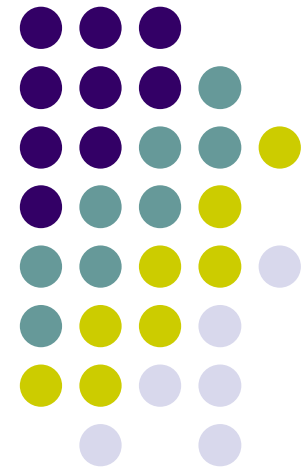


A new generation of chatter test system for improved performance

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What is a contact chatter testing?

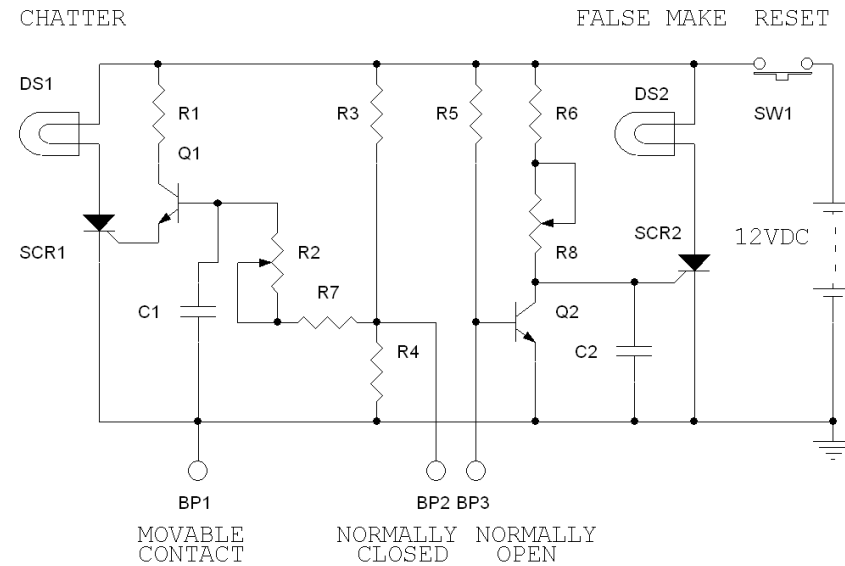


- | Application of mechanical vibration or shock to a contact which may cause the contact to momentarily change state (chatter).
- | Definition: to detect the “opening of closed contacts” or “closing of open contacts” due to vibration, shock or acceleration for longer than a specified time duration (MIL-STD-202F Method 310)
- | Typical device performances:
 - Semiconductor switches = 200G
 - Electro-mechanical switches = 20G

The standard test circuit.



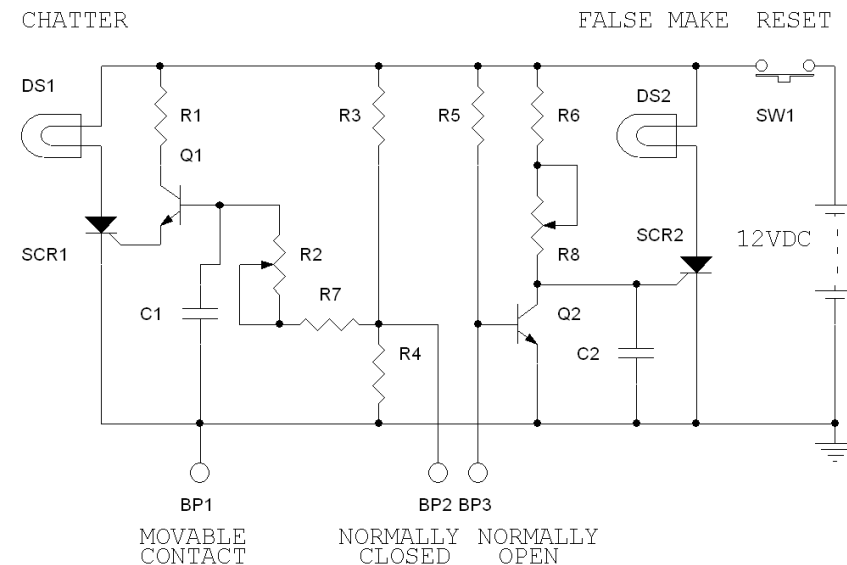
- Good points:
- Relatively simple to understand and build.



The standard test circuit...



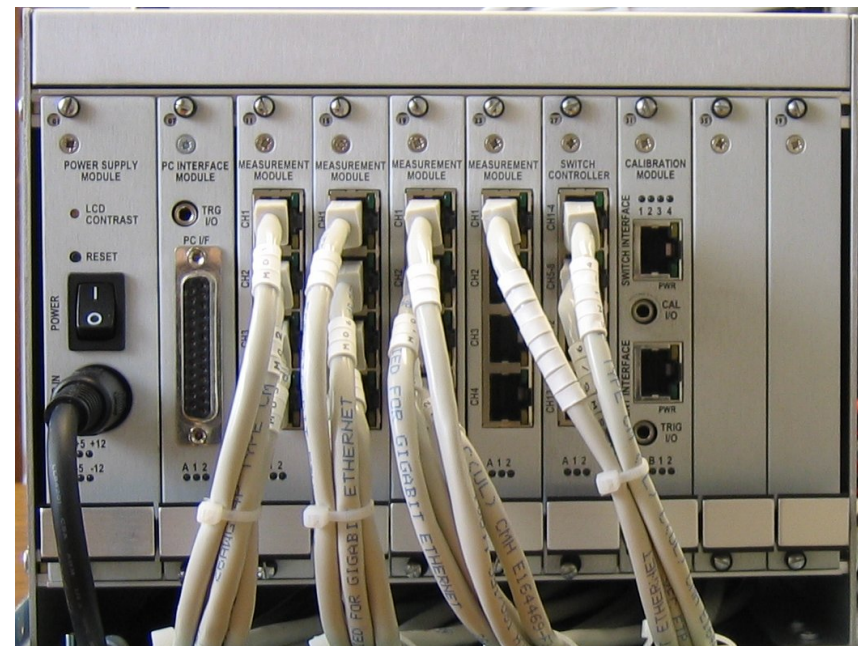
- Bad points:
 - Calibration is highly labor intensive
 - Single fixed DC contact load
 - High susceptibility to noise pickup
 - No ESD protection
 - Indication of failure - lamps
 - Wiring must be swapped over and re-calibrated when the relay state is changed.
 - Bandwidth issues on medium/long cable runs.
 - Potentially hazardous voltages present at detector input.





Our wish list.

- I To address the failings of the standard test circuit.
- I To provide a wide range of software programmable detection filter settings from 1us to at least 20ms.
- I To provide a highly automated calibration process.
- I To provide event counters to aid the user with failure analysis and reporting.
- I To utilise as much of the existing Reflex hardware / software architecture as practical.



Reflex 51 Relay Life Test System

Back to basics.

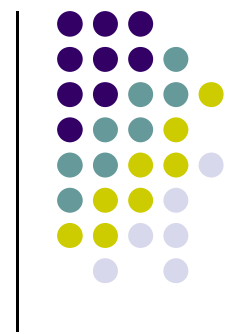
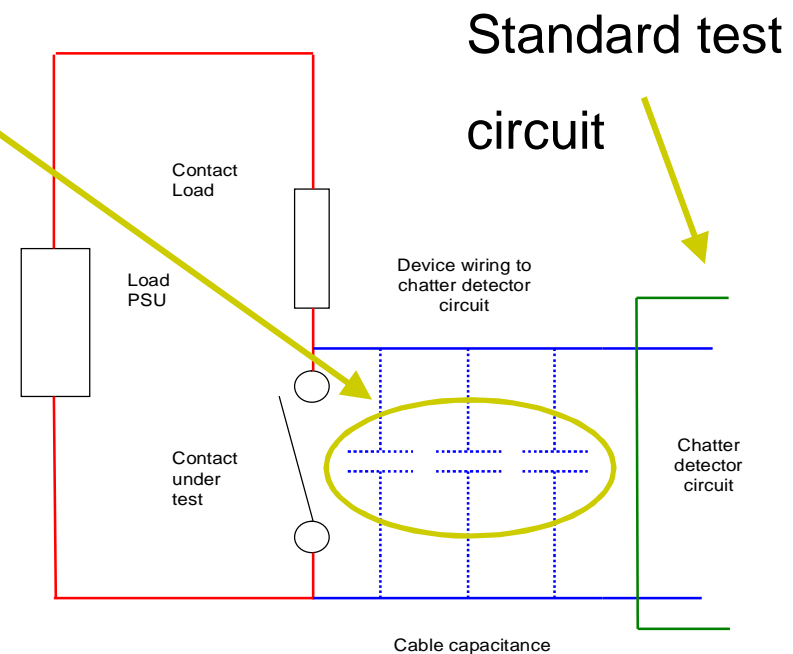
Beware stray capacitance due to the wiring between the contact under test and the chatter detector.

For example:-

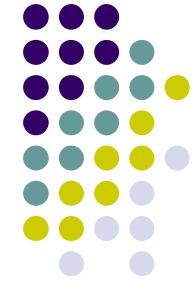
115V @ 100mA requires 1150Ω load resistor. Assume an effective cable capacitance of 300 pF:

Time constant, T

$$\begin{aligned} &= R \times C \\ &= 1150 \times 300 \times 10^{-12} \\ &= 345 \text{ ns} \end{aligned}$$



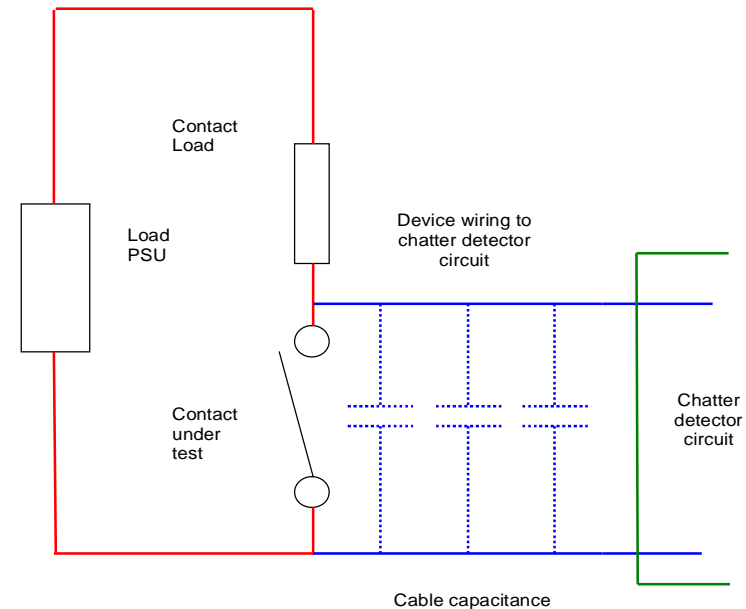
Back to basics...



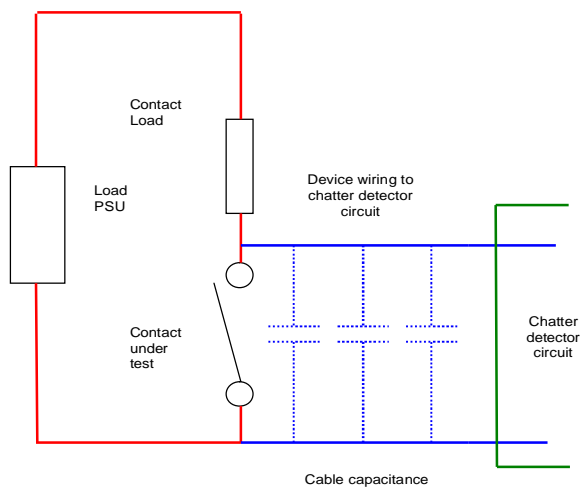
The MIL spec implies a timing accuracy of $\pm 3\%$. A 1us time constant this must be accurate to within $\pm 30\text{ns}$.

A time constant of over 10x this figure (345ns) due to wiring alone has two major implications:

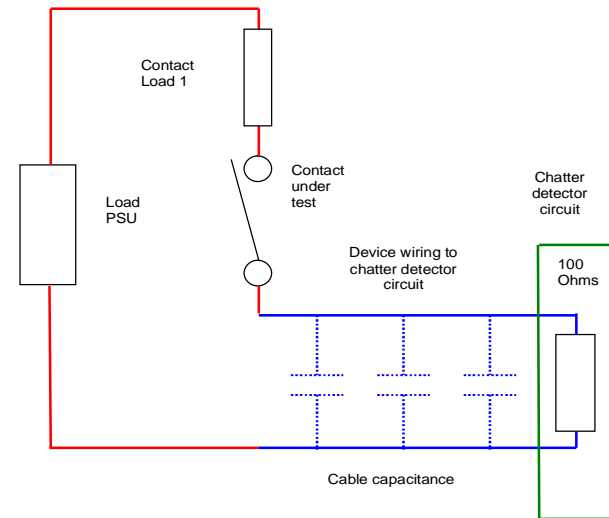
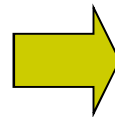
1. Calibration of the system **MUST** be performed with the device wiring in situ.
2. Any movement of the cabling will vary the cable capacitance and thus requires re-calibration.



Improved load circuit.



Detects contact VOLTAGE

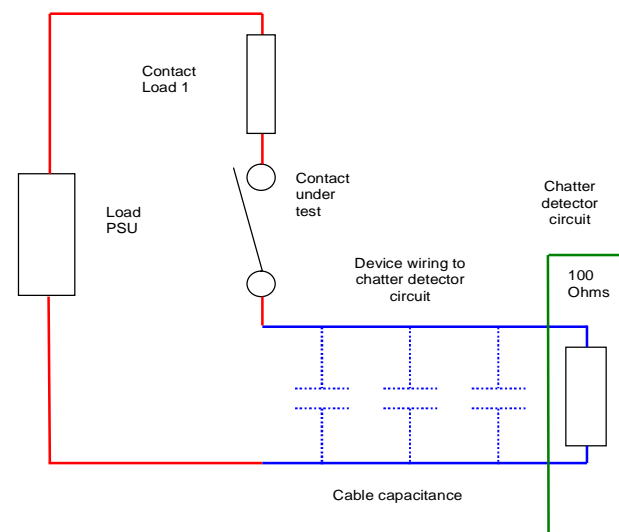


Detects contact CURRENT



Benefits of improved circuit.

- | Effect of cable capacitance is reduced – calibration NOT affected by cabling.
- | Test open and closed contacts with the same circuit. No re-wiring required!
- | The low input impedance greatly improves the intrinsic noise immunity.
- | Voltages at test system no longer potentially hazardous.
- | Additional ESD protection devices can be easily incorporated with little impact on the circuit performance.

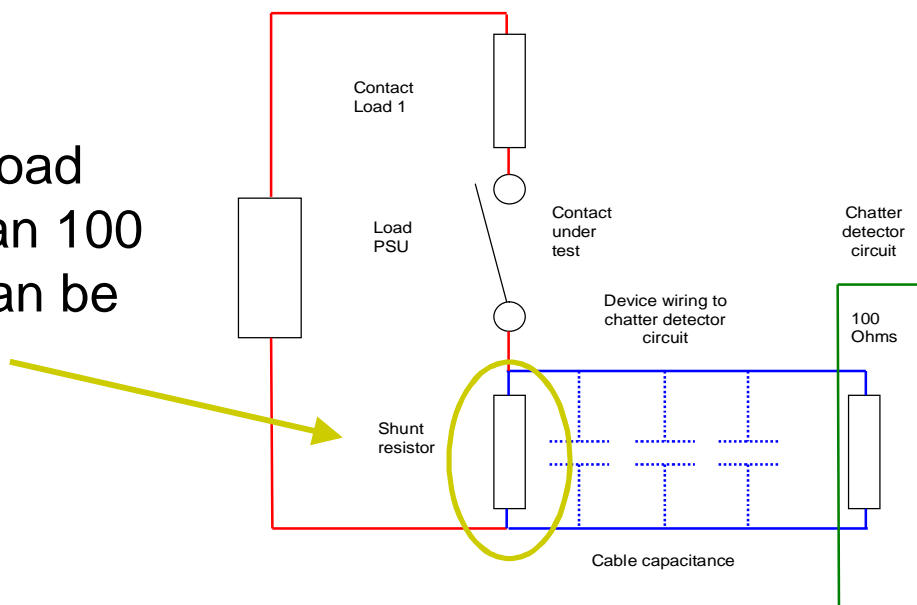




Handling high load currents.

The input impedance of the detector must now be included in the calculation.

For higher load current requirements where the load resistor would be less than 100 Ohms, a shunt resistor can be fitted.





Front end filter design

Objectives:

1. To achieve timing accuracy better than 1% over the filter range 1us to 20ms.
2. Eliminate time consuming manual filter calibration process.

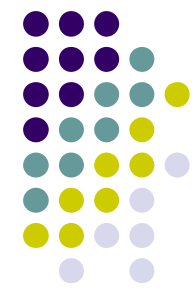
At 1us, a 1% error is 10ns, NOT practical to use a digital filter.

At $\geq 10\mu\text{s}$, a 1% error is $\geq 100\text{ns}$, IS practical to use a digital filter.

Solution:

Combine 1us analogue filter + digital filter

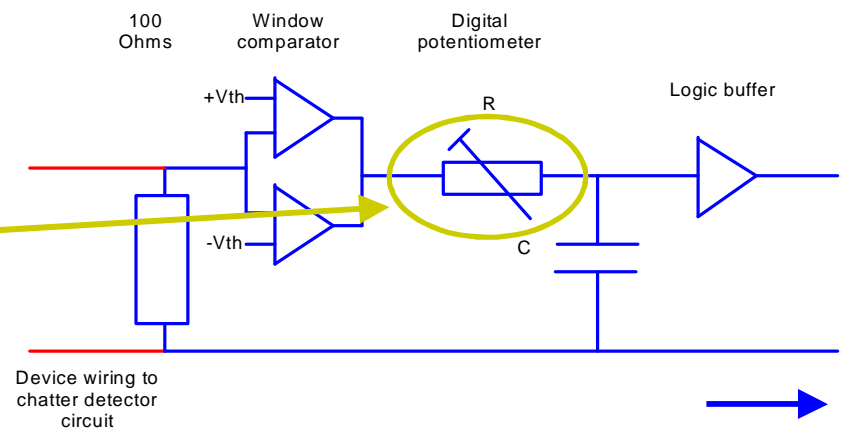
Semi-automated 1us analogue filter calibration.



Calibration software adjusts RC to $1\mu s \pm 10ns$

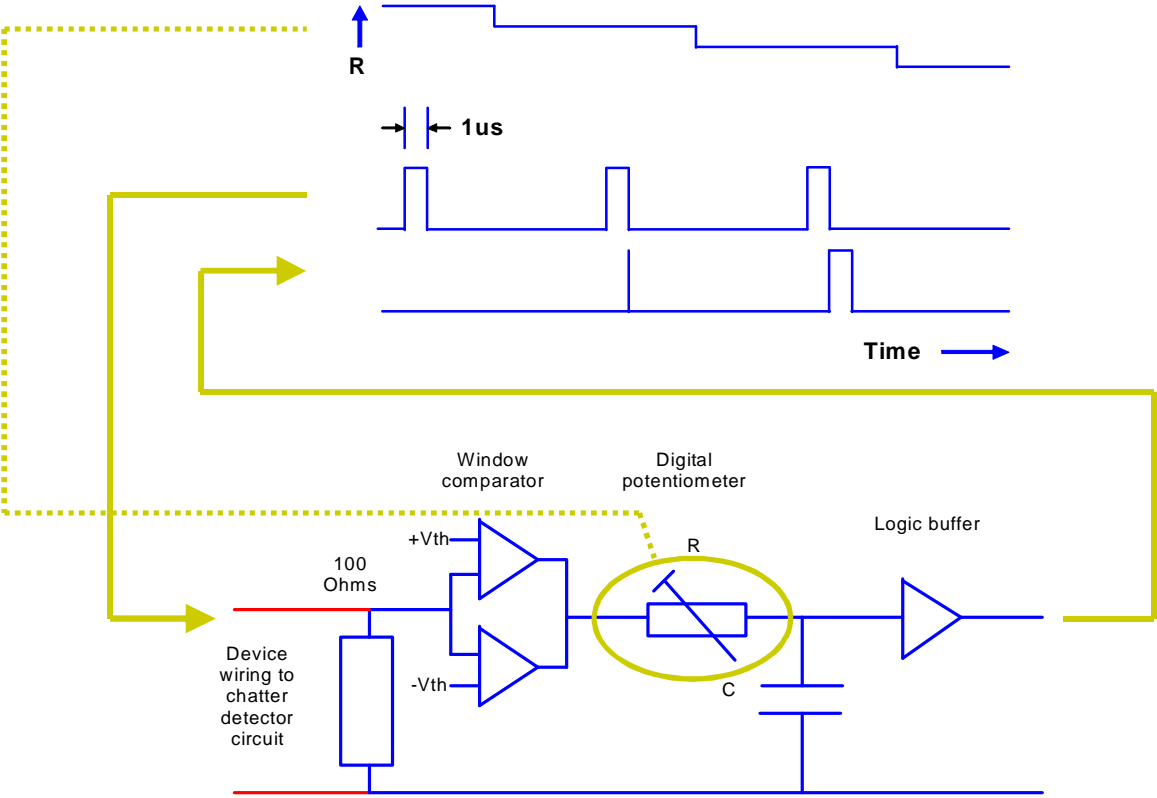


Digital potentiometer



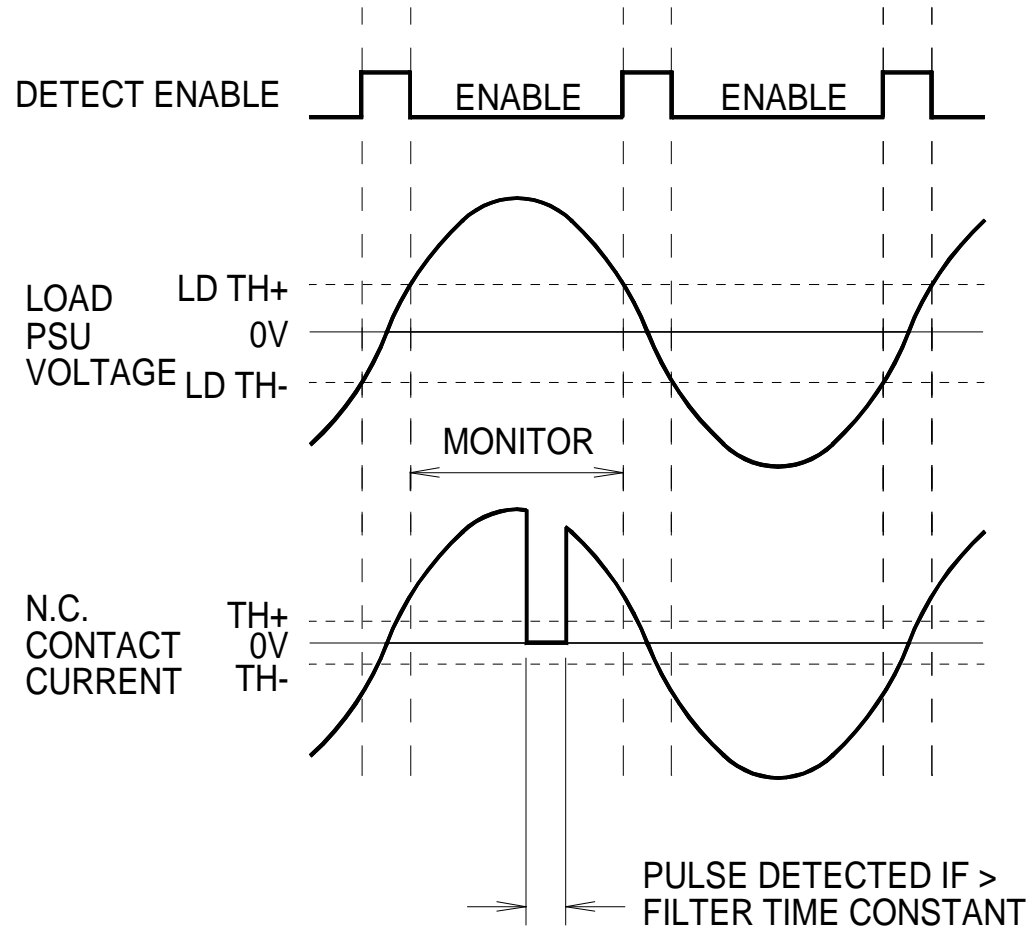
To digital filter

1us analogue filter adjustment.

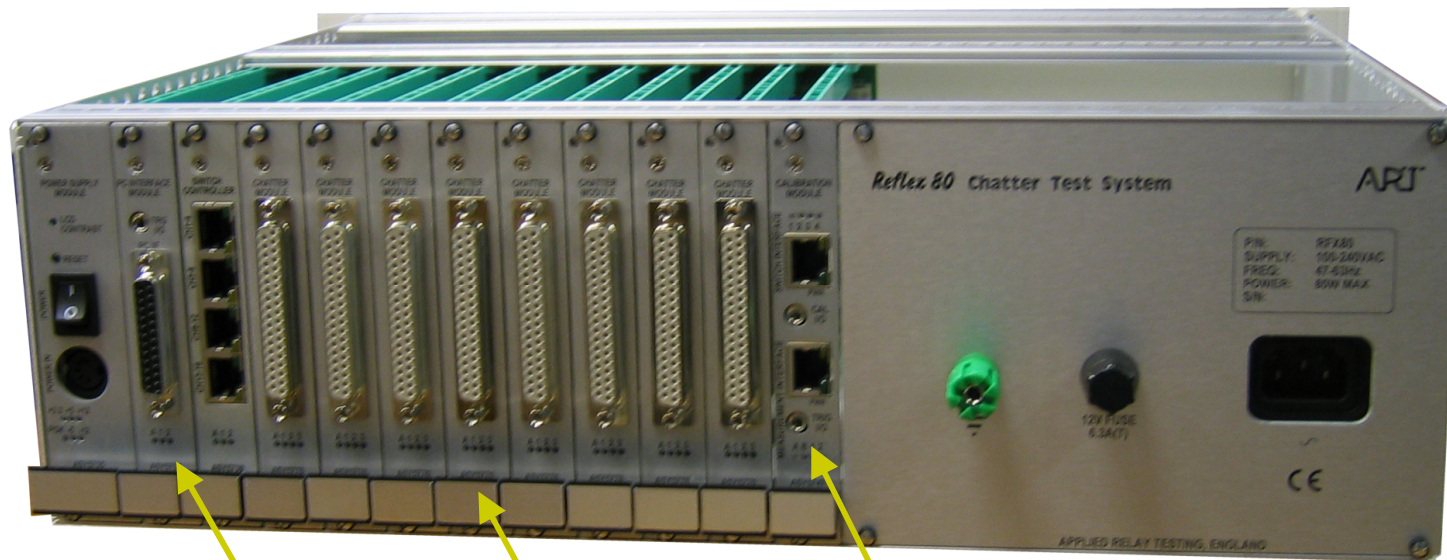


Reflex 80 DUT interface

AC loads.



The Reflex 80 Chatter Test System.



PC interface card

Up to 128 device contact channels

Calibration module

Software – Home page



View

Home

Mode

Stop

Setup

Run

Clear

Relay state

Operate

Release

All Inputs

Configure

Data file

Load

Save

C1-8	C17-24	C33-40	C49-56	C65-72	C81-88	C97-104	C113-120
0.010 ms	0.010 ms	0.010 ms	0.010 ms	0.010 ms	0.010 ms	0.010 ms	0.010 ms
C1	C17	C33	C49	C65	C81	C97	C113
C2	C18	C34	C50	C66	C82	C98	C114
C3	C19	C35	C51	C67	C83	C99	C115
C4	C20	C36	C52	C68	C84	C100	C116
C5	C21	C37	C53	C69	C85	C101	C117
C6	C22	C38	C54	C70	C86	C102	C118
C7	C23	C39	C55	C71	C87	C103	C119
C8	C24	C40	C56	C72	C88	C104	C120
C9-16	C25-32	C41-48	C57-64	C73-80	C89-96	C105-112	C121-128
0.010 ms	0.010 ms	0.010 ms	0.010 ms	0.010 ms	0.010 ms	0.010 ms	0.010 ms
C9	C25	C41	C57	C73	C89	C105	C121
C10	C26	C42	C58	C74	C90	C106	C122
C11	C27	C43	C59	C75	C91	C107	C123
C12	C28	C44	C60	C76	C92	C108	C124
C13	C29	C45	C61	C77	C93	C109	C125
C14	C30	C46	C62	C78	C94	C110	C126
C15	C31	C47	C63	C79	C95	C111	C127
C16	C32	C48	C64	C80	C96	C112	C128

Contact filter setting

Contact status

Blue square denotes contact rest state HI i.e. open contact

Reflex 80 software



Operating modes:

The system may be run in any one of three distinct modes:

- 1) Learn mode
- 2) Set-up mode
- 3) Run mode

Hardware profiles:

Stores EVENT LIST – allows coil and load power supplies etc to be configured automatically prior to testing. Allows entire process to be fully automated.

Software – ‘LEARN’ mode.

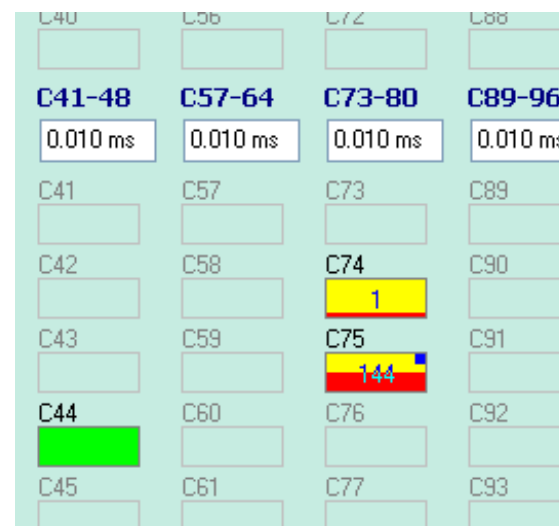
- | The system automatically detects all open and closed contacts before testing commences.
- | The operator can choose to edit manually this configuration if required.
- | The vastly simplifies the device configuration process.





Software – ‘SET UP’ mode.

- I The user can observe contact activity dynamically while the devices are being connected.
- I Any contact failure counts are reset on a regular basis and then resume counting until the failure mechanism has cleared.
- I Faults such as those due to incorrect device wiring or poor device contacts on the test fixture can be rectified as required prior to the start of the test sequence.



Software – ‘RUN’ mode.



Identical to ‘SET UP’ mode except:


- | Device failures are logged to disk (up to 255 failures can be recorded per contact).



Integrated reporting.

- I Device reports generated from data-logged information.
- I Easily customisable to suit individual customer requirements - logos, layout etc.
- I Based on standard Microsoft Word™

Chatter Test report.



Test summary

Test name	Example chatter test program
Hardware profile	
Pass / fail result	Fail
Relays state	Relays released
Report date	14-02-2006, 16.14
Test status	Last run 16:08, duration 0:00:36, events: 526
Total events	526
Software details	Reflex80 software, V1.0.8.32

Input result detail

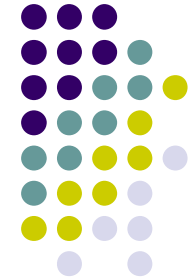
Inputs

Ref	Name	User name	Expected	Pass	Events
1	C3	C3	Low	**Fail**	232
2	C22	C22	Low	**Fail**	149
3	C44	C44	Low	Pass	0
4	C74	C74	Low	**Fail**	1
5	C75	C75	High	**Fail**	144

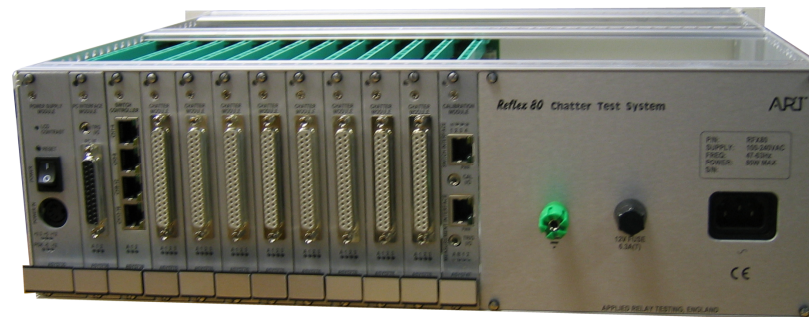
To conclude.



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The Reflex 80 Chatter Test system has eliminated many of the design weaknesses of the standard circuit.



Key benefits:

- | Greater filter accuracy $< \pm 10\text{ns}$
- | Infrequent, less manually intensive calibration
- | Remote operation – cable runs up to 10 feet are easy
- | Flexible (AC and DC) load capability
- | Powerful software modes with set up and learn facility
- | Automated data logging and test report generation