

# Technical Note 24 - Connector Harmonic Distortion

## Background

The effects of accumulations of dirt and film in connectors carrying low-level signal not only degrades the signal to noise level of the system, but should introduce significant amounts of distortion if there are conduction discontinuities with voltages caused by those dirt accumulations and films.



## Hypothesis

If discontinuities in conduction and rectification effects are present then the distortion caused by them should increase as the voltage decreases; for the increased voltage will break down the particulate and film material leading to those discontinuities.

Also, if discontinuities are present in the transfer function they should show up as disproportional amount of high order harmonic distortion as the applied signal voltage is lowered.

## Method:

Ten 100 contact gold plated edge card connectors were wired so as to place the contacts in series when ten 100 contact gold-plated card edges were prepared in similar manner. Thus ten sets of connector-edge card pairs were available for testing

Using a load resistance of 600 ohms, and a test frequency of 1 kHz, a distortion analyzer coupled to a spectrum analyzer was used, under computer control, it measure as many harmonics as could be extracted from the noise floor.

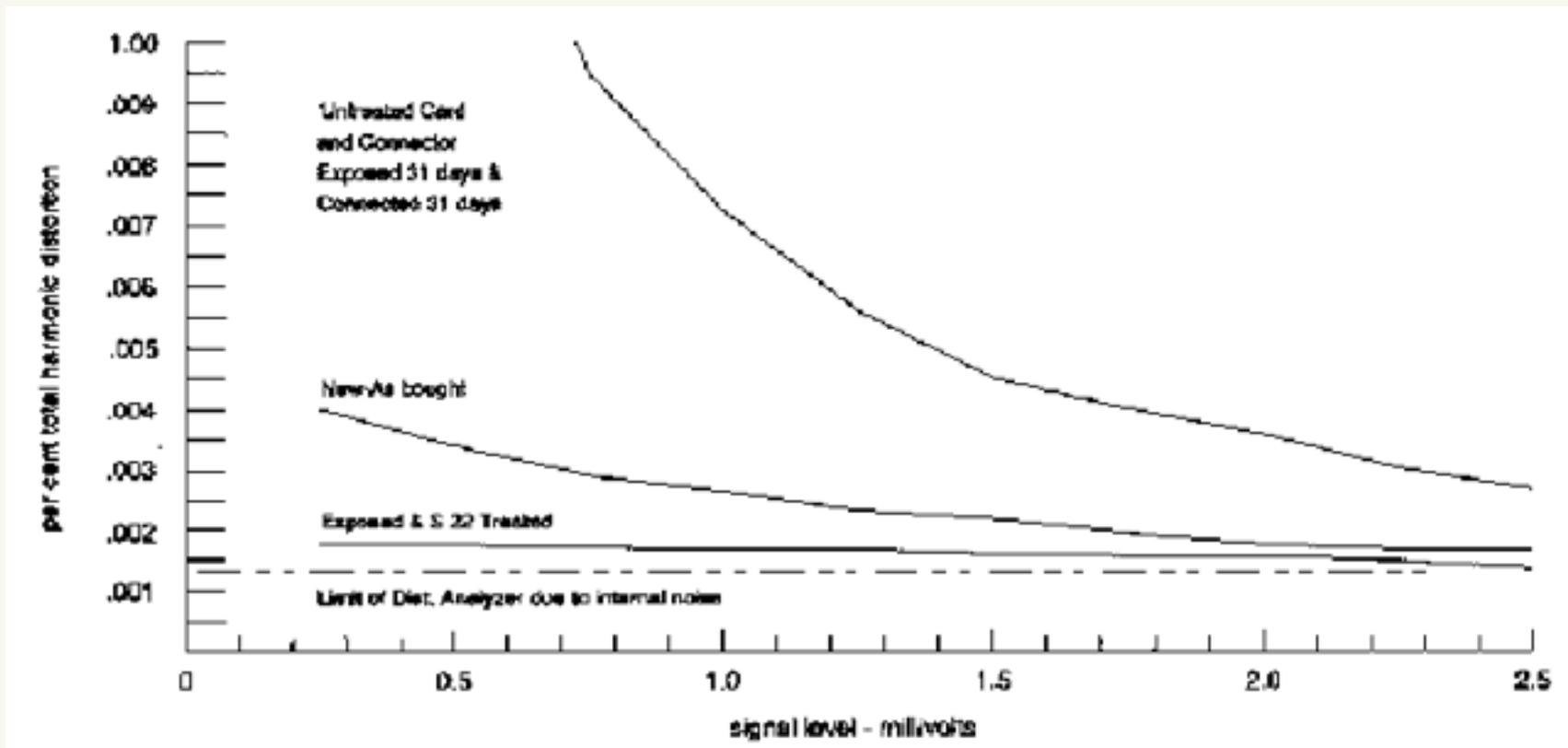
The connector distortion was measured when the units were new. Then they were uncoupled and suspended connected down from hooks under a plywood shield (to protect them from falling material), which allowed air and contaminants to circulate freely about the exposed units. They were left thus exposed for a period of 31 days in a shop which could be considered as typical of a small electronics production plant. The edge cards were then inserted into the connectors and the assembled units left for another 31 days.

They were removed and their distortion contribution measured using the identical set up as before.

The cards themselves were removed from the connectors and both faces received small bead of undiluted Stabilant along their edge. This was wiped lightly over the connector with a sable brush also saturated with the Stabilant 22 so that there was no significant scrubbing action. They were reconnected and their distortion contribution measured as before.

The connectors were unplugged and exposed for another 31 days, reconnected and exposed for an additional 31 days and measured again.

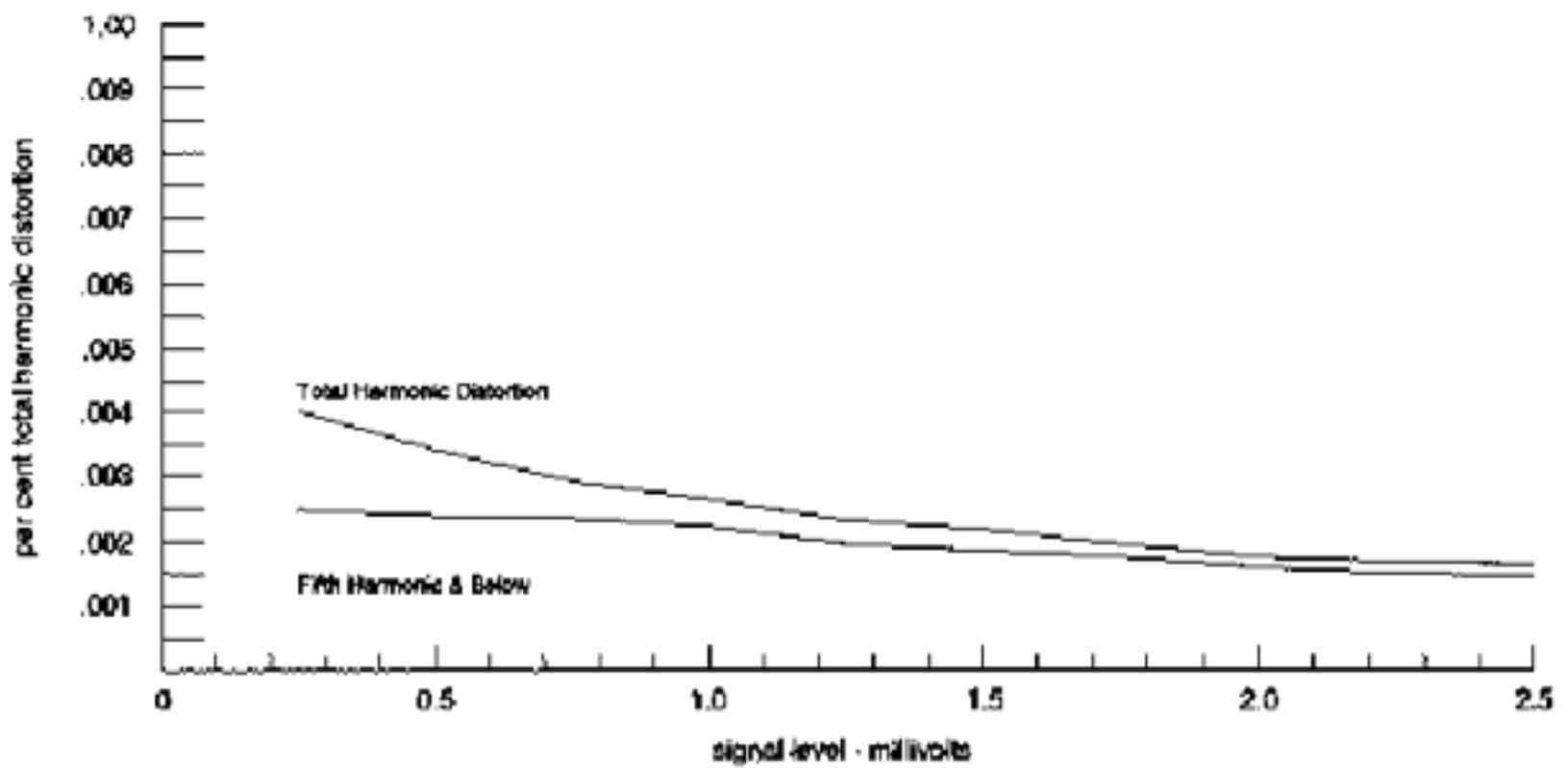
## Results



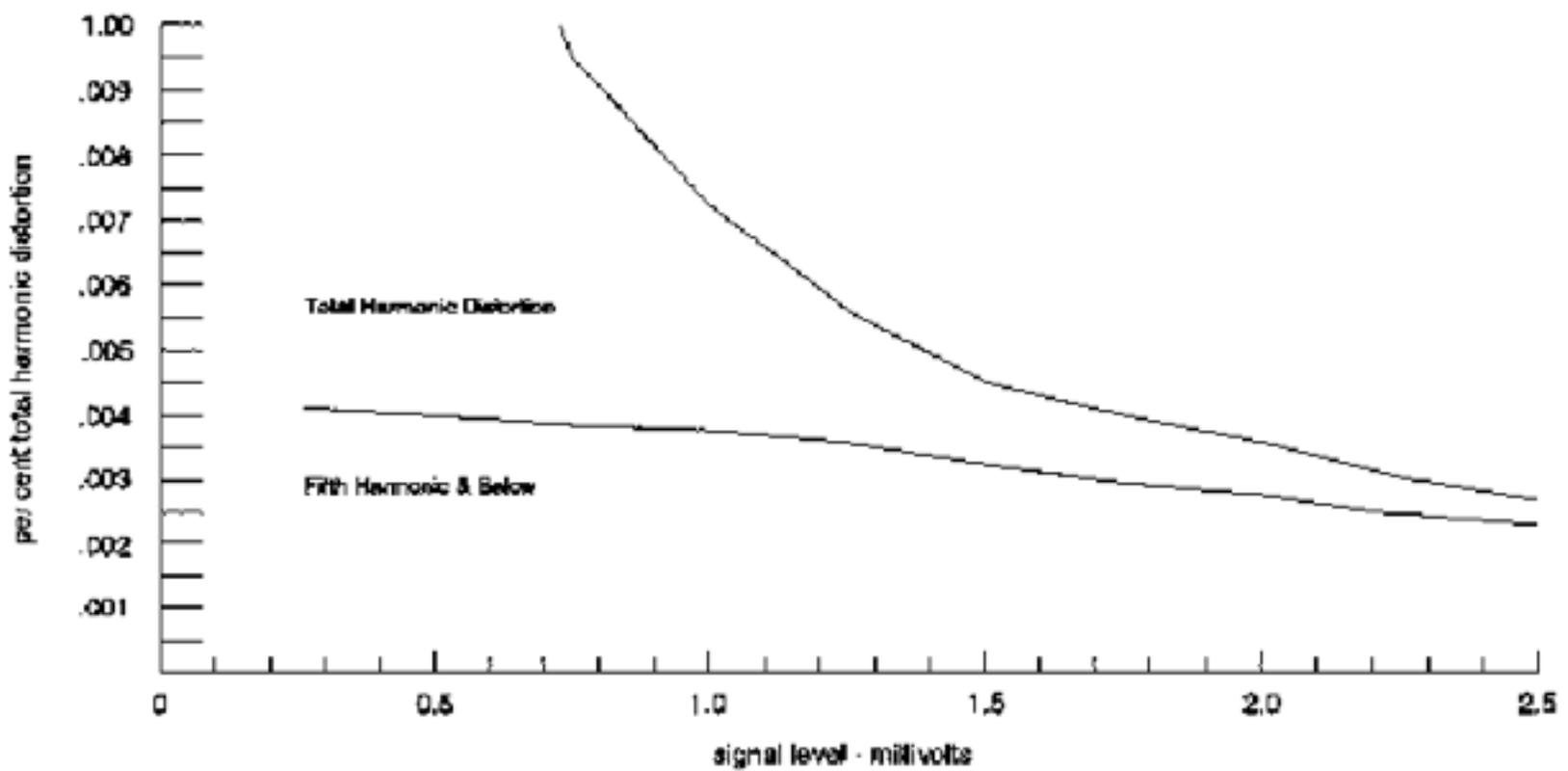
**Chart 1:** Total harmonic distortion averaged figures for 10 sets - each with 100 pairs of contacts

**NOTE:** No significant difference could be found between the measurements made the freshly treated connectors and the measurements made on the same treated connectors after they had been subjected to an additional exposure period of days unconnected, and 31 days connected.

An additional single 100 contact edge card connector pair was set up and subject to the identical procedures save for the method of application of the Stabilant 22. This was done to see if the method of application would make any difference in the test results. The Film thickness was controlled by heating the Stabilant 22 and the card to a temperature of 120 degrees Fahrenheit. The card connection was dipped straight down into the Stabilant 22 to a depth of three eighths of an inch for half second immersion then lifted vertically and hung for a period of one hour, such that the edge of the card was at forty-five degrees to the horizontal. The air temperature during the draining cycle was maintained at 120 degrees Fahrenheit as well. The resultant film thickness was estimated to be in the range of 0.6 to 0. mills. The application was such that no "cleaning action" was apparent due to "washing" of the dipped edge-card connector and an analysis of the surplus material that dripped off the connectors, showed no significant signs of contamination. The total harmonic distortion lay within the experimental deviation of the figures for the other connector sets and as no significant differences were found. These results have not been plotted.



**Chart 2:** Total & the 5th and lower harmonic distortion - averaged for ten new connector sets - each having 100 contact pairs.



**Chart 3:** As above - after exposure for a period of 31 days disconnected (with card edge contacts exposed) and 31 days connected.

**Chart 4:** *As above - after treatment with Stabilant 22*

## Conclusions

The tests demonstrate that Stabilant 22 has a significant effect in lowering the harmonic distortion in connectors. Furthermore, the tests demonstrate that the use of Stabilant 22 apparently overcomes the discontinuous conduction effects of films and particulate contaminants in connectors. The test demonstrated that this discontinuous effect produced a high proportion of high order harmonics.

## Comments:

In audio systems, high order harmonic distortion is held to be much more easily distinguished, and therefore is considered much more critical than lower order harmonic distortions of the same order of magnitude. The use of the Stabilant reduced this high order distortion through the apparent mechanism of reducing the amount of what might be termed 'contact rectification' which was taking place within the connection means. As noted, the ear has been found to be quite sensitive to these higher order harmonics, the subjective effect ranging from 'grainy' to 'glassy' depending upon the level of this distortion present in the signal. In applications such as commercial recording consoles where the signal path involves a great number of connectors, the potential for degradation of the signal is particularly high. When it is considered that the connectors employed in the test were brand new, and that the period of sixty-two days produced a significant increase in the measured distortion, the potential for this type of signal degradation on equipment that has been in use for several months to several years is very significant.

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## NATO/CAGE Supplier Code 38948

- 15 mL of Stabilant 22A (isopropanol diluted) has NATO Stock # 5999-21-900-6937
  - 15 mL of Stabilant 22E (ethanol diluted) has NATO Stock # 5999-21-909-9984
  - 15 mL of Stabilant 22 (non diluted) has NATO Stock # 5999-21-909-9981
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The Stabilants are patented in Canada - 1987; U.S. Patent number 4696832. World wide patents applied for. Because the patents cover contacts treated with this material, a Point-of-sale License is granted with each purchase of the material.

## **SAFETY DATA SHEETS ARE AVAILABLE ON REQUEST**

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[HOME PAGE](#)

[COMPANY AND CREDO](#)

[LISTING OF SDS's AND NOTES](#)

[BEGINNING OF TECHNICAL NOTE 24](#)