

**MULTI-CHANNEL
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Model MSR-3C

SHOCK & VIBRATION

R E C O R D E R



- 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

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

IST Instrumented
Sensor
Technology

MULTI-CHANNEL MULTI-CHANNEL MULTI-CHANNEL MULTI-CHANNEL MULTI-CHANNEL MULTI-CHANNEL

SHOCK & VIBRATION RECORDER

Model MSR-3C

- Field-Portable Digital Waveform Recording
- Automatic Date & Time Tagging On Records
- Programmable Time or Amplitude Triggering
- Programmable Sample Rate To 3200sps
- 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).



• Operating Mode Display and Controls Panel

• External Connector Panel

• High Speed RS-232 Communications Port

• Charger Circuit Fuses

• Weather-Resistant Hinged Panel Cover with Security Latch

(*) U.S. Patent 5, 754, 449

Channel sets may be configured to trigger independently or globally. When operating under event triggered recording a user selectable **amplitude threshold (g-level)** in conjunction with an acceleration **time duration threshold (milliseconds)** provides the trigger criterion. Using this threshold combination selective capture of transient shock based upon measured duration as well as amplitude is 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 for subsequent host-computer based analysis.

Memory Modes

Two different user-selectable memory mode storage features 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 criterion on any one or more of three channels within 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) trigger 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.

Additional programmable parameters for the **MSR-3C** are **digital sample frequency** (188-3200sps/channel), **overall start and stop times** for active sensing/recording, and **time interval for temperature/humidity recording**.

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 10 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 set-up 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 excitations, 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 fre-

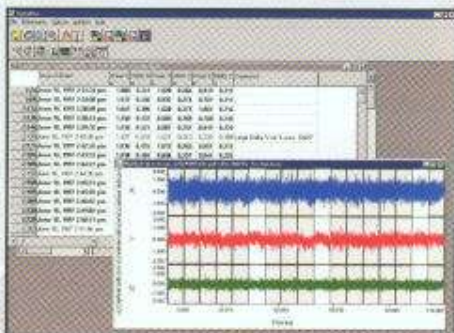
quencies are fixed at the time of manufacture. Specific analog filter cut-offs ranging from 60Hz to 1120 Hz can be chosen by the customer at the time of order to accommodate specific data bandwidth requirements.

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 per degree 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 from zero to 5 volts over changes in RH from approximately five to 95 percent.

Software Set-Up Data Recovery Analysis



DynaMax™ Suite Graphical Vibration Data Display

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 package 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.

IST

MSR-3C SPECIFICATIONS

Programmable MSR-3C Recording Parameters

Sample Frequency: 188 to 3200 Hz/channel
Amplitude Trigger Threshold: 0 to fs(range), 512 counts +/-, each channel
Duration Trigger Threshold: 1 to 2048 sample intervals, each channel
Time Trigger Delay: 53msec 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-Fill & stop / 2-sliding window overwrite
Frame Length (samples): Fixed or data dependent
Maximum Number of Frames: 1 to 5250 per 3-channel set.
Accelerometer Channel Select: PE/PR
Temperature Sample Period: 0.25 minute to 1 hour.
Active Mode Start Time Delay: Zero to 10 days
Active Mode Stop Time Delay: Zero to 30 days
Digital Clock: Month/Day/Year Hour:Min:Sec
User Documentation Fields: Optional user entered text fields.

Fixed Parameters

Dynamic Range: 54dB
Digitization: 10-bits / 1024 quantization levels per channel
Frequency Response: 0.1Hz - 1500Hz
Noise Level: 1/2 LSB
Maximum Allowable Frame Length: 9999 samples per channel
Digital Storage-Recorded Events: 1 megabyte per 3-channel set, 3 megabyte total. [12 MB Optional]
Digital Clock Resolution: +/- 53msec (frame time indexing)
Digital Clock Accuracy: +/- 1min/mon.
Temperature Measurement Range/Accuracy: -40 to 100°C +/-1°C
Analog Anti-Aliasing Filter Cutoff Frequency (3dB):
Factory options: 60, 80, 90, 110, 140, 170, 200, 340, 420, 510, 620, 750, 930, 1120
Batteries: Re-chargeable sealed lead gell-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 3200sps.

Controls And Indicators

Mode select pushbuttons (3) [2]
LED mode indicator lamps (9) [6]
Mode lock switches (3) [2]
RS-232 ports (DB-9) (1)
Battery charger receptacle (1)
PE accel inputs, 10-32 type (9) [6]
PR accel inputs, 8 position screw-type terminal strip [9-optional]
Temperature inputs, 10-32 type (3) [2]
Relative humidity inputs (3) [2]

Input Channels

Single ended for piezoelectric accelerometers (9) [6]

Bias operating point: 2-3.5V
Bias current: 500micro-Amps
Input Impedance: 1 MegOhm
Noise floor: 1 bit
Auto-Zero offset correction: 1% fs/second.
DC gain: approx. 2.0 mV/count

Differential for piezoresistive accelerometers (9) [6]

Common mode range: 0-6 V
Differential gain: approx. 2.0 mV/count
Bridge excitation: 5.0V
Input impedance: 1 MegOhm

Auxiliary Trigger Channels

Input impedance: 10k-Ohm
Switch voltage: 2.5V
Trigger on +, hold below:

Temperature Input Channels (3) [2]

Input impedance: 76k-Ohm
Input signal: 0-5V, 100k-Ohm pull-up

Humidity Sensor Input Channels (3) [2]

Input impedance: 76k-Ohm
Input signal: 0-5V, 100k-Ohm pull-up

Battery Charger

STD: 110V input, automatic external battery charger
[Optional: 12-18V unregulated input, internal battery charger]

Physical Characteristics

Size: 10" x 8" x 4"

Weight: 16lbs

Casing: Weather resistant, hinged/gasketed access panel

Mounting: Base flanges on enclosure

Temperature: operating, -40 to +100°C

Standard Equipment

MSR-3C instrument [MSR-3CM6]

Internal battery packs (1) [3]

Serial interface cables (1)

Host computer programming/data analysis software

Dynamax™, DM95-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 Dynamax analysis 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

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