CREATIVE
DETECTOR
SOLUTIONS

KETEK

THE GOLD STANDARD
IN SILICON DRIFT DETECTORS

KETEK TIMELINE

1989

KETEK GMBH FOUNDED
by Dr. Josef Kemmer

1995

1ST GENERATION SDDS

PRODUCT LAUNCH AXAS
First X-ray acquistion system from KETEK

2002

NEW MANAGEMENT
Silvia Wallner and Dr. Reinhard Fojt

INTRODUCTION OF VITUS SDD

2005

AXAS-D
with digital pulse processor DPP1

2007

WORLD RECORD ENERGY RESOLUTION
achieved by KETEK's SDD: 120.9 eV for Mn K_α line

2008

ISO 9001:2000 CERTIFICATION

VITUS CUBE SDD SERIES
with an ultra-low capacitance ASIC replacing the classical FET

FIRST KETEK SILICON PHOTOMULTIPLIERS (SiPM) PRESENTED

VITUS SDD LANDS ON MARS
on board of Mars rover Curiosity

2010

VIAMP MODULE PRODUCT LAUNCH
VIAMP = VITUS SDD + pre-AMPlifier

2012

WORLD'S LARGEST CIRCULAR SDD
with 150 mm² collimated area

2013

DIGITAL PULSE PROCESSOR DPP2

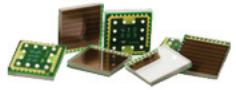
2015

2017

NEW MANAGEMENT
Dr. Jürgen Knobloch joins KETEK management

7-CHANNEL SDD ARRAY INTRODUCED
total collimated area of 560 mm²

SiPM WB-SERIES LAUNCHED
sets new standards in performance



2018

KETEK GRAPHENE WINDOW (CH) PATENTED

2019

SiPM TIA MODULE LAUNCHED
SiPM with transimpedance amplifier

VICO-DV 2.0
signal processing board with DPP2

AXAS 2.0

KETEK SiPM TECHNOLOGY TRANSFER TO BROADCOM

4TH MARS MISSION WITH KETEK SDDs
on board of Mars rover Perseverance

2020

NEW VITUS – CSA SDD SERIES
with KETEK's proprietary ASIC as Charge Sensitive Amplifier

2021

2022

KETEK LOW-ENERGY GRAPHENE WINDOW (CL)

2023

VICO-DV 3.0
with KETEK's proprietary digital pulse processor DPP3

VIAMP-KP 3.0
for vacuum applications

ARRAY 3.0
configurable multi-channel system

AXAS 3.0
incl. DPP3 with mapping mode

2024

NEW VITUS SLF
stray-line-free design

2025

PHILOSOPHY AND VALUES

With our detectors the world is getting to the bottom of materials – for engineers, scientists and other curious people.

At KETEK in Munich, Germany, an experienced team of highly motivated engineers, physicists and technicians is developing and manufacturing a unique product portfolio around the Silicon Drift Detector, starting from the bare silicon wafer to the detector chip and further to the highly complex detector module.

We are offering our customers, located everywhere in the world, tailored solutions for their analytical devices and applications, including our in-house-developed analog and digital signal processing electronics. As a 100 % independent family enterprise, KETEK has very close relationships with local universities to maintain its innovative strength. With its high degree of production automation we are a powerful and reliable OEM supplier for our industrial customers.

MANAGEMENT

SILVIA WALLNER
Managing Director

„Not everything important is measurable, and not everything measurable is important."

Albert Einstein (1879 – 1955)

DR. REINHARD FOJT
Managing Director

„The one thing that matters is the effort."
Antoine de Saint-Exupéry (1900 – 1944)

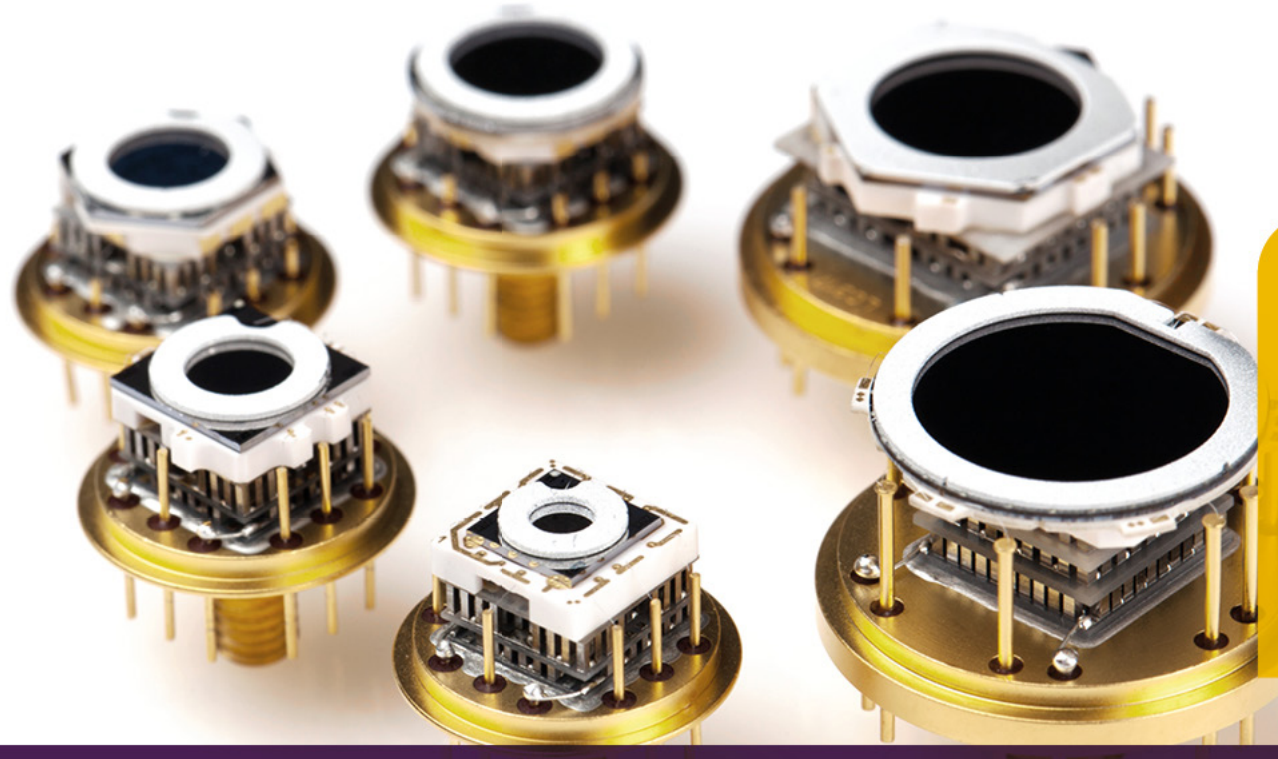
DR. JÜRGEN KNOBLOCH
Managing Director

„What you want to ignite in others must first burn inside yourself."

Aurelius Augustinus (354 – 430)

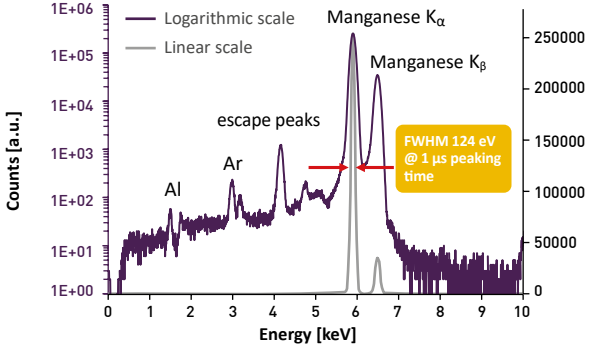
VITUS SDD MODULES

KETEK's VITUS Silicon Drift Detectors (SDD) are the state-of-the-art X-ray detectors for the energy range between 0.05 keV and 30 keV. They are used in applications such as EDS, XRF, µXRF, and TXRF in bench top spectrometers, as well as in handheld systems. Due to their wide operating temperature range, their excellent energy resolution, and high reliability they are particularly suited for industrial applications.

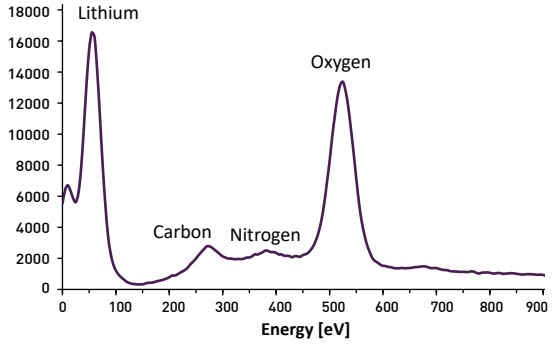


UNPRECEDENTED LOW-ENERGY PERFORMANCE **DOWN TO Li @ 53 eV**

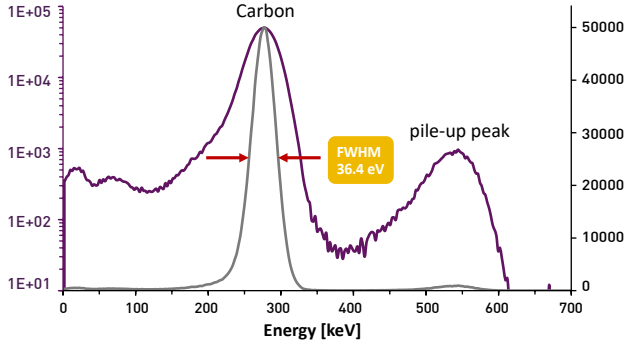
Energy resolution FWHM down to 124 eV for Mn K_α at 1 µs peaking time and -35 °C chip temperature for a VITUS H50



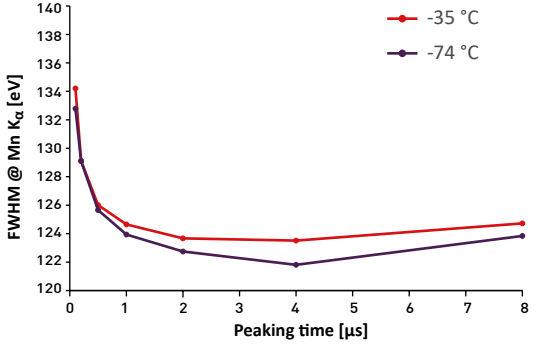
Low-energy spectrum acquired with VITUS SDD showing the Lithium and Oxygen K_α lines



Outstanding performance at low energies: FWHM of 36.4 eV for Carbon K_α line



Excellent energy resolution FWHM even at short peaking times for a wide temperature range

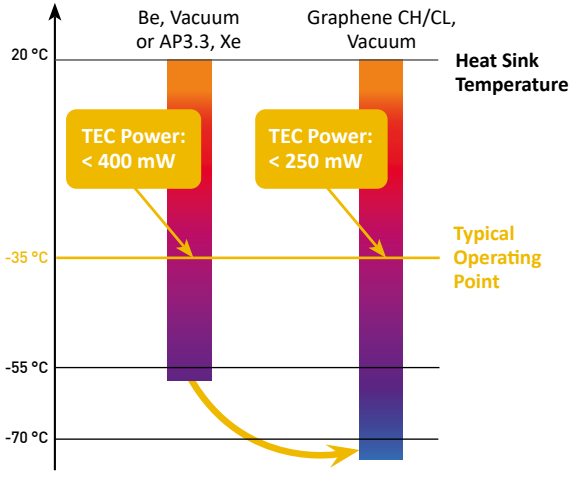


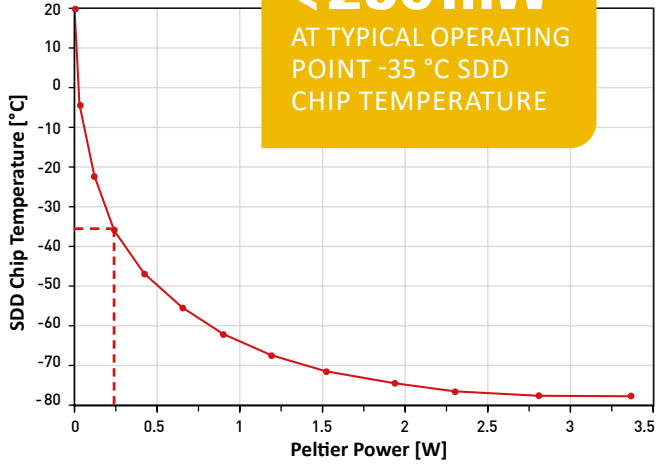
VITUS SDD INNOVATION

KETEK's R&D team constantly works on improving VITUS SDDs. The latest generation 3.0 combines exceptional cooling performance, KETEK's patented graphene windows and KETEK's proprietary charge sensitive amplification stage (CSA).

The new detector generation offers a significantly lower power consumption, a better photon transmission, an improved energy resolution at short and longer peaking times as well as a higher radiation hardness.

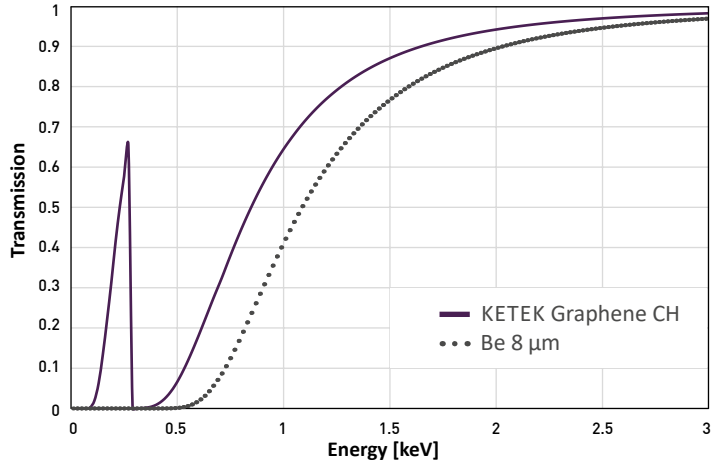
- New KETEK CSA improves the energy resolution at all peaking times
- ΔT from 90 K to 130 K depending on heat sink temperature
- Power consumption as low as 100 mW possible at 20 °C heat sink and -20 °C chip temperature
- Superior radiation hardness up to a total dose of 10^{13} incoming low energy photons





POWER CONSUMPTION
< 250 mW
AT TYPICAL OPERATING POINT -35 °C SDD CHIP TEMPERATURE

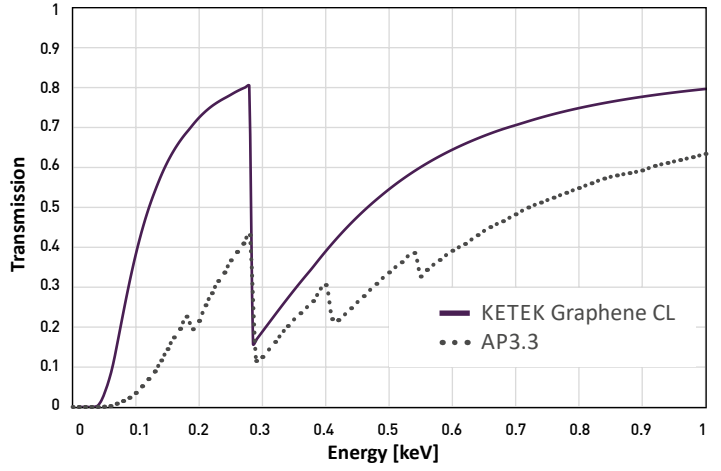
CH



TWO DIFFERENT GRAPHENE WINDOW TYPES

- CH window with 1000 nm Carbon without support grid (replacing 8 µm Beryllium)
- CL low-energy window with 165 nm Carbon, Si support grid (86 % open area) and 100° acceptance angle (typical Polymer window: 53°)
- SDDs with both window types are vacuum encapsulated and ultra-stable for many years of operation
- No fluorescence lines (pure Carbon window)

CL



VITUS SLF

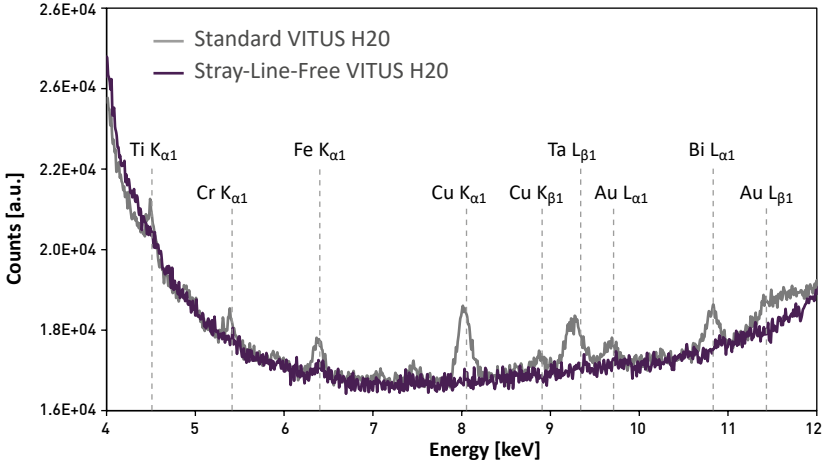
H20 SLF
STRAY-LINE-FREE SDD

The new VITUS H20 Stray-Line-Free (SLF) SDD was developed by KETEK to eliminate nearly all unwanted X-ray excitation from the SDD module components. The result is an extremely clean spectrum enabling highly precise measurements of very low element concentrations.

COMPARED TO THE STANDARD VITUS SDD
MOST STRAY LINES ARE COMPLETELY ELIMINATED

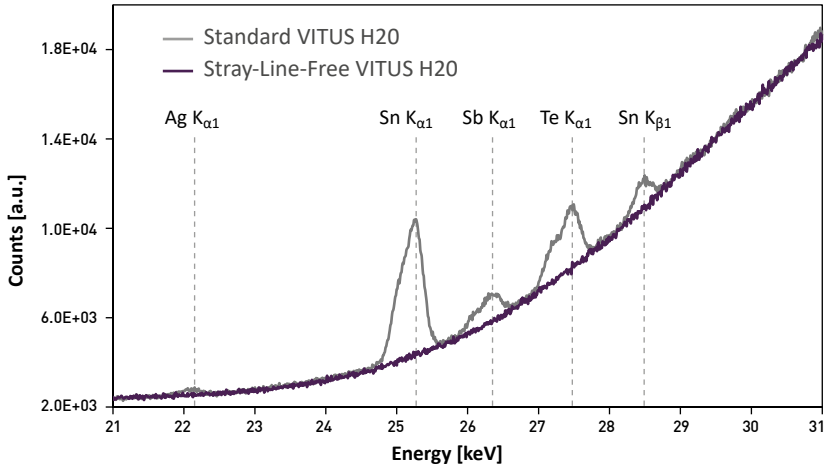
- Elimination of nearly all unwanted X-ray fluorescence (stray lines) from internal SDD components
- Enables extremely low detection limits in the ppb regime
- Significantly improved analysis of low-concentration samples, for example Ni, Cu, Ag, Au, Sn, Sb, Pb, Rh, Cd and Bi
- Superior radiation hardness for 24/7 operation
- Both Graphene window types (CH and CL) available

OPERATION UNDER HELIUM POSSIBLE

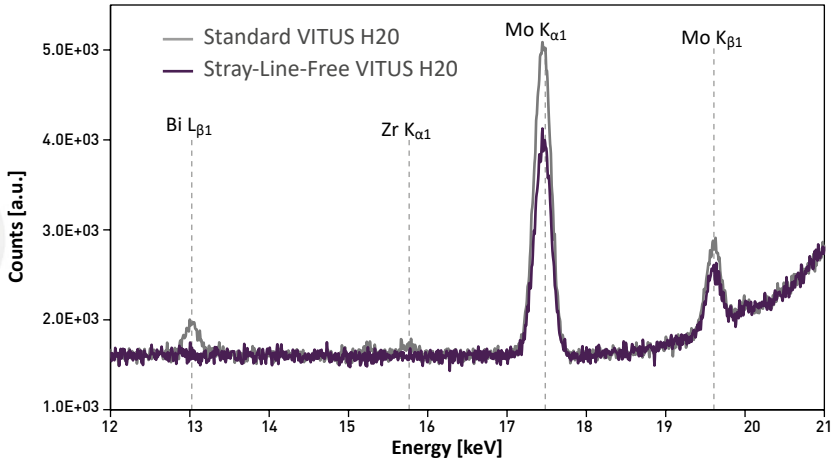


SUPER CLEAN SPECTRUM

FWHM DOWN TO 122 eV



PPB DETECTION LIMITS



PRODUCT PORTFOLIO

VITUS

VALID FOR ALL SDDS

Amplification stage:	**ASIC**
Guaranteed P/B:	**> 15000**
Guaranteed P/T:	**> 2000**
Typ. ICR @ 50 % DT:	**> 1 Mcps**
On-chip collimator:	**Multilayer**
Cooling performance: (max. ΔT @ 20 °C heat sink)	**> 95 K**

LARGE COLLIMATED AREA

COMPACT HOUSING

	H7	H20 / H20 SLF*	H30
Collimated area [mm²]	7	20	28
Active area [mm²]	13	30	41
Absorption depth Si [µm]	450	450	450
Window	CH, CL	CH, CL	CH, CL
Guaranteed FWHM Mn K_α @ 5.9 keV [eV]	≤ 129	≤ 129	≤ 129

*Stray-line-free design

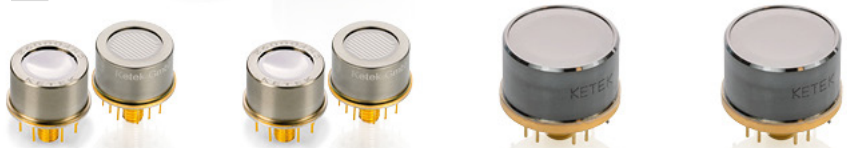
PRODUCT PORTFOLIO

VITUS

KETEK'S UNIQUE GRAPHENE WINDOW

VERY LARGE SOLID ANGLE

SENSITIVE DOWN TO BORON Kα at 185 eV

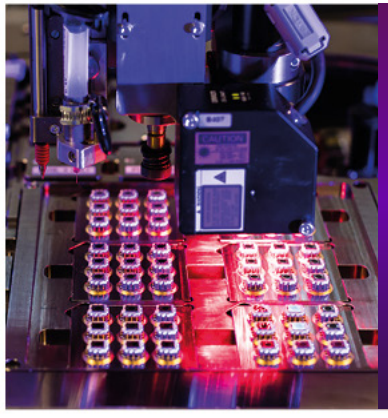


	H50	K50	H80	H150
Collimated area [mm²]	47	47	80	143
Active area [mm²]	65	65	100	170
Absorption depth Si [µm]	450	**550** (+22 %)	450	450
Window	CH, CL	CH, CL	25 µm Be	25 µm Be
Guaranteed FWHM Mn K_α @ 5.9 keV [eV]	≤ 129	≤ 129	≤ 136	≤ 136

SDD PRODUCTION

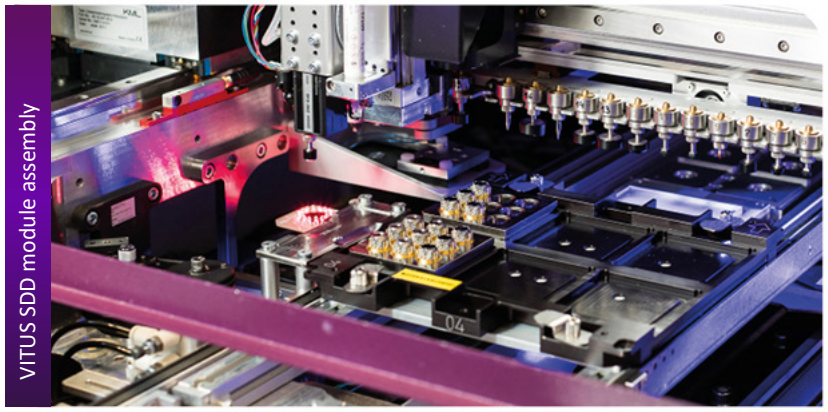
VITUS SDD modules and the corresponding electronics are produced by KETEK in our modern production facilities in Munich, Germany. A reliable volume fabrication with a high degree of automation and maximum yield are essential to deliver quality products to our customers on-time. KETEK's value chain comprises all steps from the bare silicon wafer to the fully encapsulated detector module as well as complete signal processing electronics.

Clean room



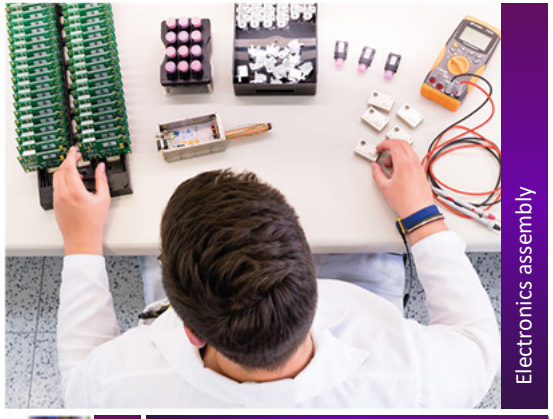
Parallel processing for high volumes

Semiconductor chip production



VITUS SDD module assembly

MANUFACTURED IN MUNICH



Electronics assembly

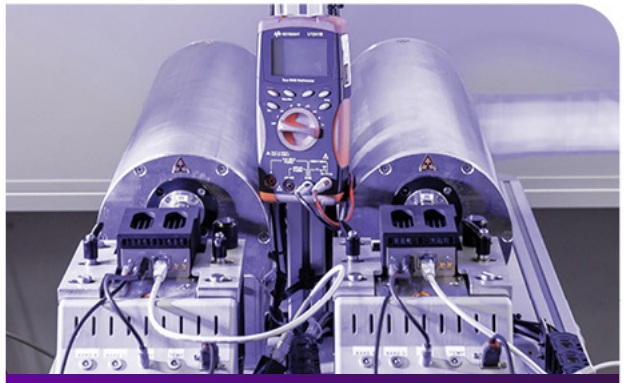
Vacuum encapsulation

Fully automated module production

SDD TESTING

All KETEK products have to pass several quality gates during production to ensure a high yield and excellent quality. Most of the automated test equipment is designed by KETEK's test system development team.

Test of leak-tight encapsulation

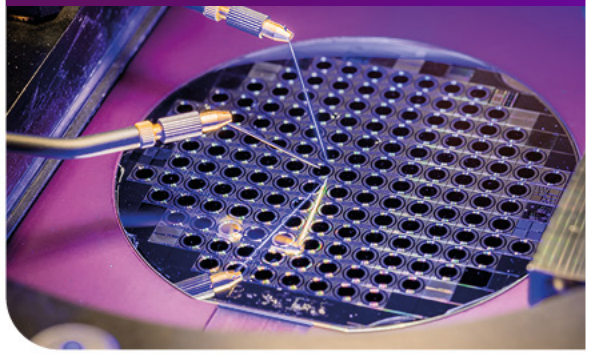


Spectroscopic test of complete systems

OPTICAL INSPECTIONS & WAFER LEVEL MEASUREMENTS

The first quality gate – after semiconductor chip production – includes optical inspections and electrical measurements. Therefore after dicing only good dies will be passed on to module production.

First quality gate on die level



TEST OF OPEN SDD MODULES

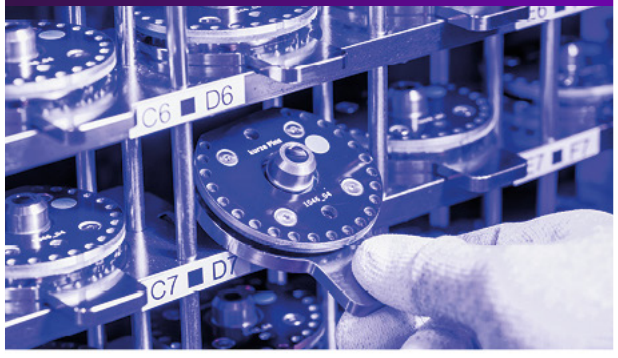
After assembly, still before encapsulation, 100 % of the modules are comprehensively tested and spectroscopically characterized for the first time. This is essential for a high yield, but also necessary because some of our modules are used windowless, e.g. in electron microscopes.

Spectroscopic test before encapsulation

VACUUM ENCAPSULATION

The next production step is the vacuum encapsulation of the modules, followed by two further quality gates: ensuring the hermetically sealing and the final spectroscopic test. The SDDs are now ready for shipment or they are passed on to our electronics production for further assembly.

Spectroscopic characterization after encapsulation



SPECTROSCOPIC TESTING

The final test for our electronics systems, like the VIAMP or the AXAS, is another spectroscopic characterization including measurements with different parameter settings. For customized solutions we measure against agreed specifications and share the acquried data.

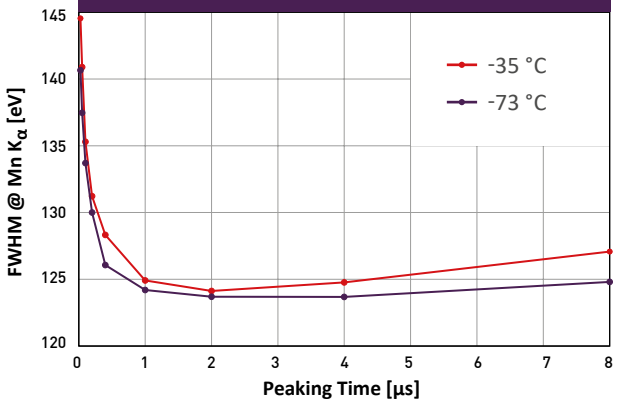
Fully automated final testing

SDD ELECTRONICS

KETEK develops and manufactures electronics engineered particularly for operating VITUS SDDs. The portfolio ranges from single components, such as preamplifiers, to complete systems, which further include all power supplies and the digital pulse processor. In combination with our tailored electronics solutions we ensure unprecedented performance with regards to FWHM and peak-to-background at ultra-short peaking times down to 25 ns as well as input count rates up to 4 Mcps at dead times < 60 %.

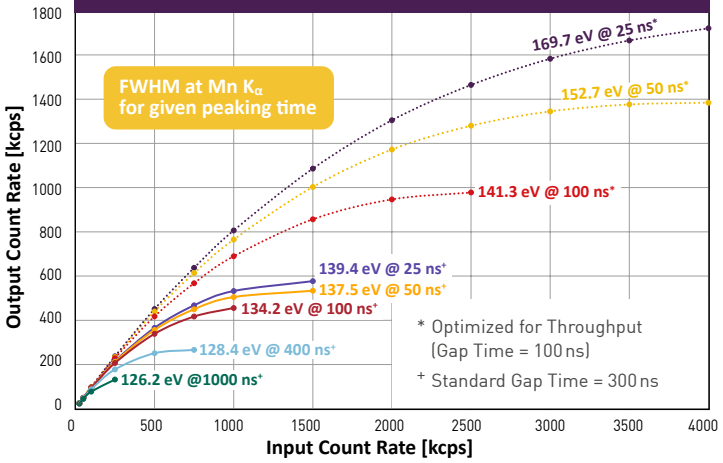
TAILORED STANDARD COMPONENTS
FOR OUTSTANDING PERFORMANCE

Energy resolution at various peaking times down to 25 ns acquired with an AXAS-D 3.0



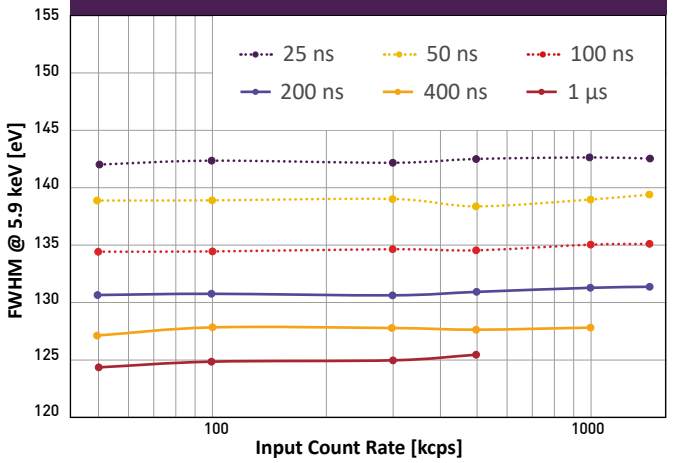
MODULAR DESIGN

Throughput with KETEK signal processing electronics at various peaking times and dead time < 60 %



The energy resolution of a system with KETEK's DPP3 is largely independent from the input count rate, no matter which peaking time is chosen. This is essential for stable performance of a spectroscopic system.

Energy resolution versus input count rate acquired with KETEK DPP3

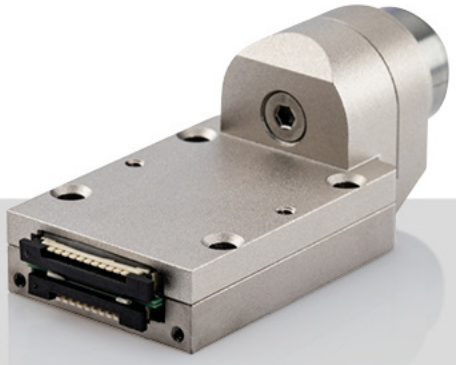


ULTRA-SHORT PEAKING TIMES DOWN TO 25 ns

VIAMP KC 3.0

SDD ELECTRONICS

The VIAMP-KC 3.0 module combines a low noise preamplifier and a VITUS SDD, matching all sizes from H7 to H50/K50. The Aluminium housing is functioning as an appropriate heat sink.



- Ultra-low noise preamplifier module VIAMP-KC 3.0
- Optimized for operation with VICO-DV 3.0 including KETEK's DPP3
- Ramped output, positive polarity
- Available with all Graphene window based VITUS SDDs
- Typical energy resolution for Mn K_α line: FWHM 125.5 eV @ 1 µs peaking time and -35 °C SDD chip temperature

ULTRA-LOW NOISE PREAMPLIFIER

SDD ELECTRONICS

VIAMP KP 3.0

ULTRA-COMPACT HOUSING DIMENSIONS

VIAMP-KP FOR **VACUUM** APPLICATIONS

OPTIMIZED HEAT SINK CONNECTION

- New VIAMP-KP 3.0 preamplifier module for vacuum applications
- Optimized for operation with VICO-DV 3.0 including KETEK's DPP3
- Ultra-compact housing dimensions: 51 × 25 × 32 mm³ (body only)
- 50 mm stainless steel finger with an optimized heat sink connection
- Designed for VITUS modules from H7 to H50/K50
- Both Graphene window types available (CH/CL)

BOTH GRAPHENE WINDOW TYPES AVAILABLE

VIAMP KL 3.0

SDD ELECTRONICS

The VIAMP-KL 3.0 combines a ultra-low noise preamplifier of the latest generation 3.0 with a housing for large active area VITUS modules H80 and H150. Like all VIAMP modules, the VIAMP-KL 3.0 also provides all necessary SDD bias voltages and the Aluminum housing serves as a sufficient heat sink.

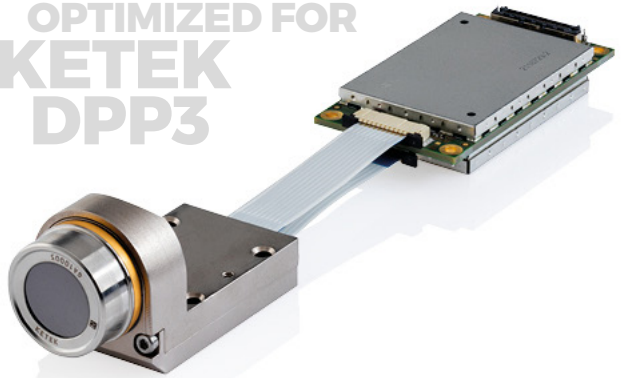
- Designed for SDDs with large active area (≥ 80 mm² collimated area)
- Electrical interface fully compatible to the VIAMP-KC 3.0
- Available with Be window
- Flex lead connection lengths from 50 mm to 200 mm
- Guaranteed energy resolution for Mn K_α line: FWHM ≤ 136 eV @ 1 µs peaking time and -45 °C SDD chip temperature
- Optimized for operation with VICO-DV 3.0

FOR LARGE AREA SDDS

SDD ELECTRONICS

VIAMP CPC

OPTIMIZED FOR KETEK DPP3



The VITUS-CPC is KETEK's new detector class replacing classical gas filled proportional counters. Compared to this old technology the new VITUS-CPC offers a significantly improved energy resolution, much higher countrate capability and a long product lifetime with stable operation. No need to exchange the detector on a regular basis as in case of gas filled proportional counters.

- Based on SDD technology
- 100 mm² active area
- FWHM ≤ 450 eV for Mn K_α @ 4 µs peaking time and -5 °C chip temperature
- 25 µm graphite window
- Low noise preamplifier in VIAMP-KL 3.0 housing
- Fully compatible with VICO-DV 3.0

VITUS-CPC
REPLACING PROPORTIONAL COUNTERS

SOLID STATE DETECTOR: STABLE OPERATION FOR MANY YEARS

VICO DV 3.0

SDD ELECTRONICS

The 3rd generation of the VICO-DV/-AV electronics board with (DV) or without (AV) digital pulse processor DPP3 is optimized for KETEK VIAMPs with the latest preamplifier generation. It contains the complete electronics for VIAMP modules, including all supplies for the SDD, temperature controlling and interfaces.

- KETEK's in-house developed DPP3 allows
  → Peaking times down to 25 ns
  → High count rate capability of up to 4 Mcps
- Ultra-small dimensions: 60 × 32 × 11 mm³
- Ethernet, USB and SPI interface
- Preconfigured for operation with KETEK's VIAMP family

- Comprehensive programming library (VICOLib), acquisition software (VICOScope) and update tool (VICOUpdate) available for Windows and Linux
- Firmware updates accessible

SOFTWARE VICOSCOPE

VICO SCOPE

The VICOScope software for Windows and Linux helps to get started easily.
It allows to change most of the KETEK DPP3 parameters, the SDD chip temperature and to acquire & display spectra. Comprehensive hardware diagnostic information is available.

- Easy installation
- Configuration of KETEK DPP3 parameters
- Spectrum acquisition and run statistics
- Automated measurement series
- Oscilloscope mode for analysis of digitalized raw signal
- Context-related help function for all DPP parameters

AXAS 3.0

SDD COMPLETE SYSTEM

ETHERNET AND USB TYPE-C INTERFACES

AXAS 3.0

MAPPING MODE FOR SCANNING APPLICATIONS

Original size

The AXAS-D 3.0 is a complete spectroscopic system for VITUS SDDs in a very compact housing. It includes all power supplies, the latest generation preamplifier, a high precision temperature controller and KETEK's proprietary digital pulse processor DPP3.
The AXAS 3.0 is available with all sizes of VITUS SDDs from H7 to H50/K50 and different lengths of the vacuum tight finger. Also the analog version AXAS-A 3.0 is available.

OUR FLAGSHIP:
KETEK'S COMPLETE KNOW-HOW
IN ONE SYSTEM

HIGH COUNT RATE CAPABILITY OF UP TO 4 MCPS

- KETEK's new high-performance digital pulse processor DPP3 with peaking times down to 25 ns
- Typical FWHM 125.5 eV @ 1 µs peaking time and -35 °C chip temp. for Mn K_α line
- Latest generation 3.0 preamplifier technology
- Available for H7 to H50/K50 SDDs with CH or CL window
- Ethernet and USB 2.0 Type-C interface
- Single supply voltage: +12 VDC / typ. 250 mA
- Acquisition software (VICOScope) and firmware update tool (VICOUpdate)
- DLLs for Windows and libraries for LINUX (VICOLib), ARM based machines supported
- CE certified according to EN 61326-1, EN 61000-4 & EN 55011

CE

EN 61326-1
EN 61000-4
EN 55011

FULLY VACUUM COMPATIBLE

ARRAY 3.0

SDD MULTI-CHANNEL

Complete XRF multi-channel system with 3 to 7 Silicon Drift Detector channels with integrated cooling and power supply unit. Each channel consists of a vacuum-tight SDD module, ultra-low noise preamplifier and a digital pulse processor board (analog version available).

- KETEK VITUS H7 to H50/K50 SDD modules (vacuum encapsulated)
- Both Graphene window types available
- Up to 350 mm² active collimated area
- Guaranteed for all channels: FWHM ≤ 133 eV @ 1 µs peaking time for Mn K_α line
- Optimized for high input count rates up to 1 Mcps per channel and short peaking times down to 0.1 µs
- X-ray detection energy range from 0.1 keV to > 30 keV
- Integrated vacuum flange
- No additional chiller, no vacuum pump, no ion getter pump necessary
  → system can be switched off without loss of vacuum
- Air cooled system, no heat pipe used
  → system can be mounted in any direction
- Exchange of individual SDD channels possible

ARRAY 3.0

FINGER LENGTHS
200 mm TO 600 mm

3, 4, 5 OR 7
CHANNELS
WITH H7 TO H50

FULLY
VACUUM
COMPATIBLE

INDIVIDUAL
CHANNEL READOUT

ANALOG AND
DIGITAL
SYSTEM AVAILABLE

COMMON INPUT
FOR EXTERNAL
RESET

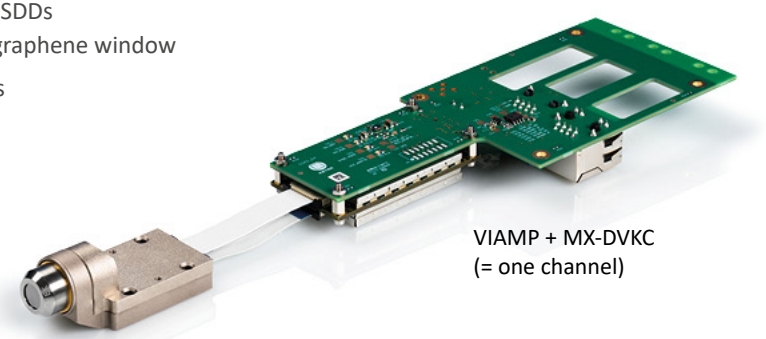
MX-SORT 3.0

MULTI-CHANNEL XRF SYSTEM FOR MATERIAL SORTING

- Designed for fast XRF material sorting in mining and recycling applications
- Acquire full spectra from all channels in typ. < 5 ms dwell time
- High throughput based on KETEK's DPP3
- Combine up to 10 XRF channels with one MX-CONTROL
- Multiple controllers support applications with more than 100 channels
- Synchronization between channels
- Internal or external trigger
- Easy communication via Ethernet
- Fully configurable via API
- All benefits from KETEKs latest VITUS SDDs like improved energy resolution and graphene window
- High mechanical stability with regards to shock and vibration (>> 50 g)
- Tested EMC compliance according to EN 61326-1, EN 61000-4 & EN 55011

FOR MINING AND RECYCLING

PROVEN RELIABILITY
IN HARSH ENVIRONMENTS

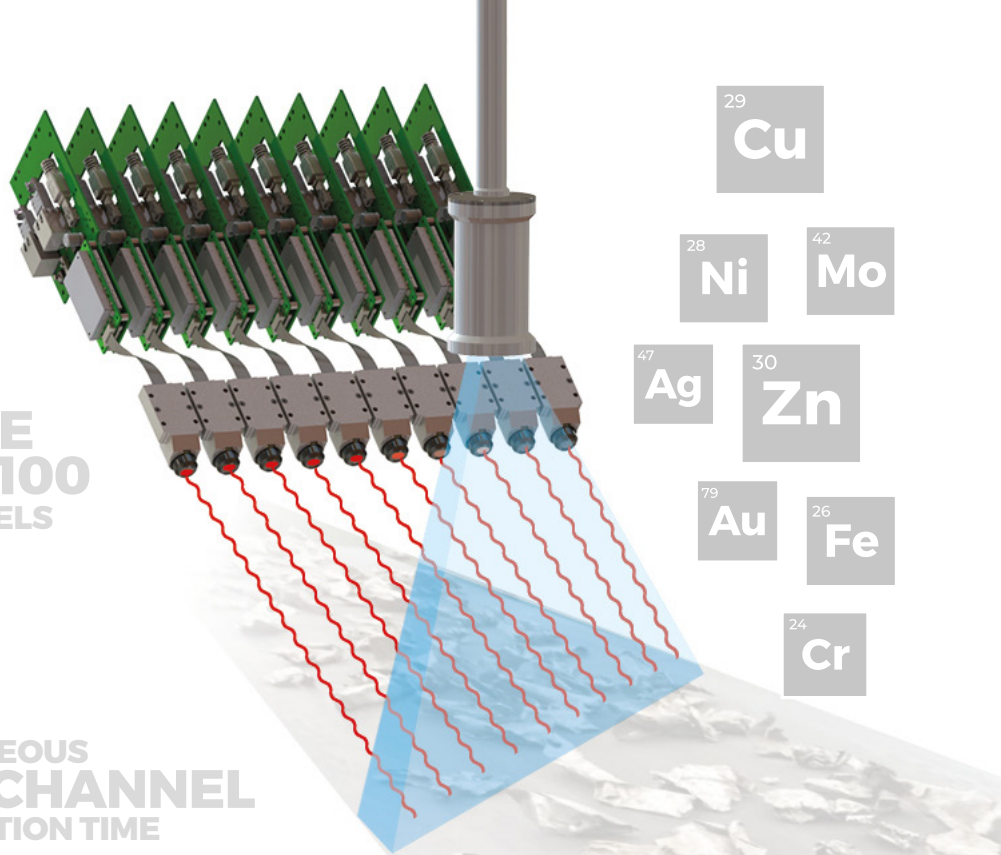


VIAMP + MX-DVKC
(= one channel)

MX-CONTROL

MORE THAN 100 CHANNELS

SIMULTANEOUS MULTI-CHANNEL ACQUISITION TIME < 5 ms



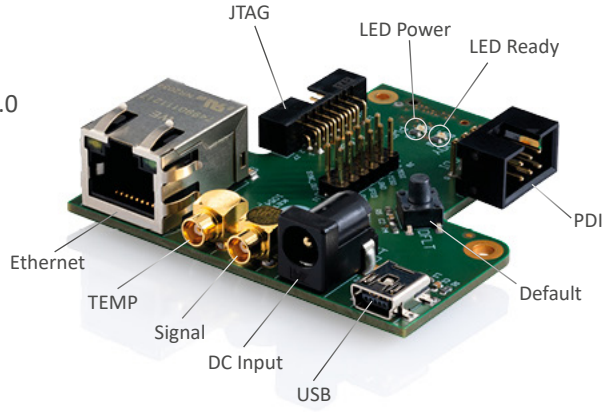
29 Cu
28 Ni
42 Mo
47 Ag
30 Zn
79 Au
26 Fe
24 Cr

VICO AXAS

ELECTRONICS ACCESSORIES

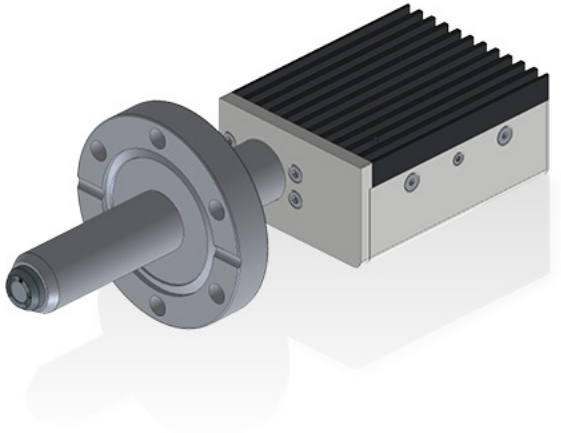
VICO ADAPTER

For a quick and easy setup of the VICO-DV/-AV 3.0 KETEK offers a breakout board with various connectors. This helps to quickly get the VICO-DV/-AV 3.0 up and running before designing your own breakout board or starting with the integration into your system.



VACUUM FLANGES

For the AXAS 3.0 customized welded vacuum flanges (e.g. CF) including test certificate are available upon request to perfectly support your vacuum application.



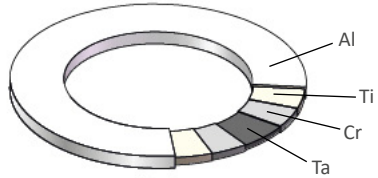
SDD ACCESSORIES

SDD

VMLCOL EXTERNAL COLLIMATOR

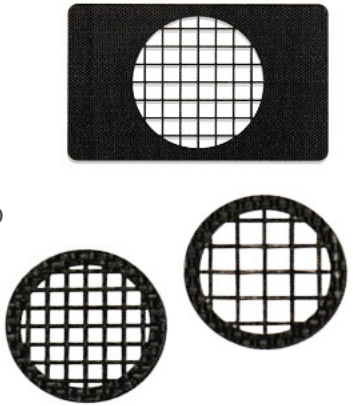
The clip-on multilayer collimators perfectly fit on the cap of VITUS modules from H7 to H50/K50. Different collimator apertures are available. The VMLCOL prevents the X-ray excitation of the SDD's cap material.

- No stray lines from SDD cap
- Improved P/B and P/T
- Additional protection for the VITUS entrance window



VCGRID CARBON PROTECTION GRID

The pure carbon grid can be mounted within an instrument in front of the SDD in order to protect its window from mechanical impact. Customized designs are available on request.



- Open area > 75 % typ.
- Thickness < 0.58 mm
- Withstands a static stress up to 50 N
- No fluorescence lines from grid material
- Customized shapes available on request

APPLICATIONS

XRF BENCHTOP

- MATERIAL SCIENCE AND R&D
- ROHS, REACH & ELV COMPLIANCE TESTING
- QUALITY CONTROL
- PRECIOUS METALS
- FORENSIC AND COUNTERFEIT DETECTION

XRF HANDHELD

- METAL ALLOY IDENTIFICATION
- MINING AND GEOCHEMICAL EXPLORATION
- ENVIROMENTAL TESTING
- SCRAP SORTING AND RECYCLING

µXRF

- METALL COATING ANALYSIS
- ELECTRONICS AND SEMICONDUCTOR INSPECTION
- GEOLOGY AND MINERALOGY
- MATERIAL SCIENCE

EDX / SEM

- NANOMATERIALS AND THIN FILMS
- SEMICONDUCTOR AND MEMS ANALYSIS
- FORENSIC SCIENCE AND TRACE EVIDENCE
- LIFE SCIENCE AND BIOMATERIALS

SORTING & RECYCLING

- NON-FERROUS METAL SORTING
- ORE ANALYSIS
- ELECTRONICS RECYCLING
- BATTERY AND E-MOBILITY RECYCLING
- CONSTRUCTION AND DEMOLITION WASTE

METROLOGY

- COATING AND SURFACE TECHNOLOGY
- AUTOMOTIVE AND AEROSPACE COMPONENTS
- MATERIAL CERTIFICATION AND QUALITY ASSURANCE

KETEK LANDS ON MARS

KETEK's Silicon Drift Detectors have arrived on Mars with several space missions:

- Spirit 2004 - 2011
- Opportunity 2004 - 2018
- Curiosity operating since 2012
- Perseverance operating since 2021

MARS 2020
PERSEVERANCE

- Two KETEK H50 SDD modules are installed in the NASA PIXL experiment on board of the Mars Rover
- VITUS SDDs have been fully qualified for space mission by NASA/JPL

QUALITY IN FOCUS

FULL COMMITMENT TO QUALITY

"Highest quality is the basis of all activities at KETEK and every single employee contributes to this every day."

CLOSE COOPERATION WITH KEY CUSTOMERS

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EN 61326-1
EN 61000-4
EN 55011

KETEK