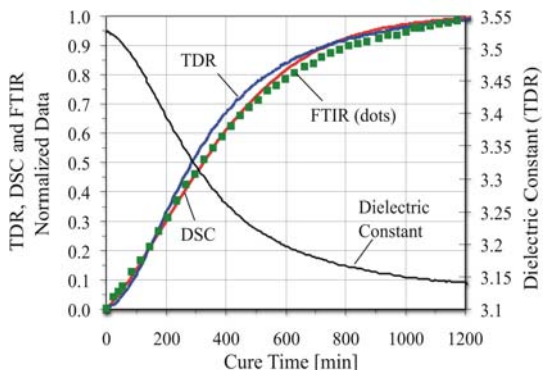




# COMPOSITE TECH BRIEF



intrinsic dynamic properties of the molecular dipoles because of the wide bandwidth of the interrogating electric pulse. The measurements compare very well with DSC and FTIR data and have been validated for various resin systems. For high accuracy measurements the time domain signals are converted to the frequency domain and material parameters such as the frequency dependent permittivity and loss factor can be measured up to the GHz range. The system can be calibrated to be temperature independent to maintain the accurate measurement even during the exothermic reaction.

## SENSOR CONFIGURATION

Various sensor configurations have been implemented. For composite molds, the TDR sensor can be integrated via two conductive parallel wires (copper or conductive fibers) in the top-surface ply below the tooling gel coat. The sensing field extends

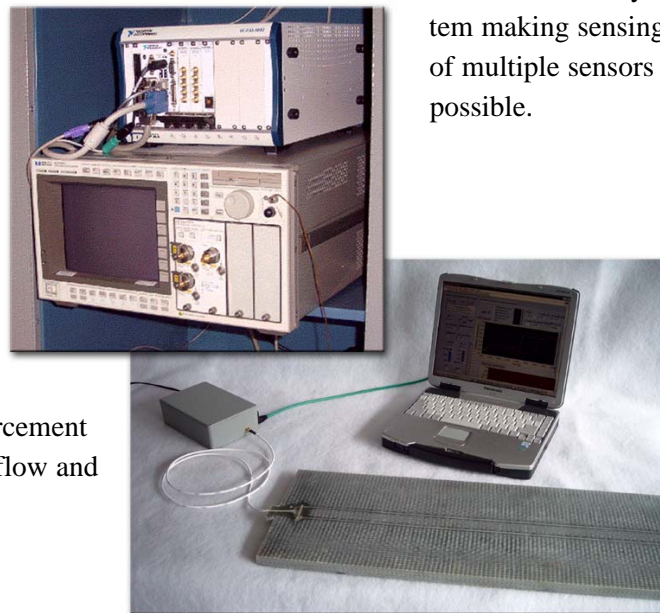
through the tooling surface, release agent and gel coat application into the reinforcement. The sensor is permanently integrated into the tool and does not affect cleaning or maintenance procedures.

Similar sensor configurations can be used in a reusable bagging approach. However, the sensor can be also directly integrated into the reinforcement to measure localized flow and cure.

## HARDWARE AND SOFTWARE IMPLEMENTATION

Two TDR measurement systems have been developed. First, a high-resolution system is based on a HP54750 TDR unit is capable of operating in the 20GHz range. This allows mm-resolution for distributed flow sensing. The TDR system is connected to a supervisory PC running the data analysis software. A low cost and robust system has been developed for industrial applications. The TDR hardware is integrated into a single box and

connected via the Ethernet to the host computer. The system has cm-accuracy and runs the same software as the high-resolution system. Both hardware methods can be extended to a multi channel system making sensing of multiple sensors possible.



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