MICRO STRESS ANALYSIS AND FORECASTED ENDURANCE
MICROSAFE™
FEATURING THE ASTM RAINFLOW CYCLE COUNTING ALGORITHM

Invocon, Inc.   **Technology Profile March 2004**

MicroSAFE is a miniature autonomous **Smart Sensor** that measures and processes strain data in real-time using the **ASTM Rainflow Cycle Counting Algorithm**. Each unit houses the algorithm electronics, excitation, signal conditioning, and analog-to-digital converter required to analyze data from one strain gauge.

The Graphical User Interface (GUI) allows easy programming of the units, and convenient downloading, saving, and graphical viewing. Communication from the PC to the device is handled through a special cable to a standard RS-232 serial port.

The user can program a periodic schedule into the unit to acquire strain data and perform real-time Rainflow processing. This schedule commands the unit to enter an active mode for acquisition and processing for programmable periods up to 23 hours 59 minutes. The schedule also dictates the low-power sleep time between active modes; sleep modes are also programmable from one minute to one week. Over one year of processed data can be stored in the unit in non-volatile memory. The Rainflow processing has programmable strain ranges for the 32 bins that count the total excursion cycles.

Once a scheduled program has been initiated, the MicroSAFE unit will continue in active or sleep mode until completion when it will return to the lowest-power idle mode. From any of the three modes, the user can download completed analyses or halt the operation. Raw strain data and processed Rainflow data are available while maintaining serial connection to the PC for short acquisitions—this function is provided to assure proper installation of the strain gauge. Before each acquisition period, the unit performs an eight-second Auto-Zero function and saves the transducer offset; this data can alert the user of gauge degradation or bias.

The standard external battery can power the unit for continuous 24-hour acquisition for over 45 days; other various sizes of batteries are available.

Rainflow Cycle Counting Algorithm

The Rainflow Cycle Counting Algorithm summarizes irregular load-versus-time histories by counting the number of times that cycles of various stresses occur. Not only is this a **highly effective data compression** scheme, it graphically illustrates the **movement of the material along the stress-strain curve**. These excursions on the curve can be quantized and used to determine life expectancy.

Specifications

SAMPLE RATE	32 Hz
EXCITATION VOLTAGE	1.2 V
GAIN & STRAIN GAUGE NOMINAL RESISTANCE	Factory set to user requirements
OPERATIONAL TEMPERATURE	-35°C to 85°C

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