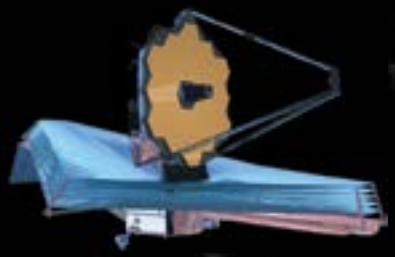
FROM
INNER SPACE
TO
OUTER SPACE

PHILTEC

FIBEROPTIC SENSORS
SOLVE
YOUR
MEASUREMENT
PROBLEMS



PHILTEC
FIBEROPTIC SENSORS

DISTANCE | DISPLACEMENT | VIBRATION

WWW.PHILTEC.COM

PRODUCT GUIDE

PHILTEC APPLICATIONS

Aerospace sensor applications are among the most demanding in the world. Philtec sensor systems have been successfully engineered into these extreme environments:

- Pressurized Cryogenic Fluids - liquid oxygen and liquid nitrogen
- Extreme Temperatures - down to 4°K and up to +450°C
- Ultra-High Vacuum
- Strong Vibrations

James Webb Space Telescope
Philtec sensors & vacuum passthru hardware were used to measure displacements of critical components of this Hubble Replacement Telescope as they were brought down to the cold temperatures of outer space.

Mars Rover
Nasa's JPL developed a Sonic Driller to drill core samples of rocks on Mars. Philtec's sensor was used to characterize the harmonic analysis and axial motion of the drill because it can detect high frequency low amplitude motions.

Space Shuttle
In the wake of the Challenger disaster, Thiokol engineers used Philtec sensors installed between the joints of rocket sections to determine how much separation occurred during firing.

Space Shuttle
Nasa's MSFC used Philtec probes in a LOX pressurized cryogenic environment to monitor bearing deflections in the Space Shuttle Main Engine

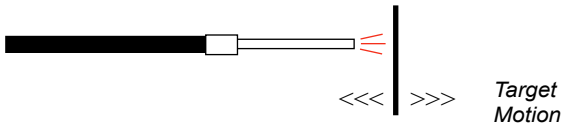
Flight Tests
Philtec 90° tip sensors were used for Airbus 380 flight tests to measure the displacement of thrust reversors.

Turbine Testing
Philtec sensors have been used for various measurements such as speed of 1,000,000 rpm micro-turbines; shaft displacements, blade clearance and growth in power turbines; time-of-arrival and flutter in gas turbine and turboshaft engines.

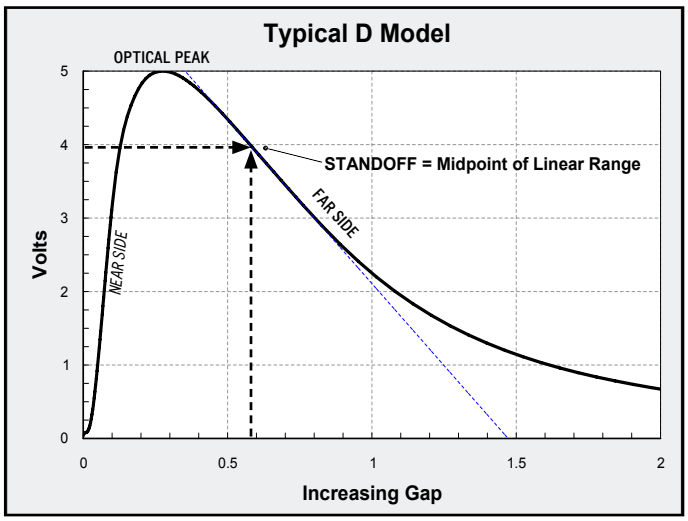
D TYPE SENSORS REFLECTANCE DEPENDENT

Maximum range 76 mm

Philtec D Type Sensors are recommended when the target moves along the axis of the sensor; i.e., single axis vibration where the target reflectivity is constant.



D type sensors provide an output proportional to distance and reflectance of the target. The output function is double-valued: Near Side operation gives highest resolution; Far Side operation gives moderate sensitivity with larger operating range.



ANALOG OUTPUT MODELS

Feature	Unit	D6	D12	D20	D21	D47	D63	D64	D100	D125	D169	D170	D171	D240
Tip Diameter	mm	0.81	0.81	0.81	0.81	1.61	3.18	3.18	3.18	3.96	4.76	4.76	4.76	7.92
Fiber Diameter	mm	0.15	0.3	0.51	0.53	1.16	1.6	1.63	2.54	3.18	4.32	4.32	4.32	6.1
Total Range	mm mils	1 40	2 80	1.3 50	2 80	5 200	3 125	6 240	10 400	15 600	20 800	30 1200	50 2000	76 3000
Optical Peak	mm	0.25	0.25	0.12	0.25	0.3	0.15	0.3	0.4	0.4	0.65	0.9	8	14
NEAR SIDE														
Standoff	mm	.09	.087	.03	.06	.06	.038	.053	.05	.05	.04	.09	0.9	4.2
Linear Range	mm	.05	.045	.02	.04	.046	.02	.036	.04	.05	.16	.064	0.5	4.5
Sensitivity	mv/µm	38	40	90	40	43	100	40	35	40	40	27	0.7	0.5
Resolution 100 Hz	µm	.08	.008	.008	.015	.010	.002	.018	.013	.002	.008	.008	0.3	0.5
Resolution 20 KHz	µm	.38	.075	.020	.05	.035	.013	.035	.04	.013	.038	.05	2.9	3
Resolution 200 Hz	µm	1.1	.12	.04	.1	.07	.026	.05	.1	.025	.076	.1	5.8	6
FAR SIDE														
Standoff	mm	0.48	0.53	0.3	0.7	1.1	.50	1.1	1.7	2.4	2.6	3.8	13	35
Linear Range	mm	0.33	0.41	0.25	0.7	1.3	.70	1.3	2.3	3.3	4.0	6.0	5.7	16
Sensitivity	mv/µm	5.5	4.4	8	4	1.6	3.2	1.3	0.7	0.6	0.5	0.33	0.33	0.19
Resolution 100 Hz	µm	0.15	0.1	0.04	0.08	0.1	0.13	0.13	0.2	0.13	1.25	0.6	0.6	1
Resolution 20 KHz	µm	1.3	0.8	0.2	0.65	0.9	0.3	0.8	1.9	0.7	3.0	3.8	4.3	8
Resolution 200KHz	µm	2.5	1.5	.4	1.3	1.8	1.6	1.5	3.8	1.8	6.o	7.5	8.6	16

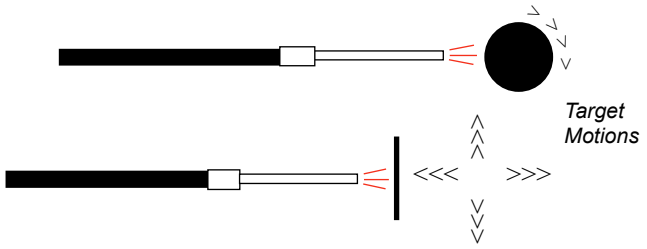
APPLICATIONS FOR D TYPE SENSORS

Actuator Dynamics Bearing Vibration Casting Porosity Check Diaphragm Deflection Fuel Injector Dynamics	Impact & Shock Studies Parts Positioning Piezoelectric Crystal Vibration Piston Registration (TDC) Piston Stroke	Scratch Detection Servo-Control Solenoid Travel Speed Sensing Structural Deformation	Surface Finish Evaluation Turbine Blade Vibration Ultrasonic Vibration Vacuum Process Control Valve Dynamics & Stroke

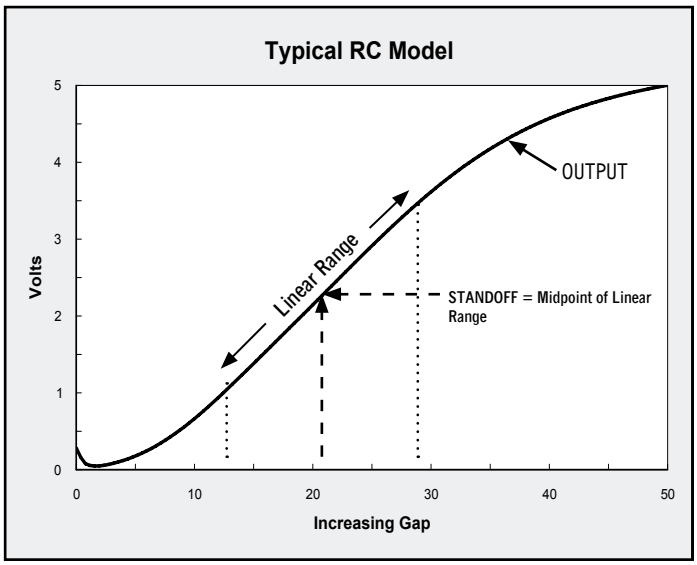
RC TYPE SENSORS REFLECTANCE COMPENSATED

Maximum range 35 mm

Philtec RC Type Sensors are recommended when the target rotates or moves past the sensor.



RC Sensors provide an output signal proportional to distance only. Reflectance changes of the target do not effect the output. The output function is single-valued.



ANALOG OUTPUT MODELS

Feature		RC19	RC20	RC25	RC32	RC60	RC62	RC63	RC90	RC100	RC171	RC190	RC290
Tip Diameter	mm	0.81	0.81	4.75	1.27	1.83	4.75	4.75	7.93	3.18	4.75	7.93	7.93
Fiberoptic Area	mm	Ø 0.51	Ø 0.51	0.64 x 3.18	Ø 0.81	Ø 1.52	1.58 x 3.18	1.58 x 3.18	2.29 x 4.75	Ø 2.54	Ø 4.34	4.83 x 4.75	Ø 7.44
Total Range	mm mils	0.4 16	1.3 50	0.76 30	2 80	3.2 125	2 80	4 160	9 350	5.1 200	12.7 500	25.4 1000	35 1380
Standoff	mm	0.3	.48	0.3	1	1.4	1	1.4	3.8	2.2	4.4	12.7	20
Linear Range	mm	.09	0.36	0.2	.75	1	.75	1.2	2.3	2.0	3.8	3.4	10
Sensitivity	mv/µm	21	5	10	3	2.2	3	1.3	0.8	1.3	0.6	0.5	0.25
Resolution 100 Hz	µm	0.08	0.25	.05	0.7	0.6	0.25	0.7	0.6	0.8	2.5	3	15
Resolution 20 KHz	µm	0.23	0.5	0.3	2	1.8	1	2	4	3	5.6	6.7	60
Resolution 200KHz	µm	0.45	1	0.6	4	3.6	2	4	8	6	11	13.4	125

OPERATING PRINCIPLE: Two fiber bundles are arranged side-by-side. Light exits one side, reflects off the target and returns to the sensor thru both sides. A ratiometric calculation of those two signals provides the distance measurement which is independent of target reflectance variations; i.e., reflectance compensated.

APPLICATIONS FOR RC TYPE SENSORS

Automated Parts Inspection Bearing/Rotor Dynamics Commutator Profile Computer Disc Assembly Deformation Studies	Distance To Glass Distance To Paper Distance To Plastic Dynamic Expansion Hard Disc Thickness	Process Control Rotor Runout Shaft Orbits Structural Deformation Surface Finish Evaluation	Turbine Blade Clearance Ultrasonic Vibration Ultra-High Vacuum Vibration Studies Warpage

PHILTEC FIBEROPTICS

Standard sensor cables use glass fibers with a protective sheathing. Cable and tip materials are chosen for best compatibility with the application's environment. In the most extreme conditions, the glass fibers can be exposed to cryogenic temperatures near absolute zero and elevated temperatures above 300°C (up to 480°C).

Philtec Sensors Are Commonly Used

- **Inside of Mechanisms**
- **In Cryogenic Environments**
- **In High Electrical Fields**
- **In Hazardous Environments**
- **In High Magnetic fields**
- **At High Temperatures**
- **At High Pressures**
- **Submerged in Oils, Water, or Other Fluid**
- **In Vacuum**

OPERATING WAVELENGTH

850 nm LEDs are the standard light source of Philtec sensors.

QUARTZ FIBER PROBES

Quartz fibers are required for use in applications where the temperatures exceed the limitations of glass fibers, and also in radiation environments. Probes made using quartz fibers and ceramic adhesives can operate up to 800°C.

Metals emit light energy in the red spectrum when heated above 600°C. For applications >600°C, Philtec sensors operate in the blue spectrum at 470 nm. Blue light operation effectively eliminates light interference from hot glowing parts and infrared heating elements.

CUSTOM PROBES

Very Small Probes

Threaded Probes

90° Probes

High Pressure Probes

SENSOR HARDWARE

Analog sensors are fast responding units ideal for relative motion measurements in dynamic applications. Available in D and RC type single channel packages.

- ***Analog Output***
  0 - 5 volt with 20 KHz standard bandwidth.

  Speeds > 1 MHz are available

D

Reflectance Dependent

RC

Reflectance Compensated

Digital sensors are the best choice for absolute distance measurements, multiplexing and process control applications. Calibration data stored on-board. D and RC models available.

- ***Digital Output***
  Linearized distance output via RS232 or USB with 5KHz maximum data rates.

FREE SOFTWARE INCLUDED!

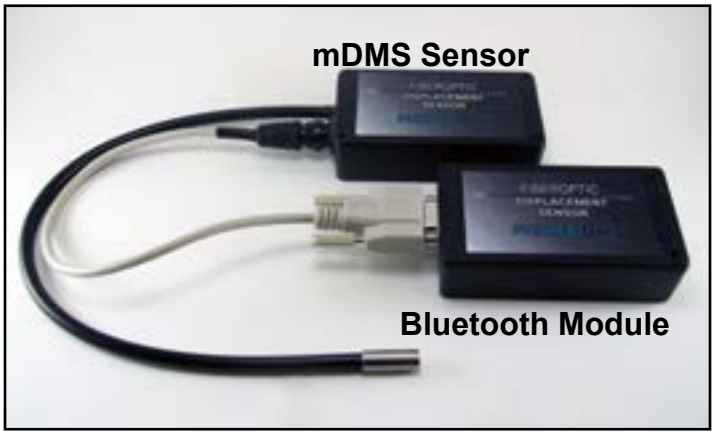
Each sensor includes free software that enables you to use your PC to:

- Setup Sensors For Operation
- Select Calibration Tables For Specific Targets
- Store Additional Calibrations
- View Live Graphs Of Sensor Outputs
- Save Data To File

10DMS 19" rack for powering and controlling up to 10 digital sensors. Features ruggedized plug-in sensor modules. Mix or match any combination of sensor models, RC or D type.

- ***10 Channel Racks***
  Use any combination of Philtec's digital sensors

Wireless sensors. An accessory pack enables any Philtec sensor with RS-232 output to be run in **wired or wireless modes**.



BAP2 includes:

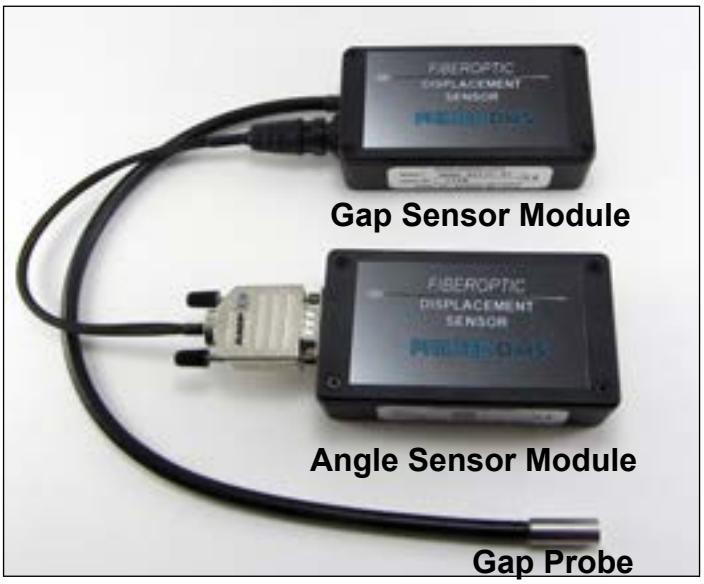
- Bluetooth Battery/Radio Module
- USB Bluetooth Micro Adaptor
- Mini to Standard USB Cable
- Sensor Data Link Cable
- Operating Software

Specifications

- Time To Charge: 4 Hours
- Run Time: 10 Hours w/full charge
- Standby Mode: 4 Weeks Max.
- Run Time: 3 Hours After 4 weeks Standby
- Max. Data Rate = 900 Samples/Second

CMS 3000 CLEARANCE MEASUREMENT SYSTEM

Wireless Sensors To Measure Turbine Blade Tip CLearance



PC Tablet Preloaded with Philtec Software for Display and Data Collection

CMS 3000 series wireless turbine blade-mounted fiberoptic sensors and Windows Tablet to digitally capture the full 360° picture of casing roundness and gap data.

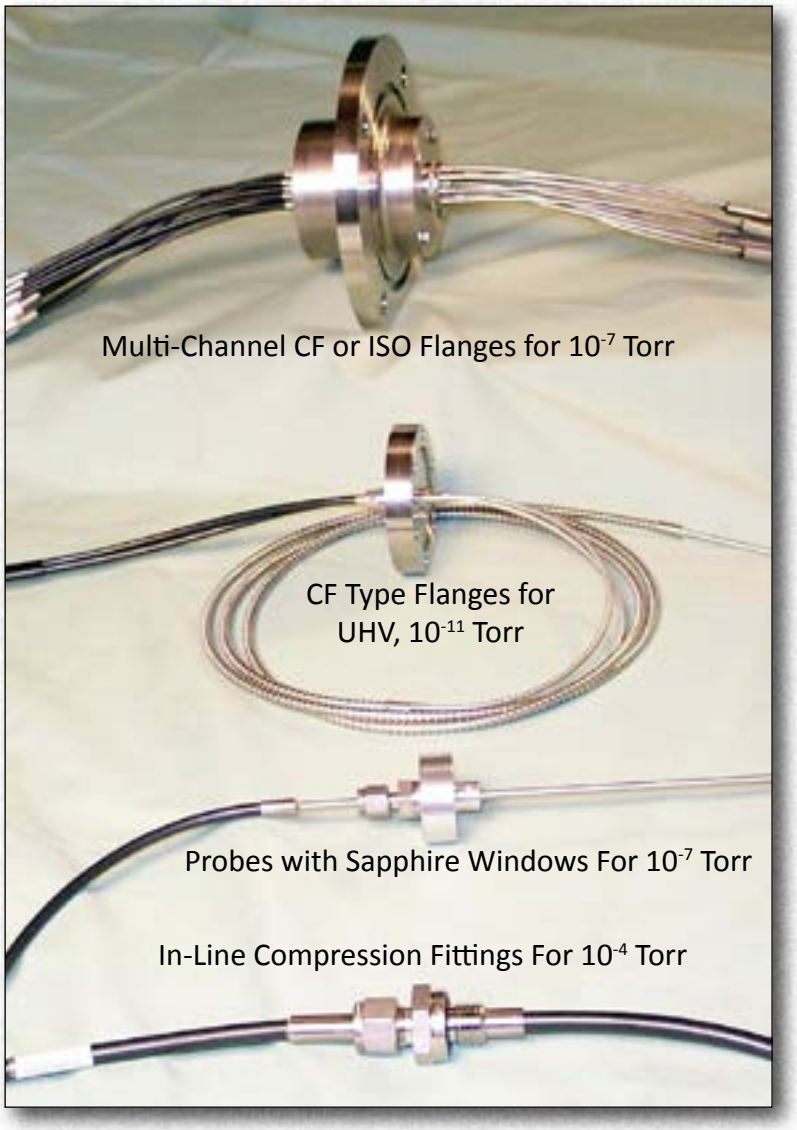
OPERATION

- Rotor/turbine blade-mounted fiberoptic probes with electronic modules provide distance and angle output data...
- The rotor is manually turned slowly...
- The Tablet collects gap and angle info, displays live charts, and saves the data to file for engineering to offload and analyze...

VACUUM HARDWARE

Fiberoptic Displacement Sensors are ideal for displacement and position measurements in vacuum. They have a wide temperature range, are UHV compatible, small in size and can have sub-micron accuracy.

Philtec's line of vacuum passthru hardware enables the installation of fiberoptic probes into vacuum chambers over a wide variety of applications, such as:



- **In High Electrical Fields**
- **In High Magnetic fields**
- **At High Temperatures**
- **At High Pressures**
- **In Ultra High Vacuum**
- **In Cryogenic Fluids**
- **At Cryogenic Temperatures**

Measurements In Vacuum Our Specialty

Custom Systems to Customer Specifications

PHILTEC FIBEROPTIC SENSORS

Non-Contact

Small Size

Configurable

Fiberoptics

- ▶ No Effect On Target
- ▶ Small Target Spot Size
- ▶ Access Hard to Reach Targets
- ▶ Intrinsically Safe
- ▶ EMF Noise Immunity
- ▶ Vibration & Shock Resistant
- ▶ Survive Extreme Environments

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