130-01 Specifications

Mechanical

Size:	◆ 5.3" high x 7.3" wide x 13.5" 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:	◆ PTO7A14-19S (2 each for 6 Ch. DAS)
Power:	◆ PTO7A12-4S
NET:	◆ PTO7A14-19P
Serial:	◆ PTO7A12-10P
GPS:	◆ PTO7A12-8S

Power

Input Voltage:	◆ 10 to 16 VDC
Average Power:	◆ ~ 1 W (3-ch., no communications)
	◆ ~ 1.4 W (3-ch.,with communications)
	◆ ~ 1.7 W (6-ch., no communications)
	◆ ~ 2.1 W (6-ch.,with communications)

A/D Converter

Type:	◆ Δ-Σ modulation, 256 KHz base rate, 24-bit output resolution
Channels:	◆ 3 or 6 channels
Input Impedance:	◆ 2 Mohms, 0.002 μFd, differential @ x100;
	◆ 25 Kohm, 0.002 μFd, differential @ x1
Common Mode Rejection:	◆ Greater than 70 dB within +/-2.5 VDC
Gain Selection:	◆ x1 and x100
Input Full Scale:	◆ 20 VPP @ x1 and 0.200 VPP @ x100
Bit Weight:	◆ 1.589 μvolts @ x1 & 15.89 nV @ x100
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

Time Base

Type:	◆ GPS Receiver/Clock plus a disciplined oscillator
Accuracy with GPS:	◆ +/- 100 μsec after validated 3-D fix and locked
Free-Running Accuracy:	◆ 0.1 ppm over the temperature range of 0° C to 40° C, and 0.2 ppm from -20° C to 0° C

Auxiliary Channels

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

Communication

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

Recording Mode

Continuous:	◆ Record length
Time Trigger:	◆ A list of record times and lengths
Event Trigger:	◆ STA/LTA with advanced features including bandpass filter LTA hold, etc.

Recording Capacity

Battery Backed SRAM:	◆ 2 Mbytes
Hard Disk:	◆ 2 Gbytes with two IBM Microdrives or CFII cards

Recording Format

Format:	◆ PASSCAL Recording Format (MiniSEED will be available)

Ordering Information

Part No.	Description
130-01/3	◆ Recorder, 3rd Generation, 3-channel
130-01/6	◆ Recorder, 3rd Generation, 6-channel
130-GPS	◆ GPS Receiver/Clock
130-FLASH/1GB	◆ Disk, Flash Memory, 1 GB CF Type II
130-Microdrive-1G-Kit	◆ Disk, Microdrive,1 GB with PCMCIA adaptor and carrying case
RT527-B01	◆ Assembly, PCB, Sensor Control Board
130-8002	◆ Channel Input mating connector
130-8004	◆ Cable, NET, 130 to Serial DB9 & Ethernet RJ45 Hub
130-8015-33	◆ Cable, GPS, 130 to GPS, 33ft (10m) (other lengths available)
130-8019	◆ Cable, NET, 130 to Ethernet RJ45 Hub
130-8023	◆ Cable, NET, 130 to Ethernet RJ45 Crossover
130-8075	◆ Cable, Power, 130 to Battery, 6ft.(~2m)
PALM	◆ PALM w/ Ruggedized Case, Cable & PFC_130
130-Reader-USB	◆ Reader, CF I/II/III, External, USB
130-Reader-SCSI	◆ Reader, CF I/II/III, External, SCSI
130-Reader-SCSI/INT	◆ Reader, CF I/II/III, Ext., SCSI, 220 VAC
130-Reader-PC	◆ Reader, I/II/III, Internal, IDE
130-Reader-PAR	◆ Reader, CF I/II/III, Ext., Parallel Port
130-Reader-PCI	◆ Reader, CF I/II/III, Internal, PCI bus
130-DRIVECASE	◆ Case, Field Carrying for 20 Microdrives
130-TRANSIT	◆ Case, Transit (holds six 130, GPS, Cables)
130-FIELDCASE	◆ Case, Transit (holds one 130, GPS, Cables)

Specifications subject to change without notice. Rev.3.2

REF TEK

Related Sub-systems:
◆ Third Generation Broadband Seismic Recorder, Model 130-02
◆ 24-Bit Strong Motion Accelerographs, Models 130-ANSS/02, 130-SM
◆ Miniature Seismic Recorder, Model 125
◆ Force-balance Accelerometers, Series 131A
◆ Advanced Seismic Networks

Third Generation Broadband Seismic Recorder

Model 130-01

Seismic 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

**REFRACTION TECHNOLOGY:** Providing Solutions That Work

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.

The 130 has 3 or 6 input channels for connection to any sensor available in the seismology market.

The network Command / Control and Data Telemetry is either Ethernet 10BaseT or serial PPP.

The disk compartment contains two CF-II slots, backup battery and status LEDs for easy servicing.
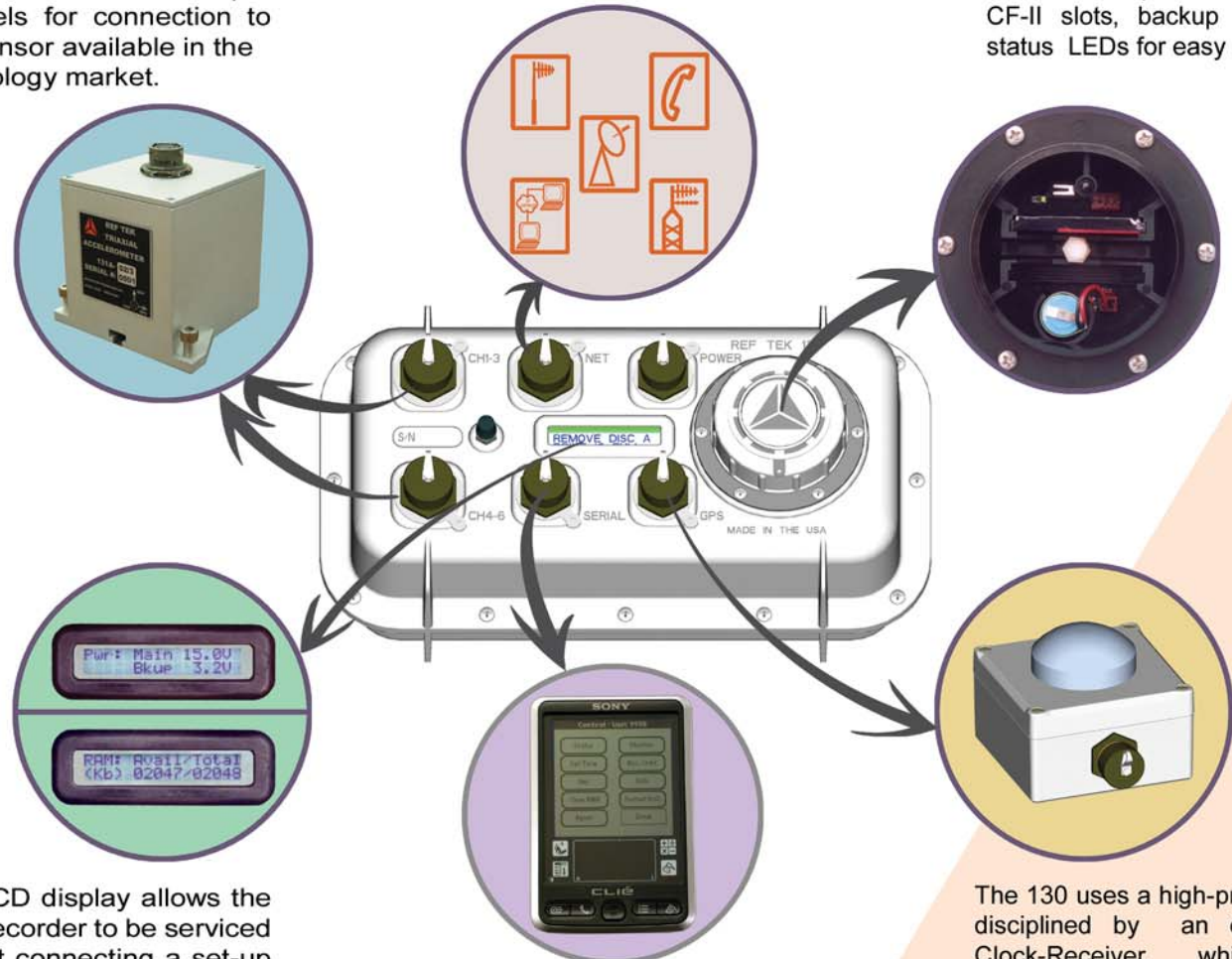
The LCD display allows the 130 Recorder to be serviced without connecting a set-up controller by displaying the 130 State-of-Health.

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 RNC2 software.

The 130 uses a high-precision TCXO disciplined by an external GPS Clock-Receiver, which maintains time accuracy to better than 100 µsec.

Hardware Modularity

REF TEK 130 is constructed with up to 5 internal boards stacked together - this arrangement 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.
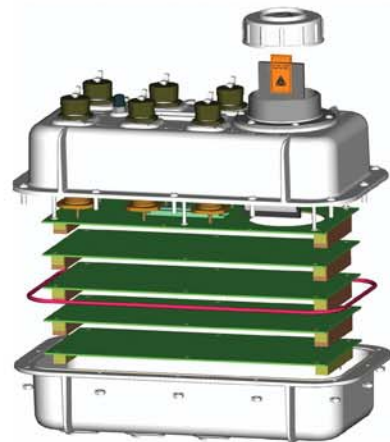
One or two removable disks reside in a sealed compartment that is accessed by opening a lid located on the top of the 130 case. The main electronics section is sealed with the lid open or closed.

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 (3 Mbytes) ✓ Serial Ports ✓ Real-time clock ✓ Ethernet Controller ✓ Enhanced Integrated Drive Electronics (EIDE)
3	ADC Board (RT505) (▲)	✓ 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 ✓ Calibration Commands ✓ Calibration Signals ✓ DC-DC Converter
5	Removable Mass Storage (External)	✓ IBM Microdrive or Compact Flash ✓ Up to 2 Gbytes ✓ RT526 Interface Board
6	GPS Receiver(External)	✓ SiRF GPS Receiver ✓ RT528 Interface Board

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 1 GB capacity. 1 GB is enough storage to hold approximately 19 days of 3 channel 100 sps compressed data. Because files are written in FAT32 format, higher capacity disks can be used as soon as available. 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.

Noise Performance

The 130-01 incorporates the 3rd generation 24-bit delta sigma type analog-to-digital converter with state-of-the-art design. This combination produces the highest performance low power 24-bit seismic recorder. On the right is the power spectral density of the ADC terminated at 125 sps.
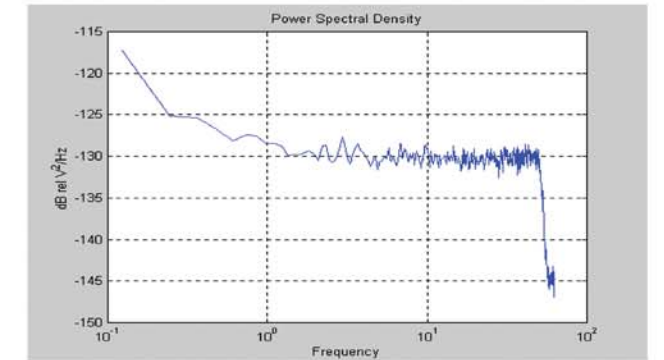
Time Keeping

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.
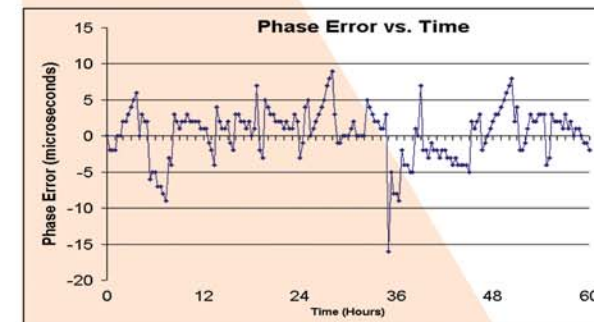
When power is applied to the 130-01, rough time is set from a battery-backed clock. A few seconds after obtaining a 3-D position fix (typically seconds after power-up or minutes if the 130-GPS has been moved a great distance since last operating), the 130-01 will set its time to GPS time. During the initial 15 minute period, the TCXO frequency and phase is measured and adjusted to GPS, then the 130-01 time is set to UTC. Within an hour of operation, the internal clock will remain within a few µsecs 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). RNC2 is a Java program and 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. RNC2 is used to edit and program the acquisition parameters of the 130 via the NET connector. 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. RNC2 is capable of displaying real-time data when operating in a telemetry mode. RNC2 maintains a Postgres database for storing current and historical settings of either single or multiple 130's.