



# Accelerograph

## REF TEK 24-BIT STRONG MOTION

REF TEK strong motion and earthquake engineering products combine the 3rd generation Broadband Seismic Recorder (REF TEK 130S) and advanced low-noise force-balance accelerometers.

The 130-SMHR and 130-SMA Strong Motion Accelerographs provide accurate and timely data and information for seismic events, including their effects on buildings and structures by employing modern monitoring methods and technologies. Both models are made for continuous monitoring of earthquakes and other seismic events, and the recording of strong earthquake shaking at ground sites, in buildings and critical structures.

The 130-SMHR and 130-SMA advanced communications features include TCP/IP over Ethernet and Asynchronous Serial. An LCD continuously displays state-of-health and status information.

Both models have three channels connected to an internal triaxial accelerometer. When ordered as a six-channel unit, the three additional channels can be connected to an external sensor.

The 130-SMHR and 130-SMA both:

- ▶ have provision for an optional internal V.90 modem for communication over standard telephone lines;
- ▶ include a battery charger for maintaining a lead-acid battery;
- ▶ are housed in an anodized aluminum instrument case with single point mounting and 3-point leveling.

The instrument case size allows the installation of an internal battery to provide backup power for more than 48 hours. An external battery can also be used.

The 130-SMA uses command line firmware, which was specifically designed for structural monitoring applications. Setup and control is accomplished using the strong motion GUI (Graphic User Interface), that runs on multiple platforms. This firmware allows control of three relay closure contacts for external alarm activation and can automatically dial the optional modem for remote notification of events and alarms.

The 130-SMHR full featured Accelerograph can also run the command line firmware, but typically runs the standard REF TEK 130 firmware. The standard firmware provides more options for sampling rate and triggering than the command line firmware, but does not include relay control. Setup and control is accomplished with either the iFSC Controller or a desktop computer running RTI. These interfaces allow the user to program the instrument's operating parameters and perform diagnostic functions.

The performance of the 130-SMHR and 130-SMA hardware is similar, with two notable differences.

- ▶ The 130-SMHR has a higher-precision oscillator for more precise timekeeping.
- ▶ The accelerometer in the 130-SMHR has a full-scale range of greater than  $\pm 4g$  with a dynamic range of 155 dB from DC to 2 Hz while the accelerometer in the 130-SMA has a full-scale range of greater than  $\pm 4g$  with a dynamic range of 112 dB (at 1 Hz).

### Key Features

- ▶ State-of-the-Art 24-Bit ADC
- ▶ Wide Dynamic Range
- ▶ Low Noise Force-Balance
- ▶ Simultaneous Telemetry/Self Recording
- ▶ IP over Ethernet and Asynchronous Serial
- ▶ Embedded / Removable Mass Storage
- ▶ Low Power

### Applications:

- ▶ Free Field Recording
- ▶ Structural Monitoring
- ▶ Dam Monitoring
- ▶ Building Arrays
- ▶ Telemetry Networks
- ▶ Aftershock Studies



## Specifications

## Full Featured Accelerograph, Model 130-SMHR (Standard)

### Mechanical:

Size:	• 9.25" high x 8.0" wide x 13.25" long (23.5 cm x 20.3 cm x 33.7 cm)
Weight:	• 10.5 lbs (4.8 kg), without internal battery
Watertight Integrity:	• IP 67
Shock:	• Survives a 1 meter drop on any axis
Operating Temperature:	• -20 °C to +70 °C

### Power:

Input Voltage:	• 10 to 16 VDC
Operating Power:	• 2 W (3-ch. @ 125 sps)
Peak Power:	• 3 W (DAS & GPS active, writing to CF)
Battery Charger:	• 15 V, 800 mA (internal)
Battery:	• 12 VDC, sealed lead-acid, 12 AmpH (optional, internal)

### A/D Converter:

Type:	• $\Delta$ - $\Sigma$ modulation, 24-bit resolution
Channels:	• 3, 6 or 9 channels
Input Impedance:	• Matched to accelerometer
Input Full Scale:	• Matched to accelerometer
Bit Weight:	• 1.589 $\mu$ V
Self Noise Level:	• 2 counts RMS @ 200 sps
Sample Rates (user selectable):	• 1000, 500, 250, 200, 125, 100, 50, 40, 20, 10, 5, 1 sps
Dynamic Range:	• >138 dB

### Time Base:

Type:	• GPS Receiver/Clock plus a disciplined oscillator
Accuracy:	• $\pm 10$ $\mu$ sec with GPS locked and a validated 3-D fix
Accuracy without GPS:	• 0.1 ppm from 0° to 60 °C, 0.2 ppm from -20° to 0 °C

### Auxiliary Channels:

Inputs:	• Battery, Temperature, Backup Battery
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### Calibration:

Enable:	• User Command
Type:	• Step applied to feedback

### Communication:

Ethernet:	• 10-BaseT: TCP/IP, UDP/IP, FTP, RTP
Serial:	• Asynchronous RS-232: PPP, TCP/IP, UDP/IP, FTP, RTP
Modem:	• N/A

### Recording Mode:

Trigger Type:	• Continuous, Event (STA/LTA), External, Level, Time, Time List, Cross, and Vote Trigger (0.0001 to 4g)
Media:	• Compact Flash, Ethernet
Format:	• PASSCAL Recording Format
Relay Closure:	• N/A

### Recording Capacity:

Battery Backed SRAM:	• 8 MB
Flash Disk (2 per unit):	• 8GB or 16GB

### Compliance:

- CE

### Internal Accelerometer:

Type:	• Force-balance (internal)
Full Scale Range:	• > $\pm 4$ g
Full Scale Output:	• $\pm 10$ V, 20 VPP
Dynamic Range:	• >155 dB (DC to 2 Hz)
Sensitivity:	• 2.5 V/g nominal (exact value in EEPROM)
Linearity:	• < 0.03 % of full scale
Cross-axis Sensitivity:	• < 0.001 g/g
Frequency Response:	• Flat DC - >150 Hz



## Accelerograph, Model 130-SMHR Command Line

- 9.25" high x 8.0" wide x 13.25" long (23.5 cm x 20.3 cm x 33.7 cm)
- 10.5 lbs (4.8 kg), without internal battery
- IP 67
- Survives a 1 meter drop on any axis
- -20 °C to +70 °C

- 10 to 16 VDC
- 2 W (3-ch. @ 125 sps)
- 3 W (DAS & GPS active, writing to CF)
- 15 V, 800 mA (internal)
- 12 VDC, sealed lead-acid, 12 AmpH (optional, internal)

- $\Delta$ - $\Sigma$  modulation, 24-bit resolution
- 3, 6 or 9 channels
- Matched to accelerometer
- Matched to accelerometer
- 1.589  $\mu$ V
- 2 counts RMS @ 200 sps
- 200, 100, 50 sps
- >138 dB

- GPS Receiver/Clock plus a disciplined oscillator
- $\pm 10$   $\mu$ sec with GPS locked and a validated 3-D fix
- 0.1 ppm from 0 ° to 60 °C, 0.2 ppm from -20 ° to 0 °C

- Battery, Temperature, Backup Battery

- User Command
- Step applied to feedback

- 10-BaseT: TCP/IP, UDP/IP, FTP, RTP
- Asynchronous RS-232: PPP, TCP/IP, UDP/IP, FTP, RTP
- V.90 (internal)

- Continuous, External, Level and Vote Trigger (0.0001 to 4g)
- Compact Flash, Ethernet
- PASSCAL Recording Format
- 3 independently programmable relay closures

- 8 MB
- 8 GB or 16 GB

- CE

- Force-balance (internal)
- >  $\pm 4$  g
- $\pm 10$  V, 20 VPP
- >155 dB (DC to 2 Hz)
- 2.5 V/g nominal (exact value in EEPROM)
- < 0.03 % of full scale
- < 0.001 g/g
- Flat DC - >150 Hz

## Accelerograph, Model 130-SMA (Command Line)\*

- 9.25" high x 8.0" wide x 13.25" long (23.5 cm x 20.3 cm x 33.7 cm)
- 10.5 lbs (4.8 kg), without internal battery
- IP 67
- Survives a 1 meter drop on any axis
- -20 °C to +70 °C

- 10 to 16 VDC
- 2 W (DAS & GPS active, writing to CF)
- 3 W (DAS & GPS active, writing to CF)
- 15 V, 800 mA (internal)
- 12 VDC, sealed lead-acid, 12 AmpH (optional, internal)

- $\Delta$ - $\Sigma$  modulation, 24-bit resolution
- 3, 6 or 9 channels
- Matched to accelerometer
- Matched to accelerometer
- 1.589  $\mu$ V
- 2 counts RMS @ 200 sps
- 200, 100, 50 sps
- >138 dB

- GPS Receiver/Clock plus a disciplined oscillator
- $\pm 10$   $\mu$ sec with GPS locked and a validated 3-D fix
- 2.5 ppm from -20 °C to 60 °C

- Battery, Temperature, Backup Battery

- User Command
- Step applied to feedback

- 10-BaseT: TCP/IP, UDP/IP, FTP, RTP
- Asynchronous RS-232: 1K XMODEM, YMODEM
- V.90 (internal)

- Continuous, External, Level and Vote Trigger (0.0001 to 4g)

- Compact Flash, Ethernet
- PASSCAL Recording Format
- 3 independently programmable relay closures

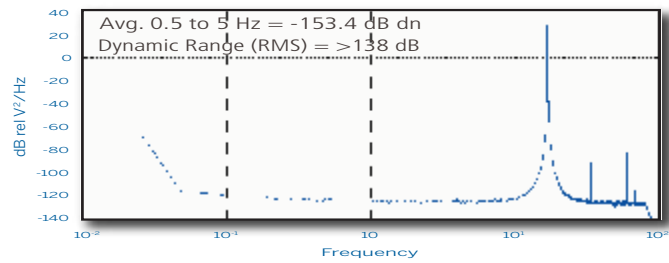
- 8 MB
- 8 GB or 16 GB

- CE

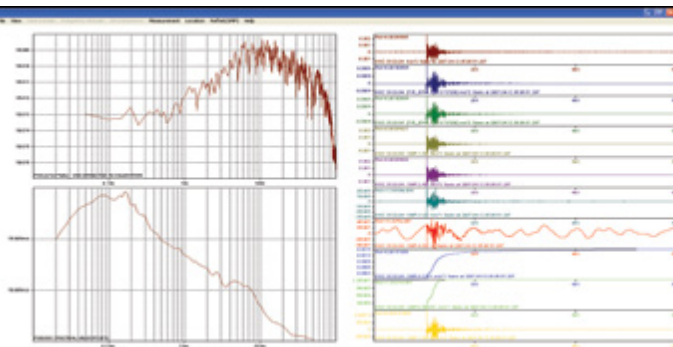
- Force-balance (internal MEMS)
- >  $\pm 4$  g
- $\pm 10$  V, 20 VPP
- 112 dB @1 Hz
- 1.6 V/g nominal (exact value in EEPROM)
- < 0.02 % of full scale
- < 0.005 g/g
- Flat DC - 500 Hz

# Accelerograph REF TEK 24-BIT STRONG MOTION

Power Spectral Density (PSD) 130-SMHR/SMA A/D



Power Spectral Density



COMPASS: Strong Motion Processing Software



SMCC: Strong Motion Command & Control included in RTI Software

## ORDERING INFORMATION

Part No.	Description
<b>130 STRONG MOTION HIGH RESOLUTION (SMHR) ACCELEROGRAPH</b>	
Standard Firmware	
97112-00	130-SMHR: Strong Motion Accelerograph
97125-00	130-SMHR/6: Strong Motion Accelerograph 6 Ch.
Command Line Firmware	
97238-00	130-SMHR/6-C: Strong Motion Accelerograph 6 Ch.
98060-00	130-SMHR/9: Strong Motion Accelerograph 9 Ch.
<b>130 STRONG MOTION (SMA) ACCELEROGRAPH</b>	
Standard Firmware	
97110-00	130-SMA: Strong Motion Accelerograph
97234-00	130-SMA/6: Strong Motion Accelerograph 6 Ch.
Command Line Firmware	
97236-00	130-SMA/6-C: Strong Motion Accelerograph 6 Ch.
<b>ACCESSORIES</b>	
97150-00	130-GPS: Receiver/Clock
97180-00	130-FLASH/8G: Disk, Compact Flash II
97181-00	130-FLASH/16G: Disk, Compact Flash II
97211-00	130-8004: Assembly, Cable, Ethernet/Modem, Ext.
97163-00	130-8015-33: Cable, 130 to GPS, 33 ft. (~10m)
97170-00	130-8019: Cable, NET, 130 to Ethernet RJ45 Hub, Ext.
97168-00	130-8039: Cable Power Supply, AC, Pin A
97169-00	130-8039A: Cable, Power Supply, AC w/ Batt. A&B
97172-00	130-8018: Cable, PC Command & Control
97192-00	130-Reader-USB: Reader, CF I/II, External (readers with other interfaces available on request)
97182-10	iFSC/W-KIT: Includes WiFi Serial Adaptor, iFSC 16GB Controller, CD
97134-00	SW-RTI-NC: Software, REF TEK Interface
97131-00	SW-COMPASS: Software, Seismic Signal Data Processing, Interactive

## RELATED REF TEK SUB-SYSTEMS:

- 3rd Generation Seismic Recorders, 130S-01
- Accelerometers, 147A
- Broadband Seismometers, 151B-120, 151B-60, 151B-30

Contact your local dealer today

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