



**Ruggedised  
field-deployable  
data acquisition  
systems for  
explosion  
monitoring**

## DATA ACQUISITION ELECTRONICS WITH EXPLOSIVE PERFORMANCE

**Instrumentel has used its experience of creating and deploying advanced data acquisition electronics into extreme environments to create its Wireless Advanced Instrumentation System (WAIS). This is a field-deployable instrumentation system which operates and survives within explosive environments.**

### Overview

Since the terrorist attacks on the World Trade Centre, western governments and their military advisors have been forced to re-evaluate engagement strategies, and reconsider the weaponry necessary to support such strategies.

Bombs that provide the “biggest bang for the buck” are arguably inappropriate for defeating terrorist threats such as biological, chemical and dirty nuclear bombs, without unacceptable levels of civilian risk and infrastructural damage.

As a result there is a need to develop explosive devices capable of delivering a targeted and metered explosion of sufficient potency to neutralise no more than the threat. The development of such devices requires knowledge of the threat, the design of an explosive capable of neutralising it, and

a means of assessing the efficiency of the conditions created by the explosion to eliminate said threat.

The assessment of the explosion and the environment it creates requires appropriate instrumentation that has been approximated to date by sampling data from the surrounding environment of an explosion and extrapolating towards its epicenter.

Instrumentel's Wireless Advanced Instrumentation System (WAIS) offers the ability to measure both the surrounding environment (using traditional wired sensors) and uniquely to monitor directly the epicenter of the blast using Instrumentel's innovative wireless data acquisition tag, the 'Enhanced XT01 tag'.

We describe here tests conducted in collaboration with the US Defense Threat Reduction Agency (DTRA) where the Instrumentel WAIS was used to collect blast data from controlled explosions.

### The Diagnostic Hub

Instrumentel's Diagnostic Hub forms an integral part of the WAIS system.

The Hub integrates high speed data logging and processing with wired and wireless sensor channels. It contains powerful processor (ARM and FPGA processors) allowing it to both control the WAIS system and monitor six sensor inputs simultaneously.



## Instrumentel's Advanced Wireless Instrumentation System (WAIS)

The Instrumentel Advanced Wireless Instrumentation System (WAIS), delivers a high performance, cost effective solution to explosion blast data acquisition. The system is comprised of the following elements: -

- An Instrumentel Diagnostic Hub (also available as a ruggedized case) configured for high speed data acquisition at up to 10 bit 500 kHz from a variety of sensor types, over both wired and wireless channels.
- Up to three wired sensor inputs, with a sampling bandwidth of 500k samples (10 bit) per channel
- One wireless sensor input, coupled to the enhanced XT01 data acquisition tag which incorporates the Instrumentel ruggedised, low power XT01 SOI transponder chip supplemented with non-volatile memory and sensor conditioning.
- An elegant and intuitive software user interface for controlling and configuring all aspects of the acquisition system, including the remote wireless tag, according to user requirements.

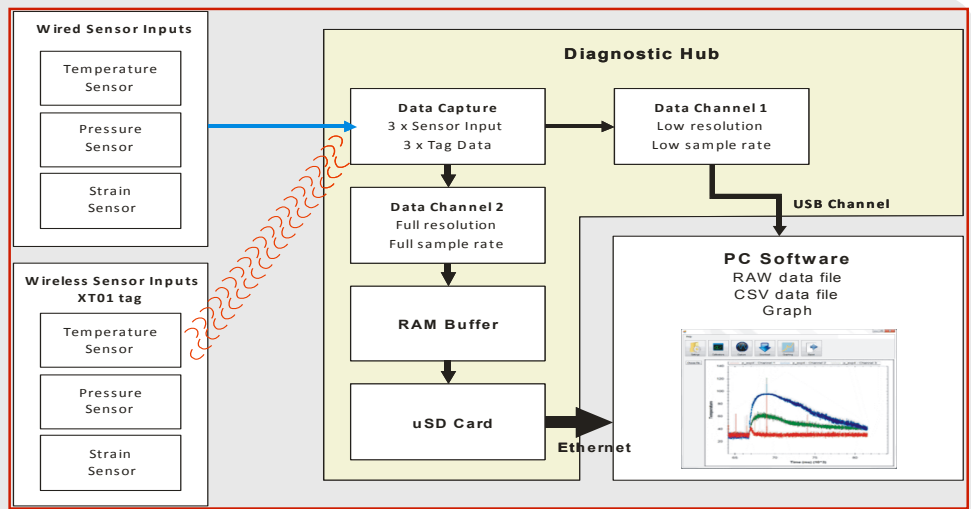
The Diagnostic Hub and Enhanced XT01 tag offer the ability to interface to a range of sensor types. These types include thermocouple, pressure and strain gauges.

During operation, the high speed diagnostic hub acts as an interface between the user's personal computer or network and the sensors to be sampled. The Hub supports Ethernet and high speed USB transfer of data and control signals.

### Experimental Data

The WAIS was developed and tested in collaboration with the US South West Research Institute (SWRI) under contract to DTRA.

Performance of the system has been validated during a series of experiments, comprising a number of enhanced XT01 tags with pressure, strain and temperature inputs placed at selected locations within a



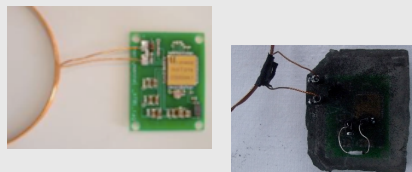
The Instrumentel WAIS comprises a high speed diagnostic hub collecting data from both wired and wireless sensors. The wireless Enhanced XT01 data acquisition tag provides the ability to place pressure and temperature sensors at the heart of the blast, with on board non-volatile memory delivering data acquisition even as the tag is dispersed by the blast.

blast chamber during simulated threat defeat explosion tests.

The system demonstrated its ability to record data during the critical first 5 to 10 ms of an explosion (from a mix of C4 and HTI's).

Enhanced XT01 tags placed at the centre of the blast experienced and recorded temperatures, strains and peak pressures in excess of 500psi, which were communicated wirelessly through the near-field inductive link (and also stored onboard) for the first few ms of the blast. The tags continued to collect data for 5 seconds as they were separated from the Diagnostic Hub during the blast, with the data being stored in the on-board non-volatile memory .

Surprisingly, perhaps, the tags (shown below) continued to operate after the blast, and stored data was readily retrieved.



### Summary

The compact and field-deployable Instrumentel WAIS has demonstrated its unique capability to deliver previously inaccessible insights into the temperature, pressure and strain profile during a threat defeat explosion.

### Instrumentel - leaders in electronic systems for data acquisition from extreme environments

Instrumentel specialises in electronic systems for acquiring data from extreme and difficult to access environments.

Our expertise has been proven in multiple markets including engine and electric motor telemetry, explosion metrology and condition-based monitoring of industrial processes and railway rolling stock.

The Instrumentel product range includes:

**MDS:** A versatile system for collecting data from moving parts such as internal combustion engine pistons and valves, turbines and electric motors.

**EDS:** A robust high-temperature system for collection of process-related data from extreme environments. The EMU has been applied to a diverse range of applications including monitoring the temperature of molten steel in a foundry and determining the temperature and pressure from the centre of an explosive blast.

**DDU:** The Doors Diagnostic Unit is optimised for condition-based monitoring of sliding doors, particularly those used in rail rolling stock and elevators. The DDU is quickly retrofitted without the need to break into existing safety systems, and provides continuous feedback on door operation.