A Self-contained, Multi-channel, Digital Acceleration Waveform Recording System

- Field-Portable Digital Waveform Recording
- Up To 9-Channel Recording Capability
- Battery Powered, 10-20 Day Operation
- Operates With PC RS-232 Interface
- COMPLETELY User-Programmable

Instrumented Sensor Technology
Model MSR-3C

- Field-Portable Digital Waveform Recording
- Automatic Date & Time Tagging On Records
- Programmable Time or Amplitude Triggering
- Programmable Sample Rate To 3200sp/s
- Up to 9-Channel Recording Capability
- Sliding Window Overwrite Mode (†)
- 3MB To 12MB Onboard Storage
- 54dB Dynamic Range (10-bit A/D)
- 3-Channel Temperature/Humidity Option
- Battery Powered, 10-20 Day Operation
- Small Size 10”x 8”x 4”, 16 lbs.
- Self-Contained Mounts In Any Orientation
- Operates With High Speed PC RS-232 Interface up to 115 kbs.
- External Trigger Channel
- User Selectable Channel Triggering
- COMPLETELY User-Programmable

Description

The MSR-3C is a self-contained, multi-channel, digital acceleration waveform recording system. The system is battery powered, designed for field applications requiring multi-channel, extended time, unattended acceleration monitoring and recording. The MSR-3C is programmed for test via a standard RS-232 interface to a host (PC-compatible) computer using IST’s DOS DynaMax™ or DynaMax™ Suite for Windows 95/NT. After field recording is complete data is transferred back to the host computer for processing and analysis. Each unit is powered from a built-in, rechargeable battery pack. The recording function of the instrument is controlled by three microprocessor-based digital data acquisition systems. Each of the systems is devoted to data acquisition on one of the three separate, three-input channel sets. Channel sets may be tied together for simultaneous triggered acquisition, or allowed to operate independently. During active recording, acceleration signals on each channel are digitized to 10-bit resolution and stored in digital memory within the unit. The MSR-3C offers 1 megabyte of data storage capacity per 3 channel set with 4 megabyte total data memory (12MB Optional). The MSR-3C also offers three input channels for optional temperature and temperature/relative humidity probes. Temperature and relative humidity recording occurs independent of acceleration recording, at regular, user-programmable time intervals.

Programmability

The MSR-3C is completely user programmable via an RS-232 interface to a host computer. Each of the three, 3-channel sets are programmed independently, and may use identical or differing recording parameters depending upon application.

Triggering

The MSR-3C may be programmed to support accurate recording of either transient shock data or pseudo-stationary vibration data. The unit may be programmed to operate under either event (amplitude-based) or time (delay-based) triggered recording. Once triggered, digital recording takes place simultaneously on all three channels of the triggered channel set.

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Channel sets may be configured to trigger independently or globally. When operating under event-triggered recording, a user selectable amplitude threshold (p-level) in conjunction with an acceleration time duration threshold (milliseconds) provides the trigger criterion. Using this threshold combination, selective capture of transient shocks or shocks captured between readings, or as amplitudes are possible.

Record sample lengths may be pre-selected using specific pre- and post-trigger sample lengths, or allowed to be data dependent. Each of the three channel sets has an associated real-time clock for event time indexing. All recorded acceleration time histories are automatically time indexed upon acquisition of subsequent host-computer based analysis.

**Memory Modes**

Two different user-selectable memory modes are available for handling large numbers of acceleration records. A 'first fill & stop memory mode' causes recording of all records satisfying the trigger criterion sequentially in time until the digital memory (within the three-channel set) is full. A second 'sliding window overwrite memory mode' option causes selective recording (and re-recording) in digital memory of a pre-selectable number of records exhibiting the largest RMS levels of all records measured by the respective three-channel set. This powerful memory mode feature can be used to guarantee that the highest-level acceleration records will be retained in memory upon completion of the field test.

**Trigger Channel Selection**

The MSR-3C may be configured for trigger criteria on any one or more of the three channels, in a particular three-input channel set. Triggering may be independently software enabled or disabled by the user for each input channel within each three-channel set. An auxiliary (external) triggering is also available for each three-input channel set. The trigger channel can be used for driving internal trigger signals out, as well as triggering the internal channels from an externally derived trigger signal.

**Power Supply**

**Battery Pack**

The MSR-3C is equipped with a single 10 AH battery and is supplied with an external battery charger. The charger features high/low indicator lights to inform you of the state of charge, and offers a large reduction in charge time. As an option, the MSR-3C may be equipped with a multiple battery configuration (3.2 AH/channel set) and an internal battery charger. This offers power redundancy and the ability for use with wide-range unregulated DC Power. When fully charged, the MSR-3C battery pack will operate the recorder from 16 through 20 days, depending on the user-programmed recorder setup.

**Housing**

The MSR-3C is constructed in a heavy duty, weather resistant housing. Access to the control panel is available under a gasket-sealed, hinged, top cover. Sensor inputs and trigger channels are laid out on a gasketed sub-panel on the outside of the MSR-3C housing. All exposed connectors are supplied with sealing caps for water resistance. The MSR-3C housing is constructed with a base mounting flange and four holes for rigid mounting to a supporting structure. The MSR-3C may be mounted in any orientation.

**Input Channel Characteristics**

**Accelerometer Input Channels**

The MSR-3C is designed to support data acquisition from either differential or single-ended analog accelerometer inputs (piezoresistive or piezoelectric). Standard units are supplied with nine single-ended input channels for use with piezoelectric (PE) accelerometers. PE input channels are designed for use with integrated electronics, voltage-mode type accelerometers. Accelerometers are powered from the MSR-3C itself and require no additional power supplies. As an option, the MSR-3C can be supplied with nine differential input channels for use with piezoresistive (PR) accelerometer inputs. The MSR-3C can also be provided with both sets of sensor input channels available, providing the user with greater flexibility in transducer selection and application. The host computer setup software enables selection of either PR or PE input channels for data acquisition.

**Digitally Controlled Auto-Zeroing**

The MSR-3C is equipped with digital auto-zero capability on all accelerometer input channels. This feature is designed to correct for DC offset, drift, characteristic of PE accelerometers subsequent to transient excitation, as well as PR accelerometers over wide temperature ranges. The digital auto-zero provides automatic offset correction at the rate of 1 percent of full scale per second.

**Signal Filtering**

Each accelerometer input channel is filtered prior to digitization utilizing a 4th-order Sallen-Key analog low-pass filter. 3dB filter cut-off frequency is fixed at the time of manufacture. Specific analog filter cut-offs ranging from 60Hz to 1120Hz can be chosen by the customer at the time of order to accommodate specific data bandwidth requirements.

**Temperature/Humidity Input Channels**

Each of the three MSR-3C channel sets is equipped with a temperature sensor input and a combined temperature/relative humidity sensor input. Temperature and humidity channel inputs are designed for use with cabled sensor assemblies supplied by IST. The temperature sensor input channel is designed for use with an integrated circuit-type temperature-to-current converter with a gain of approximately 1 micro-Amp to 0.5 degrees Kelvin change in temperature. The MSR-3C humidity input channels are designed for an integrated temperature + relative humidity (RH) sensor assembly supplied by IST. The humidity sensor provides a linear output voltage range of zero to 5 volts over changes in RH from approximately five to 95 percent.

**Software Set-Up Data Recovery Analysis**

IST supplies its DynaMax™ Suite software package for MSR-3C set-up (programming) and recorded data recovery. The software package is designed to provide a graphical means of recorder setup, download, and analysis. The software provides an easily-navigated environment for selecting operational parameters for the MSR-3C, as well as processing recorded data for generation of automatic report formats. Packages are equipped with tabular report formats, interactive waveform graphics analysis, and statistical analysis of recorded acceleration, RMS, and crest factor levels. A complete power spectral density analysis capability is also available for MSR-3C applications involving random vibration recording.
**MSR-3C SPECIFICATIONS**

**Programmable MSR-3C Recording Parameters**
- Sample Frequency: 100 to 2200 Hz/channel
- Amplitude Trigger Threshold: 0 to 1v/peak, 512 counts +/-, each channel
- Duration Trigger Threshold: 1 to 2048 sample intervals, each channel
- Time Trigger Delay: 50nsec to 2 hours
- Channel Trigger Enable/Disable: CH1, CH2, CH3
- Drive Trigger Out, ON/OFF: CH1, CH2, CH3
- Enable Trigger In: ON/OFF
- Pre-Trigger Samples: 2 to 9999 samples
- Post-Trigger Samples: 2 to 9999 samples
- Memory Mode: 1-Channel, 2-Channel, 3-Channel
- Frame Length (samples): Fixed or data dependent
- Maximum Number of Frames: 1 to 65536 per 3-channel set
- Accelerometer Channel Select: PEPR
- Temperature Sample Period: 0.25 minute to 1 hour
- Active Mode Start Time Delay: Zero to 30 days
- Active Mode Stop Time Delay: Zero to 30 days
- Digital Clock: Month/Day/Year, Hour, Minute, Second
- User Documentation Fields: Optional user entered text fields

**Fixed Parameters**
- Dynamic Range: 14 dB
- Digitization: 14 bits / 124 quantization levels per channel
- Frequency Response: 0 Hz to 20 kHz
- Noise Level: 80 nV
- Maximum Allowable Frame Length: 0.007 seconds / channel
- Digital Storage: Recorded Events: 1 megabyte per channel
- Digital Clock Resolution: +/- 0.5 second (time base indexing)
- Digital Clock Accuracy: +/- 1 minute per day
- Temperature Measurement Range/Accuracy: -40 to 100°C, +/- 1°C
- Analog Anti-Alias Filter Cutoff Frequency (JdB):
  - Fcutoff options: 60, 30, 15, 10, 5, 3, 1, 0.5, 0.25, 0.125, 0.0625 Hz
- Batteries: Re-chargeable sealed lead-acid cell. One 10 Amp-Hr cell STD.
  ([Three 3.2 Amp-Hr cells optional]
- Maximum Operational Time Period: 10-20 days ending upon digitization rate.
  - Approximately 20 days at 200 sps, 10 days at 3200 sps

**Controls And Indicators**
- Mode select pushbuttons (3) [2]
- LED mode indicator lamp (3) [2]
- Mode lock switches (3) [2]
- RS-232 ports (CR-9) (1)
- Battery charger receptacle (1)
- PC Power inputs, 12V-24V type (9) [6]
- PR Power inputs, 8 position, sub-type terminal strip (9-optional)
- Temperature inputs, 16-32 type (3) [2]
- Relative humidity inputs (3) [2]

**Input Channels**
- Single ended for piezoelectric accelerometers [9] [6]
  - Bias operating point: 2.5V
  - Bias current: 500 microamps
  - Input impedance: 1 Megohm
  - Noise floor: 1 bit
  - Auto-zero offset correction: 1% /second.
  - D.C gain: approx. 2.0 mV/Counts
- Differential for piezoresistive accelerometers [9] [6]
  - Common mode range: 0-5 V
  - Differential gain: approx. 2.0 mV/Counts
  - Bridge excitation: 2.0V
  - Input impedance: 1 Megohm
- Auxiliary Trigger Channels
  - Input impedance: 10k-Ohm
  - Switch voltage: 2.0V
  - Trigger on, hold below.
- Temperature Input Channels (3) [2]
  - Input impedance: 75k-Ohm
  - Input signal: 5-5V, 10k-Ohm pull-up
- Humidity Sensor Input Channels (3) [2]
  - Input impedance: 75k-Ohm
  - Input signal: 5-5V, 10k-Ohm pull-up
- Battery Charger
  - STD: 110V input, automatic internal battery charger
  - Options: 12V-18V, unregulated input, internal battery charger

**Physical Characteristics**
- Size: 10" x 8" x 4" x
- Weight: 15lbs
- Casing: Weather resistant, hinged/gasketed access panel
- Mounting: Base flanges on enclosure
- Temperature: operating, -40 to +100°C

**Standard Equipment**
- MSR-3C instrument (MSR-3CMX)
- Internal battery pack (1) [3]
- Serial interface cables (1)
- Host computer programming/data analysis software
- METRIX, DM-625, Base
- AC/DC battery charger module
- User operating manual

**Options**
- Accelerometers and cables
- Temperature sensor(s) and cables
- Relative humidity sensor(s) and cables
- Advanced METRIX analyzers modules
- Differential Inputs, strain gauges
- Remote alarm module

"[ ]" = Optional

**TYPICAL MSR-3C APPLICATIONS**

- Vehicular Environments
- Industrial Material Handling
- Ship/Submarine Shock Monitoring
- Avionics Reliability
- Railcar Coupling Impacts
- Vehicular Crash Testing

**Vehicle Test Track Qualification**
- Cargo Shipping & Handling
- Armament Environmental Monitoring
- Environmental Test Level Qualification
- Concealed Environmental Monitoring
- Industrial Vibration Monitoring

**Instrumented Sensor Technology**
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