

### Hydrogen Fluoride Fiber Coupled Gas Cell for Gas Sensor and Calibrator O Band

Gas cells are precision filters whose absolute wavelengths depend on specific molecular energy level transitions. Hydrogen Fluoride (HF) exhibits strong molecular absorption in the bands 1255 - 1351nm, 865 - 895nm and 2.34 - 2.82 $\mu$ m.

Our fiber-coupled HF gas cells ship with two standard pressures: 10 Torr and 50 Torr. Custom pressures and concentrations are available. Our standard backfill material is nitrogen gas (N<sub>2</sub>).

Our OFHC copper gas tube is compression-sealed for long life and features advanced optical design with wedged sapphire windows for very low level of interference artifacts. Cells may be ordered fully fiber-coupled (single mode fiber, with or without connectors), or with a built-in InGaAs photodetector on one end.

We also offer free-space HF tubes in a variety of configurations and custom pressures/concentrations.

### Specifications<sup>1</sup>

#### Gas Lines:

Wavelength Range	nm	1255 to 1351 865 to 895 (tube only) 2.34 $\mu$ m to 2.82 $\mu$ m (tube only)
Wavelength Accuracy	pm	$\pm$ 0.1pm (see following page)
Absorption line depth <sup>2</sup> (P3 line - 1312.6nm)	dB	6 (50 Torr; typ.) 4 (10 Torr; typ.)
Linewidth (P3 line - 1312.6nm)	pm	16 (50 Torr; typ.) 5 (10 Torr; typ.)
Temperature Dependence	pm	<0.01/ $^{\circ}$ C
Custom Pressures (25 $^{\circ}$ C) <sup>3</sup>	Torr	0.3 to 150 $\pm$ 10%

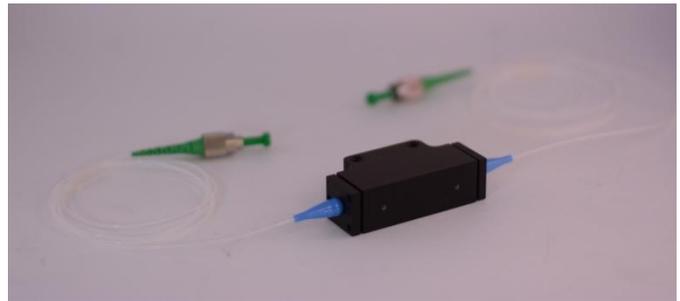
#### Gas Cell:

Cell Transmission	%	45
Spectral ripple (P-P)	dB	<0.1 P-P in any 2nm span
Cell Lifetime	years	>10
Operating temperature	$^{\circ}$ C	+5 to +70
Storage temperature	$^{\circ}$ C	-40 to +80
Connector Type		FCAPC, SCAPC, FCPC, SCPC, none, PD(Photodetector)

#### Photodetector:

Net Responsivity	A/W	>0.4
Capacitance (0V)	pF	4 typical
Shunt Resistance	M $\Omega$	>5

- 25  $^{\circ}$ C; Specifications subject to change without notice
- For instruments with resolution better than the linewidth. Using lower resolution could understate absorption.
- 150 Torr maximum for pure HF. Total pressures of 1000 Torr possible depending on concentration. Consult factory for more information.



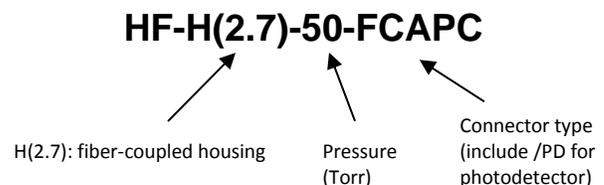
### Features

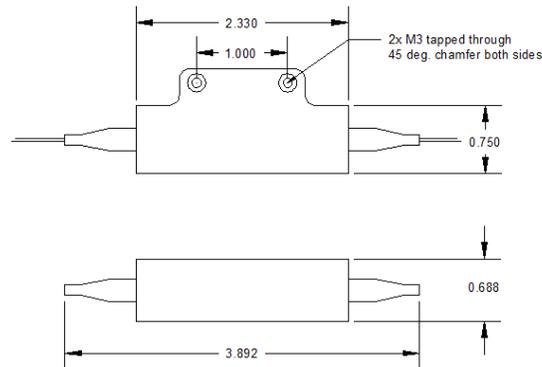
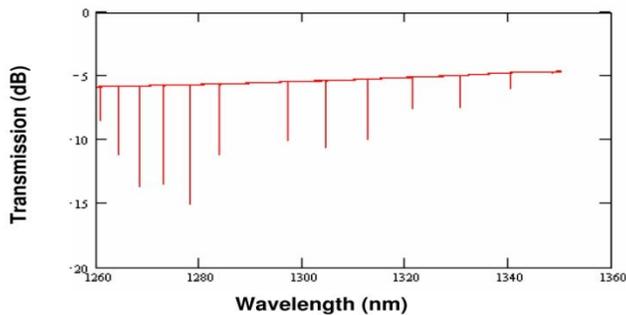
- >10 year life, compression seal (sapphire to copper)
- Sapphire windows are AR-coated and wedged for low level of spectral artifacts
- Rugged miniaturized package
- Custom pressure and connectors
- Free-space tube available in several path lengths

### Applications

- Remote optical gas sensing systems
- Bump testing gas detectors
- Embedded calibrator for tunable laser of OSA
- Wavelength locker
- Laboratory calibration source

### Ordering Information (example)





### HF fiber coupled gas cell

Dimensions in inches. Bare absorption tube is also available in multiple sizes (or custom - please inquire). The bare absorption tube is especially valuable for accessing absorption lines > 2.4 microns.

Line	Wavelength (nm) <sup>1,2</sup>	Pressure Shift <sup>3</sup> (pm/Torr)
R(8)	1253.3845	-0.010
R(7)	1255.3002	-0.010
R(6)	1257.7520	-0.008
R(5)	1260.7417	-0.006
R(4)	1264.2721	-0.003
R(3)	1268.3469	-0.001
R(2)	1272.9705	0.004
R(1)	1278.1480	0.004
R(0)	1283.8857	0.009
P(1)	1297.0703	0.003
P(2)	1304.5339	0.004
P(3)	1312.5910	0.002
P(4)	1321.2525	-0.002
P(5)	1330.5301	-0.003
P(6)	1340.4365	-0.006
P(7)	1350.9858	-0.009
P(8)	1362.1931	-0.010

1. Data from most recent HITRAN 2012 database. Significant updates were made from the previous 2008 database.
2. HITRAN line uncertainty given in terms of wavenumber: <0.0001cm<sup>-1</sup> and >= 0.00001cm<sup>-1</sup>).
3. Air-broadened pressure shift data at 296K from HITRAN 2012.

**Note:** HITRAN is a spectroscopic database involving research and standards bodies worldwide. It is headquartered at the Harvard Smithsonian Center for Astrophysics and contains the most accurate spectroscopic data in the world.

**A Note on Dimers** The dimer H<sub>2</sub>F<sub>2</sub> is generally present to varying concentrations depending on gas pressure and temperature. For room temperature (25 °C) at 100 Torr pressure the dimer concentration will be in the neighborhood of 25%. For pressures below 25 Torr the dimer concentration is generally negligible at room temperature and above. The presence of the dimer effectively reduces the concentration of the monomer but does not change the wavelength of the absorption lines except through the weak dependence on pressure shift. The most evident effect will be the absorption width getting larger at higher temperatures due to the increase in monomer concentration.

## Traceability

The resulting absorption spectra exhibited by Wavelength References HF Cells are determined by fundamental molecular energy level transitions that have been well characterized by standards bodies and stored in spectroscopic databases such as HITRAN. As such, the presence of HF at a specified pressure and temperature guarantees repeatable absorption spectra characteristics.

## Material Handling

Safety is always an appropriate concern. Occupational Safety & Health Administration (OSHA) lists a Permissible Exposure Limit (PEL) for HF of 3ppm over an 8-hour period (time-weighted average). This would correspond to inhaling a total of approximately 10mg of substance (assuming 0.5L tidal volume and 16 breaths/minute). Our 50 Torr cells contain approximately 0.02mg to 0.4mg of HF, depending on tube size. Because exposure amounts are far below any quantity deemed hazardous by OSHA, no special provisions are necessary for the handling of these cells, and they may be shipped by any customary means.