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Frequently Asked Questions About TEDS

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1. What is TEDS?

TEDS, “Transducer Electronic Data Sheet”, is nonvolatile memory within a sensor utilized to store information. The sensor manufacturer uses this memory to store initial sensor information such as manufacturer name, sensor type, model number, serial number and calibration data. The sensor operates in a “mixed mode,” i.e. analog or digital fashion. In the digital mode, the information stored in memory can be downloaded. In the analog mode, the sensor functions normally as a measurement device.

2. What are the benefits and overall reasons for the creation of TEDS?

TEDS was created with a vision of “plug and play” for sensors. There are several compelling reasons, but the two most significant are:

1.) Rather than depending upon printed calibration certificates, TEDS allows for sensitivity data to be read directly from the sensor.
2.) With large multi-channel test systems, TEDS automates channel bookkeeping, eliminates cable tracing, simplifies troubleshooting and greatly reduces the potential for errors or confusion.

3. Is TEDS an approved standard?

Yes, TEDS is described on **IEEE Std 1451.4™ - 2004** - IEEE Standard for a Smart Transducer Interface for Sensors and Actuators - Mixed-Mode Communication Protocols and Transducer Electronic Data Sheet (TEDS) Formats.

For universal applicability, the architecture of this technology has been defined on the IEEE 1451.4 standard. By conforming to the standard, a TEDS sensor is capable of being addressed by any TEDS signal conditioner or data acquisition system, regardless of manufacturer. You can find out more information from the following website: http://standards.ieee.org/regauth/1451/FAQs.html.

4. What is the “state of the union” for TEDS?

Historically, TEDS sensors have been manufactured and shipped by PCB Group and other sensor manufacturers. From 1999 to 2004, TEDS were created following a pre-ballot version of the standard that became known as P1451.4 or simply TEDS v0.9. The preliminary standard defined 25 ‘templates,’ numbered 0-24 which identified the content and memory organization for specific transducer applications (accelerometer, microphones, charge amplifiers, etc). Additionally, the standard incorporated a mechanism for manufacturers and users to define their own templates, allowing for custom TEDS applications. The v0.9 templates utilized only the RAM portion of the TEDS memory.

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It wasn't until 2004 that the TEDS standard was finally approved and sensor manufacturers began making and shipping sensors per IEEE 1451.4 templates or TEDS v1.0. The revision introduced 19 new IEEE defined templates numbered 25-43. Some of these templates consolidate information that was previously defined by several preliminary templates (e.g. the new accelerometer and force transducer template, 25, can accommodate information that was contained before in preliminary templates 0, 1 and 24). The standard's new templates also expanded the scope of the application to other transducers such as bridge sensors (33), thermocouples (36), etc.

5. What is The Modal Shop's progress on TEDS?

The Modal Shop offers products and software to support the use and deployment of TEDS transducers. TMS supports IEEE 1451.4 templates (also referred as version 1.0) as well as IEEE preliminary templates (also referred to as IEEE P1451.4, version 0.9). These include IEEE transducer templates numbered 0 to 28, as well as manufacturers' templates such as the geometry formats (automotive and aerospace) established by LMS International. For more information, please visit The Modal Shop's web site at www.modalshop.com.

6. What is the rest of the industry doing on new TEDS?

All major piezoelectric sensor manufacturers are progressing towards support of the IEEE 1451.4 standard. Many data acquisition system manufacturers are also supporting the 1451.4 standard. Progress is primarily customer driven and proceeds at various rates within individual companies. Therefore not all devices can read all TEDS sensors. Users should check with their sensor vendor on what sensors are available with TEDS capabilities, in addition to checking with the analyzer / software vendor to see what transducers and templates are supported.

7. Can I keep my P1451.4 (v0.9) version TEDS?

Yes, there is no reason, if you have a functional system, to update the sensor's template format. Make sure that when you order new transducers you specify in which format (P1451, LMS, or 1451) or template number you wish your TEDS to be written. What is important is to maintain compatibility with your data acquisition and calibration software. It does NO GOOD to purchase sensors with new formats or upgrade transducer formats if your DAQ software will not read these formats.

8. Is there anything like version compatibility?

This is dependant upon the data acquisition system. Traditional analyzer and data acquisition manufacturers often do a good job supporting legacy TEDS sensors (v0.9) as well as new sensors compliant with IEEE 1451.4. Although rare, hardware and software compatibility issues have been reported. Even systems from manufacturers that claim full TEDS support may require the system's firmware or software to be up to date to assure compatibility or bug free operation.

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9. What about the software for my PCB power supply and signal conditioner that reads TEDS?

The 440 Series Modular Signal Conditioners software has been updated to support IEEE templates 0-28. Most other signal conditioner products that read TEDS are also capable of v1.0 operations. Please contact your local PCB representative with questions or for more details.

10. What about my data acquisition system's software that reads TEDS?

Consult your data acquisition system supplier about the format they support and version compatibility.

11. If I want to program a TEDS sensor, what are my options?

The Modal Shop's 400B76 TEDS interface software kit allows you to read from a sensor's current format and rewrite it. Another option is to return your sensor to the factory or The Modal Shop's calibration facility and specify that you wish to have the TEDS format upgraded to IEEE1451.

12. What products are available to help me?

The Modal Shop currently offers the 400B76 product. This TEDS sensor support kit is designed to provide full TEDS sensor read/write capability from a PC interface. It includes software and dongle hardware.

13. Who should I contact if I have questions on TEDS?

You can contact your sensor manufacturer, your data acquisition system manufacturer or an application engineer at The Modal Shop. You can also find information from the following website: http://standards.ieee.org/regauth/1451/FAQs.html.

14. Roughly how many people are using TEDS?

Since 1999, more than 100,000 sensor channels supporting TEDS have been deployed. Mainly accelerometers and microphones, these sensors are being used by thousands of customers worldwide. TEDS has also been included with force sensors, impedance heads, impact hammers and pressure transducers. Many major data acquisition vendors currently support TEDS sensors within their hardware and software, including National Instruments, LMS, B&K, VTI Instruments, Oros, m+p international, Data Physics and many others. The current sensor manufacturer ID list is at: http://standards.ieee.org/regauth/1451/manufacturerID/Public_Listing.html.

15. What are some compelling examples of TEDS success?

The NVH laboratories at Daimler in Germany and the Honda R&D North America facility in the USA are two examples in the automotive industry. They use hundreds of TEDS transducers to minimize equipment setup and cabling time.

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A good example in the aerospace industry is ATA Engineering in southern California. The former SDRC research and consulting group outside of San Diego, ATA is recognized as a leader in large channel, modal/GVT and experimental testing and has published several application notes and conference papers on the implementation of TEDS in large multi-channel test systems.

16. Are there any "mistaken" applications of TEDS?

The best example of mistaken but useful application of TEDS is TEDS in a tube where PCB offers an in-line TEDS in a tube model 070A70 and 070A71 to retro-fit legacy ICP sensors. As long as the sensor and the 070A70 (or 070A71) unit stay together/mated, there is no problem. It can be a highly useful and inexpensive solution. On the other hand, if in-line TEDS in a tube units are swapped, problems can result. Strictly speaking, this is an example of misuse of the TEDS standard and intent given the capacity to separate the digital memory from the analog sensor it identifies, opening greater potential for human error in sensor bookkeeping.

17. Sensor vendors are onboard, but is it a standard with all data acquisition manufacturers?

Most analyzer manufacturers in the sound and vibration community now support TEDS in their front-ends and data acquisition cards. That includes support for accelerometers, microphones, hammers, impedance heads, etc. Recently we have seen more and more data acquisition support for load cells with TEDS. Please contact the data acquisition system manufacturer of interest regarding specific TEDS support capabilities.

18. What TEDS formats are available for a particular sensor?

It depends on the sensor. Contact the sensor manufacturer and ask what TEDS templates are available at the time of order. For accelerometers, the IEEE1451 (template 25) is normally the default, if not the only, choice. TEDS Accelerometers programmed with the P1451 (template 0) or LMS formats may also be available. Again make sure the format ordered is supported by the data acquisition software that will be used with the setup.

19. What type of access to the TEDS information is available with my data acquisition system?

Data acquisition system manufacturers have typically implemented support to read TEDS sensors. Many have not implemented write capability within the data acquisition system hardware and software. It is recommended to contact the data acquisition manufacturer directly regarding this capability. If the data acquisition system provider does not support write capability, products exist, like the 400B76 from The Modal Shop, that allow in-field configuration of TEDS content.

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20. I am a data acquisition manufacturer. How do I add TEDS support to my system?

If you are looking for starting point, we suggest visiting the Dallas/Maxim 1-wire website for tools. The Modal Shop offers software libraries (model KTEDS005) available to support your custom TEDS capabilities.

21. What can I write in my TEDS? What are the formats / their use / specific content benefits of each format?

You can find out more information from the following website: http://standards.ieee.org/regauth/1451/FAQs.html.

22. What is the front-running application for TEDS?

High channel count modal testing is one of the most obvious and direct benefactors of TEDS. Customers who have TEDS spend much less time tracing sensor cables and entering sensitivity data and geometry, as the information is stored directly on-board the transducer. Depending upon the format chosen and its implementation within the data acquisition system, TEDS sensors can be programmed with sensitivity, measurement location, and/or geometry information. Then, at data acquisition time, the application software can query the sensor and determine what measurement location is actually connected to what channel of the data acquisition system.

23. Can I change the contents of TEDS? RAM

Yes. The 400B76 from The Modal Shop allows full read/write capabilities of RAM sessions for TEDS memory and support templates 0 to 28. Most calibration systems (for example, The Modal Shop's 9155 system) are capable of updating the calibration section of the TEDS.

24. Can I change the contents of TEDS? ROM

No, once it has been written, it is permanent. TEDS data that follows the defined IEEE 1451.4 format of manufacturer, model, version letter, version number and serial number, is written by the sensor manufacturer, is permanent, and cannot be changed.

25. Can I change the format of TEDS?

Yes, it is possible to change between different templates. For sensors programmed using the preliminary formats (P1451, TEDS 0.9 or LMS private version) all information can be completely reprogrammed as needed. For IEEE 1451.4 compliant sensors (TEDS 1.0), template format and calibration related information can be changed. Basic TEDS information (manufacturer, model, version letter, version number, and serial number information) once written (typically by the sensor manufacturer) is permanent and cannot be changed.

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26. Is there any databasing ability with TEDS?

Not explicitly defined by IEEE1451. This is a function of an external data acquisition system or user software.

27. Is there any capability for a customer to create a sensor database?

This is specific to the data acquisition application software. The Modal Shop's 440 series signal conditioner and 400B76 software can export to CSV format or text format files, compatible with database software. Some data format conversion may be necessary.

28. Is there a database of all template formats?

You can find out more in the TEDS Template List by clicking this link, http://www.modalshop.com/filelibrary/TEDS%20Template%20List.xls, or from the following website: http://standards.ieee.org/regauth/1451/FAQs.html.

29. What about the NI virtual TEDS database?

Refer to the National Instruments website www.ni.com for further information.

30. How long does TEDS take (read RAM-write RAM-read ROM-write ROM)?

The basic node of a TEDS part consists of 256 bits, communicated at 10-100k bits per second, so much less than 25ms per sensor. The communication speed is actually data acquisition system dependent, but up to 100k bits per second is normal. Some data acquisition systems require 0.5s "settling" time when switching between analog (ICP® or IEPE) and digital (TEDS) modes.

31. How long does TEDS take, in practical terms, on a multi-channel system?

This is a complicated question and depends on the degree of "parallelism" in the multi-channel system hardware, as well as its communication interface to the host PC. For example, The PCB 440 series multi-channel ICP signal conditioning system consists of 16 channel modules, up to 8 modules per rack. The 440 software reads the TEDS information in channel pairs in parallel across all modules in the rack. Therefore, this system reads 16, 32, up to 128, with the same speed, less than 1 minute per rack. The time to read TEDS data ultimately depends on the system.

32. How is TEDS technology integrated with ICP sensors

The TEDS memory circuit is built into the ICP® sensor alongside the conventional signal conditioning circuitry. This memory is comprised of 64+64+256=384 bits of memory. The first 64 bits are programmed at fabrication time and include an 8 bit family code and a 48 bit address code. The next 64 bits are the "write once" or PROM segment that is programmed by the sensor manufacturer. This segment includes information such as manufacturer name, model number, and serial number. The next 256 bits are the Electronically Erasable Programmable Read Only Memory segment, or EEPROM, which can be programmed by the user to include information such as

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location, orientation, sensitivity, last calibration date, etc. A diode isolation scheme facilitates the switching between the ICP® sensor circuit and the TEDS circuit. When the sensor is forward biased, with its conventional positive excitation voltage, it will function as a normal measurement device and output its analog measurement signal. When the sensor is reversed biased, i.e. exposed to a negative voltage, the TEDS memory becomes accessible. The TEDS signal conditioner serves to generate the reverse bias, or negative going voltage pulses. These pulses interrogate the memory whose content is then transmitted via the same two wires, back to the signal conditioner or to the data acquisition system. The data is then available within the application software for viewing, printing or archiving in a typical spreadsheet or database fashion.

Being quite small, the TEDS circuitry adds little to the weight of the sensor and as such will not degrade sensor performance. This also permits the TEDS circuitry to be added to virtually any ICP® sensor. Excluded are only the smallest sensors where there is simply no additional space to accommodate TEDS.

33. What memory chips are supported?

The Modal Shop's 400B76 TEDS interface software now supports three commonly used memory chips: the DS2430A, DS2431, DS2433, DS24B33, and DS28EC20.