

## Model CDMS 7E 7F 9E 9F Fiber Optic Combustion Dynamics Monitoring System



**DavidsonSensors™ provide the safest, most reliable and cost-effective instrumentation for harsh industrial applications.**

This product data sheet describes Model CDMS 7E 7F 9E 9F fiber optic combustion dynamics monitoring system. This system is designed for use in General Electric 7E, 7F, 9E, and 9F gas turbines and does not require any modification to the engine.

### Performance Specifications

#### Frequency Response

2 Hz to 10 kHz +/- 0.4 dB

#### Transducer Temperature Limit

1000° F

### Background

Large power generation gas turbine engines must operate outside stable stoichiometric limits to minimize emissions and to operate efficiently. Dynamic instabilities during the combustion process cause severe stress and potential damage to the engine. Combustion dynamics monitoring systems can be used for on-line tuning and to maintain dynamic stability, minimize emissions, and detect problems. Early detection can enable the operator to avoid serious trouble and catastrophic damage to the engines.

The result is high operating efficiency, low emissions, and new insight into the health of the

engines that may enable avoidance of costly maintenance or catastrophic failures.

Davidson offers integrated combustion dynamics monitoring systems. These integrated systems include all of the transducers, cable, and signal conditioning equipment and software required for a combustion dynamics monitoring system.

Davidson fiber optic transducers can tolerate temperatures up to 1000° F and may be installed in the engine casing. These flexible fiber optic pressure transducers may be located very near the combustion zone and used in a direct-coupled method eliminating the need for electronic transducers, charge amplifiers, “infinite” length tubes, and associated purging systems.

The result of this direct measurement is a higher quality signal with lower installation and maintenance costs. Davidson combustion dynamics monitoring systems are the best value for combustion dynamics monitoring.

Davidson provides a turnkey solution including installation, commissioning, and training of site personnel. Davidson plans to offer an on-line monitoring service to assist with report generation, analysis of trends, and comparisons with other assets. In the future, this collaborative service will allow operating personnel to discuss any situation with a combustion dynamics expert at Davidson.

## System Configuration

The CDMS 7FA system consists of the following major subsystems:

- Pressure Transducers (10 to 18)
- Homerun Cable and Junction Box
- Signal Conditioner and Spectrum Analyzer
- Dynamic Monitoring System Display

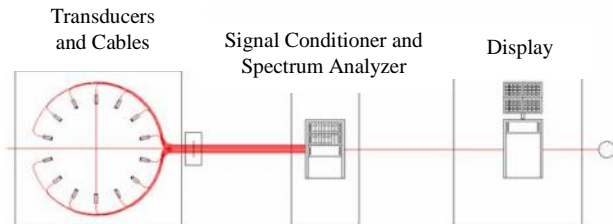


Figure 1 – CDMS 7F System Schematic

## Subsystem Details

**Transducers** - Davidson fiber optic pressure pulsation transducers are designed for installation in the turbine casing where the existing acoustic waveguides are installed. The transducer housings are designed to be installed flush with the inner liner and are tolerant to moderate misalignment of the threaded hole in the casing and the drilled hole in the liner.



Figure 2 – GT1200-7FA Transducer

The transducers have forty (40) feet of fiber optic cable rated for 550° F. The fiber optic cable is sheathed in ¼" diameter stainless steel armor for mechanical protection. The cables are terminated with ST connectors.

**Fiber Optic Signal Conditioner** – The fiber optic signal conditioner sends a continuous stream of light to each of the transducers via the fiber optic cable. Each of the separate light signals is modulated by the transducers and reflected back to the signal conditioner where it is converted into an electronic signal that is further processed by a micro-processor. The microprocessor in the signal conditioner converts the signals into pressure readings at sampling rates of 20 kHz. The microprocessor converts the pressure into an analog output signal, i.e. +/- 5 Volts, proportional to the pressure. The result is unprecedented measurement accuracy and frequency response in harsh industrial environments.

**Spectrum Analyzer** - A commercial spectrum analyzer and five-hundred feet of military-grade duplex singlemode fiber optic cable is typically included with the system. The simplex fiber optic cable is terminated on each end and is routed from the turbine electrical cabinet to a fiber optic switch in the control room for connection to the monitoring system. The simplex fiber optic cable is typically routed through the existing cable trays and enters the control room at a location to be determined at the time of installation.

**Monitoring System and Software** - The monitoring system consists of an industrial rackmount computer and a 17" LCD display for each turbine in the fleet. The computer receives the signals from the turbines and displays the signals according to a variety of options to be defined during the training session prior to installation. Setup entails a normal computer configuration with a TCP/IP address that can be connected to the plant network and provides Virtual Private Network (VPN) access to external users.

The monitoring software consists of the following:

- **Basic Combustion Measurements** - This package provides the basic combustion analysis software and allows the user to configure the display to provide a visual representation of the engine, to set thresholds for alerts and warnings, and to enter calibration constants for the transducers.
- **Criteria Trending** - This package provides the trend analysis software and allows the user to detect long term changes in the frequency spectrum of each combustor.
- **Data Miner** - This package provides the software necessary to extract data from the system archive in a variety of ways for further analysis.

- One-way MODBUS Slave Interface - This package provides a serial interface and necessary software to interface the CDMS system to the control system.

## Installation, Commissioning, and Training

Davidson provides turnkey installation, commissioning, and training for the system operators. Consider the following when developing a plan for installation of a CDMS:

- A pre-site conference call should be conducted to walk through the installation identifying the need for penetrations, permits, power, special needs, etc.
- The turbine must be shutdown and cool at the time the transducers are installed.
- The turbine must have adequate alignment between the threaded casing and the inner liners. Distortion of the existing pressure outlet tubes will indicate the need for machining of the liner to provide adequate clearance for the transducers.
- It is best to route the new fiber optic cables along existing cable trays.
- Electrical power needs to be available at the location of the monitoring system and the fiber optic signal conditioners.
- On-line or remote monitoring requires a broadband internet connection with the monitoring system.
- For planning purposes, assume that installation and commissioning can be accomplished by two technicians in two work days.
- Training in the use and setup of the system should be scheduled immediately after installation to minimize the delay in the use of the system after commissioning. The training should be planned for completion in two eight-hour days at the customer site.

## Testing and Calibration

Standard test and calibration includes the following:

Each transducer is calibrated at the factory at ambient temperature and 0.5 psi dynamic pressure.

A field calibration kit is available as an optional accessory to the CDMS.

## Documentation

Calibration data sheets will be provided for each transducer upon request.

An operator's manual is provided with each system.

## Tagging

Stainless steel tags will be permanently attached to each transducer upon request.

## Safety (Transducer with Cable)

Intrinsically-safe and suitable for use in:

- Class I, Division 1, Groups B, C, and D
- Class II, Division 1, Groups E, F, and G
- Class III, Division 1

## Other Applications

For information about other Davidson products, see [www.davidson-instruments.com](http://www.davidson-instruments.com)

## Guide to Configuring a Fiber Optic Sensing System

For information to assist you in planning a fiber optic sensing system, see

[www.davidson-instruments.com](http://www.davidson-instruments.com)

**Ordering Data**

Model Number	CDMS 7E 7F 9E 9F
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**Optional Software/Services**

Annual Monitoring Software Subscription	SS-001
On-Line Monitoring Service	MS-001
Combustion Dynamics Field Services	As specified
Combustion Dynamics Consulting / Training	As specified

**Options**

10 -Channel Fiber Optic Signal Conditioner 7E	DSC1400-10
14 -Channel Fiber Optic Signal Conditioner 7F 9E	DSC1400-14
18 -Channel Fiber Optic Signal Conditioner 9F	DSC1400-18
10 Channel Spectrum Analyzer	SA-1210
14 Channel Spectrum Analyzer	SA-1214
18 Channel Spectrum Analyzer	SA-1218

**Spares**

Pressure Transducer	GT1200 7E 7F 9E 9F
Two Channel Card for Fiber Optic Signal Conditioner	DSC1400M2
Four Channel Card for Fiber Optic Signal Conditioner	DSC1400M4
Signal Conditioner Chassis	DSC1400BP
Power Supply/ Communications Card	DSC1400PC

**Calibration Equipment**

Transducer Calibrator (ambient)	DSU1200
Hand Pump	HP1200

U.S. Patents 5,202,939; 5,392,117; U.S. Patent Pending

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