Electronic Transducer Identification Using TEDS

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1 Introduction

TEDS (Transducer Electronic Data Sheet) is a technology that enables all major characteristics of a transducer to be electronically stored inside it.

For this purpose, a microchip has been integrated in the transducer which provides the amplifier with a unique ID and all major transducer characteristics. The actual measurement signals still are the customary analog signals, for example voltage ratio with strain gage full bridge transducers or analog voltage. An appropriate amplifier automatically converts the digital transducer characteristics into the correct parameter configuration. Just connect the transducer and start measuring immediately.

The IEEE 1451.4 standard defines the TEDS data format and protocol. It's up to the manufacturers of transducers and amplifiers to provide for technical implementation.

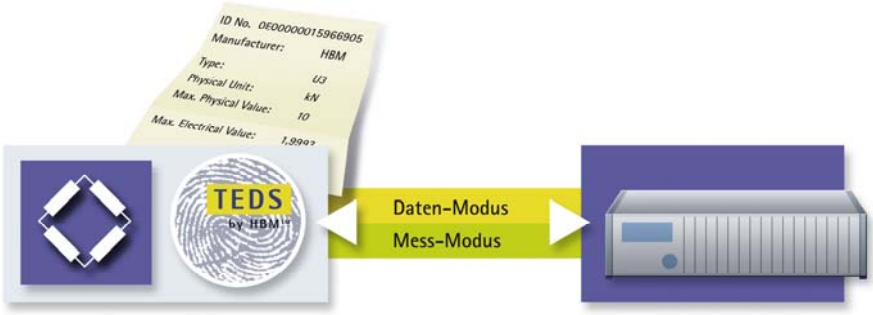

Fig. 1: TEDS provides the amplifier with digital transducer characteristics

2 Benefits and fields of application

In general, every test and measurement engineer benefits from TEDS, because when using TEDS, configuring the measurement chain becomes easier and faster. These benefits become even more apparent with frequently changing measurement configurations and tasks or if many channels are connected. Such conditions occur, for example, in development laboratories or at service providers carrying out measurements at their customers' premises.

For other applications, increased protection from measurement errors presents the major argument for using TEDS. Mobile testing in automobile development is a prime example.
TEDS enables transducers to be quickly and easily installed or replaced without the need for a test and measurement specialist being on site. This is clearly beneficial, for example, for maintenance in process control and monitoring applications. Thanks to TEDS, there is no need for the service engineer on site to deal with amplifier configuration in detail.

3 Standard

TEDS is defined in the IEEE 1451.4 standard published at the end of 2004. HBM was actively involved in the development of the standard in cooperation with other renowned manufacturers like Brüel & Kjaer and Endevco. Participation in the drafting of the standard gave HBM a time advantage for successfully implementing TEDS in its products.

4 The TEDS application philosophy

The TEDS chip saves only the data that describes the transducer as such. The amplifier performs the task of deriving and making adequate amplifier settings from the transducer data. Therefore the transducer works electrically correct and enables immediate measurement in the correct units. It must be pointed out that the TEDS data does not include specific setup parameters for the amplifier to be connected or the actual measurement task. This is to ensure interchangeability between various transducer types of different manufacturers.

Narrowly interpreted, this concept sets boundaries for TEDS options. Thus, saving parameters set by the user according to the respective measurement task is not intended. Such parameters may include, for example, filter settings or simply a suitable name for the measurement channel.

However, TEDS provides users with optional add-ons for these purposes. For example a “measuring point number“ that is included as a field of the basic template required for every TEDS transducer. TEDS provides other add-ons in the form of self-contained templates enhancing the functionality described in the standard to comply with manufacturer-specific requirements. For example, HBM offers a template which enables users to store different signal conditioning parameters in the TEDS memory such as zero offset or filter settings.

What all these add-ons have in common is that the user can and has to provide them with reasonable data content. An advantage of HBM transducers with TEDS is that those including additional information, too, are compatible with TEDS amplifiers that master the standard-compliant basic TEDS functions only.

5 The technical implementation

The so-called Dallas chip, supplied by its manufacturer Maxim especially for compliance with the IEEE 1451.4 TEDS standard, is used as a memory chip for virtually all TEDS transducers, independent of the manufacturer. It includes the writable memory and, in addition, a permanently written serial number that is worldwide unique.

It implements the one-wire protocol defined for TEDS data in the IEEE 1451.4 standard, i.e. data transfer requires, on principle, one data line and one ground line only. However, the standard does not specify any permanent presettings but only makes some proposals for connection.

5.1 Connection to separate cable cores/pins

The variant that is the first that suggests itself is to use two additional cable cores or pins for transmitting TEDS data. This means, however, that the required number of connector pins or cable cores is increased. At least 8 cable cores are required for a strain gage transducer in full bridge circuit and 6-wire configuration.

Main benefits:
Extremely easy and budget-priced circuit that does not require any additional intelligence or circuitry
Maximum guarantee for interchangeability of transducers and amplifier of different manufacturers through use of additional cable cores

HBM supports TEDS connection to separate cable cores primarily for reasons of compatibility – especially with transducers of other manufacturers. For upgrading transducers with TEDS, this method enables a particularly convenient and cost-effective solution to be implemented in all cases where the TEDS chip can be integrated in the amplifier plug. Such a solution requires a plug that offers enough space and, above all, two separate contacts (pins) for TEDS. It goes without saying that this method of retrofitting only makes sense, if the cable is permanently connected to the transducer and not by pluggable connectors with the risk of accidentally interchanging it with the cable of another transducer.

5.2 The HBM circuit (“zero wire technology”)

This circuit (patent pending) does not require any additional cables for transmitting TEDS data. The same cables are used for transmission of both TEDS data and analog measurement data. This is

possible thanks to intelligent switching between analog measure mode and digital identification mode. The one-wire protocol is still used for data transmission. The TEDS module is the unit comprising the switching mimic and the actual memory chip. It comes as a small PCB.

Benefits of the HBM circuit:
No additional cable cores required through use of special HBM technology (patent pending), reduced effort, compatibility of TEDS components and conventional technique, because connectors and cables are identical. TEDS can be used with any conventional extension cable (also for transducers retrofitted with TEDS).

The principle can be used for all transducer types with feedback, for example strain gage transducers in 6-wire configuration, inductive transducers and PT100 resistance thermometers.

Fig. 2: TEDS board from HBM

All modern HBM transducers providing TEDS as standard use zero wire technology. All TEDS-compatible amplifiers from HBM support this technology. It does not require any additional cable cores or connector pins and therefore provides ideal flexibility for combining TEDS with any desired connector or cable solution.

5.3 TEDS wireless - for special requirements

In some special cases, neither the HBM circuit nor the TEDS circuit to separate cable cores can be implemented. This is the case when no additional cable cores can be provided or no existing ones can be used. In these cases, wireless signal transmission can be used for transmitting TEDS data from the transducer to the amplifier. The content of the TEDS memory is structured in compliance with the IEEE standard. However, the transfer protocol used is determined by the transmission technology and not by the standard that defines the one wire protocol. This applies for two devices from HBM's current range of products:

The MX1609 QuantumX module is an amplifier for thermocouples with standard connector. An RFID transponder, similar to the identification chip in the car key that deactivates the electronic immobilizer, is integrated in the connector. This enables TEDS to be implemented and, at the same time, full compatibility with systems without TEDS is ensured. Standard connectors without transponder can also be used in the MX1609 (and, except for the TEDS function, the measurement chain is fully functional). Vice versa, connectors with TEDS transponder can be used with conventional amplifiers for thermocouples.

With the T12 digital, contactless torque flange, digital information is exchanged between rotor and stator anyway. In this case, TEDS data and measurement signals are transmitted and received through the same channel.

6 Upgrading transducers with TEDS

Most new transducer types from HBM come with TEDS as standard. For this purpose, a TEDS module is integrated in the transducer housing. Examples include pressure transducers from the P2V and P3 families, U10M and U15M (TEDS optional) force transducers, and U93 and Z30A.

Fig.3: HBM transducers with integrated TEDS (from left to right: P2V, U93, Z30A)

Transducers that do not come with TEDS already integrated in the housing can be upgraded by integrating the TEDS module or TEDS chip into the connector or cable. In this case, it is prerequisite that the cable is connected to the transducer permanently and not by a connector.

Fig. 4: WA displacement transducer with TEDS integrated in the connector

U3 force transducer with TEDS integrated in the cable