

DSS-12 Distributed Seismic System for Seismic Interferometry

The DSS-12 is a versatile, cost-effective seismic data acquisition system that combines 24-bit A/D performance in a rugged twelve-channel box that supports 600 channels of real-time seismic data acquisition in single-line operation, and up to 2400 channels on 64 lines in multiline (3D) operation.

The system is well suited for conventional high-resolution refraction, 2D and 3D reflection surveys and for applications requiring longer record lengths such as remote monitoring and seismic interferometry.

The System Hardware

The main elements of the DSS-12 system are the Windows laptop with DSS-12 System Software installed, the DSS-12 Acquisition Units (AU), Line Tap Units (LTU), Repeater Units (RU), AUX Unit, Line Interface Unit (LIU), BP-3 Battery Packs, BC-10 Battery Chargers, trunk lines, spread cables and geophones. AUs are connected together using eight-pair spread cables with twelve geophone takeouts between boxes and may be distributed arbitrarily around the LTU. New boxes are automatically recognized and addressed by the DSS-12 System Software, making the system easy to configure for varying field situations.

The System Software

The DSS-12 System Software runs under Windows XP and controls all aspects of data collection, display, storage and printing. Acquired data may be viewed in wiggle trace, shaded area, and solid variable area, and can be clipped or inverted, low or high pass filtered, and AGCd with adjustable mute. The frequency and period of signals can be easily measured by clicking on the events of interest. Velocity lines with multiple segments can be dragged into position to measure the velocity of reflectors and can also serve as guides during firstbreak picking.

For reflection shooting, the DSS-12 has line-management features such as auto roll, auto save, auto file increment, and a graphical line geometry display showing the shot point, roll direction, total number of channels on line, and active channel positions. And to keep the records straight, the system maintains a running history of all shooting activity in a shot log that can be easily viewed and edited by the operator. The spread may be rolled manually or automatically, and the Look Ahead function can be used to determine how many boxes are available for roll at the front and back of the spread. The system can sum up to 99 stacks, with the ability to unstack and restack after each shot and invert the polarity of stack for shearwave work.

For vibroseis operation, the DSS-12 provides AUX channels with independent preamp gain settings for recording the pilot sweep and fast, time-domain correlation for in field quality control.

To support some of the newer seismic recording techniques, the DSS-12 provides a Continuous Recording mode that allows seismic data to be collected for extended periods of time, ranging from minutes to hours



The Acquisition Unit

The Acquisition Units (AU) are the backbone of the DSS-12 system. They accurately amplify and digitize the low-level seismic signals and store and transmit the seismic data back to the laptop for display and permanent storage. The AU electronics are shock mounted in a rugged, waterproof enclosure and feature 24-bit A/D conversion on twelve channels, low-noise preamps with four remotely selectable gains, sample rates of $1/8$, $1/4$, $1/2$, 1, 2 and 4 ms, and record lengths up to 64 seconds per channel. Each AU has 512K of RAM for data buffering and supports real-time operation at 2ms sample rate with 600 active channels on a single line.

The AU has several power-saving modes that are easily controlled by the operator. When boxes are initially connected to the spread, they are in standby drawing a minimal amount of power while waiting for commands from the operator. After recording data, boxes can return to low-power idle mode or be kept powered up for continuous shooting. During move-up, or other crew activity, a single click by the operator places the spread in standby which reduces power consumption to about 45ma per box.

Two LED status indicators on each AU provide a visual indication of the line connection status and operation of the box. When a box is connected to the spread, the LED status indicator flashes to verify the integrity of the cable connection to the adjacent box. This greatly aids in the proper connection of boxes and cables and in troubleshooting any faults without

operator intervention.

To ensure that data is accurately recorded, the DSS-12 provides an extensive array of instrument tests that include amplifier noise, dynamic range, A/D offsets, amplifier pulse, CMR, timing accuracy, crosstalk, phase similarity and gain similarity. Tests can be performed individually, or a complete system test can be performed automatically,

- 24-Bit A/D conversion for wide dynamic range
- Continuous recording mode for long-term acquisition
- Single line, real-time acquisition of 600 channels at 2ms
- Multiline operation on up to 2,400 channels on 32 lines
- LED status indicators for box status and line integrity
- Lightweight - less than 3kg per Box
- Comprehensive, automated system performance tests
- Operates with any Ethernet equipped laptop
- Intuitive operation under Windows XP

DSS-12 GENERAL SPECIFICATIONS

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| Number of Channels: | 12 to 2,400 with up to 600 channels per line in real-time at 2ms sample rate |
| Controller: | Ethernet equipped laptop running Windows 2000/XP |
| Sample Intervals: | 0.125, 0.25, 0.5, 1, 2 and 4 ms |
| Record Length: | 4 ms - 64 sec, 2 ms - 32 sec, 1 ms - 16 sec, .5ms - 8 sec, .25 ms - 4 sec, .125 ms - 2 sec and 1ms - continuous |
| Noise Monitor: | Real-time, viewable between stacks |
| Multiline Operation: | 2400 channels on up to 64 lines |
| CDP Operation: | Automatic or manual roll, in single-line operation |
| Stacking: | Positive or negative vertical stack with unstack/restack |
| Cable: | 8 pair, 12 takeout reversible cable |
| Max Box Interval: | 1450 ft |
| Max Line Interval: | 1450 ft, 2900 ft with one repeater |

ACQUISITION UNIT (AU)

Each DSS-12 Acquisition Unit is a self-contained, twelve-channel data acquisition system that amplifies, digitizes and buffers the low-level analog seismic signals. The AU processes and forwards commands from the laptop, and relays status and seismic data down the line during data recording.



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| Channel: | 12 channels per box |
| A/D Resolution: | 24 bits |
| Preamp Gain (PG): | 12db, 24db, 36db or 48db, remotely selectable |
| Frequency Response: | .125 ms: 2 - 3,300 Hz, .25 ms: 3 - 1650 Hz, .5 ms: 3 - 825 Hz, 1 ms: 3 - 412 Hz, 2 ms: 3 - 206 Hz, 4 ms: 3 - 103 Hz |
| Dynamic Range: | 120db @ 2 ms PG=12db, 118db @ 2 ms PG=24db (typ) |
| Distortion (THD): | <.002% at 25 Hz, 2 ms (typ) |
| Crosstalk: | Greater than 90db |
| CMR: | Greater than 90db @ 60 Hz |
| Max Input Signal: | 1.6 VRMS @ 12db, 100 mVRMS @ 36db |
| Input Noise: | .12 μ VRMS @ 2 ms PG=36db, .70 μ VRMS @ 2 ms PG=12db (typ) |
| Anti-Alias Filters: | 4 ms 103 Hz, 2 ms 206 Hz, 1 ms 412 Hz, .5 ms 825 Hz, .25 ms 1650 Hz, .125 ms 3300 Hz |
| Test Oscillator: | 10, 25, 50, 60, 100, 125, 200, 250 Hz or variable in 1 Hz increments. Amplitude adjustable in 10 μ V steps |
| Instrument Tests: | Internal digital tests, battery voltage, internal voltage, internal crosstalk, amplifier pulse, CMR, amplifier noise, dynamic range, A/D offsets, gain & phase similarity, system timing, trigger verification, and box communications |
| Spread Tests: | Geophone pulse, geophone similarity, geophone resistance, spread cable leakage |
| Connectors: | Two 16-pin connectors for seismic line In/Out One 8-pin connector for external battery power and triggering |
| Status LEDs: | Two status LEDs indicate the state of the connection to the adjacent box and flash when data and commands are received. |
| Power: | 12 volt nominal. 90ma standby, 320ma idle and 750ma active |
| Environmental: | Waterproof |
| Physical: | 35cm x 25cm x 12cm, 2.9kg |
| Operating Temp: | -40°C to 70°C |



LINE TAP UNIT LTU/LTU-H

The LTU allows the laptop to be connected anywhere in the spread in single-line systems and also provides line-to-line communication in multiline systems.



LTU Specifications:

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| Channels: | Handles 600 channels in real-time at 2ms sample rate. Greater than 600 channels, system acquisition time increases (see LTU-H below). |
| Data Rate: | 10 Mbps on the trunk line and low/high side of spread |
| Distance between LTUs: | 1450 ft, 2900 with one repeater |
| Connectors: | Four 16-pin connectors. Trunk line in, trunk line out, low side of spread, high side of spread. Two 8-pin connectors, Batt1 and Batt2 for external battery power and triggering. |
| Status LEDs: | Four, one each for trunk line in, trunk line out, low side of spread, high side of spread. |
| Environmental: | Waterproof |
| Physical: | 25.7cm x 16cm x 6.6cm, 2.7kg |
| Operating Temp: | -40°C to 70°C |
| Power: | 12 volt nominal. 45ma standby, 120ma operating |

LTU-H Specifications:

Same as above with the following differences:

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| Channels: | Handles 2,400 channels in real-time at 2ms sample rate |
| Data Rate: | 100 Mbps on the trunk line and low/high side of spread |
| Power: | 12 volt nominal. 75ma standby, 300ma operating |

LINE INTERFACE UNIT LIU/LIU-H

The LIU provides system-wide triggering and increased distance between the recording vehicle and the spread. The LIU is usually permanently mounted inside the recording vehicle and interfaces to the radio-shooting equipment. Alternatively, an AUX unit (AU programmed as an AUX) may be used in place of the LIU to supply triggering and auxiliary channels to the system.



LIU Specifications:

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| Channels: | Handles 600 channels in real-time at 2ms sample rate. Greater than 600 channels, system acquisition time increases (see LIU-H below). |
| Data Rate: | 10 Mbps |
| Distance between LIU and LTU: | 1450 ft, 2900 with one repeater |
| Connectors: | Two 16-pin connectors. Trunk line in, trunk line out. Two 8-pin connectors, Batt1 and Batt2 for external battery power and triggering. |
| Status LEDs: | Two, trunk line in, trunk line out |
| Environmental: | Waterproof |
| Physical: | 25.7cm x 16cm x 6.6cm, 2.3kg |
| Operating Temp: | -40°C to 70°C |
| Power: | 12 volt nominal. 45ma standby, 80ma operating |

LIU-H Specifications:

Same as above with the following differences:

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| Channels: | Handles 2,400 channels in real-time at 2ms sample rate |
| Data Rate: | 100 Mbps |
| Power: | 12 volt nominal. 75ma standby, 250ma operating |

BC-10 BATTERY CHARGER

The BC-10 is a three-stage smart charger with ten independent charging stations. It is housed in a waterproof case and runs from 110/220 volts, 50/60Hz. There are two LEDs for each battery station that indicate the state of charge.



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| Number of Stations: | Charges 10 batteries at a time |
| Charging Current: | 2 Amps per station, reverse polarity protected |
| Charge Indicators: | Red and Green. Indicates state of charge |
| Charging Stages: | Three-stage: 2A charge, absorption, float |
| Environmental: | Waterproof with case lid closed |
| Physical: | 47.5cm x 35.6cm x 17cm, 15.9kg |
| Operating Temp: | -10°C to 40°C |
| Power: | 110-220V, 50/60Hz 340 watts when charging 10 batteries |