



scai slim GMS series **Data Acquisition System**

Overview

With its optimised installation, operation and maintenance philosophy **scai slim** offers the real possibility to measure any dynamic motion with an abundance of features and options.

Highly reduced cost of ownership and user-friendly approach in the design make **scai slim** the perfect choice for the most advanced user.

Numerous optimisations within the architecture and the design yields unprecedented performance for seamless and fast execution of all system processes.

Fully compatible with existing GeoSIG sensors and can co-exist and co-perform in the same network as the GMS series recorders. The simple upgrade path makes **scai slim** "future proof".

Housing is designed for easy transport with handles which also protect the connectors from impact. It features rubber gaskets for non-slip usage on most surfaces. Easy access cover to the SD card on the back requires no tools.

Applications

- ▶ Seismic and Earthquake Recorder
- ▶ Structural Health Monitoring
- ▶ Real-time Seismology for free-field and urban areas
- ▶ High-density Earthquake monitoring networks
- ▶ Shake/Hazard Mapping based on instrumental data
- ▶ Earthquake Early Warning and Rapid Response
- ▶ Damage Estimation, Disaster Management
- ▶ Seismic Alarm and Safe Shutdown
- ▶ Ambient Vibration Testing (optionally fully wireless)
- ▶ Induced Vibration monitoring and notification
- ▶ Building Code Compliant Instrumentation

Key Features

- ▶ Modular electronics for user repair and upgrade
- ▶ 3 or 6* channels, up to 2000 sps sampling rate
- ▶ Low noise individual 32-bit digitiser $\Delta-\Sigma$ ADC per channel
- ▶ Internal built-in and/or external sensor options
- ▶ Wired, Wi-Fi*, cellular*, satellite* links
- ▶ Power over Ethernet and wide power range
- ▶ Smart satellite* or network timing
- ▶ USB for storage and communication devices*
- ▶ Continuous data recording to ringbuffers
- ▶ Flexible configuration of multiple triggers
- ▶ Simultaneous data streaming to several clients
- ▶ Virtual signals from realtime processed sensor signal
- ▶ Rugged aluminium housing with easy installation
- ▶ Web interface compatible with smartphones / tablets
- ▶ Simple and secure remote access over Internet
- ▶ Alarm output with up to 4 dry-contact relays*
- ▶ Low power consumption
- ▶ Hot swappable SD card
- ▶ Third generation of NetQuakes recorders

scai slim GMS series Data Acquisition System

Specifications

Use and Versatility

An intuitive web interface is available for easy configuration and interaction as well as display of live data graphs and state of health information, using any web browser. The device configuration file in XML format alternatively can be edited on site through the instrument console, exchanged by replacing the memory card, remotely from a server, or through SSH from anywhere around the world. Modular plug-in electronics structure provides highly increased serviceability and maintenance as well as easy hardware field upgrades or replacements.

Data Analysis

scai slim can perform real-time single/double integration, differentiation, HP/LP/BP filtering, decimation, peak/average calculations on the physical sensor signal and can provide these as real-time virtual signal. All recording and monitoring features can be applied on the virtual signals, simultaneous to the physical signals.

Sensor

External: All GeoSIG sensors and any other third-party sensors with following specifications can be connected to **scai slim** as external sensor(s):

Sensor output: Differential: $\pm 20\text{ V}, \pm 10\text{ V}, \pm 2.5\text{ V}$
Single ended*: $0 - 20\text{ V}, 0 - 10\text{ V}, 0 - 2.5\text{ V}$
Current loop*: $4 - 20\text{ mA}$

Power to sensor: $15\text{ or }24\text{ VDC} / 600\text{ mA}$

Digitiser

Channels: $3\text{ or }6^*$
A/D conversion: $24\text{ bit } \Delta - \Sigma$ converters individual for each channel
DSP: $32\text{ bit output word length}$
Dynamic range: Overall: $146\text{ dB per-bin @ }1\text{ Hz rel. full-scale RMS}$
 $137\text{ dB @ }50\text{ sps peak-peak RMS to RMS shorted input noise}$

Wide-band: $0 - 500\text{ Hz}$: $118\text{ dB RMS full-scale peak to RMS shorted input noise}$

ANSS: $0.002 - 50\text{ Hz}$: $127\text{ dB RMS full-scale peak to RMS shorted input noise}$
 $0.01 - 15\text{ Hz}$: $132\text{ dB RMS full-scale peak to RMS shorted input noise}$
 $15 - 30\text{ Hz}$: $133\text{ dB RMS full-scale peak to RMS shorted input noise}$

Sampling rate: configurable up to $6\text{ channels @ }2000\text{ sps}$
supports 2 different simultaneous sample rates
each channel can have different sampling rates
Max. bandwidth*: $0\text{ to }1000\text{ Hz standard (other optional)}$
Anti-aliasing filter: Analog and digital FIR (finite impulse response)

Indicators

LED indicators: RGB LEDs for Power, System, Data, Network and Sensor

Triggering

Several trigger sets can be defined in the instrument. Each set can be flexibly configured regarding the source of trigger, main and advanced trigger parameters, trigger processing and selected channels for storage. A voting logic based on the monitored channels can be defined.

Trigger filter: Fully independent high-, low- or bandpass trigger filters
Level: Freely user configurable threshold
STA/LTA: Freely user configurable STA/LTA trigger and de-trigger ratios
Schedule / manual: After start-up, at a given date/time, after event or manual
Early Warning (EEW)*: JMA Earthquake Early Warning
Common trigger: Common triggering among separate units over Ethernet TCP/IP networks

Event Recording

Pre-event memory: $1 - 720\text{ seconds typical; freely user configurable}$
Post-event duration: $1 - 7200\text{ seconds typical; freely user configurable}$

Event Summary and Parameters

Content: PGA, PGV, PGD, SA (at $0.3, 1, 3\text{ Hz}$)
Transmission delay: User defined from trigger time

Data Stream

Protocol/compatibility: GSBUS, SeedLink, Earthworm*

Ring Buffer (Continuous Recording)

Usage: User can request an event from any period of the ring buffer by specifying the start time/date and the duration from the console or remotely from a server.
Method: Ringbuffer files with freely configurable duration which can be uploaded automatically to data server.

Storage Memory

Size and type: $8\text{ GByte Removable SD Card, FAT32 or EXT4 formatted}$
Higher capacity on request*
Management: Intelligent management of memory card capacity using storage policy to define reserved space per file type.
Recording format^o: miniSEED and extended miniSEED with information encapsulated into blockette 2000
Estimated capacity: Sampling rate [sps] x $0.4\text{ [MB/day/3 channel]}$ (example: $40\text{ MByte/day/3 channel @ }100\text{ sps}$) typical, since the data is compressed, capacity depends on the context of the data.

Self Test

- ▶ Permanent self-monitoring of hardware and software components without affecting their normal operation
- ▶ User-configurable periodical state of health (SOH) report based on comprehensive test of instrument, which can be requested at any time.
- ▶ User configurable periodical sensor test.
- ▶ Advanced sensor testing with sine, saw, and square wave injections.
- ▶ Logging of temperature and humidity inside the unit.

Timing

Internal clock: Intelligent Adaptive Real Time Clock (IARTC)
Sources: Network Time Protocol (NTP), GNSS (GPS, GLONASS, BeiDou and Galileo) with external antenna up to 5 m cable, or with external module up to 100 m cable^* , wired interconnection (ICC)*

Free running drift: without any source: $\pm 0.5\text{ ppm @ constant }25^\circ\text{C}$
 $\pm 2.5\text{ ppm @ }-10\text{ to }50^\circ\text{C}$
after learn (source disconnect): $\pm 0.02\text{ ppm @ constant }25^\circ\text{C}$
 $\pm 0.1\text{ ppm @ }-20\text{ to }50^\circ\text{C}$

Accuracy: running free: Calculate from above drift
with NTP: $< \pm 0.5\text{ ms}$
with GPS and ICC: $< \pm 0.001\text{ ms}$
Common time: NTP grade timing accuracy among separate units over Ethernet TCP/IP networks

Power

Input voltage: $9 - 48\text{ VDC}$
Power over Ethernet: $90 - 260\text{ VAC} / 50 - 60\text{ Hz}$ to 15 VDC switched UL approved external power block*
Consumption: $130\text{ mA @ }12\text{ VDC}$ for 3 channels
 $200\text{ mA @ }12\text{ VDC}$ for 6 channels

Communication and Connectivity

Configuration, Data retrieval: Ethernet, Wi-Fi*, serial line (console), removable SD card, USB-storage*
Network requirements: Fixed or dynamic IP on Ethernet LAN and/or Internet connection with Ethernet interface or OpenVPN, upload to HTTPS and SFTP servers, Wi-Fi (b/g/n) network with WEP, WPA, WPA2 security and Enterprise Mode*
Security: GeoDAS proprietary protocol over SSL, Checksum and software handshaking
Connectors: Power, Ethernet, Multicom (USB and Serial RS-232), SD card*, Sensor(s), GPS*, Alarm*, Option*, Intercon*, Wi-Fi*, micro-USB console*

Alarm and Notification

This provides a seismic switch functionality. SMS notification is available.*
Alarms: 4 independent solid state relay contacts for trigger alarm and/or error (user selectable). NO or NC contacts available. With 1 acknowledge input.
Alarm levels: Freely user configurable based on event triggers
Relay hold-on: $1\text{ to }60\text{ seconds, typical; freely user configurable}$
Capacity: The contacts are suitable for a low voltage control. In case a large load must be switched then external relays should be implemented.
Max voltage: $60\text{ V} / 250\text{ mA}$ per relay

Modem / WAN Interfaces*

External peripheral modules for cellular 3G/4G, SHDSL, fibre optic, etc, are available.

Environment / Reliability

Operational temperature: $-20\text{ to }+70^\circ\text{C}$
Storage temperature: $-40\text{ to }+85^\circ\text{C}$
Humidity: $0\text{ to }100\%\text{ RH (non-condensing)}$
MTBF: $> 500'000\text{ hours (based on GMS series)}$

Housing

Type: Aluminium housing
Connectors: Metallic circular screwed, or MIL-style*
Size (handles included): $275 \times 190 \times 100\text{ mm (W x D x H)}$
Weight: 3 kg
Protection: IP65 (NEMA 4), IP68 (NEMA 6)*
Easy transport: Handles for improved portability and mechanical protection of connectors.

*: optional;

^o: Retrieved data can be in the following formats depending on transmission, software and storage method used: miniSEED, DAT, ASCII, SEISAN, SUDS, SAC, SEG-2, Matlab, Artemis