Electron Multipliers

ETP Electron Multipliers are individually tested to ensure the highest quality.

ETP Electron Multipliers, a wholly owned subsidiary of SGE is a world leader in the design and manufacture of ion detection and ion optics technologies for use in mass spectrometers. A wide variety of models has been designed and built to cover most common types of mass spectrometer, including ICP-MS, GC-MS, LC-MS/MS and MALDI across all mass analyzer types, quadrupole, ion trap, magnetic sector and time of flight.

SGE's ETP Electron Multipliers team has over 100 years combined experience in the design and fabrication of detectors for mass spectrometry applications.

Ion detection systems based on electron multipliers have been widely used as detectors of charged particles and high-energy photons in analytical instrumentation for more than 30 years. Their basic function of detection and amplification of very small signals has remained unchanged since the beginning; however, modern computer design and modeling techniques, as well as advancements in materials and manufacturing, have enabled development of extremely sensitive, yet rugged, devices vital to the performance of today's mass spectrometers. ETP electron multipliers from SGE are the most advanced high-performance detectors available today.

How Do They Work

An electron multiplier is used to detect the presence of ion signals emerging from the mass analyzer of a mass spectrometer (*see Figure 1*). The task of the electron multiplier is to detect every ion of the selected mass passed by the mass filter. How efficiently the electron multiplier carries out this task, represents a potentially limiting factor on overall system sensitivity. Consequently, the performance of the electron multiplier can have a major influence on the overall performance of the mass spectrometer.

The basic physical process that allows an electron multiplier to operate is called secondary electron emission. When a charged particle (ion or electron) strikes a surface it causes secondary electrons to be released from atoms in the surface layer. The number of secondary electrons released depends on the type of incident primary particle, its energy, and characteristics of the incident surface (*see Figure 2*).

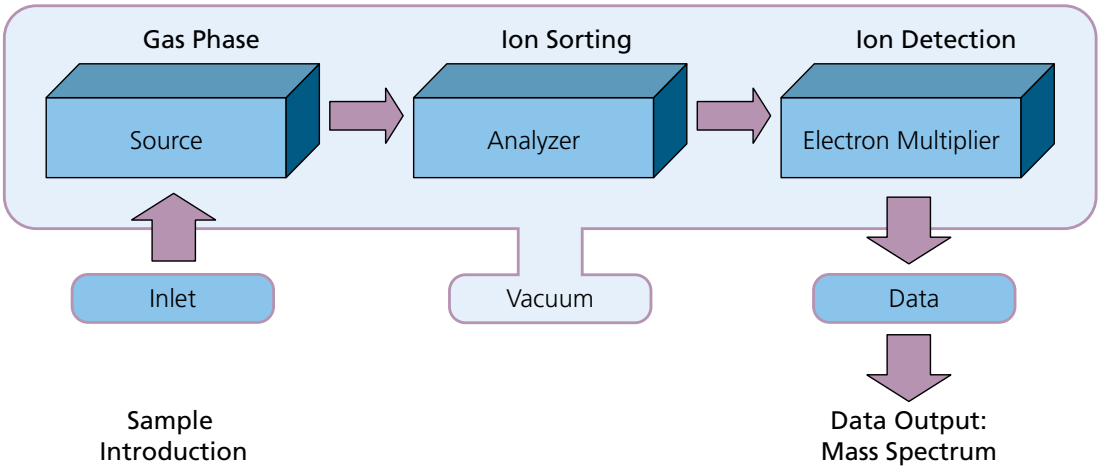


Figure 1. Components of Mass Spectrometry. The general layout of a mass spectrometer consists of the following elements; Sample introduction and separation system, Ion source, Mass analyzer, Ion detection system, Data processing.

Expert Tip :
Operate at the lowest voltage consistent with desired results.

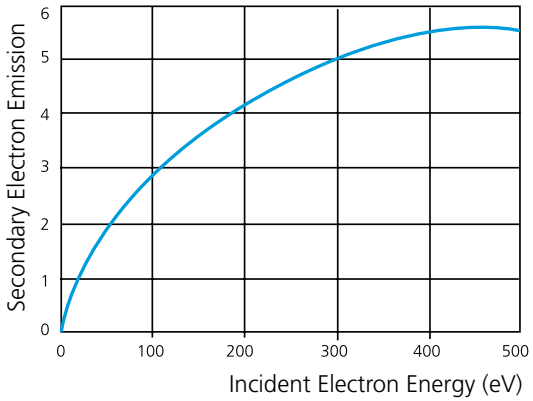


Figure 2. Secondary Electron Emission. The average number of secondary electrons emitted from the surface of an ETP electron multiplier plotted against the energy of the incident primary electron.

There are two basic forms of electron multipliers that are commonly used in mass spectrometry:

- The discrete-dynode electron multiplier.
- The continuous-dynode electron multiplier (often referred to as a channel electron multiplier or CEM).

All ETP electron multipliers are of the discrete-dynode type (*see Figure 3*).

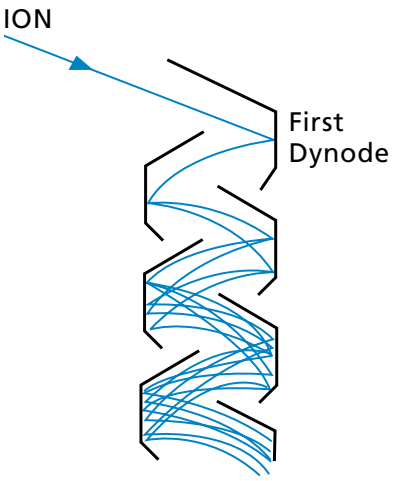


Figure 3. Ion-optics of an ETP discrete-dynode electron multiplier showing the electron gain at each successive dynode. This electron cascading process results in gains up to 10^8 being achieved with ~21 dynodes.

A typical discrete-dynode electron multiplier has between 12 and 24 dynode stages, and is used at an operating gain of between 10^4 and 10^8, depending on the application. In GC-MS applications, for example, the electron multiplier is typically operated in analog mode with a gain of around 10^5. For a new electron multiplier this gain is typically achieved with an applied high voltage of ~1400 volts.

Features

ETP Electron Multipliers manufactured by SGE use a proprietary dynode material. This material has a number of properties that make it very suitable for use in an electron multiplier. It has very high secondary electron emission, which allows exceptional gain to be achieved from each dynode. This material is also very stable in air. In fact, an ETP electron multiplier can be stored for years before being used. As a direct result of the high stability of the active materials used in ETP electron multiplier, they come with a 2 year shelf life warranty. Many testing laboratories take advantage of this long shelf life by keeping a replacement ETP electron multiplier on hand, ready for immediate installation. This keeps the instrument down time to a minimum.

For a typical ETP electron multiplier for GC-MS, the total active dynode surface area is ~1000 mm^2. This can be compared to a standard continuous-dynode multiplier that has a total channel surface area of only around 160 mm^2 (for a channel with 1mm diameter and 50 mm length). This increased surface area spreads out the "work-load" of the electron multiplication process over a larger area, effectively slowing the aging process and improving operating life and gain stability. These unique features lead directly to a range of benefits outlined below.

Benefits

- Optimized sensitivity for each mass spectrometer type.
- High dynamic range.
- Long operational lifetime.
- Two-year shelf life guarantee.

Expert Tip :
Do not apply power if multiplier has been contaminated by pump oil.

Part No. 14511

Expert Tip :
Store your multiplier in the original container when possible.

GC-MS

Instrument	Analyzer Type	Technique	Part No.
Agilent Technologies			
5970 (All)	Quadrupole	GC-MS	14511
5971, 5972, GCD	Quadrupole	GC-MS	14516
5973 (For initial installation - includes mount)	Quadrupole	GC-MS	14617
5973 (Replacement multiplier only)	Quadrupole	GC-MS	14616
JEOL			
K-9 (For initial installation-includes mount)	Quadrupole	GC-MS	14632
K-9 (Replacement multiplier only)	Quadrupole	GC-MS	14630
Shimadzu			
QP 5000	Quadrupole	GC-MS	14533
Varian			
Saturn 2000, 2100, 2200	Ion Trap	GC-MS	14147

LC-MS

Instrument	Analyzer Type	Technique	Part No.
AB Sciex			
API 2000	Quadrupole	LC-MS	14610
API 3200	Quadrupole	LC-MS	14610
3200 Q-TRAP	Quadrupole	LC-MS	14610

ICP-MS

Instrument	Analyzer Type	Technique	Part No.
Agilent Technologies			
4500	Quadrupole	ICP-MS	14573
7500	Quadrupole	ICP-MS	14222
GBC			
OptiMass	TOF	ICP-MS	14834H
PerkinElmer			
ELAN 9000, DRC	Quadrupole	ICP-MS	14217
ELAN 6000, 6100, 6100 DRC	Quadrupole	ICP-MS	14210
Thermo Scientific			
PQ (SXP rods)	Quadrupole	ICP-MS	14562A
PQ-3, Excel (Sequential)	Quadrupole	ICP-MS	14562A
PQ-3, Excel (Simultaneous)	Quadrupole	ICP-MS	14214
Varian			
UltraMass	Quadrupole	ICP-MS	14566

Part No. 14516

Part No. 14617

Part No. 14210

For your instrument specific leak-free SilTite™ ferrules refer to the Instrument Quick Pick Guide on pages 167-180.

Expert Tip :
Set power supply to lowest, or default, setting when installing a new multiplier.

SGE Analytical Science incorporating ETP electron multipliers

Copies of technical posters presented at scientific congresses can be downloaded at **sge.com/support/documents**

TOF-MS

Instrument	Analyzer Type	Technique	Part No.
Amersham			
Amersham Ettan	TOF	MALDI-TOF	14824
BioRad (Ciphergen)			
Protein Chip (2)	TOF	MALDI-TOF	14875
Comstock			
MiniTOF	TOF	TOF	14824
GBC			
OptiMass	TOF	ICP-MS	14834H
Kratos			
Kompact MALDI	TOF	MALDI-TOF	14820
Axima (Linear)	TOF	MALDI-TOF	14870
Axima (Linear-High Dynamic Range)	TOF	MALDI-TOF	14874
SENSAR/LARSON-DAVIS			
TOF 2000	TOF	TOF	14823H

Magnetic Sector

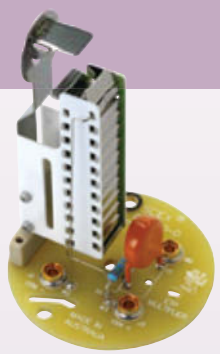
Instrument	Analyzer Type	Technique	Part No.
CAMECA			
3F, 4F	Magnetic Sector	SIMS	14133
5F, 6F	Magnetic Sector	SIMS	14133H
Nu Instruments			
Nu Plasma	Magnetic Sector	Isotope Ratio	14143
Nu Plasma with filter	Magnetic Sector	Isotope Ratio	14144
Thermo Scientific (Finnigan MAT)			
MAT 262	Magnetic Sector	Isotope Ratio	14150HM9

Expert Tip :
Ensure all connections have been properly made.

Part No. 14143

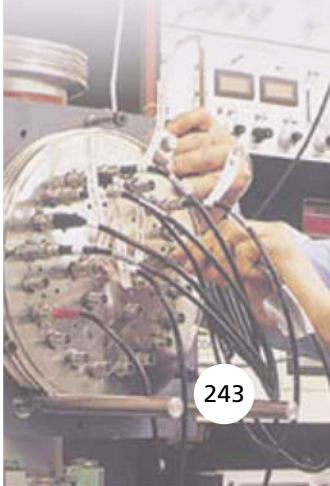
Part No. 14133H

Electron Multipliers | Selection by Instrument



Part No. 14610

Instrument	Analyzer Type	Technique	Part No.
AB Sciex			
API 2000	Quadrupole	LC-MS	14610
API 3200	Quadrupole	LC-MS	14610
3200 Q-TRAP	Quadrupole	LC-MS	14610
Agilent Technologies (HP)			
4500	Quadrupole	ICP-MS	14573
7500	Quadrupole	ICP-MS	14222
5970 (All)	Quadrupole	GC-MS	14511
5971, 5972, GCD	Quadrupole	GC-MS	14516
5973 (For initial installation - includes mount)	Quadrupole	GC-MS	14617
5973 (Replacement multiplier only)	Quadrupole	GC-MS	14616
Amersham			
Amersham Ettan	TOF	MALDI-TOF	14824
BioRad (Ciphergen)			
Protein Chip (2)	TOF	MALDI-TOF	14875
CAMECA			
3F, 4F	Mag Sector	SIMS	14133
5F, 6F	Mag Sector	SIMS	14133H
Comstock			
MiniTOF	TOF	TOF	14824



Expert Tip :
Handle only using powder-free gloves.

Part No. 14632

Electron Multipliers

Part No. 14147

Instrument	Analyzer Type	Technique	Part No.
GBC			
OptiMass	TOF	ICP-MS	14834H
JEOL			
K-9 (For initial installation-includes mount)	Quadrupole	GC-MS	14632
K-9 (Replacement multipler only)	Quadrupole	GC-MS	14630
KORE Technology			
MS 200	TOF	TOF	14824
Kratos			
Kompact MALDI	TOF	MALDI-TOF	14820
Axima (Linear)	TOF	MALDI-TOF	14870
Axima (Linear-High Dynamic Range)	TOF	MALDI-TOF	14874
Nu Instruments			
Nu Plasma	Mag Sector	Isotope Ratio	14143
Nu Plasma with filter, Nu AttoM	Mag Sector	Isotope Ratio	14144
PerkinElmer			
ELAN 9000, DRC	Quadrupole	ICP-MS	14217
ELAN 6000, 6100, 6100 DRC	Quadrupole	ICP-MS	14210
SENSAR/LARSON-DAVIS			
TOF 2000	TOF	TOF	14823H
Shimadzu			
QP 5000	Quadrupole	GC-MS	14533
Thermo Scientific (VG Elemental)			
PQ (SXP)	Quadrupole	ICP-MS	14562A
PQ-3, Excel (Sequential)	Quadrupole	ICP-MS	14562A
PQ-3, Excel (Simultaneous)	Quadrupole	ICP-MS	14214
MAT 262	Mag Sector	Isotope Ratio	14150HM9
Varian			
UltraMass	Quadrupole	ICP-MS	14566
Saturn 2000, 2100, 2200	Ion Trap	GC-MS	14147

Expert Tip :
Use only non-polar solvents for cleaning. See the care and handling booklet supplied with each electron multiplier for details.

For your instrument specific leak-free SilTite™ ferrules refer to the Instrument Quick Pick Guide on pages 167-180.