

# Hiden 3F Triple Filter Mass Spectrometers for precision gas analysis and scientific applications



vacuum analysis

surface science

plasma diagnostics

gas analysis

# 3F Series Overview

## High performance quadrupole mass spectrometers from Hiden

Benefiting from a modular design, the 3F Series mass spectrometers are available with mass range options of 50, 300, 510, 1000 and 2500 AMU, and offered in four application specific configurations:

**HAL/3F** - for high performance residual and precision gas analysis applications - for example: catalysis characterisation, and clusters analysis.

**3F/PIC** - for fast event gas studies, UHV/XHV analysis, and thermal desorption studies.

**EPIC** - for radicals analysis, time resolved studies (100 nano-seconds gating resolution) and positive and negative ion detection. EPIC systems include internal control of the quadrupole mid axis potential (pole bias), scanning up to 100eV as standard, and +/- 1000eV optional.

**IDP** - an extension of the EPIC series with integrated 4-lens ion optic optimized for the study of electron, photon and laser stimulated desorption of low energy ions.

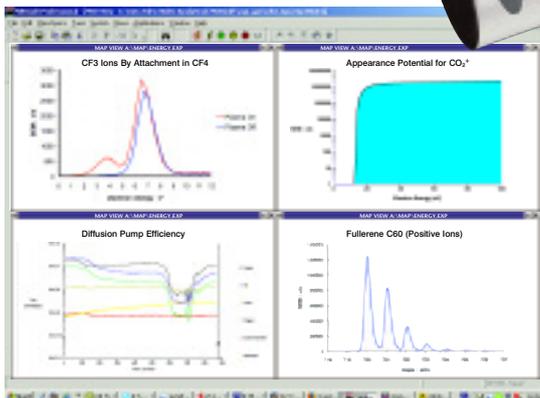
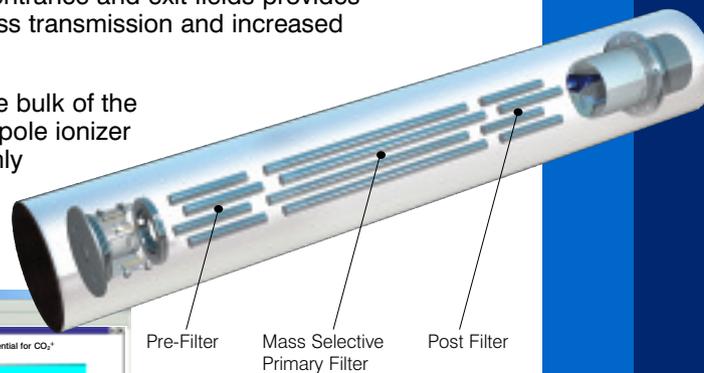
**EPIC** and **IDP** systems are fully upgradeable to the Hiden SIM/ EQS/ PSM/ EQP Series mass spectrometer systems with integrated ion energy analyzer.

Hiden 3F series mass spectrometers are configured with 6mm, 9mm, and 12 mm pole diameters, with a choice of detector and a broad specification range. The common factor used throughout the 3F Series range is a precision-assembled triple mass filter with unique, independently driven, RF-only secondary filter stages preceding and following the primary mass filter.

### Why have a triple filter?

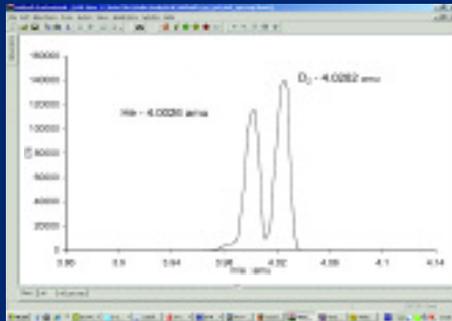
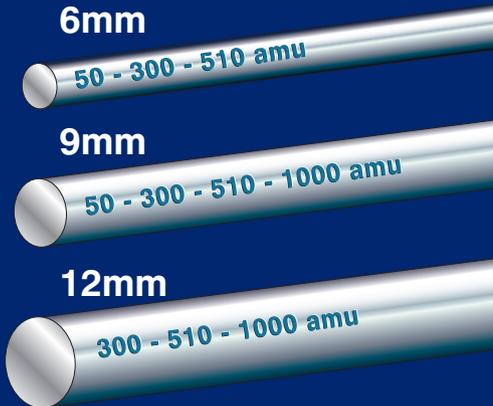
The triple filter assembly provides two main advantages over systems offered with single filter only:

- Strict control of the quadrupole entrance and exit fields provides enhanced sensitivity for high mass transmission and increased abundance sensitivity.
- Enhanced long-term stability. The bulk of the deselected ions from the quadrupole ionizer deposit harmlessly on the RF-only pre-filter stage, minimizing contamination on the mass selective primary filter.



DMM - dynamic multi-mode scanning - permits fast measurement of ion energy and appearance potentials. DMM is uniquely applied to the electron attachment ionization technique for electro-negative gas studies.

## What pole diameter do I need?



Ultra high resolution for the 50 AMU mass range 3F system separation of helium and deuterium peaks with a mass difference of only 0.0256.

**Rule 1** Total RF output power is fixed for a given generator.

**Rule 2** Power demand increases dramatically with increasing RF frequency (function  $F^5$ ). For a given mass, doubling the frequency increases power demand in excess of x30.

**Rule 3** For a given mass, performance improves with increasing frequency.

**Rule 4** For given machining tolerances, transmission and mass separation improve with increasing pole diameter.

**Rule 5** Overall size and cost increase with increasing pole diameter.

**Rule 6** Enlarging the pole diameter increases assembly capacitance and limits RF frequency range (increases power losses).

Hidden Analytical RF power supplies are frequency-selected to optimize performance for the selected mass range of interest.

In general:

1. Identify the primary parameters needed in terms of operational performance.
2. Establish the budgetary range.
3. Identify user-system mounting limits (mounting flange size).
4. Select the largest pole diameter and lowest mass range compatible with the application and available budget.
5. For multiple applications requiring optimum performance consider procuring two appropriate RF generators, for example a 6mm pole diameter mass filter with both 50 amu and 300 amu RF generator systems.

## 3F Series which ionizer type should I use?

Ionization sources are selectable for diverse applications:



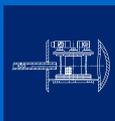
**Standard RGA** A radially symmetric configuration for general applications.



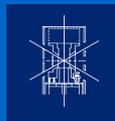
**UHV Low Profile** Optimized for UHV TPD studies enabling closer proximity of the ion source to the evolution surface.



**Closed Source** For high pressure studies with direct gas input used in conjunction with a differential pumping stage for the analyzer.



**Gas Cross Beam** Designed for non condensing molecular beam studies. A pathway through the source cage is provided for the molecular beam.



### XBS Cross Beam

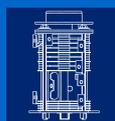
The XBS Cross Beam is configured specifically for MBE deposition rate monitoring and control.



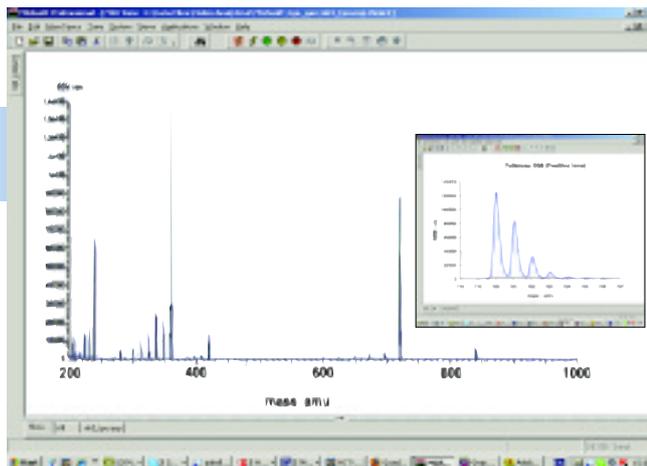
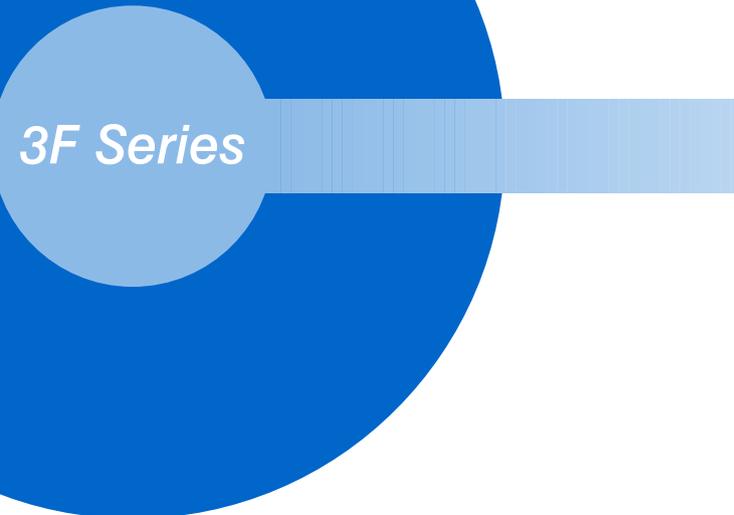
**Basic Cross Beam** The Basic Cross Beam source is used for analysis of molecular beams, where the beam may be liable to condense on ionizer surfaces. The source features an unobstructed pathway through the ionising region of the source. External shrouds are available to protect the quadrupole mass filter from condensing species.



**Laser Cross Beam** The Laser Cross Beam source includes two orthogonal unobstructed pathways for laser photon ionisation within the source cage region, providing an alternative to electron impact and electron attachment ionisation.



**4 lens ion optics with integral ionizer** Additionally enables analysis of low energy positive and negative ions generated externally to the analyzer. For electron, photon, and laser-stimulated desorption studies.



C60, 1000 AMU spectrum from EPIC mass spectrometer.

## 3F Series Data acquisition and review

### Detector

The Analog Detector- a dual Faraday/SCEM with 10 decade dynamic range. Designed for diverse applications from precision residual gas analysis to part per billion abundance determination.

The PIC Detector- an SCEM for fast ion counting from 1c/s to 10<sup>7</sup>c/s with continuous seven decade dynamic range. A Faraday detector option additionally enables measurement of high intensity ion beams to 5x10<sup>10</sup>c/s. Applications include fast event gas studies and measurement of externally generated ions.

### Programmable signal gating

A sophisticated gating system including virtual foreground and background detectors to allow the system to be used for time resolved measurements and to monitor differences between two time zones relative to a repeated event - automated data acquisition during beam on and beam off cycles in modulated molecular beam studies for example.

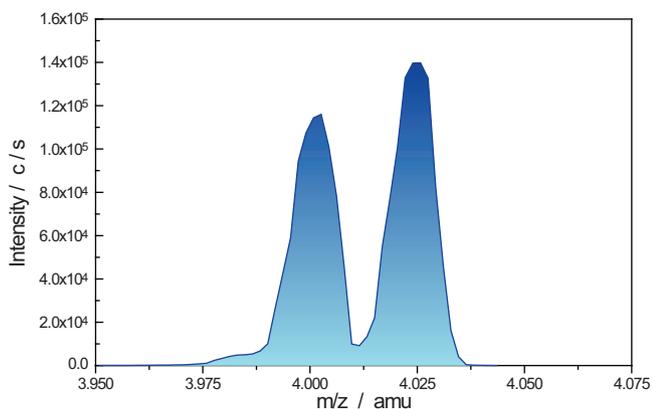
Both the foreground and background delay timings can be sequentially incremented, automatically, to analyse the process structure step-by-step through a single period of a fast, repetitive event.

The minimum programmable signal gate delay and the minimum gate width are 100 nanoseconds.

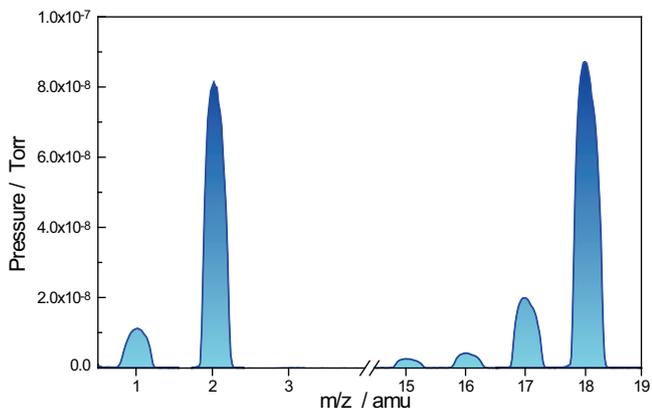
For fast repetitive events with frequency up to 150KHz.

### Multichannel scaler PC card detector option

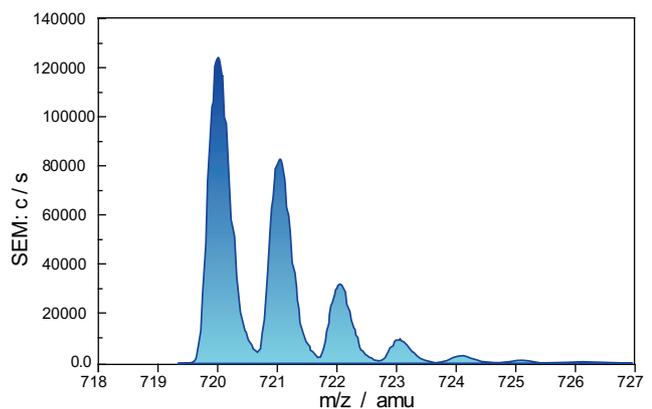
For systems that include pulse ion counting detection, the multi channel scaler card option provides for time-of-flight data acquisition with 100 nanosecond time resolution.



Ultra high resolution of the 3F system, 9mm pole diameter - 50 amu mass range system. Separation of the helium and deuterium peaks with a difference of only 0.0256.



Low mass performance of the 3F system 6mm pole diameter - 50 amu mass range system. Excellent abundance sensitivity and peak separation over the entire 1- 50 amu mass range.



High mass performance of the 3F system, 9mm pole diameter - 1000 amu mass range system. C60 peak at mass 760 with natural abundance carbon isotope peaks at mass 721, 722, 723 and 724....

## 3F Series

### Mass Spectrometers in Application Specific Analytical equipment

The 3F series mass spectrometers are integral to Hiden's range of application specific analysis systems. Each system is designed and developed to provide the optimum sampling interface to match the application requirement.

#### HPR-20 Precision gas Analysis System

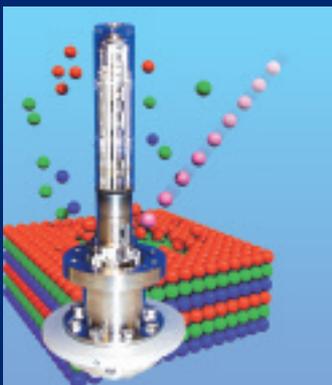
Hiden's HPR-20 system is a compact bench top gas analysis system designed specifically for continuous monitoring of production processes

and research experiments operating in the pressure range 10 torr to 2 bar.



#### UHV-TPD.

A 3F/PIC mass spectrometer configured for UHV TPD applications.



#### EQP Mass and Energy analyzer

For neutrals, radicals and positive and negative ions with RF driven sampling orifice.



#### HPR-60 Molecular Beam Sampling System

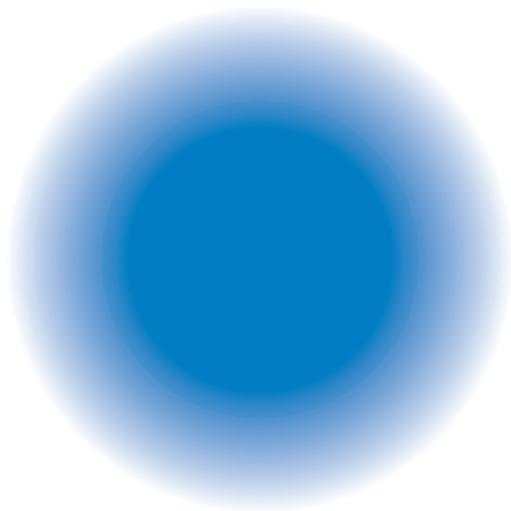
Designed specifically for the study of both stable and reactive species, including radicals and ions, at pressures up to

1000 mbar. The HPR-60 features precision axially aligned orifices for minimum process perturbation.

Primary applications include plasma studies, gas kinetics and high mass cluster analysis.



# 3F SERIES



# HIDEN ANALYTICAL



Manufactured in England by:

HIDEN ANALYTICAL LTD

420 EUROPA BOULEVARD

WARRINGTON, WA5 7UN, ENGLAND

Tel: +44 (0)1925 445225 Fax: +44 (0)1925 416518

Email: [info@hiden.co.uk](mailto:info@hiden.co.uk)

Web Site: [www.HidenAnalytical.com](http://www.HidenAnalytical.com)

It is Hiden Analytical's policy to continually improve product performance and therefore specifications are subject to change.

TECHNICAL DATA SHEET 151