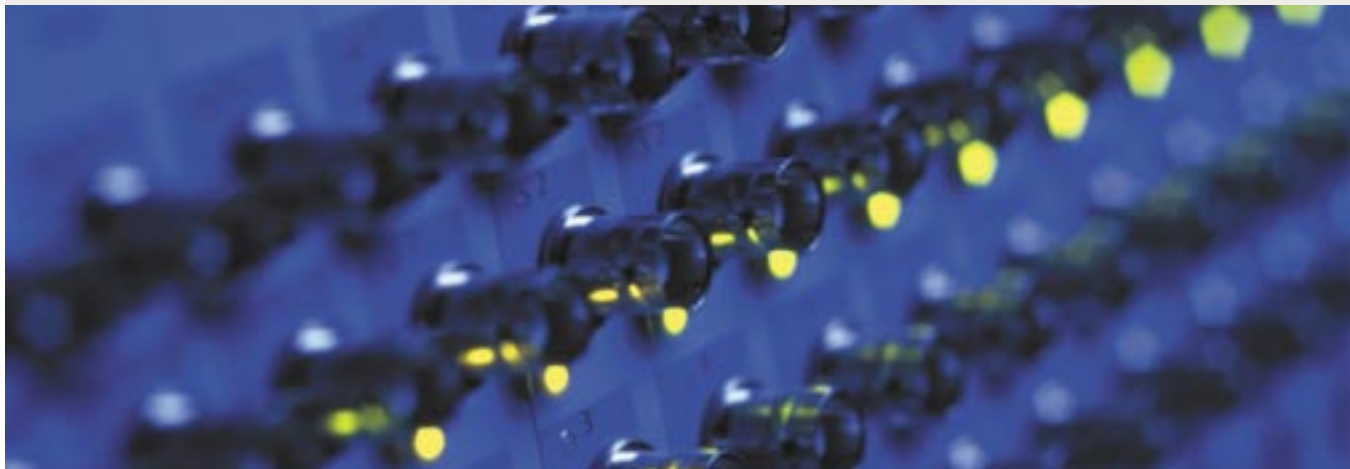


# LMS Solutions Guide

## *LMS SCADAS III*

# LMS SCADAS III

## Signal Conditioning and Data Acquisition for Lab and Field Testing



LMS SCADAS III offers complete, high-quality and cost-effective solutions for high-speed data acquisition and signal conditioning, in a wide range of applications. The SCADAS III front-end is tightly integrated with the LMS Test.Lab software and optimally tuned to meet the specific needs of noise and vibration engineering. It offers a flexible choice of hardware frames and modules and an outstanding performance.

### Maximum modularity...

The modular LMS SCADAS III solution can expand from an inexpensive base with only four channels, to a mobile solution for operation from a vehicle battery, to a distributed system with over a thousand channels. SCADAS III has a very flexible architecture that lets you configure the system to your precise needs – add more channels, swap signal conditioning modules and boost the signal processing power as you wish. The LMS SCADAS III front-end family offers system configurations for laboratory and mobile usage, and offers the possibility to standardize laboratory and field-testing on the same hardware platform. The tight integration of LMS SCADAS III with the LMS Test.Lab software offers operators the comfort of working with the same common software platform for all their testing tasks, both in the lab and in the field.

### ...and optimal scalability

The scalability of LMS SCADAS III enables its users to apply a high number of measurement channels in extensive testing campaigns, using a daisy-chained master/slave configuration, or divide the channels over multiple separate testing systems. The master frame can optionally be connected to the host computer by a fiber optic link with a maximum length of 500m, and each slave frame can be over 50m away from the previous master or slave frame. This distributed approach means that you can minimize costly transducer cabling - and obtain much higher quality measurements.

- One single platform for laboratory and field-testing
- Tightly integrated with LMS Test.Lab
- Delivering maximum user comfort, flexibility and test data consistency
- Superior modularity and scalability protects hardware investments
- Direct plug & play connection of transducers and distributed frames reduces setup time
- Higher quality data, with measurement chain integrity indication
- Parallel signal processing capacity safeguards system performance as channel count increases

### High performance digitization and DSP

The outputs from the various signal conditioning modules are routed to the SP92 digitizer cards in a very flexible and software controlled manner. Digitization incorporates state of the art delta-sigma techniques that combine an ultra-low noise floor with fully linear 24-bit system performance at up to 204.8kHz per channel. The combination of a high throughput capacity host interface with 24-bit fixed point DSPs on each four-channel module enables a maximum distribution of processing power for true real-time operations on a large number of channels. Processing functions include digital filtering and decimation, order tracking and harmonic extraction, as well as real-time third octave filtering.

### Designed for noise and vibration engineering

LMS SCADAS III supports virtually all types of transducers relevant in the world of NVH measurements. Whether you want to capture rpm, acceleration, speed, force, displacement, strain, temperature, sound or torsion: SCADAS III offers an off-the-shelf solution. Dedicated high precision tacho acquisition allows order tracking as well as spectral/octave acquisitions against rotational speed. Tacho signals up to 15kHz and 1024 pulses per revolution are supported, while auto-ranging inputs and programmable signal conditioning ensure that even 'industry quality' analog tacho signals with all kinds of noise and changing amplitudes will still result into stable readings. For Vibration Control or Time Wave Replication applications, we offer the possibility of installing from 2 up to 60 generator channels in one single SCADAS III frame. Output signals with ultra-low distortion and noise are ensured by the use of 24-bit digital to analog bit stream converters.

### Delivering superior hardware quality

LMS SCADAS III achieves high-level reliability through rigorous design standards, efficient quality control and a strong service organization. Our quality standards are the outcome of a 25-year accumulation of practical knowledge in signal conditioning and processing. We are critical when selecting components and suppliers - and quality control begins in the prototype phase. Our products are considered out of development only when the first production series is completed successfully to ISO9001 standards. Careful tracking of each system module allows our service organization to carry out preventive maintenance for our customers so that downtime for calibration or repair is reduced to an absolute minimum.



The LMS SCADAS 305 mobile testing front end includes high quality acquisition power into a compact and rugged design.



The LMS SCADAS 310 portable front end excels in performance and flexibility, with 10 slots for up to 40 channels or more in master slave configuration for high channel count testing.



The LMS SCADAS 316 combines extremely high channel counts possibilities, real time processing capabilities and unmatched throughput performance.

## LMS SCADAS 305, mobile data acquisition power

The LMS SCADAS 305 mobile front-end can be installed just as easily in the test laboratory as in a test vehicle. Accommodating from 4 up to 20 channels in a compact frame, SCADAS 305 sets a new benchmark for high-performance mobile testing. This mobile data-acquisition front-end is not just easy to carry; it also offers easy cable connections. All cables, except the AC mains power cable, plug in the front side of the LMS SCADAS 305, facilitating installations in locations that are small or difficult to access. Its wide-range power supply accepts AC and DC input voltages, but it can also operate from the built-in battery.

This mobile front-end packs the renowned quality and acquisition power of LMS SCADAS III into a compact and rugged design, offering a versatility of data-acquisition and signal-conditioning capabilities and maximum ease of transportation. The hardware architecture that it shares with other LMS SCADAS III test equipment assures that signal-conditioning modules are easily interchangeable. The tight integration and optimal tuning between LMS SCADAS III test hardware and LMS Test.Lab / LMS CADA-X software delivers maximum performance, user comfort, test data consistency and reliability.

### LMS SCADAS 305 at a glance

Small rugged frame for use in the field

Battery backup: guaranteed independent operation for more than ten minutes

Easily interchangeable signal-conditioning modules

Flexible host interface for plug & play operation

Expandable from 4 to 20 measurement channels

Built-in calibration source for easy system and module calibration

All connectors on front panel, except AC mains inlet

On-board dual tacho and signal generation (no extra slots required)



	LMS SCADAS 305 mainframe	LMS SCADAS 306S slave frame
Number of slots	5	6
Max number of channels per frame	20 (60 with V12 modules)	24 (72 with V12 modules)
Max total channel count (master/slave combined)	44 (132 with V12 modules)	n.a.
Dimensions (WxHxD)	410 x 110 x 410 mm	410 x 110 x 410 mm
Weight	8 kg (fully equipped)	8 kg (fully equipped)
AC power input	88 to 264VAC	88 to 264VAC
DC power input	10 to 42VDC	10 to 42VDC
Max power consumption	100W	100W
Battery operation	Yes (more than 10 minutes)	Yes (more than 10 minutes)
Host interface	SCSI	n.a.
Master/Slave interface	Standard (serial, up to 2m.)	Standard (serial, up to 2m.)
Associated slave frames	LMS SCADAS 306S	n.a.

## LMS SCADAS 310, the compact lab system

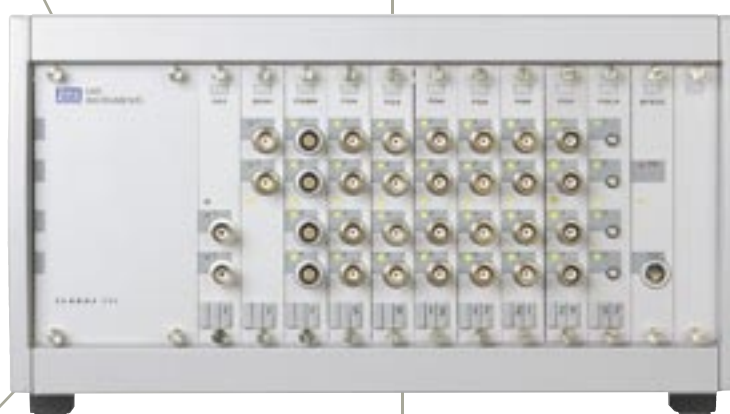
The LMS SCADAS 310 front-end accommodates 10 slots for up to 40 channels in a portable system that retains the full SCADAS III performance and flexibility. It can scale up to relatively static setups for test laboratories, or be scaled down to a minimum for mobile in-vehicle measurements. With the optional master slave interface, the SCADAS 310 can be combined with other SCADAS III frames in order to participate in a high channel count testing campaign.

### LMS SCADAS 310 at a glance

Portable frame for lab and field use

Expandable from 4 to 40 measurement channels

Easily interchangeable signal-conditioning modules



Battery backup: guaranteed independent operation for more than ten minutes (DC version only)

Built-in calibration source for easy system and module calibration

Industry standard wide or narrow SCSI host interface

	LMS SCADAS 310 mainframe	LMS SCADAS 310DC mainframe	LMS SCADAS 311SDC slave frame
Number of slots	10	10	11
Max number of channels per frame	40 (120 with V12 modules)	40 (120 with V12 modules)	44 (132 with V12 modules)
Max total channel count (master/slave combined)	40 (120 with V12 modules)	1840 (5520 with V12 modules)	n.a.
Dimensions (WxHxD)	336 x 183 x 461 mm	336 x 183 x 461 mm	336 x 183 x 461 mm
Weight	13 kg (fully equipped)	13 kg (fully equipped)	13 kg (fully equipped)
AC power input	88 to 264VAC	88 to 264VAC	88 to 264VAC
DC power input	None	10 to 42VDC	10 to 42VDC
Max power consumption	160W	160W	160W
Battery operation	No	Yes (more than 10 minutes)	Yes (more than 10 minutes)
Host interface	SCSI	SCSI	n.a.
Master/Slave interface	Optional	Standard	Standard
Associated slave frames	n.a.	LMS SCADAS 311SDC LMS SCADAS 317S	n.a.

## LMS SCADAS 316, the versatile lab system

LMS SCADAS 316 offers a unique combination of extremely high channel count possibilities, channel count independent real time processing capabilities and unmatched throughput performance. The modular LMS SCADAS 316 frame with 16 slots for up to 64 channels allows channel counts expansion as needed, with the possibility to connect multiple frames in master/slave configurations. This modular solution can fit the need of any noise and vibration laboratory, starting from an inexpensive base with only four channels - to a system with several hundreds of channels. The scalability and modularity of LMS SCADAS III enables its users to apply a high number of measurement channels in extensive testing campaigns, or divide the channels over multiple testing systems. A low noise floor and fully linear 24-bit system performance at up to 204.8kHz per channel characterize the high-quality digitization of the signal. A high-speed DSP on each 4-channel module delivers high distributed power for real-time operations with high channel counts. The master frame can optionally be connected to the host computer by a fiber optic link, and each slave frame can be over 50m away from the previous master or slave. This distributed approach means that you can minimize costly transducer cabling and obtain much higher quality measurements.

### LMS SCADAS 316 at a glance

Expandable from 4 measurement channels up to 2000

Prepared for 19" rack mounting

Easily interchangeable signal-conditioning modules



Maximum throughput performance of 6.5 MSamples/s

Built-in calibration source for easy system and module calibration

Industry standard wide or narrow SCSI host interface

	LMS SCADAS 316 mainframe	LMS SCADAS 317S slave frame
Number of slots	16	17
Max number of channels per frame	64 (192 with V12 modules)	68 (204 with V12 modules)
Max total channel count (master/slave combined)	1920 (5760 with V12 modules)	n.a.
Dimensions (WxHxD)	448 x 183 x 461 mm	448 x 183 x 461 mm
Weight	20 kg (fully equipped)	20 kg (fully equipped)
AC power input	88 to 264VAC	88 to 264VAC
DC power input	None	None
Max power consumption	220W	220W
Battery operation	No	No
Host interface	SCSI	n.a.
Master/Slave interface	Standard	Standard
Associated slave frames	LMS SCADAS 311SDC LMS SCADAS 317S	n.a.

## Mix and match data acquisition channels

The LMS SCADAS III mainframe accepts up to 12 different module types, including any combination of input/output cards, tachometer inputs and a variety of signal conditioning modules. The integrated signal conditioning and direct connection of each transducer to the inputs eliminates interconnection problems associated with multiple units or breakout boxes, such as hum, noise, and ground loops. The entire measurement chain is continuously monitored during testing for open or short circuits. Overload checks are carried out on several places in the signal paths, including full bandwidth checking upfront of the anti-alias filters. Finally, calibration is on a module-by-module basis and is an entirely digital process. This ensures high quality data over an extended period, or when cards are swapped over.

### LMS SCADAS III input modules

#### Programmable Quad Amplifier (PQA)



The PQA is a basic four-channel voltage/ICP® conditioning module. Each channel has an individually programmable input range, with AC/DC/ICP® coupling, and an analog A-weighting filter. The PQA has grounded BNC inputs.

- Input range  $\pm 62.5\text{mV}$  to  $\pm 10\text{V}$
- 4mA ICP® supply
- Analog A-weight filter

#### Programmable Quad Floating Amplifier (PQFA)



The PQFA adds a number of features to the basic PQA concept. Floating inputs eliminate the risk of ground loops, and an analog programmable high pass filter removes unwanted low frequency components. Smart transducers (TEDS) can be connected directly to the PQFA module. It helps users to drastically reduce the setup time and even more important, to avoid cabling errors, which can possibly call for a rerun of the measurement.

- Input range  $\pm 100\text{mV}$  to  $\pm 10\text{V}$
- Floating / single ended inputs
- 4mA ICP® supply
- 5 to 75Hz programmable high pass filter
- TEDS support

#### Programmable Quad Microphone Amplifier (PQMA)



The PQMA is ideal for vibro-acoustic measurements. It can connect four conventional, prepolarized or ICP® microphones, as well as force transducers, or voltage inputs. The analog high-pass filter optimizes the use of the ADCs dynamic range.

- Input range  $\pm 62.5\text{mV}$  to  $\pm 25\text{V}$
- Semi differential inputs
- 4mA ICP® supply
- 1 to 255Hz programmable high pass filter
- 200V polarization voltage
- 30 or 60V preamplifier supply

#### Programmable Quad Charge Amplifier (PQCA)



The PQCA can connect four conventional piezoelectric accelerometers to the system using microdot connectors and the built-in charge amplifier. The PQCA has an exceptionally high dynamic range for the most demanding structural measurements.

- Input range  $\pm 25\text{pC}$  to  $\pm 51200\text{pC}$
- Single ended inputs
- 0.5 or 5Hz high pass filter

## LMS SCADAS III input modules

### Programmable Quad Bridge Amplifier (PQBA)



The PQBA supports four channels of strain transducers - and those based on the same principle, such as piezoresistive or variable capacitor sensors. Full, half, and quarter bridge configurations are supported, with bridge completion resistors fully software switched. Automatic bridge nulling uses current injection techniques.

- Input range  $\pm 5\text{mV}$  to  $\pm 1\text{V}$
- Fully differential inputs
- Maximum  $\pm 5\text{V}$  bridge supply with sense mechanism
- Bridge nulling and calibration using accurate current injection techniques

### Quad Digital Audio Module (QDA)



Supporting AES/EBU and SPDIF data formats, the QDA is a dedicated audio interface module, specifically designed for artificial heads. The QDA accepts 16 or 24-bit data and all standard audio sample rates. HMS data is retrieved from the audio stream and separately sent to the host. Because the QDA resamples the input data to the standard SCADAS III internal sample rates, the output data of QDA is fully compatible with data from other modules. Therefore, digital audio measurements can be done in parallel (synchronous) with other vibration or sound measurements.

- Support of AES/EBU and SPDIF input data at all standard sample rates
- Support of HMS data
- Synchronization of digital audio streams with other inputs
- All processing functions, including filtering, order tracking and 1/3rd octave are available

### Programmable 12 channel module (V12)



The V12 is a twelve-channel voltage and ICP<sup>®</sup> conditioning and data acquisition module that triples your conventional channel count in a SCADAS III frame. Because of its high channel density, the V12 is ideally suited for connecting triaxial accelerometers. AC, DC and ICP<sup>®</sup> coupling is supported, as well as reading out smart sensors. The V12 is a one-board solution, incorporating 24 bits ADCs with a maximum sample rate of 51.2kHz. A high performance on-board DSP allows real time embedded processing such as decimation, order tracking and 1/3<sup>rd</sup> octave filtering.

- Input range  $\pm 1\text{V}$  to  $\pm 10\text{V}$
- 4mA ICP<sup>®</sup> supply
- TEDS support

## LMS SCADAS III tacho modules

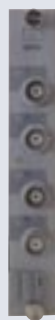
### Programmable Dual Tacho Module (PDT)



The tacho module allows order tracking as well as spectral/octave acquisitions against rpm. Tacho signals up to 15kHz and 1024 pulses per rev are supported, while auto ranging inputs and programmable signal conditioning ensure that even 'industrial quality' analog tacho signals with noise and changing amplitudes will result in stable readings.

- Auto ranging differential input
- Bias voltage compensation from  $-5V$  to  $+5V$
- 40ns tacho counter resolution
- Tacho preview with 16-bit ADC
- Double and missing pulse compensation
- rpm smoothing filter

### Quad Torsional Vibration Module (QTV)



The QTV is a four-channel tacho input module, designed for the acquisition and analysis of torsional vibration phenomena. Through the use of high bandwidth ADCs and dedicated embedded processing, the QTV is able to detect and represent high frequency tacho variations with a precision that exceeds that of conventional (counter based) solutions. QTV dynamic rpm data is acquired with 24-bit precision and is perfectly synchronous with all other input channels present in the LMS SCADAS III system. The LMS SCADAS III QTV module offers a dedicated solution for highly accurate torsion analysis of rotating objects.

- Input range  $\pm 62.5mV$  to  $\pm 25V$
- Maximum tacho frequency 50kHz
- Acquisition synchronous with all other input channels in LMS SCADAS III
- Frequency independent resolution

## LMS SCADAS III output modules

### Quad Digital to Analog Converter (QDAC)



Output signals with ultra-low distortion and noise are ensured by the use of 24-bit digital to analog bit stream converters, analog and digital reconstruction filters, and up-sampling digital filters with noise shaping. The four channel QDAC module includes firmware to support sine, random, burst sine or random, chirp and arbitrary signal generation. This output module is also available in a two channel variant (DDAC).

- 24-bit signal generation
- 20kHz bandwidth
- $\pm 5V$  output voltage
- Short circuit protected

### Quad Monitor Output Amplifier (QMO)



The QMO is a four-channel output module for SCADAS III. As an output amplifier, it provides an analog output of one of the stacked signal conditioners. The output amplifier is AC coupled. The QMO modules support recording in parallel to the normal acquisition via the SCADAS III on e.g. a tape recorder in data reduction systems.

- Calibrated monitor output
- $\pm 2V$  output voltage
- Short circuit protected

### Dual channel output for VibCo and Durability (VDAC)



The VDAC is a versatile dual channel output module for applications such as vibration control testing and time waveform replication, but also for Multiple Input Multiple Output (MIMO) modal testing. It can be used as an advanced signal generator or to replay signals that are generated on the host computer. To assure a true replay of the original signals, ultra-low distortion digital interpolation filters are used. Dedicated hardware circuits guarantee smooth shutdown of the output signals, even in case of power failure, to protect the structure under test.

- 24-bit signal generation
- 20kHz bandwidth
- $\pm 10V$  output voltage
- Fail-safe

## Overview LMS SCADAS III signal conditioning modules

Input Modules	PQA	PQFA	PQMA	V12
Function	Voltage and ICP®	Floating voltage and ICP®, with TEDS	Microphone and ICP®	Voltage and ICP®, with TEDS
Number of channels	4	4	4	12
Connector	4 x non isolated BNC	4 x isolated BNC	4 x 7-pole LEMO	4 x 9-pole LEMO
Input mode	Single ended	Floating and single ended	Semi differential	Semi ended
Input coupling	DC/AC/ICP®	DC/AC/ICP®/TEDS	DC/AC/ICP®	DC/AC/ICP®
Full scale input range	±62.5mV to ±10V	±100mV to ±10V	±62.5mV to ±25V	±1V to ±10V
Input impedance	1MΩ//50pF	1MΩ//50pF	1MΩ//50pF	1MΩ//50pF
Analog filtering	A-weight	High-pass: 5 to 75Hz	High-pass: 1 to 255Hz	No
Signal to noise ratio	> 90dB	> 100dB	> 88dB	> 102dB
Total harmonic distortion	< -87dB	< -90dB	< -87dB	< -100dB
Crosstalk	< -106dB	< -106dB	< -100dB	< -116dB

Input Modules	PQCA	PQBA	QDA
Function	Charge	Full, half and quarter bridge	Digital audio: AES/EBU and SP-DIF
Number of channels	4	4	2 x stereo
Connector	4 x 10-32 Microdot	4 x 6-pole LEMO	2 x 3-pin LEMO and cinch
Input mode	Single ended	Fully differential	Digital
Input coupling	n.a.	DC	n.a.
Full scale input range	±25pC to ±51200pC	±5mV to ±1V	n.a.
Input impedance	< 0.1Ω	1GΩ//50pF	TTL compatible
Analog filtering	High-pass: 0.5 or 5Hz	None	n.a.
Signal to noise ratio	> 88dB	> 93dB	> 139dB
Total harmonic distortion	< -87dB	< -87dB	< -123dB
Crosstalk	< -106dB	< -106dB	n.a.

Tacho Modules	PDT	QTV
Function	Tacho acquisition	Torsional vibration
Number of channels	2	4
Connector	Isolated BNC	Non isolated BNC
Principle	26MHz tacho counter	24-bit AD conversion + dedicated signal processing
Full scale input range	Autoranging $\pm 100\text{mV}$ to $\pm 10\text{V}$	$\pm 62.5\text{mV}$ to $\pm 25\text{V}$
Input impedance	112k $\Omega$	1M $\Omega$
Max tacho frequency	15kHz	50kHz

Output Modules	DDAC/QDAC	QMO	VDAC
Function	General purpose signal generation	Analog output for signal conditioner	VibCo and TWR
Number of channels	2 or 4	4	2
Max output level	$\pm 5\text{V}$	$\pm 2\text{V}$	$\pm 10\text{V}$
Resolution	24-bits	n.a.	24-bits
Output impedance	< 1 $\Omega$	< 1 $\Omega$	50 $\Omega$
Output coupling	DC	AC	DC
Noise floor	< -110dB	< -101dB	< -110dB
Total harmonic distortion	< -96dB	< -97dB	< -96dB
Shutdown control	Software	n.a.	Hardware
Additional outputs	n.a.	n.a.	CLO and Status

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