

**Measuring for the blue helmets:  
Explosion experiments have tough specifications**



**The Wehrtechnische Dienst 91 ( "Army Technical Service 91") in Meppen Germany**



**is one of ten technical or scientific departments responsible for testing defense technology and procurement. It has a long history dating back more than 125 years, even before the beginning of the artillery range built by the Krupp company in 1887 for the King. Currently its responsibilities include the examination and testing of weapons, munitions, and armored vehicles of any form. A large tract of land in Emsland serves as ideal stage for the explosion experiments on tanks, mine hunting, and medical vehicles as well as on buildings. This large area is an especially hard criteria to fulfill for the measuring technology.**

In regard for the new peace keeping and peace assurance missions in crisis regions of the German Army as dictated by the UN is a vehicle's tolerance to mines used in these operations of special importance for the WTD 91.



Explosion experiments on tanks and other military vehicles.

The possible effects on the occupants are investigated. Dummies and seats with sensors to record the forces and accelerations are used to this end. The dummies used are similar to those used in the familiar crash test dummies for automobiles but more robust and even more pumped full of sensors.



Possible repercussion to the inmates in terms of forces and acceleration are measured and evaluated with help of dummies.

From the data a so called “Dynamic Response Index” is calculated, which can then be compared to ergonomic limits. The measurement challenge for these experiments lie in the extremely small time resolution and the number of simultaneous channel required. The measurement duration is typically only 60 milli seconds, but can also last up to 2 seconds. The sampling rate and number of channels needed: 1MHz per channel (1 million sample per second) and 32 channels. Because the object to be measured is often destroyed and due to



the cost can not be repeated, it is of great importance the system have a high redundancy and data security. The measuring device are kept in safe container at a secure distance during the experiment, which implies a difficult and laborious cabling with lengths of up to 100 meters.

Using the LTT-186 the WTD has a new means to satisfy their demanding measurement specifications.



LTT-186-Frontends for Data acquisition and processing with 16 channels per unit are cascable up to 256 channels.

The transient recorder from the Würzburger specialists for fast measurement techniques broadens the conventional PC supported systems into areas not yet reached. A single recorder offers 16 differential analog inputs and 16 digital inputs (TTL). Because the recorders can be cascaded together a synchronised system of several hundred channels is possible. Separate AD converters and amplifiers assure a simultaneous sampling for every channel and a channel individual amplifier allow for input ranges from 1V to 500V. The possible sampling rate per channel is from 1kHz to 2.5MHz at 16bit up to 20MHz at 12bit. Each input has an adaptive anti-aliasing filter.

A patented SCSI-II interface serves as connection to the PC. Using an off the shelf SCSI-Firewire converter allows for Firewire connections. The device itself needs no device driver and is immediately usable after it has been turned on. The internal hard disk is automatically recognized by Windows as just another hard disk thus allowing for direct access to the recorded data by arbitrary software. Included in the flash memory of the device is software for configuration of the LTT-186 including type of measurement (simple or ring), trigger options (pretrig, pre and postrig clock, level, level & slope, etc) , time reference (external or internal). Up to 16 different measurement configurations can be stored for the Stand-Alone Operation. Of course when connected to the PC the data can be viewed online and manipulated.

The measured data is saved either to a high speed ram (128MB) or to the integrated, shock proof 8 GB hard disk. Due to the redundancy specification the WTD uses always 2 separate systems. Which means for a 32 channel system 2 groups of 2 LTT-186 will be used. The first system runs in transient mode and is triggered automatically using a digital input and the second system is triggered manually using the either the start button or per mouse click. The saved data is then analysed over the complete bandwidth of the implemented accelerometers (typically 40kHz) to find an overdrive. Subsequently a digital filter is used for bandwidth limiting of the interpretation of each relevant array.

For the WTD91 engineers the implementation of the new LTT systems meant an improvement in efficiency of their work. Before the experiments were carried out using magnet band recorders which were heavy and the sensitive tapes made storage demanding. The analog signals had to be first digitalized before an analysis could be performed. Additionally the sampling rate was limited to 80 kHz per channel and was pushing hard on the limits of the needed bandwidth. PC card alternatives due to their limited sampling rate and signal bandwidth did not offer the needed flexibility. First the LTT system brought the desired solution and thanks to the online functionality the data using a PC can be immediately verified. This allows for a system check, e.g. cable break, right before the start of the trial and thereby raises the level of redundancy. The data can easily be stored to CDs and is exceptionally easy, saves space, and permits a flexible retrieval of data from an arbitrary PC system.

Andreas Evelt the leader of the measurement group is very satisfied: "The compact and robust LTT devices are light and easy to transport and allow for a substantially increased flexibility. Additionally the cost and maintenance are more economical as our old tape recorders, which in these times of smaller budgets an important factor!"

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