New Acoustic Emission Measurement System AMSY-6

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ABSTRACT

A new multi-channel acoustic emission (AE) measurement system - model AMSY-6 - is described. It is the successor of AMSY-5 and fully compatible to ASIP-2, the dual channel signal processor used with AMSY-5. Several hundred AMSY-5 systems with several thousand AE channels are in world wide use, for pressure vessel testing, tank floor testing, testing of FRP structures, e.g. Formula 1 racing cars and their components, partial discharge testing, and many other applications.

AMSY-6 can be connected to any PC over USB 2.0 "high speed" as easy as a mouse. No access to PC-internals is necessary. There is no longer a need to consider ever changing PC bus systems and operating systems. AMSY-6 works with any current Windows operating system, including Windows 7 in 32 and 64 bit version.

Multiple AMSY-6 chassis can be conveniently paralleled over an USB hub to form one large system without degrading data processing performance. The user can assign any unique logical channel number to each hardware channel by software.

Total data transfer rates of over 40 MByte/s from multiple AMSY-6 chassis have been measured.

The time-counters in paralleled AMSY-6 chassis are synchronized, so location calculation can be made over channels in different chassis. Chassis for housing up to 4, 12 and 38 channels are available.

The usability of AMSY-6 is furthermore enhanced by making many functions interactively available during data acquisition.

Each of 4 or 8 parametric inputs of AMSY-6 is sampled (16 bit) every 50 µs and digitally low-pass filtered and stored according to the requirements of the application.

AMSY-6 can be operated from any place in the world over internet and standard remote desktop.

KEYWORDS:

AE instrumentation

INTRODUCTION

In the European research project CORFAT (Cost effective corrosion and fatigue monitoring for transport products), partly funded by the European Commission FP7 program (Contract SCP7-GA-2008-218637) a need came up to modify the AMSY-5 system for permanent monitoring of a tank lorry carrying explosive goods. Sensors on the tank must be certified intrinsically safe for explosion hazardous zone 1, according to the European ATEX directive (EG94/9). The PC and measurement system must be installed in the driver cabin of the tank lorry, which is classified to a less explosion hazardous area, zone 2.

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During the definition of the needed modifications, the system controller ASyC has been identified as main bottleneck to make AMSY-5 explosion proof. ASyC is an AE dedicated PCI board installed within the PC. We have not found an interface solution using ASyC with an explosion proof PC, so a new interface was developed. In the course of further analysis of the needed modification, we had to decide to consider a number of other details. Finally, we decided to give this modified system a new name, AMSY-6.

REALISATION

Figure 1 - AMSY-6 systems in benchtop cases housing 4, 12 and 38 AE channels

The leftmost frontpanel of each box is called Control Panel (CP1). At two switches the user can enable or disable data recording during measurement. The upper switch disables or enables AE-feature and waveform data recording, the lower switch controls waveform data recording only.

The 4 BNC sockets on CP1 are parametric inputs. The measurement range of each input can be configured by software to ±1 V or ±10 V at 16 bit resolution. Each input is fully differential and the shield as reference input is isolated from ground in order to avoid ground loop disturbances induced by different ground potentials between AE system and parameter source. The differential function is maintained over an input range of ±40V at each input pole. The parametric reference pole (shield) should have a relation with ground of signal source ±30V.

Each parametric input is sampled every 50 µs. All samples during the user-defined acquisition clock, e.g. 20 samples during a 1ms parametric clock, are averaged, what results in a low pass filter that effectively eliminates undesired noise.

All other front panels in Figure 1 belong to AE-signal processors of type ASIP-2. All other BNC connectors are connected to AE preamplifiers. In case of using intrinsically safe sensors, signal isolators act as safety barriers, assuring that voltage, current, power and pulse amplitudes transferred into the hazardous zone are limited as specified in ATEX Standard EN 60079-11 (intrinsic safety). Figure 2 is a simplified block diagram showing the main components of the AE monitoring system.

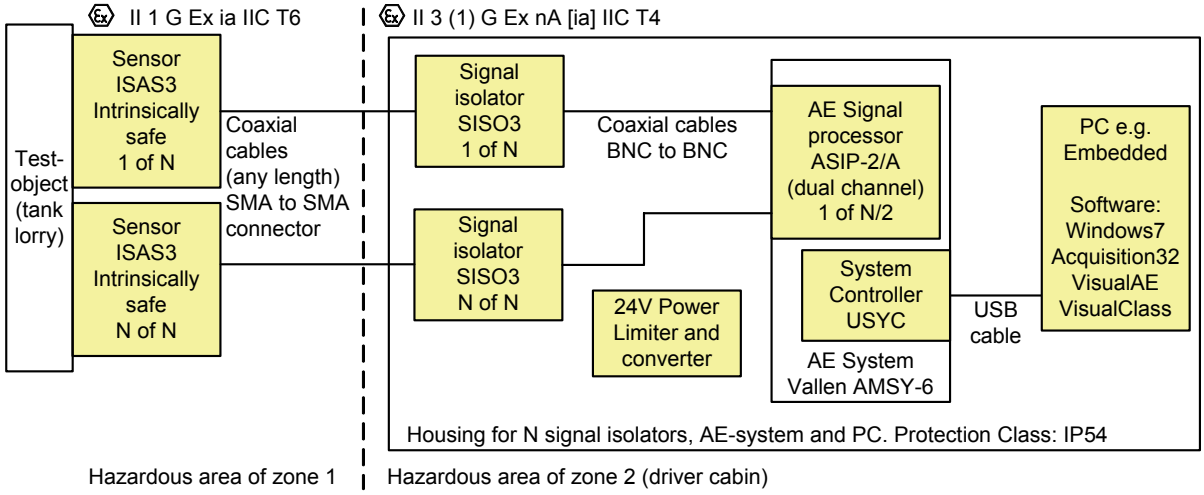

Figure 2 - Simplified block diagram of an AE system for permanent monitoring of a tank lorry

Figure 3 - AMSY-6 MB2 front

Figure 4 - AMSY-6 MB2 rear

Figure 3 shows the front and Figure 4 the rear side of the smallest benchtop chassis AMSY-6 MB2 for 4 channels. This high density box has no internal speaker but offers a connector for an external speaker.

Figure 5 shows the AMSY-6 internal components and the external connections needed to combine multiple chassis into one integrated system. Each chassis offers a "Next Port" and a "Previous Port" for a sequential connection of up to 7 slave chassis to a master chassis for synchronisation of the time counters. As a result precise delta-ts can be calculated from channels in different chassis. Each chassis is identified by a unique address (1 to 8) at the address switch. Each channel in a multi-chassis system can be assigned a unique logical channel number between 1 and 255 by software.

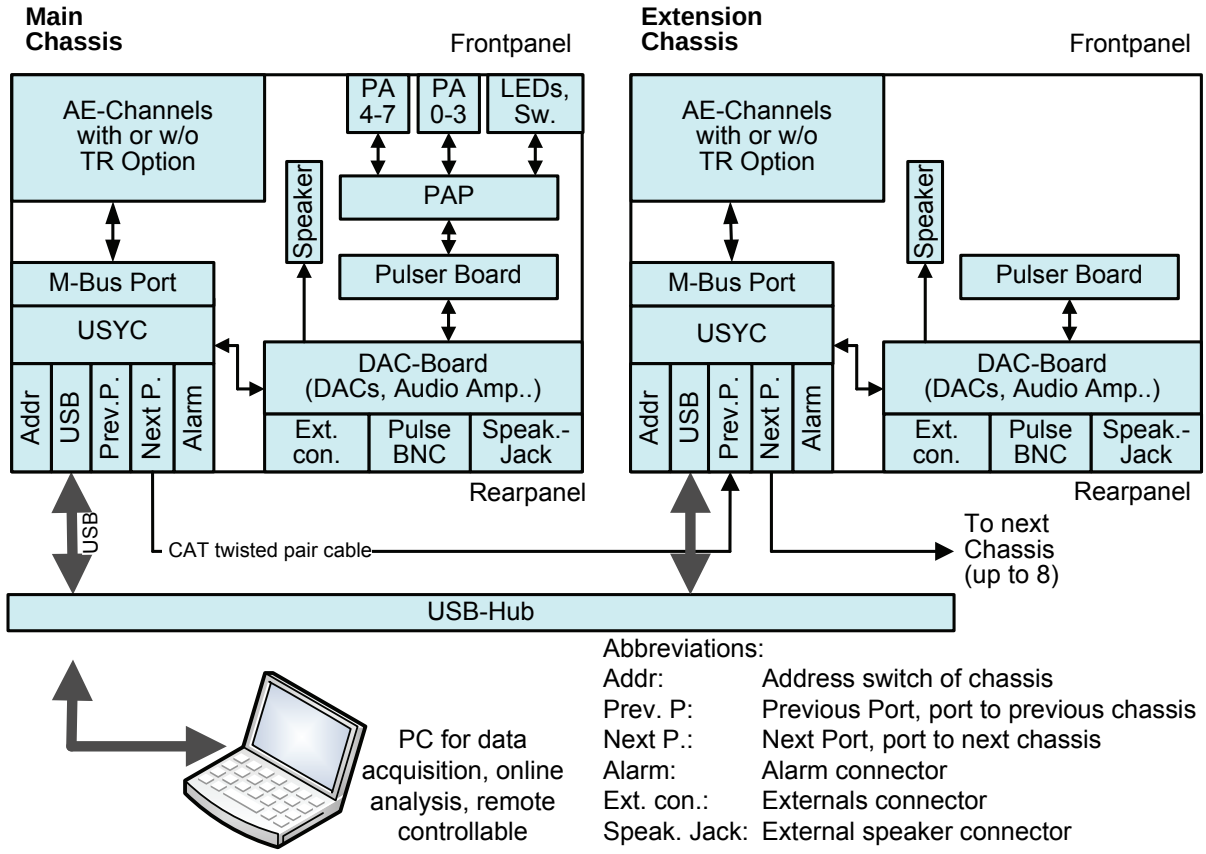

Figure 5 - Internal components of AMSY-6 and external connections of multi-box configuration

AMSY-6 is not limited to permanent monitoring applications. AMSY-6 combines a traditional AE system with feature extraction as requested by several standards and provides in addition waveform acquisition and analysis as well. With streaming options and intelligent streaming filter, it can be used for all types of known AE applications today.

The AMSY-5 software has been expanded to run also AMSY-6 with all well known features, such as separation of data acquisition and data analysis, online data filtering, location calculation with many different topological algorithms as well as clustering. The Embedded Code Processor (ECP) allows the user to implement own analysis routines of any complexity in real time, or transfer any or all data in real time to a user application. In parallel to AE feature acquisition, waveform data can be acquired, stored and e.g. classified by VisualClass-classifier, online as well as offline.

For maximum speed of feature data, waveform data are stored on a separate file. A 38 channel chassis stores over 120.000 hit data sets per channel, time sorted to the PC hard disk. In parallel, it stores up to 6,5MB/s waveform data whereby future optimizations may allow an increase.

Special provisions are foreseen to use AMSY-6 in remote control, from any place in the world over Internet. An Alarm Manager with watchdog capabilities checks ongoing data acquisition, verifies sufficient free disk space, analyzes user defined AE-conditions, and more. In case of a warning or alarm condition, it whistles, sends an email or asserts other actions as defined by the operator. AMSY-6 software can even be configured for automatically resuming data acquisition and data analysis after a reboot.

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