



**REF TEK** 

**Unshakable.**

# Third Generation Broadband Seismic Recorder **MODEL 130-01**

## Applications:

Local and Regional  
Broadband  
Aftershock  
Active-Source  
Micro-Zonation Survey  
Site Noise Survey

## 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

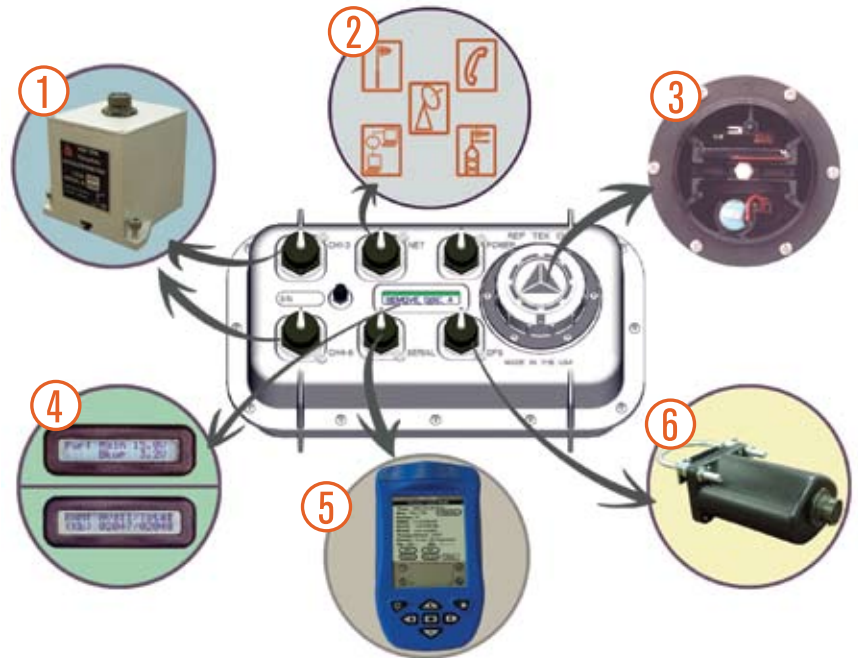
**CE**



## 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.
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 msec.

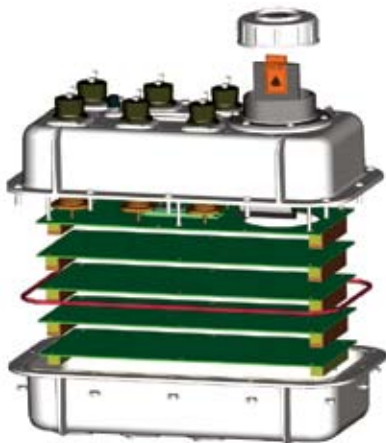


## Hardware Modularity

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.

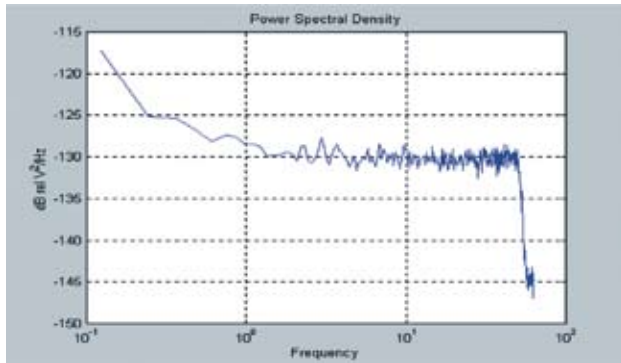
The GPS Receiver is separate from the main unit in order to allow the GPS antenna to be located some distance away.



| Module | Description  | Contents   |
|--------|--|--|
| 1      | Lid Interconnect Board (RT520) (▲)   | Power Supply<br>Lightning Protection<br>Physical Interface<br>DC-DC Converter  |
| 2      | Microcomputer Board (RT506) (▲)  | CPU<br>Battery Backed SRAM (up to 16 MBytes)<br>Serial Ports<br>Real-time Clock<br>Ethernet Controller<br>Enhanced Integrated Drive Electronics (EIDE)   |
| 3      | ADC (RT505) (▲)  | 24-Bit ADC Channels (3 each)<br>Input Pre-Amplifier<br>Digital Anti-Alias Filters<br>1M SRAM<br>Direct Memory Access (DMA) Controller<br>DC-DC Converter |
| 4      | Sensor Control Board (RT527) (*) (▲)<br>*Optional, installed upon customer's request | Monitoring of Mass Position<br>Re-Centering Command<br>Calibration Commands<br>Calibration Signals<br>DC-DC Converter                                    |
| 5      | Removable Mass Storage (External)  | IBM Microdrive or Compact Flash<br>Up to 10 Gbytes<br>RT526 Interface Board  |
| 6      | GPS Receiver (External)  | Garmin GPS Receiver<br>RT528 Interface Board   |

## Noise Performance

The 130-01 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 terminated at 125 sps.



## Data Retrieval

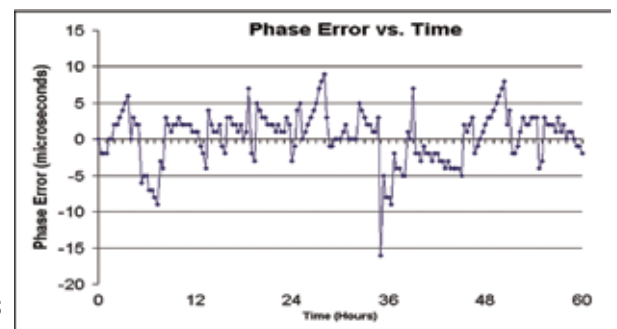
The 130-01 may be equipped with one or two Compact Flash Type I or Type II storage media (disks). CF flash storage or rotating disks are available up to 8 GB capacity. For example, 4 GB is enough storage to hold more than 100 days of three channel, 100 sps data recorded with Steim 2 compression. Files 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 CP-II reader. Data can also be remotely downloaded from the 130-01 disk using FTP over LAN/WAN.

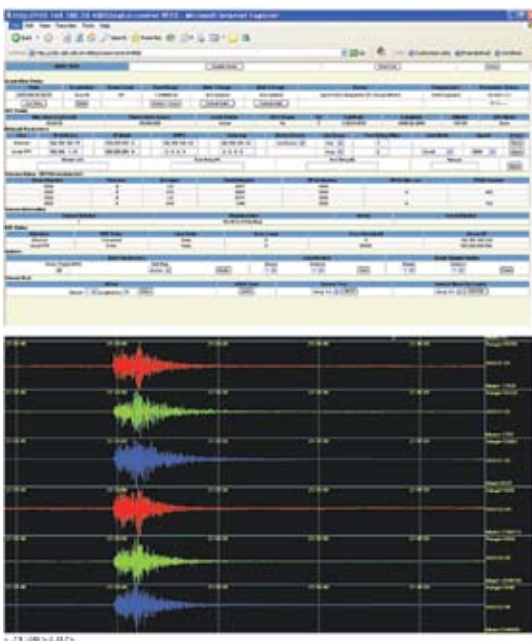
## Time Keeping

In order to maintain accurate time over a long period, the 130 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 130-01, 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 usecs 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. PFC\_130 is a Palm OS program for use on a Personal Digital Assistant (PDA). REF TEK Interface (RTI) is a set of server / client applications which runs on Windows, Linux, or Solaris notebook / desktop computers. PFC\_130 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.



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## Related Sub-systems:

Strong Motion Accelerographs, 130-SM & 130-SMA  
Miniature Seismic Recorder, 125A-01 "Texan"  
Accelerometers, 131A & 131B  
Advanced Seismic Networks

Specifications subject to change without notice. Rev. 3.4  
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## 130-01 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 +60°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:** 10 to 16 VDC  
**Average Power:** ~1 W (3 ch., GPS, writing to disk, no communications)  
~1.4 W (3 ch., GPS, writing to disk, with communications)  
~1.7 W (6 ch., GPS, writing to disk, no communications)  
~2.1 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:**  $\Delta$ - $\Sigma$  modulation, 256 KHz base rate, 24-bit output resolution  
**Channels:** 3 or 6  
**Input Impedance:** 2 Mohms, 0.002 uFd, differential @ x32; 25 Kohms, 0.002 uFd, differential @ x1  
**Common Mode Rejection:** Greater than 70 dB within  $\pm 2.5$ VDC  
**Gain Selection:** x1 and x32  
**Input Full Scale:** 20 VPP @ x1 and 0.625 VPP @ x32  
**Bit Weight:** 1,589  $\mu$ volts @ x1 and 49 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

### 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:**  $\pm 10$   $\mu$ sec after validated 3-D fix and locked  
**Free-Running Accuracy:** 0.1 ppm over the temperature range of 0°C to 60°C, and 0.2 ppm from -20°C to 0°C

### Recording Modes

**Continuous:** Record length  
**Time Trigger:** A list of record times and lengths  
**Time List:** A list of records at specified times  
**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 GB with two CFII cards

### Recording Format

**Format:** PASSCAL Recording Format

### Compliance

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## Ordering Information

| Part No.       | Description   |
|----------------|---|
| 130-01/3       | Recorder, 3rd Generation, 3-Ch.   |
| 130-01/6       | Recorder, 3rd Generation, 6-Ch  |
| 130-GPS        | GPS Receiver/Clock  |
| 130-FLASH/1GB  | Disk, Flash Memory, 1GB Compact Flash II  |
| 130-FLASH/2GB  | Disk, Flash Memory, 2GB Compact Flash II  |
| 130-FLASH/4GB* | Disk, Flash Memory, 4GB 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)                                 |
| 130-PDA-KIT    | PDA w/ Ruggedized Case, Cable & PFC_130   |
| 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   |

\*Higher capacity CF drives available. Please contact REF TEK.