

CANTERBURY SEISMIC INSTRUMENTS

CUSP-3 Series Strong Motion Accelerographs

Applications

- Free-field networks
- Dense arrays
- Aftershock studies
- Strong motion monitoring
- Structural monitoring
- Construction monitoring

Features

- Intuitive yet powerful user interface
- Up to 3 triaxial sensors up to 500m apart
- High performance triggering and recording
- Large storage capacity
- Flexible communications
- Highly Internet integrated
- Low operation and deployment costs



CUSP-3X Specifications

Sensors

Mounting	Internal sensors, optional external mounted.
CUSP-3B	
Type	Triaxial MEMs silicon accelerometers
Range	$\pm 4g$
Dynamic range	80dB
Offset error	$< \pm 1\%$ over operating temperature range
Linearity	$< \pm 0.25\%$ ($\pm 1g$) $< \pm 1\%$ (full range)
Gain error	$< \pm 1\%$ over operating temperature range
Hysteresis	$< 0.5\%$ over operating temperature range
CUSP-3C	
Type	Triaxial MEMs silicon accelerometers
Range	$\pm 4g$
Dynamic range	108dB
Offset error	$< \pm 2\%$ over operating temperature range
Linearity	$< \pm 0.1\%$ ($\pm 1g$) $< \pm 1\%$ (full range)
Gain error	$< \pm 2\%$ over operating temperature range
Hysteresis	$< 0.5\%$ over operating temperature range
CUSP-3D	
Type	Triaxial MEMs servo silicon accelerometers
Range	$\pm 4g$
Dynamic range	114 dB (120dB typical)
Offset error	$< \pm 0.02\%$ over operating temperature range
Linearity	$< \pm 0.1\%$
Gain error	$< \pm 0.08\%$ over operating temperature range
CUSP-3E	
Type	Triaxial MEMs servo silicon accelerometers
Range	$\pm 3g$
Dynamic range	120dB (126dB typical)
Offset error	$< \pm 0.01\%$ over operating temperature range
Linearity	$< \pm 0.1\%$
Gain error	$< \pm 0.01\%$ over operating temperature range

A/D conversion CUSP 3B

Sampling	Zero skew autonomous sampling 1ppm time-base (0-60°C)
Anti-Alias	8th order elliptic synchronised switched-capacitor anti-alias filter ($f_c = 2x$ measurement BW)
Sensor data output rate	400Hz
A/D type	16 bit S-A A/D
Integral non-linearity	< 3 LSB
Resolution	16 bits
SNR	91 dB

A/D conversion CUSP 3C, 3D, 3E

Sampling	Zero skew autonomous sampling 1ppm time-base (0-60°C)
Anti-Alias	1-pole RC filter ($f_c = 10\text{kHz}$)
Sensor data output rate	200Hz
A/D type	24-bit Σ - Δ A/D
Integral non-linearity	< 0.0004% (full range)
Resolution	31 bits
SNR	130 dB (200Hz) 133dB (100Hz) 136dB (50Hz)

Data Signal Processing

Filtering	FIR digital anti-alias filter/decimator Linear phase
Measurement bandwidth	DC to 20, 40 or 80Hz
Sensor data output rate	200Hz
Recorded dynamic range	130dB (80 Hz BW) 133dB (40 Hz BW) 136dB (20 Hz BW)

Processor

Type	Low power x86
OS	Multi-tasking real-time Linux based

Communications

Type	LAN, Dial-up server and client, Serial link, Cellular modem, WiFi
Protocol	TCP-IP, PPP
Services	SSL-HTTP web server, FTP, Telnet, SSH, SFTP, RSYNC, SEEDlink Email/FTP/SFTP transfer-on-event
Data integrity	Password control to access instrument configuration and data areas with multiple data and administrator accounts SSL/SSH encryption
Features	Remote configuration of all parameters including IP number, Instrument setting, Power management etc Data retrieval Diagnostics

Triggering

Type	STA/LTA <AND> or <OR> absolute level detection Remote manual trigger from web interface Remote trigger transmission/reception to/from multiple array management systems (e.g. CUSP-HUB systems) Remote trigger transmission/reception to/from one other CUSP-3 series or CUSP-M instrument for, e.g., structural monitoring
Pre-trigger filter options	0.1 Hz high-pass 1 Hz high-pass 5 Hz low-pass 10 Hz low-pass 0.1 – 5 Hz band-pass 0.1 – 10 Hz band-pass 1 – 5 Hz band-pass 1 – 10 Hz band-pass
STA/LTA	Independent trigger and dettrigger thresholds on each channel Selectable <AND> or <OR> triggering on each channel Thresholds adjustable from 1.1:1 to 200:1 LTA lock-on-trigger for 5–60 seconds 0.3 to 500 s term lengths
Absolute level	Independent thresholds on each channel Selectable <AND> or <OR> triggering on each channel Level from 0.1mg to 3 g in 0.1mg steps
Pre-event length	10 to 120 seconds in 1-second steps
Post even length	10 to 120 seconds in 1-second steps

Storage

Format	MiniSEED (Steim 2 compression) ASCII (gzip or uncompressed)
Type	Wear-leveling FLASH disk Unique record file names indicating time and instrument, PGA, and trigger duration
Storage time	> 3 days @ 200 samples/s (1GB card) > 16 days @ 200 samples/s (4GB card) No upper limit – depends of FLASH disc size

Timing

Type	Low power GPS (standard) NTP network timing Backup real-time clock
Accuracy	Better than 10us of UTC with GPS lock 5ms NTP timing (typical) 50ppm with backup real-time clock (NB this is not the sampling time-base - 1ppm TCXO)

Power

Supply voltage	10.5 – 18.0V DC
Power consumption	3.6 W typical, 4.2W max
Supply monitoring	User adjustable low voltage shut-down and auto re-power on resumption of power

User Interface

Type	Web browser based Fully interactive Platform independent Linux/Windows/Mac Can be configured / interrogated remotely from any Internet-connected PC Secure SSL-encrypted Apache web server
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Options

Sensors	Up to two external sensors in addition to the internal sensor Acceleration, wind, geophone or displacement options
Output	Relay output at programmable PGA or MMI

Environmental / Casing

Protection	IP65, NEMA4 waterproof case
Temperature range	-10 – +50°C standard
Humidity	0 to 100% (non condensing)
Mounting	Three feet and a central lock-down bolt

Note specifications may change without notice.

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