ENVIRONMENTAL & SHOCK VIBRATION SENSOR/RECORDERS

Models EDR-3C, EDR-3D

- Measures Shock & Vibration, Temperature, Humidity
- Built-in PR Triaxial Accelerometer
- True DC Frequency Response
- 5200 event Memory
- Vibration PSD Capability
- Advanced Data Management Features
- Sliding Window Overwrite Mode™
- Event Type Memory Partitioning
- Up to 6 High Speed Accel Channels
- USB Data Transfer
- Selectable Digitization to 3.2kHz/CH
- Programmable Triggering Schemes
- Automatic (DC) Offset Correction
- Vibration Controller Compatibility
- Battery Powered 30-60 days
- Small size: 37 cubic in., 2 lbs.
- Powerful Windows Software Included
- Easy To Setup and Use

Typical Applications

- Intermodal Transportation Studies
- High-Value Transport Monitoring
- Transformer Shipment Monitoring
- Vibration Test Spec Development
- Launch Vehicle Vibration
- Avionics Environmental Reliability
- Concealed Monitoring
- Package Test Shipments
- Railcar Impact and Vibration
- Crash Recording
- Aircraft Flight Vibration
- Brake Testing

Description

The Model EDR-3 series data recorders are self-contained, user-programmable acceleration sensor/recorders. The compact, 2 lb. package is designed for remote, stand-alone shock, and vibration measurement and recording over extended time periods ranging from several hours to several weeks. The models EDR -3C and -3D are precision field measurement instruments offering small size & weight, recording speed, onboard data storage, channel throughput, and data management and programmability features. The EDR3 series recorders offer the user a time-tested reputation for proven performance and reliability with hundreds of successful installations worldwide. The 3C and 3D models operate similarly, and differ mainly in programmability features, onboard storage and channel capacities.

The recorders are setup using a standard USB port, along with IST's DynaMax Suite software. After field recording data is transferred back to the host PC for processing and analysis. Each recorder is powered by a specially designed, convenient C-cell battery pack. An alternative 9 volt battery pack is also available for very high shock applications.

The instrument's recording function is controlled by a custom-designed digital recording and management engine. The design is optimized for minimal power consumption while running at high, multi-channel digitization. During active recording, acceleration signals are digitized and stored in digital memory onboard. Each recorded event is also date and time tagged for future reference. Advanced data management capabilities of the EDR3 allows the unit to measure and record over 5000 separate 3-channel or 6-channel waveform sets comprising transient shock events and/or continuous vibration time samples. IST's unique "Event Type Partitioning" of separate time-triggered and event-triggered data may also be performed during recording. This feature improves post-collection data reduction and analysis. The length of each event is also user-selectable between event types, enabling the unit to be optimized for capture of both shock and vibration data during a single field recording session.

Acceleration recording can be configured from the internal triaxial accelerometer channels and/or from up to three optional external accelerometer channel inputs. External accelerometer input channels provide signal conditioning, filtering, and constant current excitation for use with low power voltage mode piezoelectric accelerometers.

The EDR-3 also measures and records environment temperature using sensors built into the instrument and/or connected externally. Internal and external relative humidity sensors are also available.

Accelerometers

Each EDR-3 instrument is supplied with a specially designed and calibrated, built-in triaxial accelerometer. The internal accelerometers are piezoresistive devices, offering superior low frequency response characteristics and extremely low power consumption. Different full scale measurement ranges from 2g to 500g are available to optimize the recorder to a particular application. Internal accelerometers are temperature compensated to ensure accurate signal recording over a broad (-40 to +70° C) temperature range. The accelerometers are mounted approximately at the center-of-gravity of the instrument enclosure, enabling accurate sensing of the accelerations to which the unit is subjected. The rigid, machined aluminum instrument housing permits accurate transmission of mechanical shock and vibrations directly to the internal accelerometers, with a mechanical frequency response up to several kilohertz.

Self-Calibration Checks: Since internal PR accelerometers offer true DC response, the user can easily check the calibration of several ranges of internal transducers. This is done by simply recording the true 2.0g step generated by a simple 180 degree rotation of the recorder in earth gravity on each axis. This calibration check can easily be performed by the user.

Auto-Zero Calibration Feature: Before initiating a new recording session the EDR-3 unit performs an automatic, internal zero calibration check on each of the three axes. This procedure ensures that no erroneous offsets are present as a result of temperature variation or recent orientation changes.

Auto-Zero Offset Control: The EDR-3 recorder provides automatic digital offset correction between recorded events. This feature compensates for DC offsets resulting from temperature variation, as well as changes in orientation. The correction rate is 1 % of full scale per second. Once a triggered recording begins the correction is disabled until the recording is completed. In this way the unit offers true DC response during the recording of an actual acceleration event.

External Accelerometers: The optional external accelerometer input channels are designed for use with piezoelectric voltage mode devices. External channels provide signal conditioning, filtering, and constant current excitation for use with voltage mode accelerometers. This choice of transducer offers significant advantages in low noise performance and reliability as well as relative immunity to calibration errors in comparison to charge mode devices.

External Input Triggering: An external bidirectional trigger channel is available on both EDR-3 models. This digital channel is used for communicating trigger status among multiple EDR-3s as well as for providing a remote control triggering capability. The channel can also be used to set an alarm condition whenever the unit triggers.

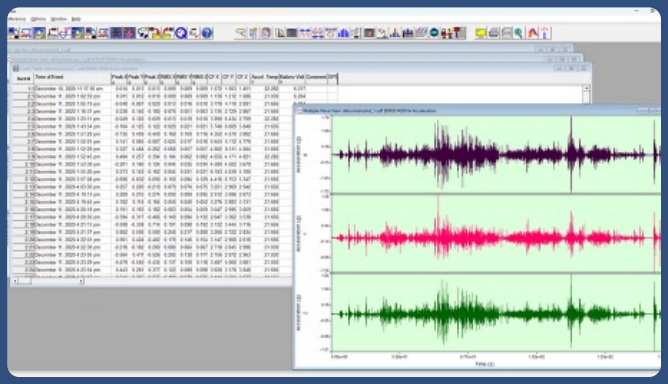
Advanced Programmability

The EDR-3 is completely user programmable for accurate recording of either (transient) shock and/or pseudo-stationary vibration data. The instrument may be setup to operate under both event (amplitude-based) and/or time (periodic) triggered recording. Once triggered, high speed digital recording takes place simultaneously on all three or six of the selected internal or external accelerometer input channels. Each recorded event is then time-indexed with current date and time and stored in digital memory.

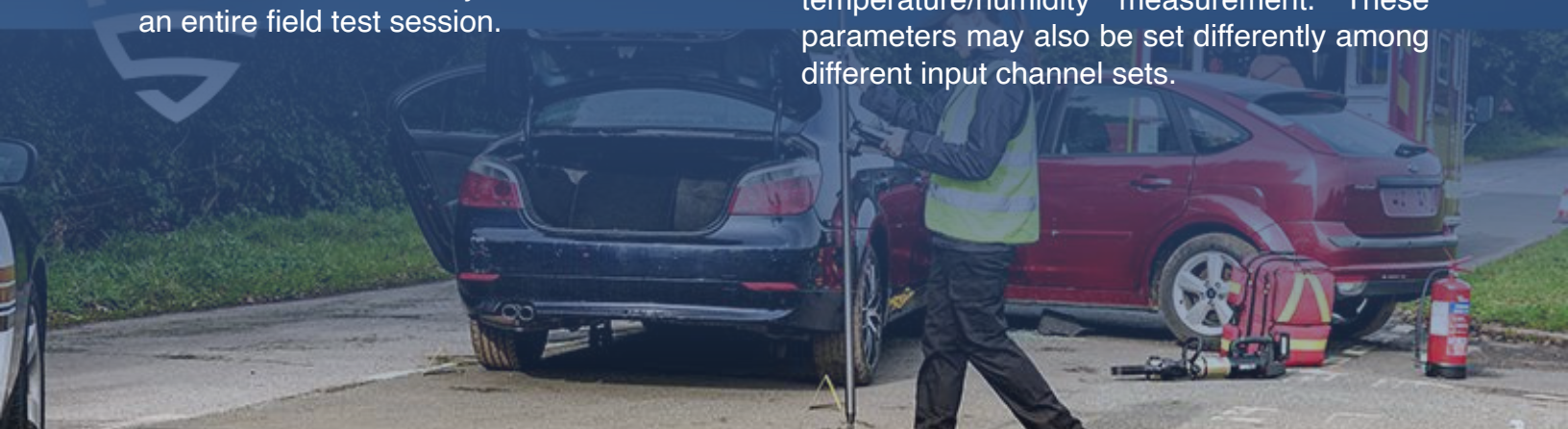
When a particular 3-channel set is operating under event triggered recording, a user selectable amplitude threshold (g-level) in conjunction with a duration threshold (milliseconds) provides the trigger criterion. When using this threshold combination selective capture of transient shock based upon measured amplitude as well as duration is possible. The result is effectively a velocity threshold for triggered recording. Recorded event lengths may be pre-selected by using specific pre- and post-trigger sample lengths. These parameters may be set separately for different triggering schemes (event or time-based) as well as for different accelerometer channel selections. Event lengths can also be data dependent.

Data Management

Several different data management features are available for handling large numbers of captured time histories. Fill & stop memory mode results in recording all frames satisfying the trigger criterion sequentially in time until the digital memory in the instrument is full. A second overwrite memory mode option causes recording in digital memory of a selectable number of events having the largest RMS levels of all events measured. When recording shock-type data the overwriting method accumulates those events having largest total resultant velocity change. This powerful memory mode is used to selectively record the highest level accelerations sensed by the instrument over an entire field test session.



Additional programmable parameters include digital sample frequency (125 - 3200 Hz/channel), overall start and stop times for active sensing/ recording, and time interval for temperature/humidity measurement. These parameters may also be set differently among different input channel sets.



Overwrite Mode (SWO)™

The EDR-3 models offer a powerful recording feature called Sliding Window Overwrite (or SWO) developed exclusively by IST. SWO provides the advantages of standard overwrite mode and much more. With SWO the field test period is effectively partitioned into a user selectable number of time windows or bins. The size of the time windows are also selected by the user. Event overwriting can only occur within respective time windows. As a result the user will be assured of having subsets of worst-case (ie. highest level) event data that is collected uniformly throughout the entire field test. This feature also enables the recorder to uniformly capture data during different modes of transport which may actually have significantly different overall amplitudes. Without SWO the recorder would often fill its entire memory (through overwriting) during transport through the particular mode having the highest levels.

Sliding Window Overwrite Mode with Event Type Partitioning (SWO- ETP)

As an extension of SWO, Event Type Partitioning during SWO restricts overwriting to occur only within similar data types. Time-triggered data may only overwrite other time-triggered events, and amplitude-triggered data may only overwrite other amplitude-triggered events. In this way shock data is recorded and overwritten separately from (time-triggered) vibration data, even when measured during the same time window.

Event type partitioning can also apply to channel set selection, even when setup to capture similar event types. For example, both internal and external accelerometers could be set for time-triggered recording. However overwriting can be set to occur independently and with the same or different window sizes, etc.

Improved Laboratory Simulation

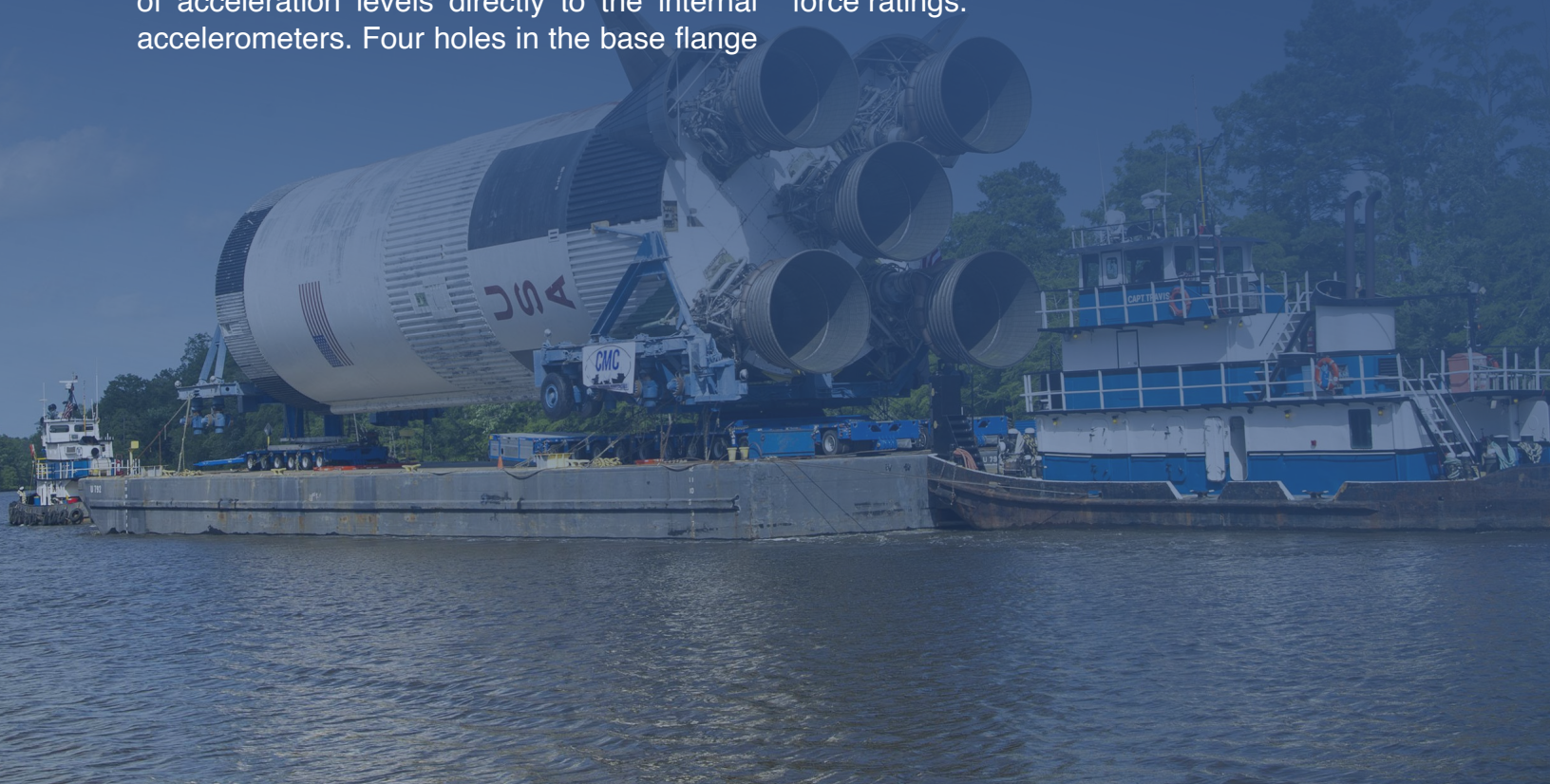
SWO enables the user to uniformly capture selective highest-level “time windows” of data during a field test. Recorded SWO data can be processed with IST’s PSD software module to generate a separate PSD profile for each time window. Separate PSD profiles can then be used to build sequential PSD random vibration simulations, instead of using a single “average” profile for the entire field test. The result is an improved and more focused simulation of the actual field environment.

Vibration Test System Compatibility

Data recorded with all EDR-3 models can be processed with IST software for direct compatibility with many digital vibration controllers. Whether the requirement is for PSD test profile simulation or real- time history reproduction IST can offer a software interface solution providing direct compatibility with most commercially available controllers.’

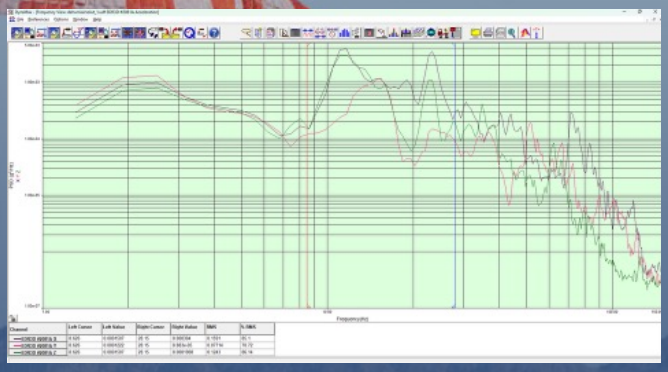
Instrument Mounting

The instrumentation and sensors of the EDR-3 are built into a specially designed, machined aluminum enclosure. The enclosure is designed for accurate mechanical transmission of acceleration levels directly to the internal accelerometers. Four holes in the base flange of the housing are provided for rigid mounting of the instrument by the user. Magnetic mounting bracket assemblies are also available for use in mounting the recorder in 110 1b and 220 1b force ratings.

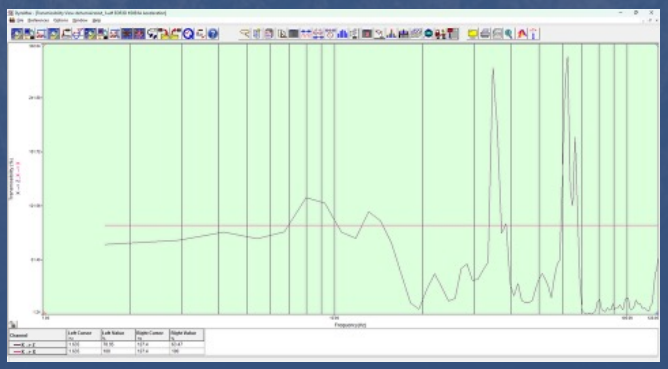


Software

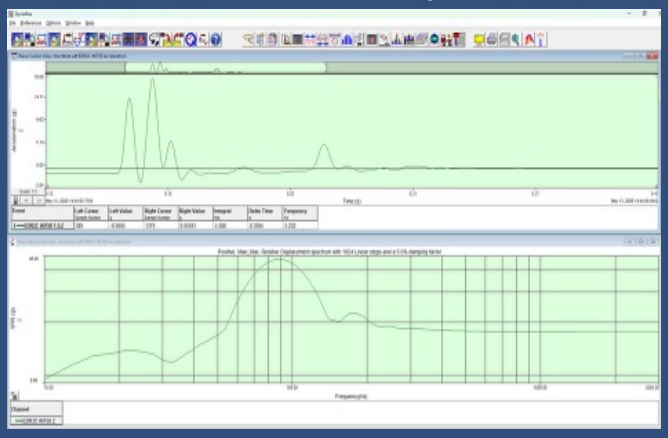
Supplied with the EDR-3 instrument is IST's DynaMaxTM Suite Windows software package. The software is used for preprogramming the EDR-3 prior to field testing, retrieving recorded data subsequent to test, and processing and analyzing recorded time domain acceleration data. Other features of the software include spreadsheet-like data manipulation, sorting and editing, waveform graphics, histogram generation, digital filtering, printing and exporting. Other advanced software features include velocity and displacement calculations, derivative(jerk) calculation, power spectral densities(PSD), shock response spectra(SRS), transmissibility functions, probability density function calculation, and packaging drop heights with package animation.



Power Spectral Density Calculation (PSD)



Transmissibility



Shock Response Spectrum (SRS)

Performance History

The EDR-3 series recorders have been used in a broad range of high performance applications worldwide for several years. A few of the EDR-3s more prominent application areas include:

- Previously Mandated by US. Auto Club as the "crash recorder" for all INDY racecars
- Selected by NASA for measuring cargo bay vibration aboard U.S. Space Shuttle
- Selected by NASA Prime Contractors for continuous railcar transport of all Shuttle Solid Rocket Motors as well as newer propulsion systems
- Selected by many Fortune 500 companies for in transit shipment monitoring
- Used by the U.S. Army Ft. Bragg for parachute testing and deployments

EDR-3 Series Recorder Specifications

DATA ACQUISITION	EDR-3C	EDR-3D
#Simultaneous High Speed CHs:	3	6(6)
#Low Speed CHs:	4	8
Simultaneous Low Speed Channels	4	8
Temperature Sensor CHs	4	8
Humidity Sensor CHs	(1)	(2)
Battery Voltage CHs	1	2
Trigger CHs	(1)	(2)
High Speed Digitization Rate	125-3200	125-3200
Low Speed	1 sample every 15 sec to 1 sample every 166 hours both models	
Digitization, Aggregate MAX, sps	9600	19200
DATA MANAGEMENT		
Fill & Stop Memory Mode	X	X
Overwrite Memory Mode	X	X
Sliding Window Overwrite Mode™	X	X
Sliding Window Overwrite with		
Event Type Partitioning		X
Sliding Window Overwrite with		
Channel Set Partitioning		X
Sliding Window Size	Selectable 1 min to 30 days	
Separate Time Windows	Selectable 1 to 100	
Data Communication	USB	USB
SENSORS		
Internal Accelerometer: Piezoresistive Triaxial	X	X
Accelerometer fs Range Choices	±2, ±5, ±10, ±20, ±50, ±100, ± 200, ±500g both models	
Accelerometer Frequency Responses		
2g, 5g fs	DC-250 Hz	DC-350 Hz
10g, 50g fs	DC-400 Hz	DC-1000 Hz
100g, 200g	DC-1500 Hz	DC-2000 Hz
Signal Filtering: 4th Order Anti-Aliasing		
Standard 3dB cutoff choices	60, 80, 90, 110, 140, 170, 200, 340, 420, 510, 620, 750, 930, 1120, 1915 Hz	
Automatic Auto-Zero Offset Correction	1% fs/sec both models	
External Accelerometers:	Voltage mode piezoelectric, 0.5mA, 3.4V bias, 0.5mv/g to 1000 mv/g, both models	

PROGRAMMABILITY		
High Speed Sample Rate	x	x
Trigger selection	Internal or external channels and/or external trigger input, both models	
Triggering	x	x
Amplitude Threshold	x	x
Separate channel thresholds	x	x
Duration (time at level) Threshold	x	x
Separate channel thresholds	x	x
Trigger Duration Threshold	1 to 34463 samples both models	
Time Trigger Delay (forced time delay between triggered recordings)	1 to 35000 seconds both models	
Time Triggered Recording	1 sample every 15 sec to 1 sample every 166 hours both models	
Maximum Number of Events	5291	10582
Event Length: Pre-trigger samples Post-trigger samples	Fixed or Data Dependent 2 to 9997 both models 1 to 9999 both models	
Maximum Event Length cutoff:	9999 samples both models	
Memory Modes	FS, OW, SW	FS, OW, SWO, SWO-ETP,-CSP
OPERATIONAL		
Temperature Recording	Internal & external both models	
Range/Resolution	-40 to +70° C ‘ both models	
Humidity Recording	0 to 100% RH / +/-3% RH both models	
Range/Resolution	1 to 60° C both models	
Usable Temperature Range	1 to 60° C both models	
Digital Clock	Month/Day/Year, both models	
Date & Time Tagged to each acceleration event	Month/Day/Year both models	
Resolution/Accuracy	53 msec / plus minus 3 min/Mo both models	
Auto ON and OFF times	X	X
Battery Life (Typical) Alkaline C-cell Batteries	30+ days	30+ days
Data Memory Backup	12+ months both models	
PHYSICAL		
Size	4.2”x 4.4”x 2.2”	4.2”x 4.4”x 2.5”
Housing	Black Anodized Aluminum, watertight, gasket sealed	
Weight	2.2 1b	2.6 1b
Operating Temperature Range	-40 to +70^0 C both models	
Shock Fragility	500g or 20 x fs, both models	

SOFTWARE TIME DOMAIN ANALYSES

3-Channel Acceleration waveform graphics, histograms, temp/hum process
Resultant Acceleration waveforms
Spreadsheet tabulation of max, min, peak, duration, RMS, crest factor, velocity change, temperature, humidity, dew point, battery voltage
Data editing and sorting by selected event parameters, statistical summaries
Digital filtering- low pass, high pass, bandpass

ADDITIONAL ANALYSIS FEATURES

Velocity and Displacement Waveforms
Power Spectral Density (PSD) calculation and analysis
Shock Response Spectrum (SRS) calculation and analysis
Packaging Drop height - Equivalent impact, Zero-G free fall, package trajectory animation, impact direction & type.
Jerk Waveform calculation and display
Transmissibility function calculation and display
Sample probability density function calculation and display

HARDWARE OPTIONS

External Channel inputs	3 accel, temp, power, COM, trigger	
Relative humidity sensor	internal and/or external	
Auxiliary battery pack	x	x
Hand-Held remote trigger (HRT-I)	x	x
Remote Alarm Module (RALM-I)	x	x

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