

By: Dr. Raymond B Sepe, Jr.

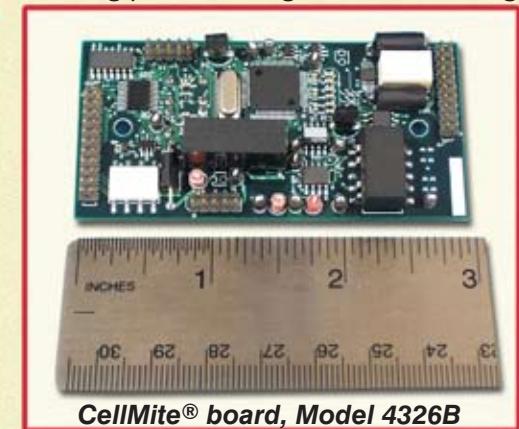
Mini-Digital Signal Conditioner Tackles Big Machine Control Problem

A little board with a lot of capability

The CellMite® Intelligent Digital Signal Conditioner transforms standard sensors into nearly ideal sensors with local intelligence that can be distributed in a sensor network for machine control and monitoring. The CellMite® can be built into a strain gage sensor such as a load cell to create a smart cell; or it can be used in a standalone package connected in series with the sensor. CellMite® contains all the signal conditioning, excitation and sense voltages, digitization, and processing power, along with both analog and digital serial outputs suitable for direct connection to a PC. It creates a complete interface between the PC and the strain gage sensor such as a load cell or extensometer. CellMites® are individually addressable so that a complete sensor network can be established by simply bussing together multiple units.

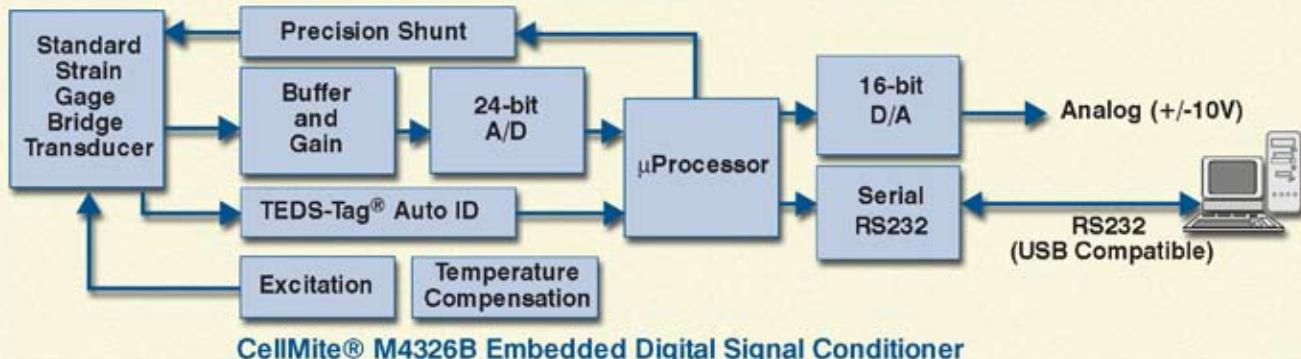
When embedded into a strain gage sensor, the CellMite® can be used to locally read the sensor, digitally compensate for nonlinearities, and present a nearly idealized smart sensor output in both analog and digital form to the user. The digital memory necessary for a Transducer Electronic Data Sheet (TEDS) sensor is also contained on the CellMite®. The CellMite® is significant because it combines many of the capabilities found in high performance instruments with the size and cost sensitivity of embedded systems to create a product that simplifies the interconnection and use of distributed sensors across a wide range of applications. In addition to its ability to condition, monitor, and filter the incoming sensor signal, its local intelligence can be programmed to use its digital and analog outputs to tune and/or control local actuators. The analog output of the CellMite® can be programmed to track the sensor signal, or it can be programmed to output voltage waveforms to control actuators in response to user commands or signal conditions.

CellMite® features excitation, buffering, and gain for the strain gage interface, 24-bit A/D conversion, internal temperature compensation, onboard digital processing power, 16-bit D/A analog outputs, as well as direct serial data outputs. Other features include remote shunt capability and flexible unit addressing modes.



CellMite® board, Model 4326B

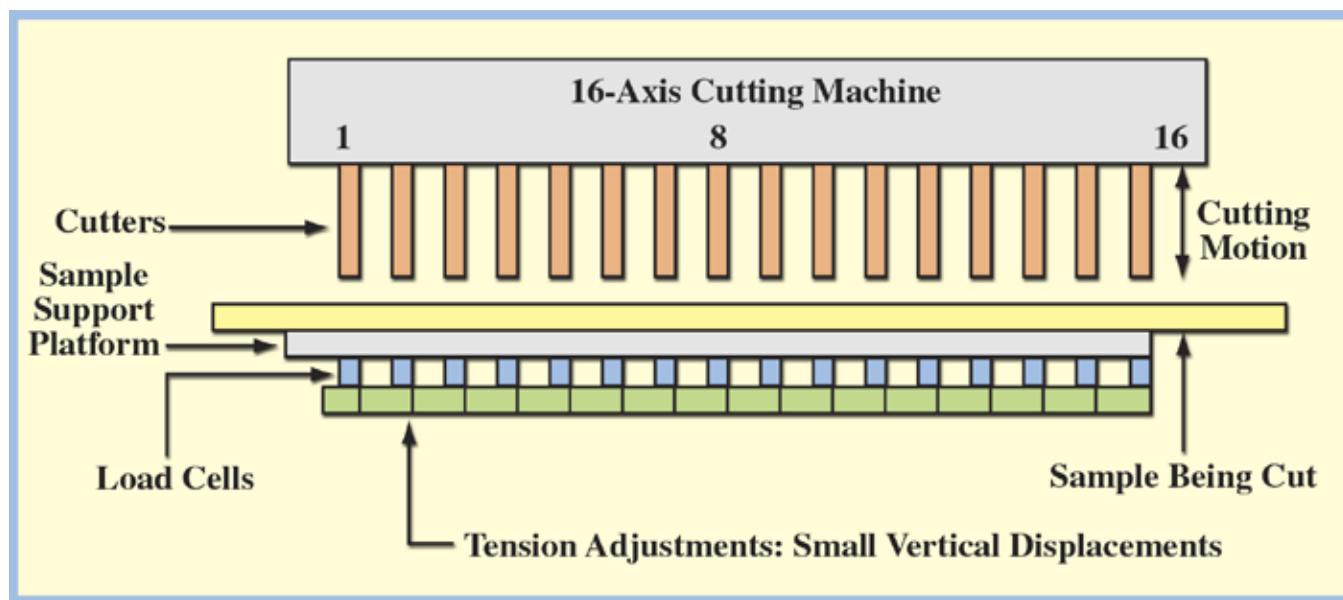
CellMite® Transforms Standard Transducer into a Smart Cell!



Functional Diagram of CellMite® board.

CellMite® for Machine Control & Monitoring of Multi-Axis Cutting Machine

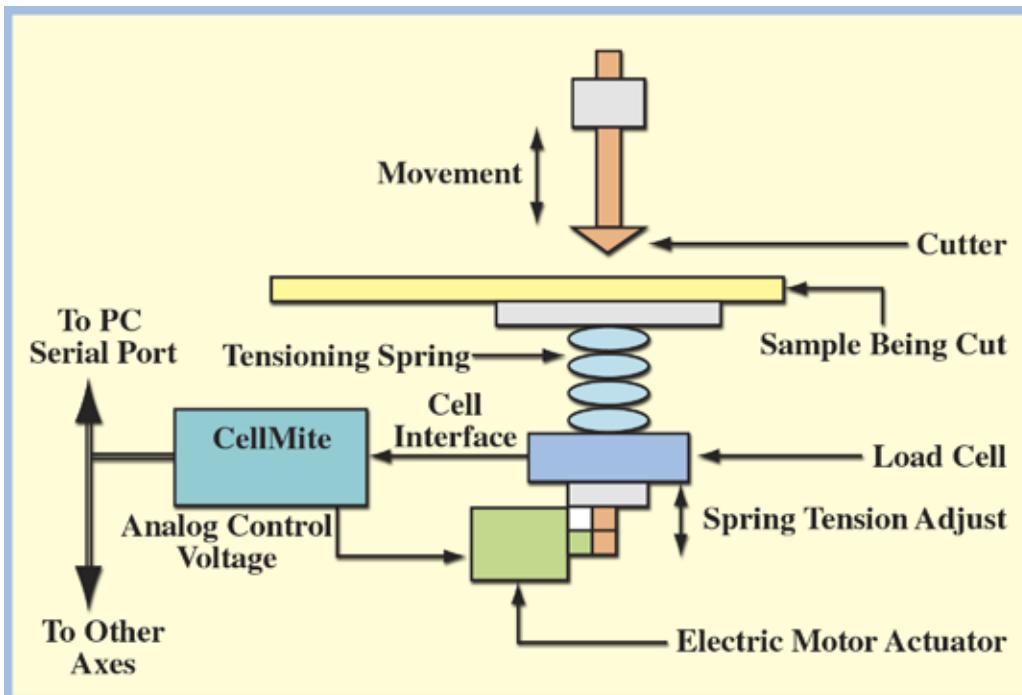
An example of CellMite® in action is the creation of a turnkey process monitoring system for a multi-axis industrial cutting machine. Load cells are used to measure the force being applied at each cutting station. In order to guarantee that the force on each axis is within acceptable limits, a load cell is used to measure the applied force and its output needs to be monitored. In this environment, several requirements can be identified for best performance. Because the machine is fairly long and in a noisy environment, it is not desirable to run long cables from each of the 16 load cells back to a large conditioning unit. The load cell signals are on the order of 30mV peak and are susceptible to interference and cable losses. All 16 channels need to be monitored to be sure that the long samples being cut are not loaded unevenly during the cutting process. An easily scalable solution is desired so that the number of cutting axes can be changed with ease. Each axis should have a tension adjustment control in order to fine tune the passive force exerted by the sample support platform. The system should be of reasonable cost so that each cutting machine in the factory can be outfitted. The goal is to realize a reduction in scrapped materials and machine downtime and to achieve an overall cost saving.



Block diagram of 16-axis cutting machine.

This is an ideal application for the CellMite®. Shown above is a detailed conceptual view of a single cutting axis. The CellMite® is located near the load cell to minimize the length of cable that carries the very low-level analog signals. It provides all necessary excitation and sensing. It locally digitizes the analog signal, provides digital filtering if needed, and presents the data in a serial digital format to an RS232 multi-drop bus. The bus connects to the other axes of the cutting machine and to the PC. Because each unit has a unique communications address, the PC can interrogate each unit and monitor the tension on each cutting axis. Each CellMite®, with its embedded intelligence, continuously monitors the sensor, even when the PC is communicating with another axis. Each unit maintains its own peak and valley for each axis. The CellMite® supports a broadcast command set that also allows all units to respond to a single command. In this way, a synchronized data read across all channels can be accomplished. The CellMites® have formed a distributed sensor network with local intelligence simply by being bussed together.

In addition to monitoring the force, it is desirable to adjust the spring tension by using the electric motor actuator to move the lower support platform up and down. The input to the actuator is a +/-10V analog voltage that represents the commanded position of the actuator. The analog output of the CellMite® can be programmed to either track the measured load cell signal or output a voltage under computer control. Using the computer control mode allows each cutting axis to have its tension adjusted remotely using the CellMite®. With its 0.01% accuracy and 24-bit resolution, force can be precisely measured and tension can be tuned throughout the cutting machine on a per axis basis over the distributed network. The output voltage levels are 16-bit resolution for precise movement control and are stored in each CellMite's® nonvolatile memory. The stored voltages are retrieved and applied each time the system is powered up.



Detailed conceptual view of a single cutting axis.

Having established networked control and monitoring of the 16-axis cutting machine using CellMites®, code can be written using software drivers provided for the CellMite® boards so that operation of the CellMite® network becomes part of the user's application code. Alternatively, an ASCII command set is available allowing the entire network to be operated using a simple ASCII viewing program such as HyperTerminal. CellView Lite graphical user interface software and a Standard Windows PC allow for a turnkey CellMite® network solution. The software is capable of calibrating each unit, monitoring the 16 unit channels, and providing alerts for out-of-bounds signal conditions.

Low-cost, Small & Powerful products do more with less.

In today's lean manufacturing environment, it is necessary to do more with less. In this application, CellMite® enabled older equipment to operate in a new more efficient way. CellMite® can be built into new products saving design time, or it can be attached to existing systems for monitoring and control. Small, powerful, and inexpensive products such as CellMite® are in demand in today's lean times.