

AMSY-5 System Specification

This document explains the meaning of the part codes used in our quotations, gives outline specifications of the individual system components, and helps to assemble modules to complete system configurations.

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1 Configuration Hints

A complete AMSY-5 system consists at least of

- one master unit (e.g. M6-2, M16-2 or M37-2, including data acquisition software SWACQ)
- one external PC (desktop PC, laptop, industrial grade,...) with monitor, keyboard, mouse
- one ASyC (AE System Controller) PCI interface board, mounted in the external PC
- one cable CBL1-1.5 to connect the ASyC with the AMSY-5
- one or more AE-channels (see below)
- the basic analysis software package SWBN
- optional software for filtering, location calculation, clustering etc. as desired.

A complete AE-channel consists at least of

- one channel of ASIP-2 board (ASIP-2 = **A**coustic **S**ignal **P**rocessor for **two** channels)
- one preamplifier (e.g. AEP3 or AEP4), one AE-sensor, e.g. VS150-M, and cable SEC to preamplifier or an AE-sensor with integrated preamplifier (e.g. VS150-RIC)
- one BNC to BNC cable, e.g. BNC-5M (preamplifier to ASIP-2).

Various options can be chosen as described in this document.

VisualAE, VisualClass, VisualTR, AMS3, AMSY4, ASIP-2 and AMSY-5 are trademarks of Vallen Systeme GmbH, Germany.

2 AMSY-5 Units

- Mxx-2 Master unit, e.g. M6-2, M16-2, or M37-2 (see below), strong metallic bench-top case containing a digital AE acquisition and analysis unit, includes
- Single range power supply, Power Factor Correction
 - Autocalibration Pulser up to 400V_{PP}, adjustable manually and by software menu
 - Audio unit and speaker to play AE-signals from selected (or all) channels
 - Parametric counter PCTD (digital inputs for clock, reset, enable), TTL, up to 100kHz clock
 - Front panel switches: AE record enable/disable, TR record enable/disable, Power On/Off
 - Front panel LEDs: AC On, DC On, AE-disable, TR-disable, External disable, Running, Warning, Alarm, Full, Long, plus 2 spare.
 - Strong connectors at rear side for: power, pulser input/output, ASyC-Bus-in (from ASyC or previous AMSY-5 units), ASyC-Bus-out (to next AMSY-5), External, Warning/Alarm, bus-in: Mini C50 male, bus-out: Mini C50 female
All I/O-lines protected against electrostatic discharge up to 15kV (human body model)
 - Space for 2, 4, or 8 optional parametric inputs, 16 bit (see PB2, PB4, PB8 below)

Together with the ASyC PCI board and a separate PC the AMSY-5 provides data acquisition rates of more than 30,000 hits/s (AE-data), and more than 2.5MB/s TR-data (waveforms), all time sorted, sustained, to hard disk.

An extension unit E20-2 is available for extending the channel number of any AMSY-5 master unit. The extension unit is connected by 2 cables (CBL1-x.x for data, BNC for autocalibration) with the master unit.

Available AMSY-5 Units

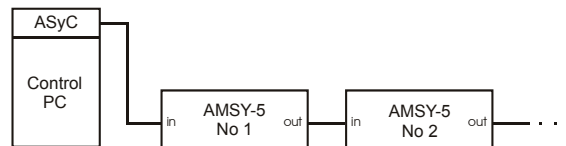
- M6-2 Master unit for up to 6 ASIP-2 boards (up to 12 channels),
size and weight: 25.5 cm width, 15.5 cm height, 38 cm depth, 9 kg fully loaded,
power requirements: 90-250 V_{AC}, 50-60 Hz, 20 VA (no ASIP-2) + 10 VA per ASIP-2 (w TR-2/2GB) + 4.5 VA per preamplifier (saturated output), max. 131 VA
- M16-2 Master unit for up to 16 ASIP-2 boards (up to 32 channels),
size and weight: 47 cm width, 15.5 cm height, 50 cm depth, 17 kg fully loaded,
power requirements: 90-250 V_{AC}, 50-60 Hz, 35 VA (no ASIP-2) + 10 VA per ASIP-2 (w.TR-2/2GB) + 4.5 VA per preamplifier (saturated output), max. 342 VA
- M37-2 Master unit for up to 37 ASIP-2 boards (up to 74 channels),
size and weight: 47 cm width, 28 cm height, 50 cm depth, 34 kg fully loaded,
power requirements: 90-250 V_{AC}, 50-60 Hz, 70 VA (no ASIP-2) + 10 VA per ASIP-2 (w.TR-2/2GB) + 4.5 VA per preamplifier (saturated output), max. 780 VA
- E20-2 Extension unit for an AMSY-5 master unit, for up to 20 ASIP-2 boards (up to 40 channels)
size and weight: 47 cm width, 15.5 cm height, 50 cm depth. 18 kg fully loaded,
power requirements: 90-250 V_{AC}, 50-60 Hz, 35 VA (no ASIP-2) + 10 VA per ASIP-2 (w TR-2/2GB) + 4.5 VA per preamplifier (saturated output), max. 420 VA

Operating Conditions: Temp: +4°C to +40°C; Humidity: 20% to 90%, not condensing.

Combining Multiple AMSY-5, Cable Configuration

One to six AMSY-5 Units can be connected to one ASyC in the PC (see figure below). Up to 254 synchronized AE-channels can work together in such a configuration.

The cable length between ASyC and AMSY-5 unit is usually 1.5m (Cable code: **CBL1-1.5**), between AMSY-5 units it is 0.7m (Cable code: **CBL1-0.7**). The total length of all CBL1-x.x cables at one ASyC must not exceed 1.5m + (5 * 0.7m). Beside of CBL1-x.x, a BNC cable for the distribution of the Calibration Pulse is needed between two AMSY-5 units. With more than two units, up to 4 BNC-T-Pieces are also needed.



3 ASyC AE-System Controller

High-speed PCI data transfer board to be mounted in a PC running under Windows 2000[®] or Windows XP[®].

- Speed:** Transfers over 30.000 AE Hits/s to the PC's hard disk (sustained), time sorted (important for correct online location).
Transfers over 2.5MB/s TR data to hard disk (sustained, time sorted).
- Buffer:** Large (32MB) buffer for efficient scatter-gather DMA transfer. Prevents data loss even under highest traffic on the PCI-bus.
- Flexible:** Supports automatic detection and configuration of the connected AMSY-5 units (single or multiple Master Units, with or without additional Extension Units). Supports user defined channel mapping.
- Reliable:** Very strong external bus-connector (Mini C50 female). All I/O-lines protected against electrostatic discharge up to 15kV (human body model).
- Connector:** The ASyC contains one connector to the outside (50-pole Mini-Centronics, female) for the bus cable CBL1-1.5 to the first AMSY-5 unit controlled by that ASyC.
- Size:** Half size PCI board (155mm x 105mm x 15mm board size inside PC).
- PCI bus:** PCI Local Bus Specification Revision 2.2 or higher (3.3V supply). Specification can be obtained from the PCI Special Interest Group (administration@PCISIG.com).

4 External PC

The AMSY-5 is controlled by an external PC in which one ASyC interface board is mounted. The cable CBL1-1.5 connects the AMSY-5 with the ASyC. Any kind of PC, e.g. desktop, lunchbox, 19" rack industry standard PC can be used, if that meets the PCI2.2 specification. Thereby the system can easily be upgraded to latest PC technology. A notebook can be used in combination with either a suitable docking station (offering one or more PCI slots) or a PCI Expansion.

Minimum:

OS: Windows XP SP3

CPU: Minimum: Intel Pentium 4 / AMD Athlon

RAM: 256 MB (analysis only), 512 MB (including data acquisition)

HDD: 200 MB of free disk space on drive c: for software installation (100 MB required); 1 GB of free disk space for data acquisition, formatted with NTFS.

Recommended:

OS: Windows XP (32 bit) SP3 or Windows 7 (32bit) with Vallen AE-Suite Software release R2011.0509 or later
 CPU: x86-64 Dual Core (AMD / Intel)
 RAM: 2 GB or more.
 HDD: 20 GB of free disk space for data acquisition or more, formatted with NTFS.

Also Supported:

Windows Vista (32bit) with Vallen AE-Suite Software version R2011.0509 or later

Attention: Use the NTFS file system instead of FAT. You can convert a FAT partition on your hard disk with the "Convert" command without data loss. See Windows help, keyword "Convert", for detailed information on how to convert a FAT partition to NTFS.

5 Parametric Inputs

Parametric inputs are used to record values of external parameters, such as load, temperature, displacement, or others, for easy correlation with the AE data. One of the options PBx below can be chosen. PBx is mounted on the Special Feature unit which is part of the Master unit Mxx-2.

- PB2 Two parametric inputs PA0 and PA1, each with the following specifications:
- Isolated front panel BNC-connector for differential input $\pm 100V$ CMV (Common Mode Voltage)
 - Range: $\pm 1 V$ or $\pm 10 V$, switch-selectable at front panel.
 - Over-voltage protection for shield-to-ground isolation: 100V varistor parallel 10nF
 - Over-voltage protection for differential input: 33 V varistor.
 - Input impedance: $120 K\Omega // 330pF @ \pm 10V$ range, $12 K\Omega // 330pF @ \pm 1V$ range.
 - Input filter: 2-pole, 16 Hz or 175 Hz -3dB (jumper-selectable), Butterworth (other frequencies on request). Range selectable by front panel switch
 - Programmable sample rate 100Hz to 5kHz (storage rate while hits arrive)
 - Programmable storage rate 1/10min to 5kHz (storage rate while no hits arrive)
 - 16 Bit analogue to digital converter 10 μ s conversion time.

Parametric input PA0 can also be used:

- to count cyclic loads (e.g. fatigue tests) in PCTA (16 bit) or PCTE (32 bit)
- to separate hits from increasing/decreasing load (needs filter software)
- to control (enable/disable) data recording

PB4 As PB2, but 4 isolated parametric inputs (2x PB2 = PA0 to PA3).

PB8 As PB2, but 8 isolated parametric inputs (4x PB2 = PA0 to PA7).
 Note: PB8 occupies the space of one ASIP-2 board next to the SF plug-in in the master unit.

Up to 8 parametric inputs can be used, even if they are in different but interconnected AMSY-5 master units.

6 ASIP-2: Dual Channel AE Signal Processor

- ASIP-2/S ASIP-2 Standard – dual channel AE signal processor board, (Eurocard plug-in 100x280 mm, 0.32 kg), to be mounted in AMSY-5 Master/Extension Unit. Specifications:
- analog filter 1.6 or 18 kHz (switch selectable) – 2.4 MHz (-3dB)
 - ADC: 40MHz, 16bit (per channel)
 - FIR low-pass 3.6MHz (-6dB), 40MHz clock, 18 bit, for noise reduction, resulting bandwidth after both, analog and FIR Filter: 2.2MHz (-3dB)
 - Digital low-pass (LP) and high-pass (HP) filters, each 8th order Butterworth (@20MSPS),
 - Eight band-pass filter configurations included: 25-45kHz, 25-300kHz, 25-850kHz, 50-300kHz, 50-850kHz, 95-300kHz, 95-850kHz, 230-850kHz, Bypass (wideband option),

e.g. required for System Verification and also recommended for Vallen Sensor Tester (VST)). All filters are selectable per channel

- For more band-pass filter configurations: see option DigBP-2
- Very low system noise: $1.5\mu\text{V}_{\text{RMS}}$, $6\mu\text{V}_P$; (95-300kHz filter, referred to $\pm 100\text{mV}_P$ range at preamp. Input.
- Squarers for True Energy and True RMS calculation.
- TR-recording up to 10MHz (needs one TR-2 module for both channels)
- Calibration pulse through
- Selectable input modes: 28V_{DC} @50Ohm or AC@100kOhm
- Dual Core Feature Extractor with loadable firmware for optimum flexibility. Extracts:
 - feature extraction at 10MHz.
 - arrival time (48bit, 100ns resolution)
 - peak amplitude & threshold (resolution: Maximum(0.375dB; $76.3\mu\text{V}/\text{Gain}$))
 - rise time & duration (resolution: Maximum (200ns; 0.025%))
 - counts (16 bit)
 - cascaded hits, cascaded counts, cascaded energy of the complete hit-cascade
 - flags, indicating a time-out-hit, artificially started hit, calibration hit, and more

when true energy mode is on:

- true energy ($1.8 * 10^{-18}\text{V}^2\text{s}$ resolution, $1 \text{ eu} = 10^{-14}\text{V}^2\text{s}$, RTS*)
- true RMS of noise before the hit ($<1 \mu\text{V}$ resolution RTS*)
- true RMS of hit ($<1 \mu\text{V}$ resolution RTS*) (needs SW-option VAEUPE: User Processor)

when true energy mode is off:

- signal strength (0.3pVs resolution, $1 \text{ eu} = 1\text{nVs}$, RTS*) (eu = energy unit)
- average level of noise before the hit ($<1\mu\text{V}$ resolution RTS*)
- average level of hit ($<1\mu\text{V}$ resolution RTS*), (needs SW-option VAEUPE: User Processor)

* RTS = referred to sensor signal at 34 dB preamplifier gain

- Processes hit-cascades. One hit data set can represent the total no of hits, counts and energy of 1 to 127 hits of one hit-cascade (hit cascade: a dense series of hits).
- Processes hit-time-outs to terminate (and restart) endless hits or hit-cascades and to avoid counter overflows.
- 15,000 hits/second (peak) can be filled into the buffer of each channel, $>30,000$ hits/second can be transferred to the PC and stored on the hard disk drive continuously, in parallel with the lower prioritized data analysis program.
- Considers programmable duration discrimination time (DDT), rearm time, floating or fixed threshold, and status interval for time-driven data sets.
- Avoids any buffer-overflow of hit-data by setting all ASIP-2s into Long-DDT-Mode, when one ASIP-2 buffer in the system runs half full, or into Long-Rearm-Mode, if the ASyC-output buffer runs 80% full.
- Each ASIP-2 can house one transient recorder storage module of type TR-2/xxMB (see below) to store waveforms in parallel to the classical AE parameters per channel.
- Frontpanel LEDs indicate per channel: threshold crossing, preamp. saturation, preamp. connected, DC-output overload, AC/DC input mode, calibration mode, audio-selection (makes AE signal audible)
- 2 BNC connectors for preamplifier connection (one per channel)
- Frontpanel switch to toggle Audio on/off (one position per channel)
- Compatible with ASIPP
- Independent parameter settings per channel (threshold, filter, timing)
- Each ASIP-2 board is independent of each other
- Requires SW-release R2007 or later

- ASIP-2/A ASIP-2 Advanced dual channel AE signal processor board.
 Size, weight and specifications as ASIP-2/S, plus the following :
- feature extraction at 10MHz, 20MHz or 40MHz
 - all available band-pass filter configurations (see DigBP-2) included in price
 - Third input mode: 8-28 V_{DC} (programmable voltage) @ 200Ohm. Other impedance values or modification for ICP sensors (constant current supply) on request.
 - Fourth input mode: 8-28 V_{DC} (programmable voltage) @ 50Ohm.
 - Three software selectable input ranges (10Vpp, 5Vpp, 2.5Vpp) for better resolution in low amplitude applications
 - Notch filter stage (4th order @20MHz -, or 8th order @10MHz sample rate). Notch filter is to reject a user-selectable frequency.
 - TR-recording up to 40MHz/channel (not with systems comprising ASIPP or ASIP-2/S)
 - Arrival time resolution 25ns / 50ns / 100ns (not with systems comprising ASIPP or ASIP-2/S)

Options for ASIP-2

DigBP-2: One digital band-pass filter configuration for one ASIP-2 (i.e. for two channels).
 Almost **500** digital band-pass filters are available for selection!

Select corner frequencies from the following lists:

High-Pass [kHz]: 3.1⁺, 6.2⁺, 9.3⁺, 12.4⁺, 17⁺, 20⁺, 20, 25, 30, 35, 40, 50, 65, 75, 85, 95, 100*, 110, 125, 140, 160, 180, 230, 300, 340, 400, 520

Low-Pass [kHz]: 45, 100, 120, 140, 160, 180, 200, 240, 270, 300, 350, 400, 440, 500, 580, 660, 750, 800, 820, 850, 960, 1100, 1250, 1420, 1600, 1800*, 2000*, 2200*

Examples: DigBP-2/95-300 means digital bandpass 95-300kHz
 DigBP-2/25-1420 means digital bandpass 25-1420kHz

DigBP-2/bypass: wideband option (without digital filtering) for one ASIP-2 board.
 Required e.g. for System Verification and also recommended for the VST (Vallen Sensor Tester).

*: For these high-pass filters the switch on the analog filter shall be "ON" (for 1.6kHz high-pass), otherwise "OFF" (for 18kHz high-pass). Signal processing of frequencies below 12 kHz needs input mode "AC@100K" (no DC supply for preamplifier possible).

*: These filters are of 4th order and for ASIP-2/A only, for sample rates of 40 MHz (transient recording, feature extraction). All other filters are for processing rates up to 20 MHz

Any number of DigBP-2 configurations can be installed on an ASIP-2.

- TR-2/16MB 16MB Transient recorder storage module for ASIP-2 (8MB per channel), one TR-2 per ASIP-2 (for 2 channels). Sub-dividable into pages of user-defined length (0.5K, 1K, 2K,... up to 512K samples per page). Programmable sample interval (1-30x0.1µs) rate of 10MHz -333 kHz; (ASIP-2/A: up to 40MHz per channel). Programmable pretrigger (up to 64K samples). Internal trigger, pool-trigger capability (Pool-trigger is where the first-hit channel simultaneously triggers all the other TR-2 channels of the defined pool of channels in the system), Master and Slave trigger.
- TR-2/512MB 512MB TR module for ASIP-2 (256 MByte per channel), other specifications like TR-2/16MB
- TR-2/2GB 2GB TR module for ASIP-2 (1 GByte per channel), other specifications like TR-2/16MB

7 Preamplifiers

For information about preamplifiers please see separate **Acoustic Emission Preamplifier** data sheet (available on www.vallen.de, on the Vallen AE Suite CD-ROM, or from sales@vallen.de).

8 Sensors, Cables, Magnet Holders, and other Accessories

For information about sensors please see separate documents **AE-Sensor Overview** and **Acoustic Emission Sensors Frequency Responses**.

AE-sensors of piezo type as offered by various manufacturers can be used with the Vallen Systeme GmbH line of AE systems: AMS3, AMSY4, and AMSY-5.

Regarding cables, magnet holders, and other accessories please see separate document **Accessories**.

Documents are available on www.vallen.de, on the Vallen AE Suite CD-ROM, or from sales@vallen.de

9 AMSY-5 Software - Basic packages (Release 2008.0829 or higher)

The AMSY-5 software license grants the non-exclusive right to use the software package on up to 5 separate PCs at one time. It does not grant title to the software nor copyrights in it. Software is delivered on CD-ROM with automatic installation procedure. During software installation, a KeyFile that specifies the included options is automatically generated and stored on the PC.

The AMSY-5 package is designed for Windows 2000®/XP®. Vallen support and warranty for AMSY-5 is only available for Windows 2000®/XP®. Please find the End User License Agreement at the end of this document.

- SWACQ Software package for the AE- and TR-data acquisition (price included in the AMSY-5 hardware)
- *Acquisition32*: 32bit data acquisition program, stores AE-features and waveforms (TR-2 hardware required) simultaneously or only AE-features, supports:
 - Acquisition setup for many parameters (gains, thresholds, timing parameters (DDT, RAT), TR-trigger-mode, sample rate, pretrigger samples, filter-module selection, counter-level, voltage controlled gate, parametric clock interval, parametric storage interval, front-end filter conditions, application-specific settings, calibration pulser settings, comments, and more).
 - Storage of AE- and TR-data on separate files (separation of files accelerates online AE-analysis when waveform data need not to be read).
 - Change of acquisition parameters within one file on multiple sections, settings of each section are stored and can be read later.
 - Insertion of labels (text strings) that can be used as start- and termination criteria for analysis
 - Pulsing: generates pulses for sensor coupling check and evaluation of the velocity of sound. Autocalibration can be started manually or at user programmed times or time intervals.
 - During acquisition, all analysis parameters can be changed, new diagrams/listings added or removed without affecting data acquisition
 - A change of acquisition parameters within the same file generates a new section with individual parameter storage.
 - Remote control support over modem or LAN (via Remote Desktop, VPN): by controlling the control PC of the AMSY-5, the Acquisition can be started, stopped, files changed, parameters changed, PRI-files read, feature extraction from TRA-files started, TRF-files read, and more.
 - Up to six AMSY-5 units can be controlled by one ASyC in the separate PC and behave like a single large system. The software detects automatically how many units are combined, suggests suited channel mapping, avoids address conflicts, and secures fast and safe data transfer.
 - HW-Reporter: tool providing a detailed configuration report of the connected AMSY-5 hardware.
 - ActiveX interface for external control of Acquisition32
 - Command line tool for external control of Acquisition32

- Extensive context-sensitive help text (English) for all menus included.

SWBN

Basic software package for the analysis of AE-data and AE-waveforms for classical as well as wave-based AE. All components provide extensive context-sensitive online-help.

SWBN includes:

- *Vallen Control Panel*: for easy access to all acquisition and analysis programs and utilities
- *Scheduler*: for the communication between simultaneously running acquisition and analysis programs
- *Alarm Manager*: Alarm System for Acquisition32 for AMSY-5, and VisualAE with AMSY-5.

Alarm Processor:

Monitors user-defined alarm and warning criteria within VisualAE (like a filter) and triggers the Alarm Manager when the user-defined limits are exceeded. Alarm/Warning criteria can be derived from activity, intensity, clustering, polygon results etc.

Alarm Evaluators:

Software modules in VisualAE and Acquisition32 that survey the run status of these programs, and a number of PC resources, such as free disk space for data and temporary files. The Alarm Evaluators trigger Alarm Actions via the Alarm Manager, before a lack of such resources may endanger reliable data acquisition and online analysis.

Alarm Manager:

Checks Alarm Evaluators and Processor for the occurrence of alarm or warning conditions. Upon the occurrence of such a condition, the Alarm Manager performs user-defined Alarm Actions, such as

- turning on a sound (user selectable wave file), and/or
- sending an email using SMTP protocol, and/or
- sending a message to a machine or user within the network (using the Microsoft™ 'net send' command), and/or
- turning on an AMSY-5 LED and raising a line at the Alarm connector (on rear), and/or
- triggering a custom action which can be any user-written routine using the Active-X Alarm Manager Programming Interface.

- *VisualAE*: newest generation of online/offline analysis software for Win98/NT/2000/XP:
 - Shows on the same page any combination of Visuals. A Visual is either an AE-diagram, a listing, or a waveform diagram (waveform diagrams need option VTR or VAE2)
 - Click on an AE-data point and get its ID-window, see its highlighted listing line and the corresponding waveform
 - AE-diagrams can show any result vs. any other result, one filter per diagram
 - At each axis: auto/fix-scaling, linear/logarithmic scaling, round readings
 - Listing with user selectable results, fast backward and forward scrolling capability
 - Library import of set-ups for diagrams, listings, optional locations etc.
 - Parametric conversion (from mV into engineering units, such as MPa, bar, °C...)
 - Location processor with event builder for zonal location
 - Unlimited number of optional location-, filter-, cluster-, and user-processors
 - Processing structure can be defined by drag & drop
 - Unlimited number of pages, diagrams and listings
 - Mature printing functions with preview, size, and format selection
 - Page-export to *.BMP file, user-defined resolution
 - Zoom function to expand selected diagram to full page
 - Random access to data by start- and termination criteria (set-no., label)
 - Calibration table for a selectable calibration-run or differences between those
 - Performance meter to visualize analysis speed
 - Set-up reports on screen/printer/file for all analysis and acquisition parameters for easy documentation
- *TR-Viewer* displays waveform diagrams, auto or fixed scaled, in time and frequency domain, master and client window (client shows data range selected by mouse in master window). ASCII-output, Bitmap output, Windows printing with preview capability, portrait or landscape orientation, adjustable printer page setup.
- *KeyReporter*: to display/print the installed software options

- *ADC-Tester* and *TR-Tester*: Test-utilities.
- *Pri-Glue*: tool to concatenate several pri+tra-files into one larger pri+tra file, time offsets between the individual pri-files can be defined by the user.

- VAE1 Extension module 1, extends VisualAE functionality as follows:
- Enables second (right) vertical axis result for distribution, history or point plot, e.g. to show external parameters within an AE-diagram
 - Multi-plane support: unlimited number of planes at each axis, individual plane settings (style, color, symbol, filter, legend), for each plane multiple filter conditions can be used.
 - A diagram's ASCII-table can be exported to file or clipboard
 - A diagram's bitmap (graphic) can be exported to clipboard, resolution is selectable
 - Caption and multi-line comment text for each diagram and listing can be activated
 - Window-IDs, to indicate the position of each Visual in the analysis tree and to identify the Visuals (for transparent analysis structure)
 - Waveform features (extracted by VisualClass, TR-utilities or user-written program) can be used and visualized in combination with other results or used as filter criteria
 - Display of the Free disk space history is available, indicating currently free HDD space
- Utilities:
- *PCTA-Counter Extender*, to expand the 16 bit counter to 32 bit on existing data
 - *PAX-Modifier*, for manual entry of external parameters (e.g. pressure) if these were not measured as analogue voltage

- VAE2 Extension module 2, needs VAE1, extends VisualAE functionality as follows:
- Provides 3D diagrams: any result combination possible, can be rotated around any axis and stretched into any direction
 - Diagram: picture overlay (a bitmap or vector graphic can be placed behind a diagram), background black or white selection
 - Diagram/Listing position on page can be changed: Exchange, Shift, or Move to other page
 - Export of listings: ASCII output to file and clipboard enabled
 - Page: layout selection from a number of predefined arrangements; the name of a page (tabs), caption, and multi-line comment text for each page can be entered
 - Page export in BMP and JPG format (data compression)
 - Exporting diagrams, listings, processors etc. to the library
 - Waveform diagrams as provided with TR-Viewer, waveform selectable by a mouse click on an AE-data point

- SWupd Extension of an existing software update contract for 12 more months:
- Enables the installation of software updates published during the validity period of the update contract. Thereby you benefit from the ongoing software development as well as from bug fixing.
 - Covers all Vallen Systeme GmbH AE software modules.
 - A valid update contract is required for software extensions (e.g. purchasing new software modules).

10 VisualAE Location Processor

The location processor assembles hits to events (hits determined to be generated by a single source), calculates the location of the source, and adds results, such as X, Y, LUCY (location uncertainty), time-differences, number of hits of the event, and more, to the event's data for further processing by subsequent processors or Visuals. All calculated results can be shown graphically in plots or numerically in a listing or be used as filter criteria. Behind a location processor, AE parameters, such as amplitude, counts, etc., are taken from the first-hit of the event. The calculated kind of location results depend on the kind of location algorithm and can be x-, x-y-, x-y-z-coordinates or degrees latitude and longitude, for example. The location processor can be set up according to the requirements of the application.

The Eventbuilder is part of the SWBN basic package and provides zonal location. The Eventbuilder delivers the channel-no. of the 1st hit, 2nd, 3rd, ..., 7th hit and the corresponding delta-ts.

- VAELL** Linear location module:
- arbitrary sensor placement in circular/non-circular chain of sensors (linear ring, linear rod)
 - arbitrary spatial sensor placement in non-circular chain of sensors (Lin3D)
 - delivers correct results even at unequal sensor spacing
- Needs at least hits from 2 sensors.
- VAELP** Planar/Cylindrical location module:
- Arbitrary sensor locations and location results possible, defined in x, y-coordinates. It is not necessary to arrange the sensors in a predefined array. The sensors may be placed according to your structure's requirements.
 - Needs at least hits from 3 sensors
 - Considers a user-selected maximum number of hits (up to 255)
 - Evaluates Location Uncertainty (LUCY) from more than 3 hits
 - If more than 3 sensors are hit, location uncertainty (LUCY) is calculated. LUCY can be used to separate good from non-plausible location results
- Different algorithms available (numerical, analytical, mixed). Places of high location density in such a plot can be indicated as clusters (requires option VAECP).
- VAELMG** Multi-Group extension for location modules:
- Several channel groups can be used within one Location Processor
 - Each channel group with its own co-ordinates and location algorithm
 - Allows for Multi-Triplet-Set location (needs VAECP).
- VAELS** Spherical location module:
- Arbitrary sensor locations and location results defined in degree longitude and latitude, results also given in x,y,z-triples
 - Needs at least hits from 3 sensors
 - Considers a user-selected maximum number of hits (up to 255)
 - Location results can be shown as points on a 3-dimensional image of the sphere on screen (or hardcopy), or can be listed in degree longitude and latitude. The image of the sphere can be rotated and zoomed to any desired point-of-view (needs VAE2). Places of high location density can be indicated by round clusters (requires clustering option VAECP).
 - Evaluates Location Uncertainty (LUCY) from more than 3 hits. LUCY can be used to separate good from non-plausible location results
- VAEL3D** 3D-location module to detect AE-sources in a three dimensional solid part, or liquid:
- Arbitrary sensor locations and location results defined in x,y,z-triples
 - Sensors can be mounted in one plane
 - Needs at least hits from 4 sensors, 5 sensors recommended
 - Considers a user-selected maximum number of hits (up to 255)
 - Evaluates Location Uncertainty (LUCY) from more than 4 hits. LUCY can be used to separate good from non-plausible location results
- Results can be shown in 3-dimensional dot-plots, rotated and zoomed (needs VAE2), or in several 2-dimensional dot-plots from different views. Places of high location density can be indicated by clusters (requires clustering option VAECP) in 3D-point plots, clusters are shown as vertical bars with a mark indicating the location of the center of the cluster.
- VAELTB** Tank-Bottom location module:
- different algorithms implemented
 - able to locate sources outside of a sensor triplet. Selects the best-suited sensor triplet for each event.
 - Sensor positions entered in length along circumference
 - Equal sensor spacing not mandatory

- VAELAC Amplitude Correction module (needs VAEUP and a location module):
- Performs amplitude correction as a function of the measured amplitude and the distance between calculated source and first-hit sensor.
 - Considers near-field and far-field attenuation (e.g. dB/m)

11 Other VisualAE Processors

- VAEFP Filter Processor:
- Filters hit data with respect to any available result, e.g. Amplitude, Energy, external parameters, location coordinates, location uncertainty, waveform features... Only data fulfilling the filter conditions pass the filter and are available to the analysis behind that filter processor.
 - An unlimited number of filter processors can be used in the data processing structure. Filters can be placed anywhere in the structure by drag & drop, e.g. before or after location calculation, clustering, etc.
- VAEPP Polygon Processor (graphic filter):
- Includes a tool to draw polygons (ellipses, rectangles, arbitrary shapes).
 - Data falling inside a polygon receive a mark that can be used for filtering.
 - Polygons are displayed in Visuals behind the polygon processor.
- VAECP Cluster Processor:
- Draws colored rectangles or circles around clusters of AE data
 - Any attribute(s) can be used for clustering (e.g. location, Energy, Duration...)
 - Multi-dimensional clustering possible, e.g. clustering according to x, y, and time..
 - User-defined cluster size and minimum number of elements
 - The number of elements contained in a cluster can be color-coded.
- Supports planar, spherical and 3-dimensional dot-plots
- VAEUP User Processor:
- Calculates a user result e.g. standard deviation, from a selected result, e.g. counts, by a statistical function.
 - Available functions: sum, min, max, variance, means, standard deviation, average change
- User results can be used in VisualAE like any other result.
- VAEUPE User Processor Extension:
- Extends the User Processor by the functions divide, multiply, power, linear scale, logarithm, and different rate calculations.
- VAEAP Alarm Processor
- This is part of the basic VisualAE software module SWBN

12 VisualTR - Waveform Analysis Software

- VTR Software package for the efficient analysis and management of transient recorder data (waveforms):
- *VisualTR*: displays multiple waveforms per page, multiple pages, selectable FFT windowing functions: Rectangle, Hamming, Hanning, Trapezium, Bartlet, Welsch; digital frequency filtering (high-pass, low-pass, band-pass, band-rejection, corner frequencies and steepness (in dB/octave) set by user); Single frequency selection over Gaussian cross-correlation; flexible printing including user-comments; copy ASCII to clipboard and Bitmap to clipboard eases data/graphic import into other Windows programs. The option VTR enables the above-mentioned functionality also for the waveform diagrams in VisualAE.

Utilities included:

- *TR-Copy*: copies the waveforms from one input file to one output file per class according to a list (CLASS vs. TRAI) that can be generated e.g. automatically by the AE-software VisualAE/Multi-Plot or manually by the user. Helps to establish a learning data base for the training of a classifier
- *TR-Combi*: eases the selection of learning data from multiple input files to one output file per class for the efficient building of a data base for the training of a classifier.
- *TR-Indexer*: Re-numbers the TR indices in a TR-file before combining TR data of different input files. Eases to keep track which waveforms came from which test.
- *Feature Extractor*: extracts features from waveforms, (e.g. spectrum center of gravity, or spectral ratios over 4 user-definable time and 5 frequency segments) for listing, plotting or filtering in VisualAE.
- *FFT-Averager*: This utility calculates the FFT of all signals on a TRA file and averages each frequency bin by three different methods: Linear average, RMS, average of dB values. It presents them in three overlaid FFT diagrams. Where differences by the different averaging methods are visible, there are differences in the spectra among the averaged signals.

13 VisualClass - Pattern Recognition Software

- VCL VisualClass pattern recognition and classification software package
- For the fast, comfortable, transparent development of an analytical classifier to recognize different AE-signal patterns
 - For supervised and non-supervised learning strategies
 - For classifier development
 - Classifier program assigns a class number and class fitting values to each data set of unknown data
 - Class number and fitting values can be read by VisualAE (SWBN), combined with classical AE-features, locations, parametric, and statistically analyzed, displayed, listed, used for filtering; online as well as offline.

14 Programming Interface

ECP Embedded Code Processor (ECP): Programming interface within VisualAE allowing the implementation of user programmed code by a C-like programming language. Any VisualAE results can be imported into the ECP, processed according to the implemented code, and any number of new results can be returned to VisualAE. These new results are then available for further processing and display using the powerful VisualAE processors, diagrams and listings.

There are 3 different license types available for the ECP (details in table below):

- VAECPU ECP-User: allows one to run an ECP, but not modify or view the source code.
- VAECPV ECP-Programmer: allows one to create ECP and write code for it (includes VAECPU).
- VAECPV ECP-Validator: allows one to protect an ECP against unauthorized usage (includes VAECPV).

	No ECP license	VAECPU	VAECPV	VAECPV
Available functions:	Roles			
Open VAE w/ ECP	X	X	X	X
Delete ECP	X	X	X	X
Copy/duplicate ECP	X	X	X	X
Move ECP	X	X	X	X
Create ECP			X	X
Run validated ECP		X*	X*	X*
View validated ECP / Export Code				X**
Edit validated ECP / Import Code				X**
Run non-validated ECP		X	X	X
View non-validated ECP / Export Code		X	X	X
Edit non-validated ECP / Import Code			X	X
Validate ECP				X

*) KeyID must be in Licensee List and Expiration Date valid

***) KeyID of original Validator only

XTR ActiveX (COM) Interface to read TRA-files and write feature files (.trf): lets one write programs in any 32-bit Windows supported programming language (e.g. C, Delphi, VisualBasic, EXCEL...) that read TR-data, extract special features and write those to a feature file that can be read and processed by VisualAE (a fully documented Excel sample is included as macro for quick start). The extracted features can be used in listings, graphs, and filters.

15 Verification Tools

VST Vallen Sensor Tester Package; measures, displays and prints the sensor sensitivity curve versus frequency. Includes

- Programmable HP function generator (model Agilent 33120A, 33220A, or compatible)
- Signal emitter (Panametrics V103 or V101)
- Cable set VSTCBL
- Vallen Sensor Tester Software package VSTSW, further required:
- One ASIPP to be equipped with dummy filters or ASIP-2

SysVeri Vallen System Verification Software Package: allows for very quick, precise and software supported (semi automatic) verification of AMSY4 / AMSY-5 systems and the installed ASIPP and/or ASIP-2 boards. After running the verification a detailed report can be generated and printed. To run system verification one needs:

- Vallen SysVeri software package
- SysVeri-Cset: cable set including the ET1 adapter and several special cables
- One (reference-) ASIP-2 (or: ASIPP equipped with dummy filters)
- Programmable HP function generator (model Agilent 33220A, 33120A, or compatible)
- Programmable DC calibrator Martel 2000 plus RS232 cable, or manually adjustable DC source (0.015% accuracy), e.g. MIVC222
- WinWord 2000 or higher for report generation
- A few BNC cables (male-male)

16 Data Converter Software

DTA-Conv Tool to time-sort and convert dta-files into the Vallen file format. This tool comes “as is” without the warranty to convert all existing sub versions of dta-files. You can use the evaluation installation to check if the DTA-Conv works properly with your dta-files.

17 Warranty Conditions for AMSY-5

The warranty period is two years from the date of its delivery for AMSY-5 hardware and for software. This warranty does not cover the repair of any damage to the products generated by accident or improper handling. For warranty conditions for consumables such as sensors and cables see our documents “AE Sensor Overview” and “Accessories for AE Systems”.

We warrant that the goods as delivered will conform to the given specifications. We do not warrant that software is totally free from errors (See the End User License Agreement hereafter). If notified during the warranty period that the delivered AMSY-5 system contains defects such it does not conform to the specifications, we will make it operate as specified by providing replacement parts or software updates as determined by us, free of costs, and within a reasonable time. If transportation should become necessary, the customer has to provide the permits for export and re-import of replacement parts and bear the costs of transportation.

Except as expressed before, we disclaim all other warranties. We shall not be liable for any direct, indirect, consequential or incidental damage arising out of the use or inability to use of the delivered system. We reserve the right to charge for any efforts taken to remedy any incorrect or user-altered PC configurations or other problems for which we are not responsible.

18 End User License Agreement

This License Agreement applies to all Vallen Systeme GmbH (“VS”) AE software.

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If the VS software was purchased in the frame of a complete system, and one or more topics in the VS order confirmation deviate from this License Agreement, the deviating sentence in the signed VS order confirmation shall supersede the corresponding sentence in this Agreement.

19 Arbitration

All disputes arising out of or in connection with the present contract shall be finally settled under the Rules of Conciliation and Arbitration of the International Chamber of Commerce in Munich, Germany by one or more arbitrators appointed in accordance with the said Rules.

Specifications are subject to change as product developments are made.