

Jörg Fochtmann

Non-destructive Quality Control of the Contact Normal Force in Electrical Connectors: A Sensor and System Approach

**Non-destructive Quality Control of the Contact Normal Force in Electrical
Connectors: A Sensor and System Approach**

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Gutachter Prof. Dr. rer. nat. Bertram Schmidt

 Prof. Dr.-Ing. Ulrike Steinmann

 Prof. Dr.-Ing. Sören Hirsch

Weiteres Mitglied Prof. Dr.-Ing. Roberto Leidhold (Vorsitzender)

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Jörg Fochtmann

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„Erschd de Orbeed, dann es Vergnüschn!“

Phrase and Thinking in deepest Saxony

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Jörg Fochtmann, December 2018

Zusammenfassung

In dieser Arbeit wird eine Vorgehensweise zur Messung der Kontaktnormalkraft an verschiedenen Kontaktpunkten in elektrischen Steckverbindern vorgestellt. Basierend auf den Anforderungen in der Produktion von Steckverbindern und der nachfolgenden Qualitätskontrolle werden Spezifikationen für Sensoren und entsprechende Messvorrichtungen abgeleitet. Daraus folgend entstehen geometrische Designs für verschiedene Steckverbindergrößen und die Erarbeitung eines Modells für die sensorischen Elemente. Im Modell wird die Einstellung des Arbeitspunkts, die Einstellung der mechanischen Spannungen und die Position von Sensorelementen erarbeitet, um eine ausreichende Sensitivität zu erreichen und dabei die Bruchanfälligkeit gering zu halten. Anhand der abgeleiteten geometrischen Abmessungen für die Fertigung, werden MEMS-Prozesse ausgewählt, die zur Bearbeitung und Herstellung der auf Silizium und Metall bestehenden Sensoren dienen. Das Ergebnis eines gefertigten Sensors wird dabei näher erläutert und die Aufbau- und Verbindungstechnik vorgestellt. Anschließend ist die Anbindung des Sensors an eine Datenakquiseeinheit notwendig, wofür eine entsprechende elektronische Lösung erarbeitet, untersucht und vorgestellt wird. Zusammen mit der entwickelten Software bietet diese eine universelle Umgebung zum Einsatz in den zwei Systemvarianten. Diese Varianten bilden die Umgebung zur Verifizierung der Eignung des Sensors als Messmittel in der Kontaktnormalkraftbestimmung. Hierzu werden Messfähigkeitsuntersuchungen angestellt und die Ergebnisse ebenfalls erläutert. Zusammenfassend werden die Verfahren verglichen, Charakteristika der Sensorgeometrien anhand von Kennlinien beschrieben und ein Ausblick in Richtung Aufbau einer Kleinserie gegeben.

Abstract

This work presents a procedure for measuring the contact normal force at various contact points in electrical connectors. Both, the production of connectors and the subsequent quality control lead to specifications for sensors and corresponding measuring devices. This results in geometric sensor designs for different connector sizes and the development of a model for the sensor elements. In the model describes the behavior of bias point, mechanical stresses and the position of sensor elements in order to achieve sufficient sensitivity while keeping the susceptibility to breakage low. Based on the derived geometrical dimensions for fabrication, requires a favourable selection of MEMS processes to fabricate the silicon and metal components. The work describes the obtained results for the manufactured sensors in more detail and presents the packaging technology. Subsequently, the connection of the sensor to a data acquisition unit is necessary. The development and characterization for the corresponding electronic solution are explained. Together with the developed software, this offers a universal environment for use in the two system variants. These variants form the environment for verifying the suitability of the sensor as a measuring means in the contact normal force determination. For this purpose, measuring capability investigations provide results supporting the feasibility of the approaches. Finally, a comparison of the procedures, devices and sensor characteristics build the basis towards an outlook of a small production series.

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