

Related Sub-systems:

Strong Motion Accelerographs, 130-SMHR & 130-SMA
Miniature Seismic Recorder, 125A-02 "Texan"
Accelerometers, 147 & 131B
Broadband Seismometers, 151-120, 151-60 & 151-30
Advanced Seismic Networks

Specifications subject to change without notice. Rev. 3.4.1
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Unshakable.

130 Specifications

Mechanical

Size: 5.3" (135mm) high x 7.3" (185mm) wide x 13.5" (343mm) long
Weight: 4.5 lbs (2 kg)
Watertight Integrity: IP 67
Shock: Survives a 1 meter drop on any axis
Operating Temperature: -20°C to +70°C

Connectors

Channel Input: PT07A14-19S (2 each for 6-Channel DAS)
Power: PT07A12-4S
NET: PT07A14-19P
Serial: PT07A12-10P
GPS Antenna: PT07A12-8S

Power

Input Voltage: 9 to 24 VDC
Average Power: ~1 W (3 ch., GPS, writing to disk, no communications)
~1.25 W (3 ch., GPS, writing to disk, with communications)
~1.45 W (6 ch., GPS, writing to disk, no communications)
~1.7 W (6 ch., GPS, writing to disk, with communications)

Communications

NET Connector:
Ethernet: 10-BaseT, TCP/IP, UDP/IP, FTP, RTP
Serial: Asynchronous, RS-232, PPP, TCP/IP, UDP/IP, FTP, RTP
Serial Connector:
Terminal: Asynchronous, RS-232, 130 Command

A/D Converter

Type: Δ - Σ modulation, 24-bit output resolution
Dynamic Range: >138 dB @100 sps (130S-01); > 135 dB @ 100 sps (130B-01)
Channels: 3 or 6 (130S-01); 3 only (130B-01)
Input Impedance: 2 Mohms, 0.002 uFd, differential @ x32;
25 Kohms, 0.002 uFd, differential @ x1
Common Mode Rejection: Greater than 70 dB within ± 2.5 VDC
Gain Selection: x1 and x32 (130S-01); x1 (130B-01)
Input Full Scale: 40 VPP @ x1 and 1.25 VPP @ x32
Bit Weight: 2.724 μ volts @ x1 and 85 nV @ x32
Noise Level: ~1 count RMS at 50 sps @x1
Sample Rates: 1000, 500, 250, 200, 125, 100, 50, 40, 25, 20, 10, 5, 1 sps
FIR Filter: 130 dB down passband to Nyquist

Auxiliary Channels

Inputs: 3 Channels Available on each Sensor Connector
Supply Voltage
Backup battery Voltage
Temperature

Time Base

Type: GPS Receiver/Clock plus a disciplined oscillator
Accuracy with GPS: ± 10 μ sec after validated 3-D fix and locked
Free-Running Accuracy: 0.1 ppm over the temp. range of 0°C to 70°C, and 0.2 ppm from -20°C to 0°C (130S-01)
2.5 ppm over temp. range of -20°C to 70°C (130B-01)

Recording Modes

Continuous: Record length
Time Trigger: Specific record length at periodic interval
Time List Trigger: A list of record times and lengths
Event Trigger: STA/LTA with advanced features including bandpass filter
LTA hold, etc.
Level Trigger: Absolute value, user selectable: g, or % of full scale,
or counts including bandpass filter
Vote Trigger: Level trigger with weighting
External Trigger: External pulse on trigger input line
Cross Trigger: One stream triggers recording of another

Recording Capacity

Battery Backed SRAM: 8 to 16 MB user specified
Hard Disk: 2,4,8,16, 32 GB with two CFII cards, settable in "ring-buffer" configuration

Recording Format

Format: PASCAL Recording Format

Compliance

CE

Ordering Information

Part No.	Description
130S-01/3	Recorder, 3rd Generation, 3-Ch.
130S-01/6	Recorder, 3rd Generation, 6-Ch.
130B-01/3	Recorder, 3rd generation, 3-Ch.
130-GPS	GPS Receiver/Clock
130-FLASH/2GB	Disk, Flash Memory, 2GB Compact Flash II
130-FLASH/4GB	Disk, Flash Memory, 4GB Compact Flash II
130-FLASH/8GB	Disk, Flash Memory, 8GB Compact Flash II
130-FLASH/16GB	Disk, Flash Memory, 16GB Compact Flash II
RT527-B01	Sensor Control Board Assembly
130-8002	Channel Input Mating Connector
130-8004	Assembly, Cable, Ethernet / Modem, External
130-8015-33	Cable, 130 to GPS, 33ft. (~10m); other lengths available, please contact REF TEK
130-8019	Cable, NET, 130 to Ethernet RJ45 Hub, External
130-8023	Cable, NET, 130 to Ethernet RJ45, Crossover, External
130-8075	Cable (with ring lugs), Power, 130 to Battery, 6ft. (~2m)
IFSC-KIT	Kit, iPod touch, cable and CD
130-Reader-USB	Reader, CF I/II/III, External, USB (readers with other interfaces available upon request)
130-Transit	Case, Transit (holds six 130, GPS, Cables)
130-FIELDCASE	Case, Transit (holds one 130, GPS, Cables)
PT06A12-4P	Mating Connector, Power Input
PT06A14-19S	Mating Connector, NET Input
PT06A12-10S	Mating Connector, Serial Input
PT06A12-8P	Mating Connector, GPS Input



Third Generation Broadband Seismic Recorder MODEL 130S-01 MODEL 130B-01/3

Applications:

Local and Regional
Broadband
Aftershock
Active-Source
Micro-Zonation Survey
Site Noise Survey
Earthquake Early Warning
Rapid Transportation

Features:

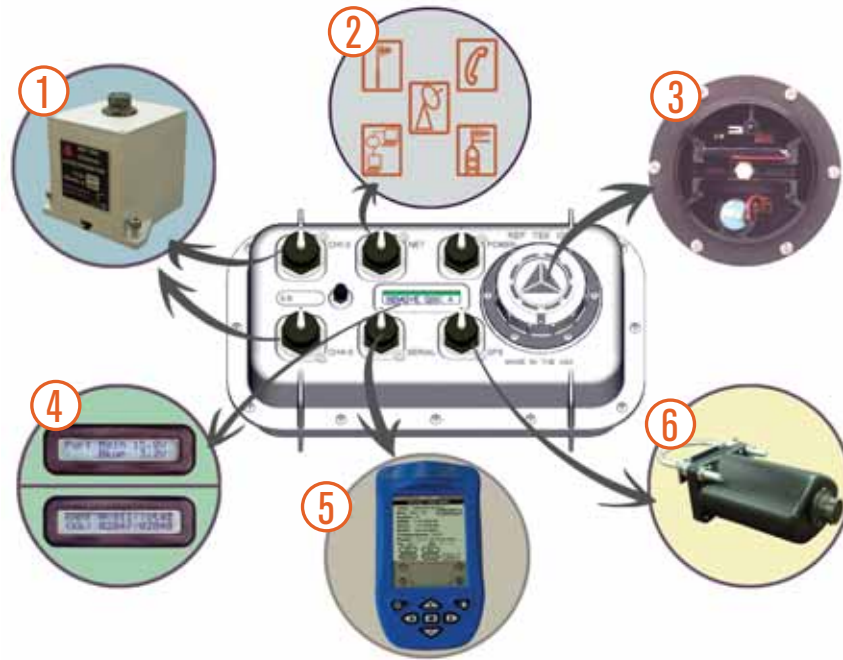
State-of-the-Art ADC for BB/SP Seismometers
Small Size and Light Weight
Modular Hardware and Software
IP Communications over Ethernet
and Asynchronous Serial
Embedded/Removable Mass Storage



Introduction

The 130 Broadband Seismic Recorder has been designed to be easier to use – more compact, lighter in weight, lower power, and requires less maintenance than other recorders. Not only is the hardware optimized for field deployments, software tools have been specially developed to support both field and base station operation. The 130 case is a clamshell design, inherently waterproof, with easy access to all user features on the top of the unit.

1. The 130 has 3 or 6 input channels for connection to any sensor available in the seismology market. Note: Model 130B-01/3 is available in 3-channel configuration only.
2. The network Command / Control and Data Telemetry is either Ethernet 10BaseT or serial PPP.
3. The disk compartment contains two CF-II slots, backup battery and status LEDs for easy servicing.
4. The LCD display allows the 130 Recorder to be serviced without connecting a set-up controller by displaying the 130 State-Of-Health.
5. User set-up, control, status, and data monitoring is done either with a PDA (Palm OS) device running PFC software or with a PC or Workstation running RTI application software set.
6. The 130 uses a high-precision TCXO disciplined by an external GPS Receiver / Clock, which maintains time accuracy to better than 10 μ sec.

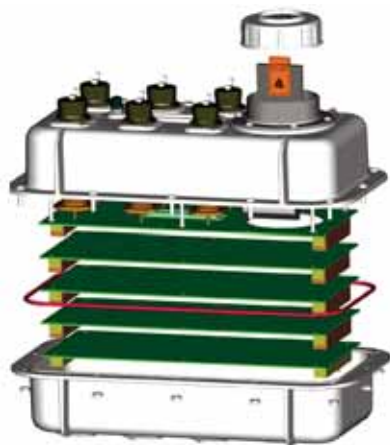


Hardware Modularity

REF TEK 130 is constructed with up to five internal boards stacked together – an arrangement that is more reliable and less costly than a traditional backplane arrangement. The 130 comes with a Lid Interconnect Board, a Microcomputer Board, and one or two ADC Boards. The Sensor Control Board is available as an option.

One or two removable disks reside in a sealed compartment that is accessed by opening a lid located on the top of the 130 case. The main electronics section is sealed with the lid open or closed.

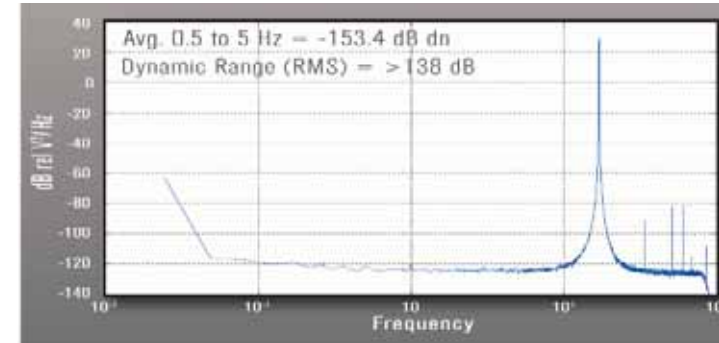
The GPS Receiver is separate from the main unit in order to allow the GPS antenna to be located some distance away.



Module	Description	Contents
1	Lid Interconnect Board (RT520) (▲)	Power Supply Lightning Protection Physical Interface DC-DC Converter
2	Microcomputer Board (RT506) (▲)	CPU Battery Backed SRAM (up to 16 MBytes) Serial Ports Real-time Clock Ethernet Controller, full stack Enhanced Integrated Drive Electronics (EIDE)
3	ADC (RT649) (▲)	24-Bit ADC Channels (3 each) Input Pre-Amplifier Digital Anti-Alias Filters 1M SRAM Direct Memory Access (DMA) Controller DC-DC Converter
4	Sensor Control Board (RT527) (*) (▲) *Optional, installed upon customer's request	Monitoring of Mass Position Re-Centering Command; Mass Lock/Unlock Calibration Commands Calibration Signals DC-DC Converter
5	Removable Mass Storage (External)	Compact Flash (two slots available) 2 to 32 Gbytes total capacity RT526 Interface Board
6	GPS Receiver (External)	Garmin GPS Receiver

Noise Performance

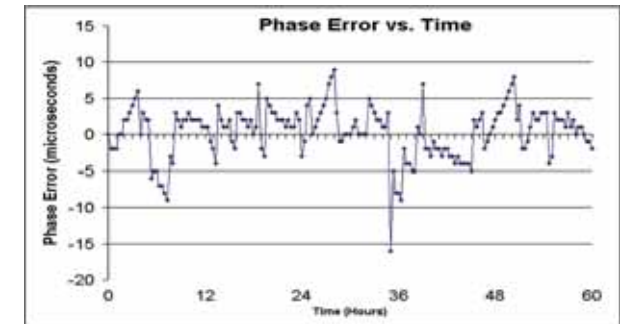
The 130 series Recorders incorporates the 3rd generation 24-bit delta sigma type analog-to-digital converter with state-of-the-art design. The combination produces the highest performance low power 24-bit seismic recorder. Below is the power spectral density of the ADC with the full scale sine wave input.



Time Keeping

In order to maintain accurate time over a long period, the 130 Recorders uses both a high-precision TCXO and an external reference provided by the 130-GPS Receiver / Clock that uses the Global Positioning System (GPS) for time, frequency, and position reference.

When power is applied to the 130 Recorder, rough time is set from a battery-backed clock. A few seconds after obtaining a 3-D position fix (typically seconds after power-up or minutes if the 130-GPS has been moved a great distance since last operating), the 130-01 will set its time to GPS time. During the initial 15 minute period, the TCXO frequency and phase is measured and adjusted to the GPS, then the 130-01 time is set to UTC. Within an hour of operation, the internal clock will remain within a few μ secs of UTC while the 130-GPS runs with a 5% duty cycle. The frequency setting is maintained across power cycles thus the oscillator's frequency is compensated for aging and temperature drift automatically.



Field Operation



REF TEK has developed two programs for Command / Control of the 130. iFSC is an iOS app developed to work with iPod touch and iPhone with an iOS of 4.0 or later. REF TEK Interface (RTI) is a set of server / client applications which runs on Windows, Linux, or Solaris notebook / desktop computers. iFSC is used to edit and program the acquisition parameters of the 130 via the Serial connector. RTCC (part of RTI) is used to edit and program the acquisition parameters of the 130 via the NET connector using standard WEB browsers. Additionally, State-Of-Health monitoring is accomplished with an extensive set of Status commands. The State-Of-Health information includes acquisition status, memory and disk usage, GPS status, main and backup battery voltage, time, and temperature. Additional commands are used to set up network connections and check their status. Data monitoring without stopping acquisition is available. RTDisplay (part of RTI) is a Windows client to RTPD. The data viewer provides browsing of data coming to the RTPD server in real-time.



Data Retrieval

The 130 series Recorders may be equipped with one or two Compact Flash Type I or Type II storage media (disks). CF flash storage is available up to 16 GB capacity. For example, 4 GB is enough storage to hold more than 100 days of three channel, 100 sps data recorded with Steim 2 compression. Files are written in FAT32 format allowing high capacity disks to be used. To swap a disk during acquisition, simply open the cap that seals the disk compartment. A red LED indicates the disk is busy. When inactive a green LED signals to remove the disk and insert another one in its place. Replace the cap resealing the compartment.

Data from the disk may be read on any PC / Workstation using a CF-II reader. Data can also be remotely downloaded from the 130-01 disk using FTP over LAN/WAN.