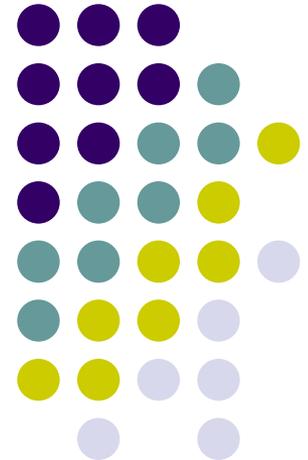


Meeting the Challenges of Testing Filtered Connectors

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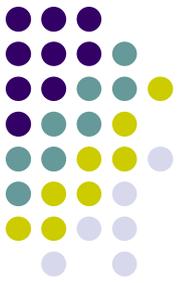


Filtered connectors – increasingly important.

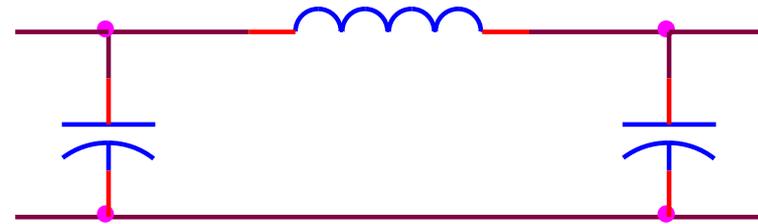


- A filtered connector is any type of connector that contains additional components to attenuate the passage of unwanted signals through it.
- Increasingly used to protect ‘mission critical’ electronic systems against EMI such as lightning discharges and unwanted RF transmissions - inward or outward!
- 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.

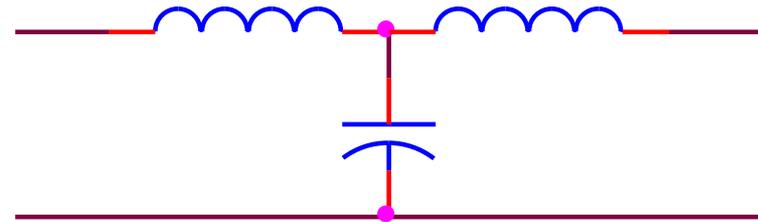
A typical filtered connector internal circuit.



- 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.

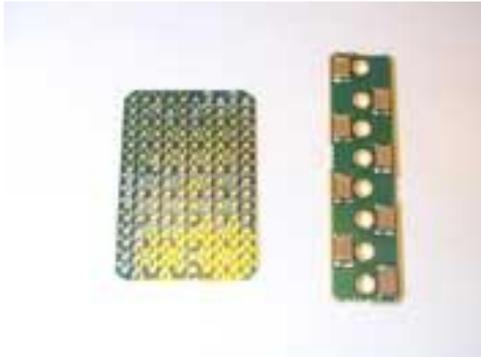


'Pi' Filter



'T' Filter

Physical construction is becoming more integrated.



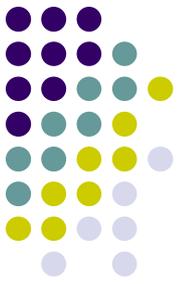
- Early filtered connectors were made using PCB-mounted discrete components – difficult to assemble and less reliable in use.
- Capacitor arrays improved integration and filter performance.
- Combination of capacitor and varistor array is the most highly integrated.

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.

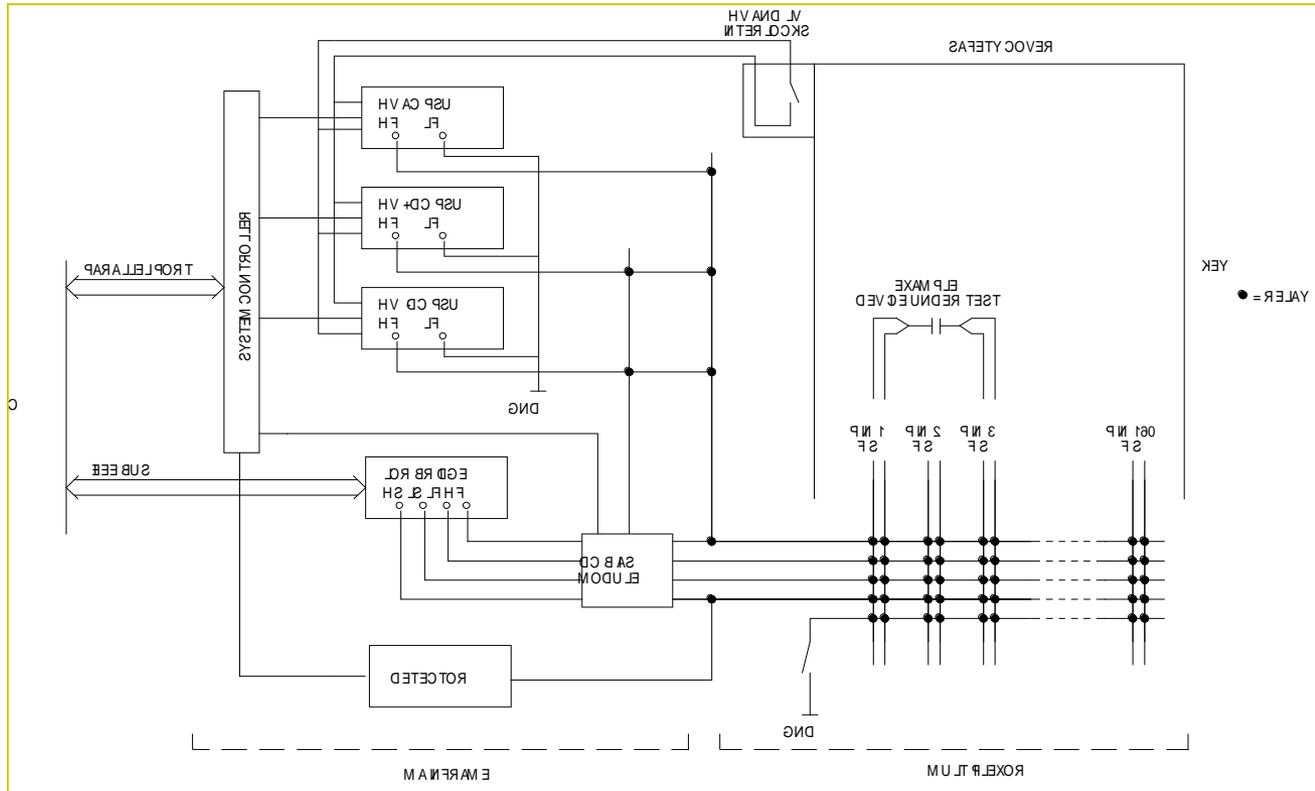
The Reflex 950 – a dedicated filter connector test system.



- 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.

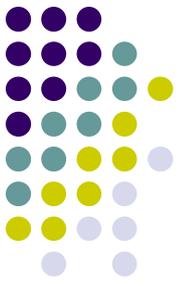
Fixturing is vital for measurement performance.



- 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.

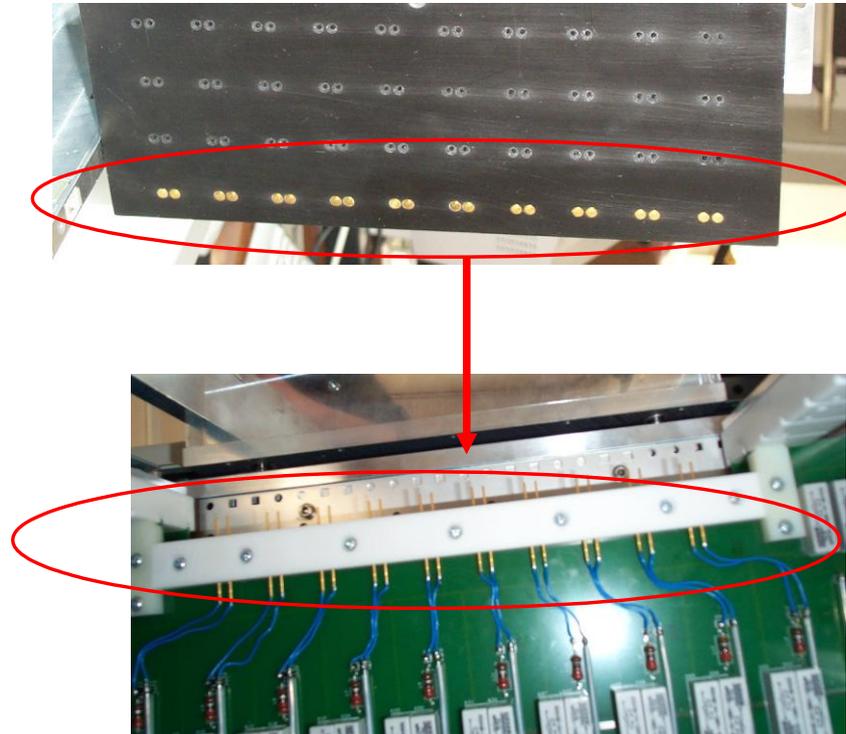
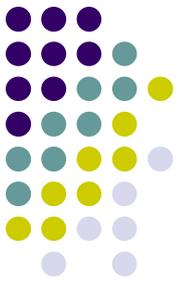


Fixturing is vital for measurement performance.



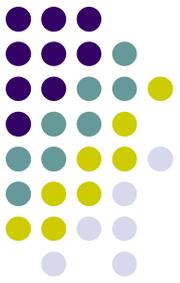
- Tester 'bed of nails' mates with the fixture module.
- A large test area provides opportunity to test one large connector or multiple smaller connectors.

Fixturing is vital for measurement performance.



- Device site connects almost directly to the switching network.

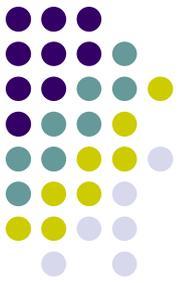
Fixturing is vital for measurement performance.



- 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.



Reflex950 software, V1.0.41.264 (Administrator)

Home page

Offline

Busy

Tested 1
Passed 0 0.0%
Failed 0 0.0%

Part number --

Stop

Open

Release fixture

View

Home page

Test data

Device pin map

Device reporting

Engineering Manage

Log off

Hiopot, Route 3 of 30

DPM155PinConnector

SHELL

150 101 102 103 104 100

141 142 143 144 145 146 147 148 140

131 132 133 134 135 136 137 138 139 140

120 121 122 123 124 125 126 127 128 129 130

110 111 112 113 114 115 116 117 118 119

100 90 97 98 99 100 101 102 103 104 105 106 10

90 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94

80 70 71 72 73 74 75 76 77 78 79 80 81 82

70 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74

60 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64

50 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54

40 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44

30 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34

20 10 11 12 13 14 15 16 17 18 19 20 21

10 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14

Test sequence

	Test program
✓ 0 Batch definition	Test program
1 Hipot check	Route 2 of 30
2 Manual prompt	-----
3 Leakage current and IR	-----
4 Manual prompt 2	-----
5 Hipot check pin to pin	-----
6 Hipot check (2)	-----

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

Test programming



The screenshot shows the Reflex950 software interface (V1.0.41.264) running as Administrator. The main window displays test data for a 'Hipot check' program. The interface includes a menu bar (File, Edit, View, Run, Options, Maint, Help) and a toolbar with various icons. The test data is organized into sections: 'User data' (C109, C110, C30) and a 'CONDITION LIST' for the 'Hipot check' (C841-C844, C833-C280, C544-C380, C545, and C288). The 'C288 HV voltage applied' parameter is highlighted in blue and set to 1500.0 V. A status bar at the bottom shows test statistics (Last busy: 5024.227 ms, Tested 0, passed 0 (0.0%), failed 0 (0.0%), bin 0) and a large green 'Pass' button.

Item	Parameter	Value
C109	User data 9	=
C110	User data 10	=
C30	Small display font	= No

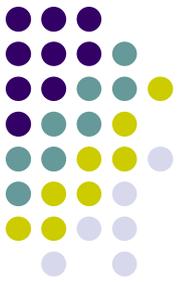
2 [-]	Hipot check	-----
CONDITION LIST		
C841	Pins high	= 70-74
C842	Pins low	= 100-105
C843	Pins grounded	=
C844	Pins scan method	= High stepped to
C833	HV generator mode	= DC
C280	HV slew rate	= 10.0 V per s
C544	Hipot dwell time	= 0.3 s
C380	Hipot event threshold	= 1.0 mA
C545	Hipot event filter	= Longest (1ms)
C288	HV voltage applied	= 1500.0 V

Status: Last busy: 5024.227 ms
Tested 0, passed 0 (0.0%), failed 0 (0.0%), bin 0
Datalog ON, Last UID: ---
No remote control

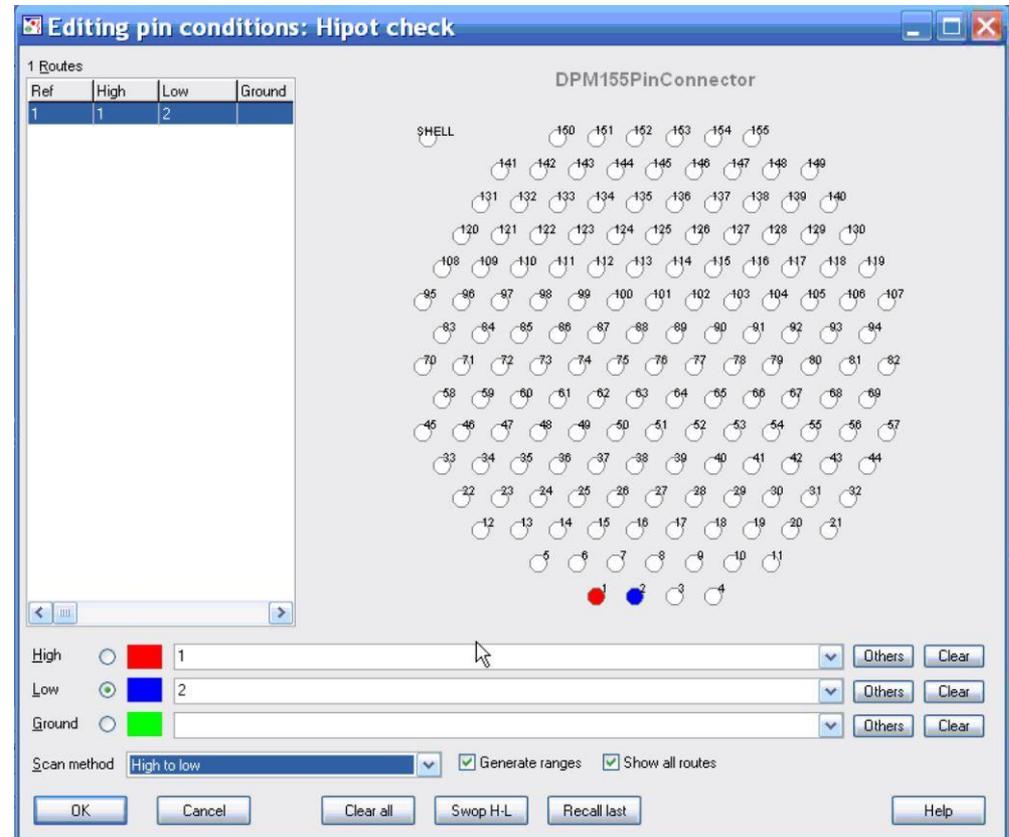
Buttons: Test, Cycle sequence, Reset all, Retest, Abort run, Execution times, Selftest, Calibration, Pass

- Test programming uses a 'menu' structure for setting parameters.

Flexible pin connection editor.



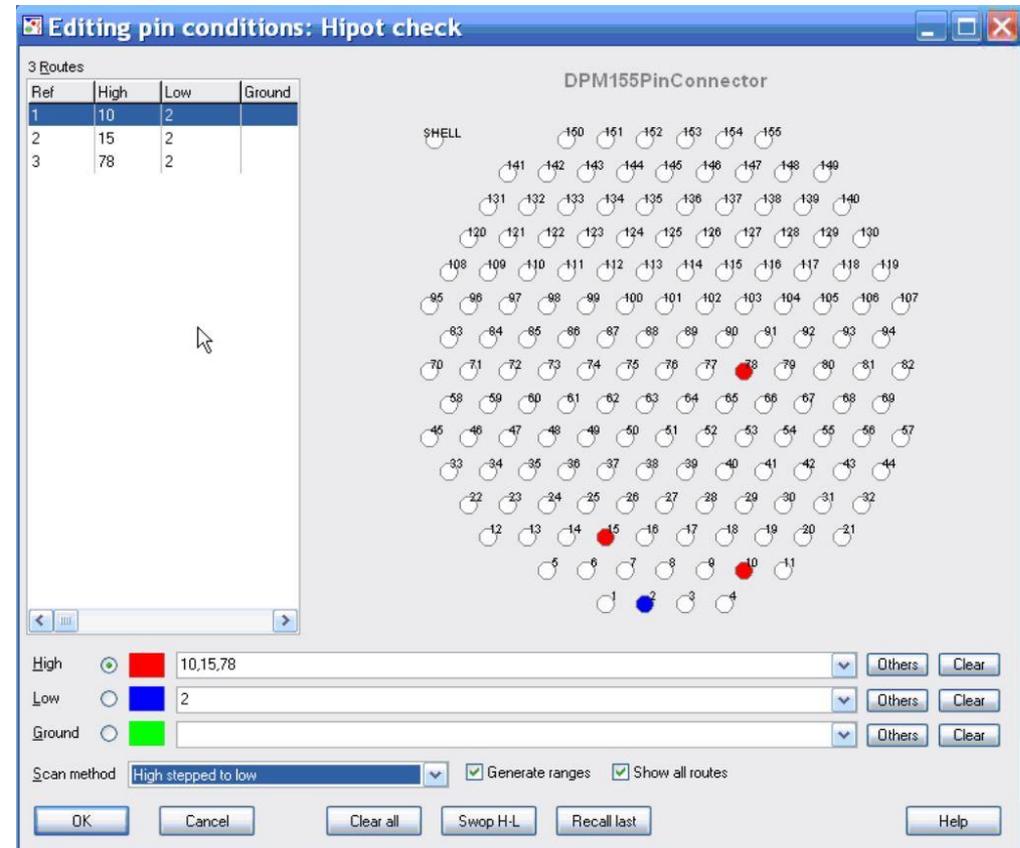
- Architecture maps 4-wire measurement bus on to any number of physical device connections.
- Working layout can be any chosen 'view', e.g. actual connector plan form or a derivative.



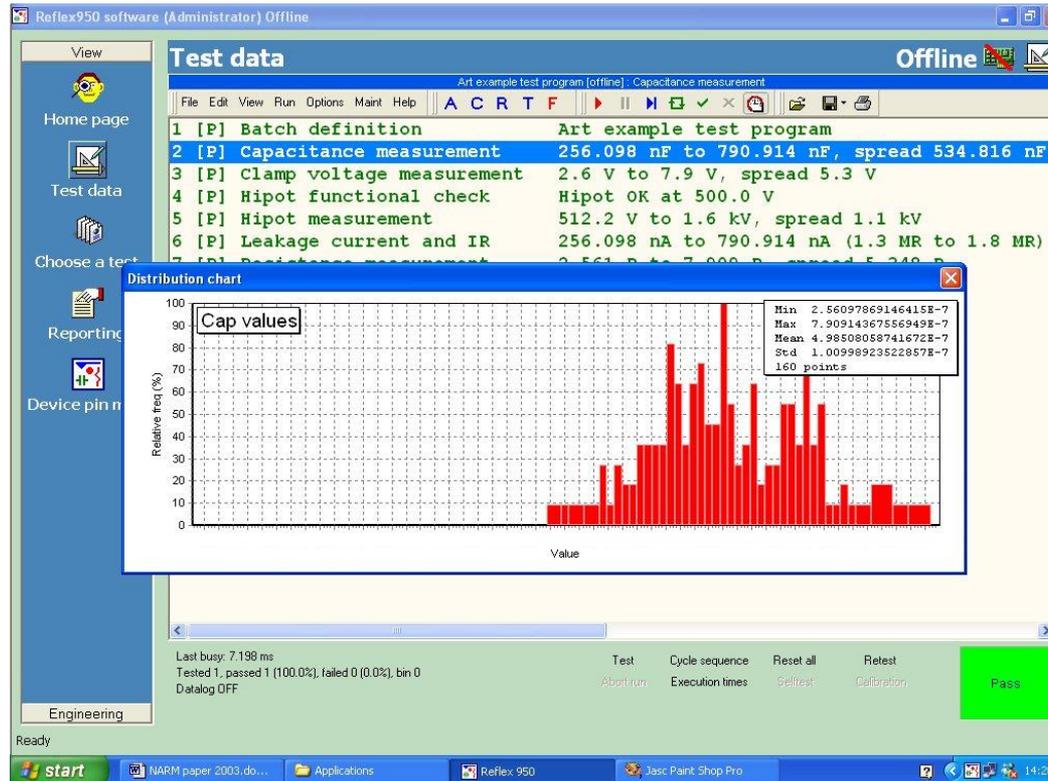
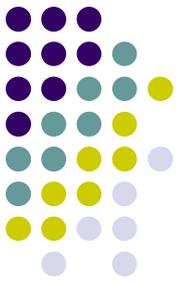
Flexible pin connection editor.



- 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.

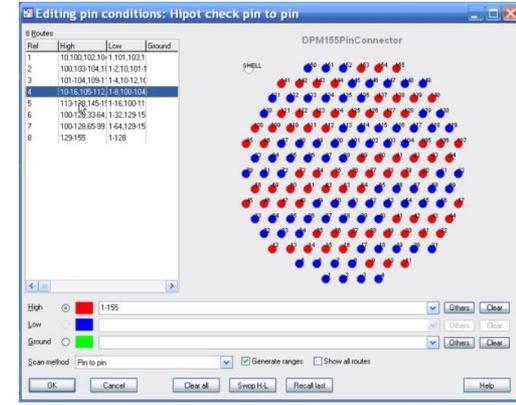
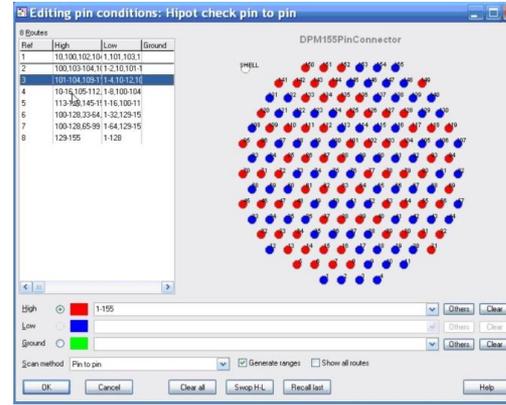
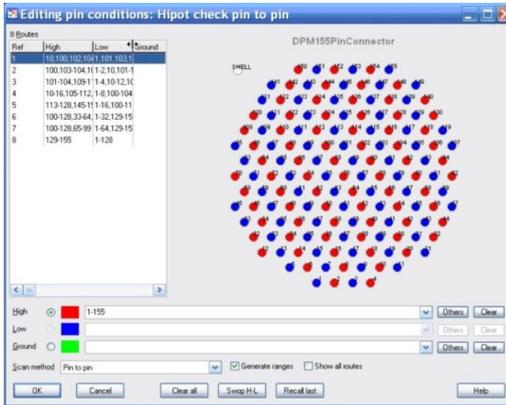
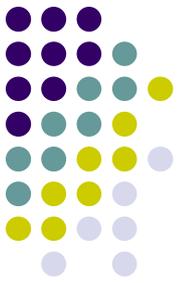


Charts are used to enhance result clarity.



- 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.



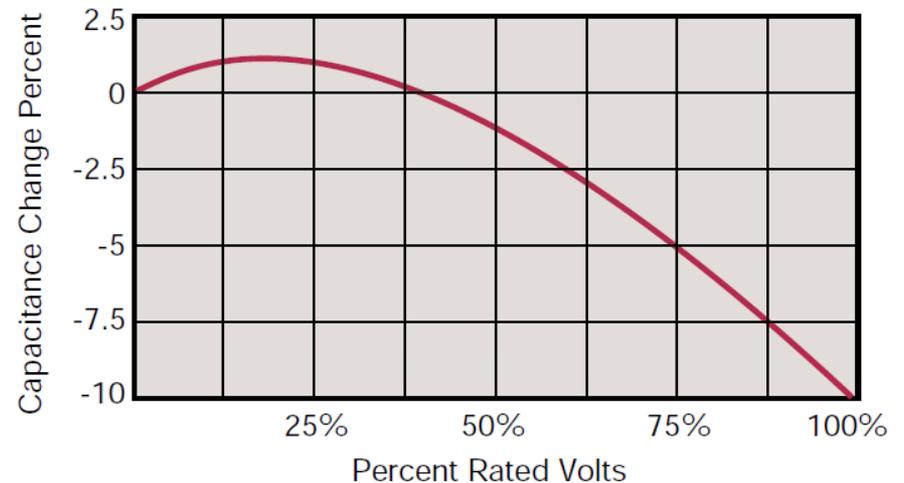
- 'Binary-split' technique is available for applying any test across a large number of pin connection routes.
- Guarantees test polarity reversal to all adjacent pins (e.g to confirm absence of solder 'whiskers' between pins).
- Technique permits 128-pin connector to be fully tested in only 7 automatic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

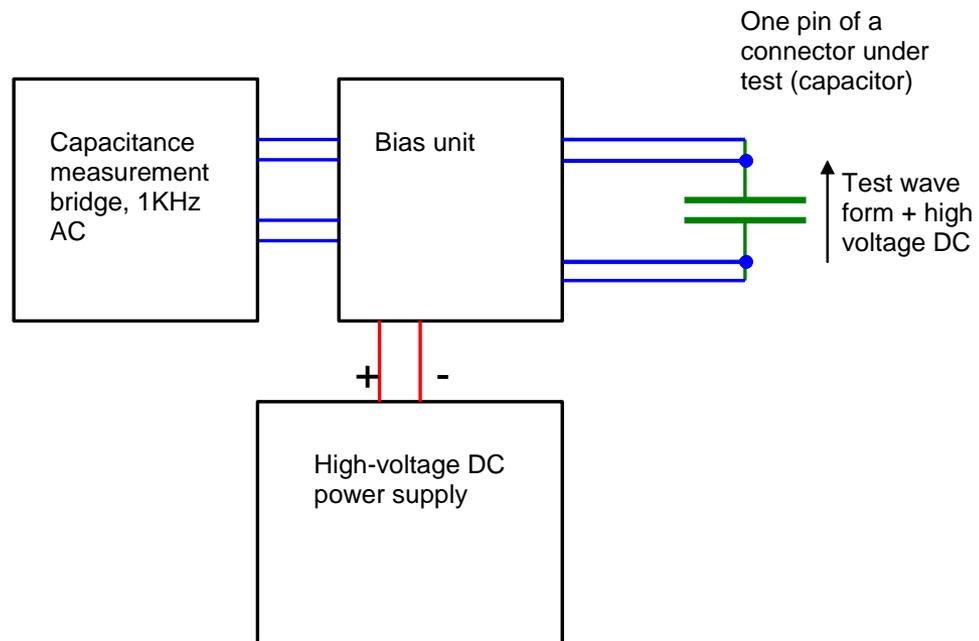
Typical Cap. Change vs. D.C. Volts
X7R



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.



- 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.