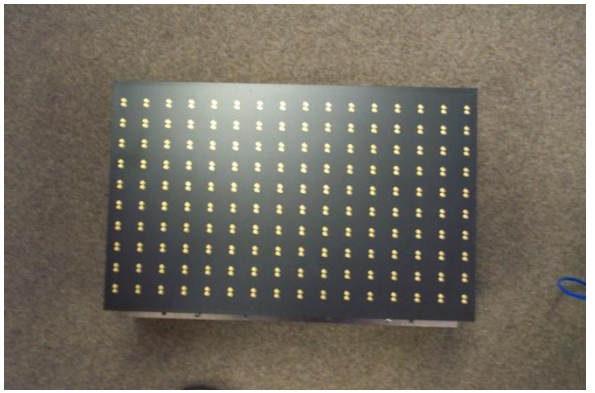


- Flexible 4-wire matrix connects the measure resources and the device under test.

Fixturing is vital for measurement performance.

- Filtered connector test device is mounted on a removable fixture module.
- Underside of fixture module is populated with pairs of connection ‘lands’ which mate with tester probe ‘nails’.
- Wiring from these ‘lands’ to the device is internal to the module and easily customised.
- Solution provides very low stray capacitance and ease of device interchange.

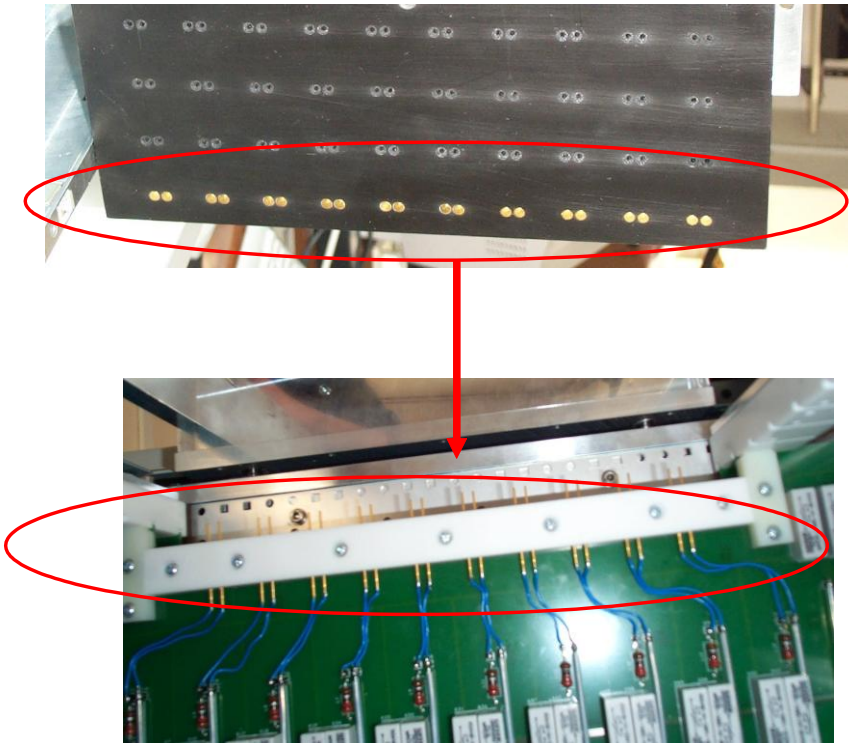




Fixturing is vital for measurement performance.

- Tester ‘bed of nails’ mates with the fixture module.
- A large test area provides opportunity to test one large connector or multiple smaller connectors.

Fixturing is vital for measurement performance.

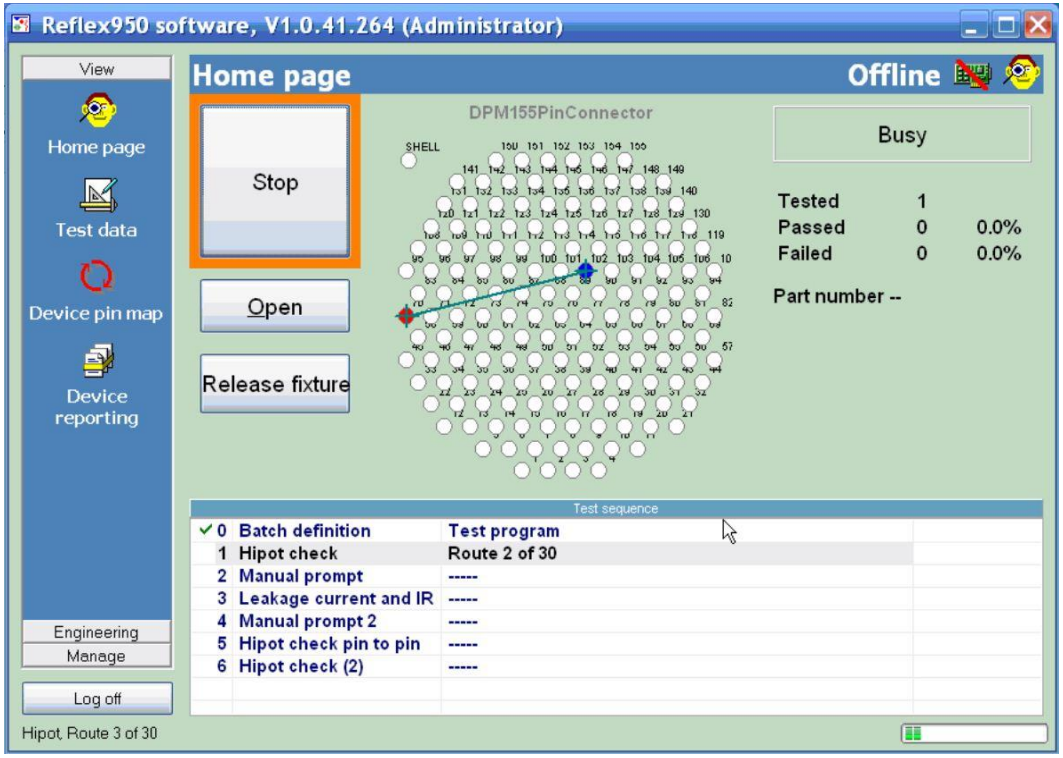


- Device site connects almost directly to the switching network.

Fixturing is vital for measurement performance.

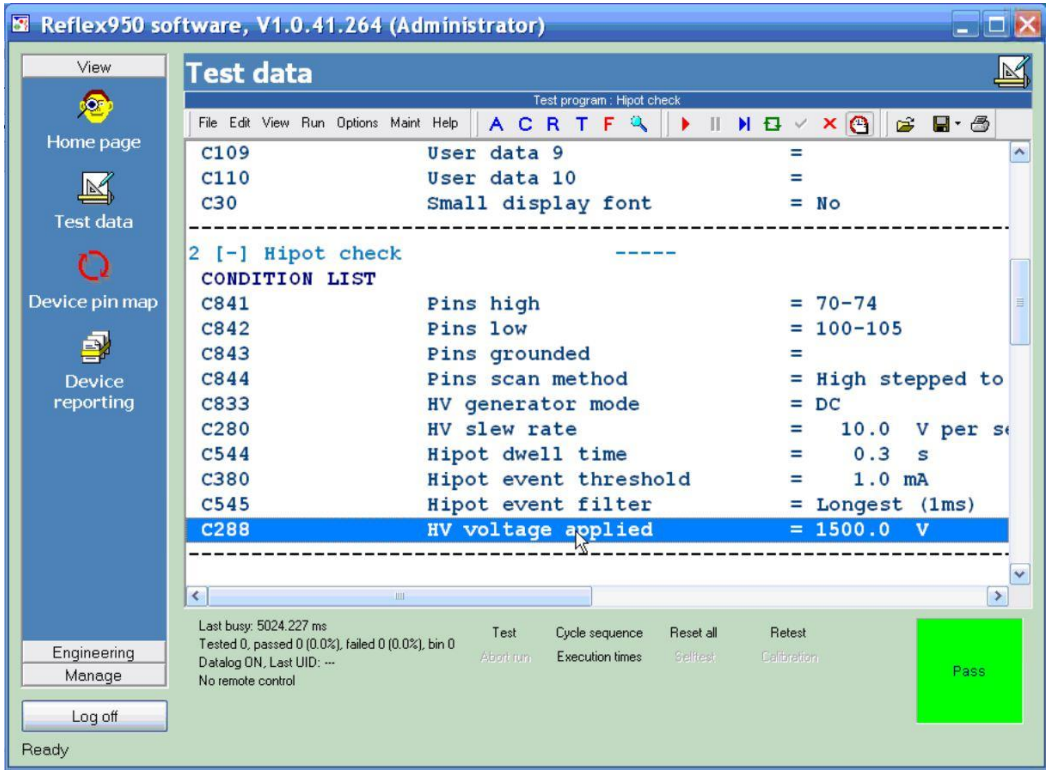
- Close physical connection of the device site and the switching network.
- Stray capacitance and crosstalk dramatically reduced over a cable solution.

Test execution – visual techniques aid clarity.



- Test activity and connections are displayed during test.
- Any test failure can be left visible for clarity.

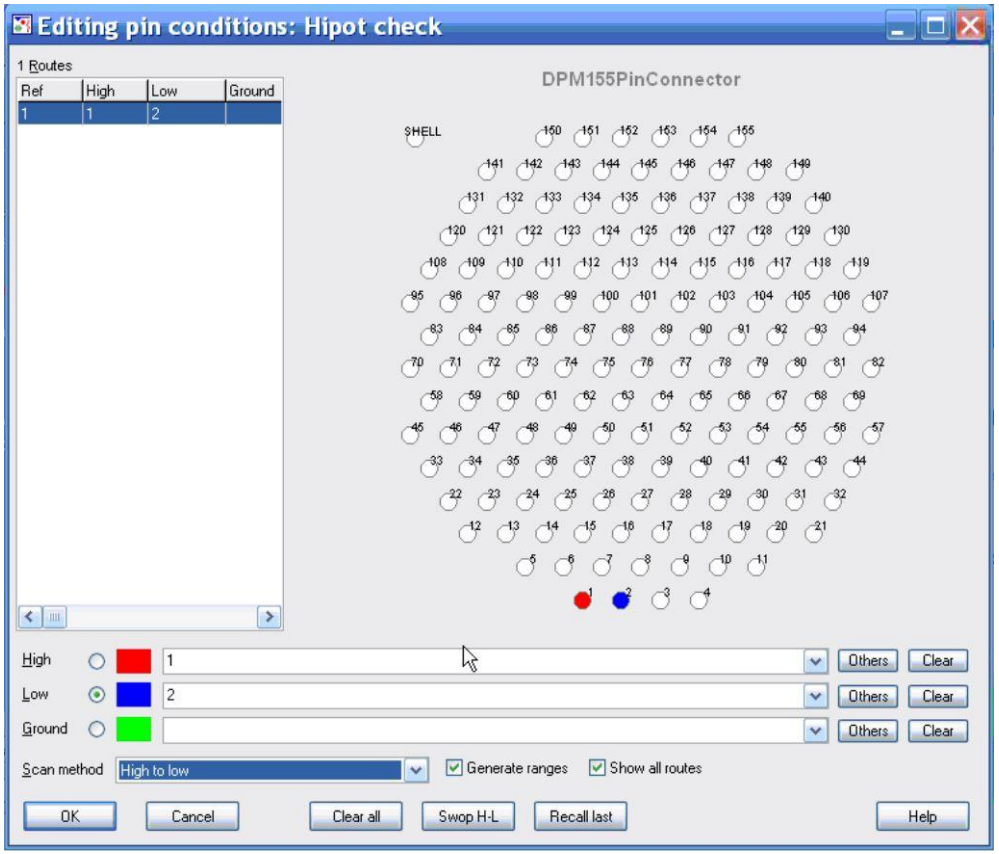
Test programming



- Test programming uses a ‘menu’ structure for setting parameters.

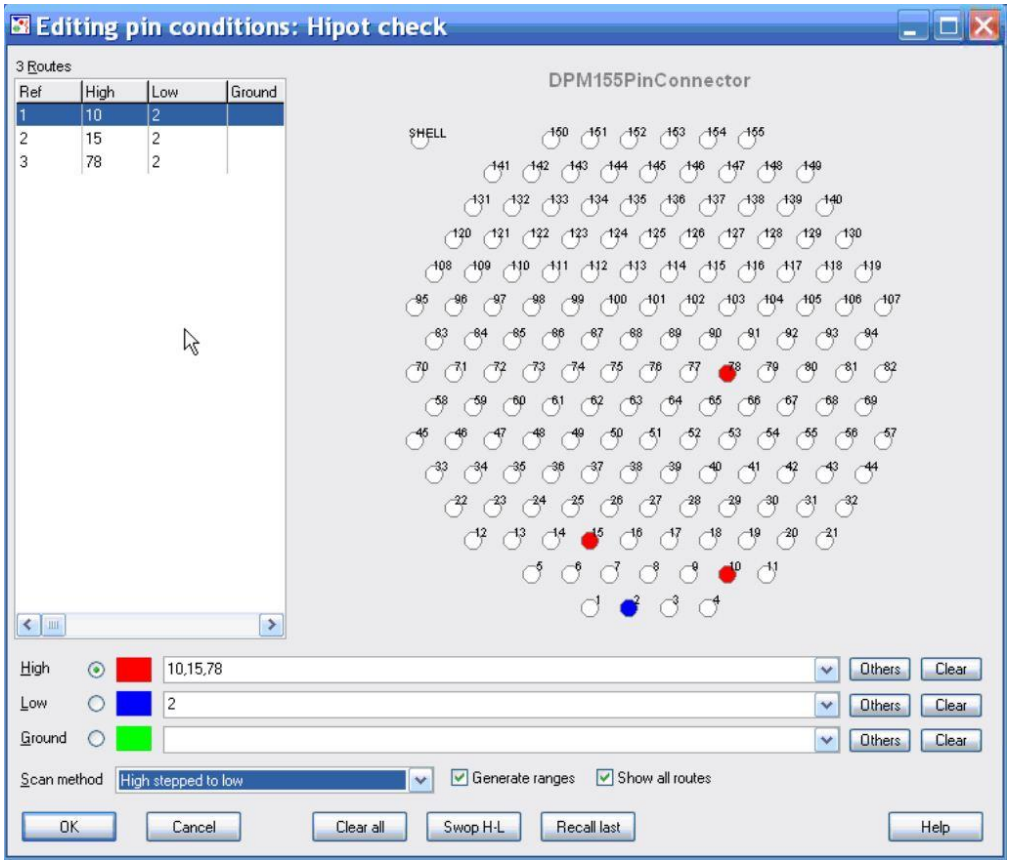
Flexible pin connection editor.

- Architecture maps 4-wire measurement bus on to any number of physical device connections.
- Working layout can be any chosen ‘view’, e.g. actual connector plan form or a derivative.

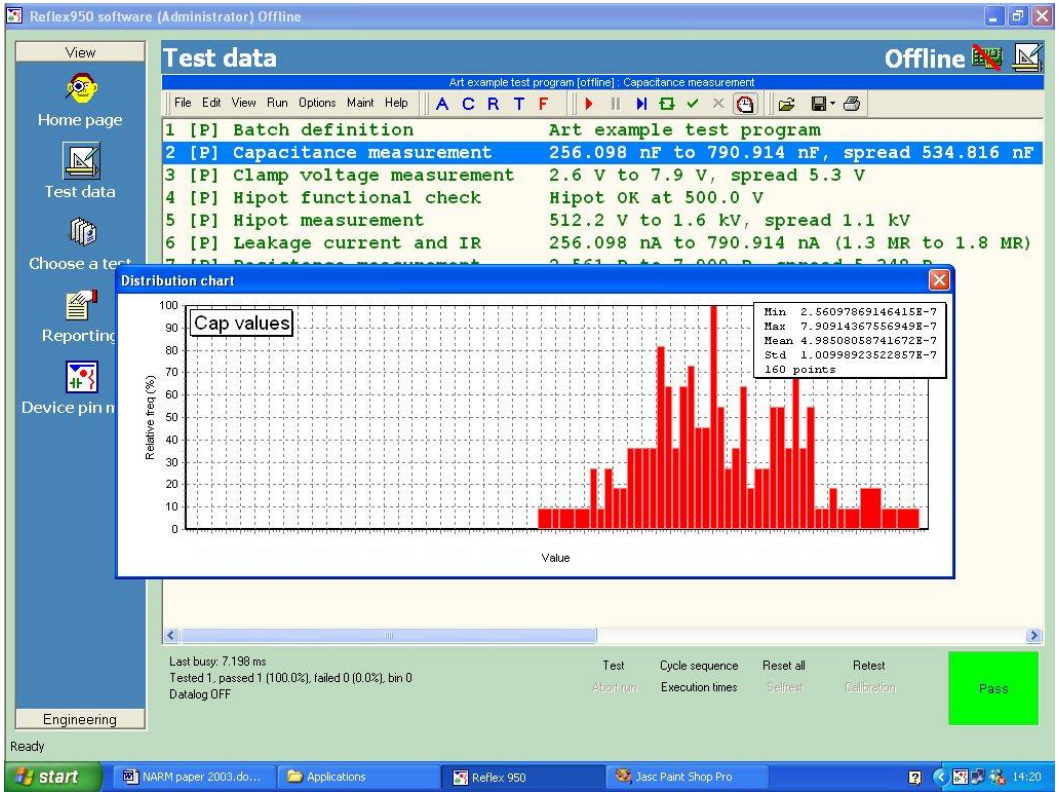


Flexible pin connection editor.

- Architecture maps 4-wire measurement bus on to any number of physical device connections.
- Working layout can be any chosen ‘view’, e.g. actual connector plan form or a derivative.
- All similar test routes are visible on one simple screen.

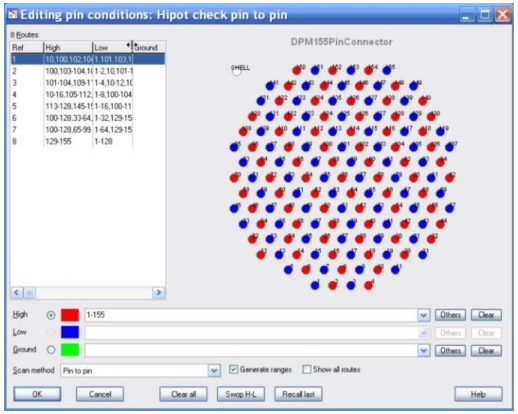


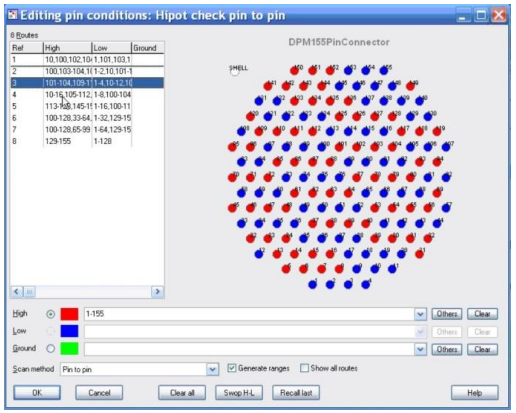
Charts are used to enhance result clarity.

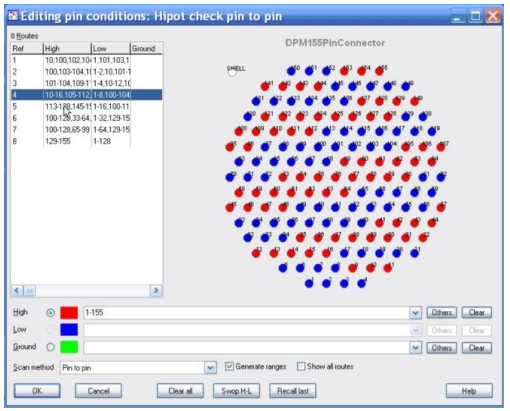


- Charts allow large number of routes to be compared, e.g. for assessing capacitance matching.

Pin-to-pin test method for fast device test coverage.



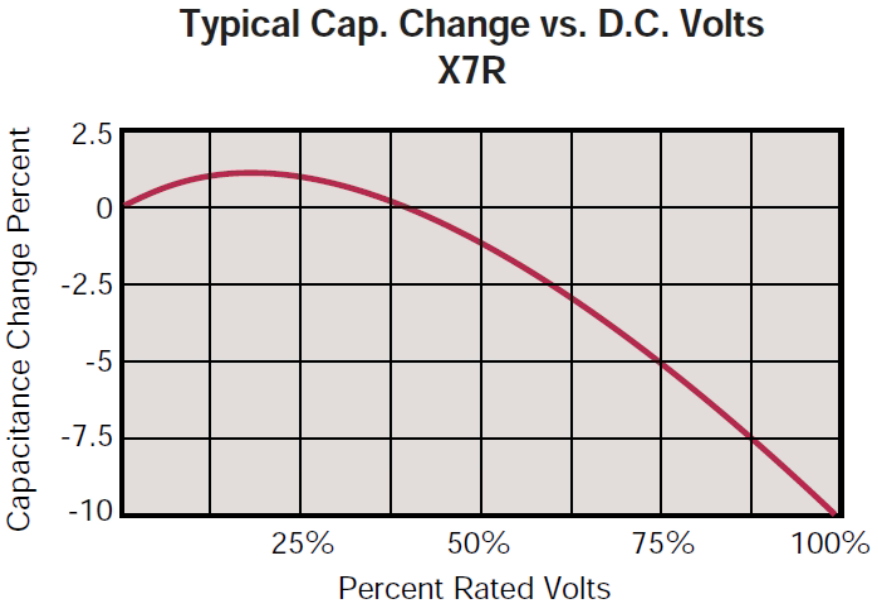




- 'Binary-split' technique is available for applying any test across a large number of pin connection routes.
- Guarantees test polarity reversal to all adjacent pins (e.g to confirm absence of solder 'whiskers' between pins.
- Technique permits 128-pin connector to be fully tested in only 7 automatic test steps.

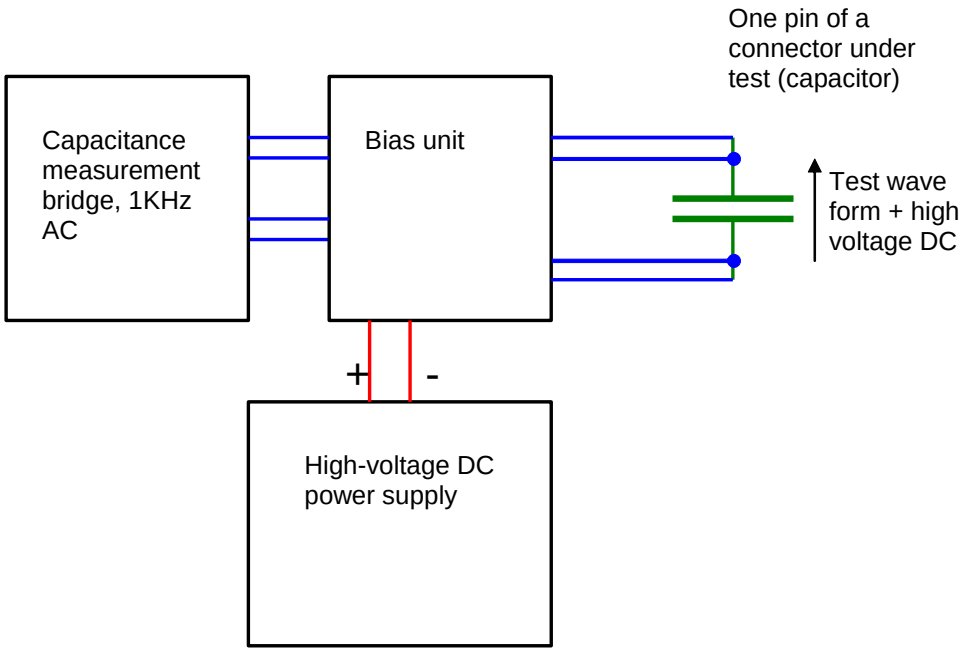
Measuring capacitance at elevated voltage.

- Few designers using ceramic capacitors realise that capacitance can fall significantly with rising voltage.
- Capacitance change affects filter cut-off frequency and / or decoupling performance
- Filter connectors should be tested for this parameter.
- Most industry solutions only allow capacitance to be measured with a few tens of applied volts.



Measuring capacitance at elevated voltage.

- The Reflex 950 solution allows the entire applied voltage range to be used for capacitance and DF measurement.
- Full 4-wire isolation is achieved.



Measuring capacitance at elevated voltage.

- Valuable engineering insight is gained from elevated voltage capacitance measurement.
- The technique is increasingly popular and enhances customer confidence in quality.
- Technique is also applicable to a stand-alone laboratory application.

To conclude.

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- Filtered connectors are increasingly important ‘complex passive’ devices.
- Correct testing of these unique parts is not trivial.
- A dedicated filtered connector test system has been created which implements novel fixturing, connection and test techniques to solve the test problems raised.
- Further test insight has been provided with the capability to measure Capacitance and DF at elevated voltage.

Thank You.