Multipoint calibration with a third order regression for the Hybrid III Family Chest Potentiometer
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Recommendation for the data exchange

1. Polynomial Calibration

For EuroNCAP tests using the Hybrid III Family the chest potentiometer calibration has to be performed according SAE J2517 Rev. SEP2006.

SAE J2517 of September 2006 specifies a multipoint calibration with a third order regression to correct for the nonlinearities of the system (polynomial calibration).

The relation between the sensor output readings S [mV/V] to the displacement values D [Unit] is given by the following equation:

(1) $$D_{Poly} = A * S^3 + B * S^2 + C * S + M$$

where

D_{Poly} is the actual displacement in [Unit] from polynomial calibration
S is the sensor output reading in [mV/V]
A, ***B***, ***C*** and ***M*** are the calibration coefficients

2. Linear Calibration

The conventional linear calibration (SAE-J2517 June 2000) is performed according to the following equations:

(2) $$D_{Lin} = S^* * b - D_{Offset}$$

where

D_{Lin} is the actual displacement in [Unit] from linear calibration
S* is the sensor output reading in [mV/V] after the electrical offset compensation prior to the test
b is the inverse sensitivity in [Unit /(mV/V)]
D_{Offset} is the physical offset correction done after the test (**offset post test**)

and

(3) $$S^{*} = S - S_{Offset}$$

where

S	is the sensor output reading in [mV/V]
$\boldsymbol{S_{Offset}}$	is the electrical offset correction done directly before the test (**offset pre test**)

3. Recommendation for the data exchange

For the data exchange the values of sample are the balanced values calculated with the linear calibration method $\boldsymbol{D_{Lin}}$. The channel code has to be **`??CHST0000H3DSX?`** for the 50th percentile male Hybrid III dummy**.** In addition to the header information according ISO 13499 (MME version 1.5) the following descriptors have to be added:

Field Descriptor	Data format	Remark
`Inverse sensitivity`	`float`	`b in Eq.2 [Unit / Sensor output]`
`Inverse polynom coeff A`	`float`	`A in Eq.1 [Unit /(Sensor output)^3]`
`Inverse polynom coeff B`	`float`	`B in Eq.1 [Unit /(Sensor output)^2]`
`Inverse polynom coeff C`	`float`	`C in Eq.1 [Unit /(Sensor output)^1]`
`Inverse polynom coeff M`	`float`	`M in Eq.1 [Unit]`
`Offset pre test`	`float`	`S offset in Eq.3 [Sensor output]`
`Offset post test`	`float`	`D offset in Eq.2 [Unit]`

The unit used for the coefficients has to be equal to the unit of the data values of the linear calibrated channel.

The new descriptors are optional as a complete group, but mandatory completely whenever one of them is used.

With these additional information it is possible to calculate the polynomial displacement values $\boldsymbol{D_{Poly}}$ from the linear displacement values $\boldsymbol{D_{Lin}}$ according equation (1) with

(4) $$S = \frac{D_{Lin} + D_{Offset}}{b} + S_{Offset} \quad .$$

4. Recommendation for the data storage

If it is necessary for storage or illustration to use both kinds of calibration at the same time, the polynomial calibrated data has to be marked by the value 03 in the FineLocation2 of the channel code e.g. **`??CHST0003H3DSX?`.**