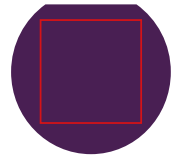
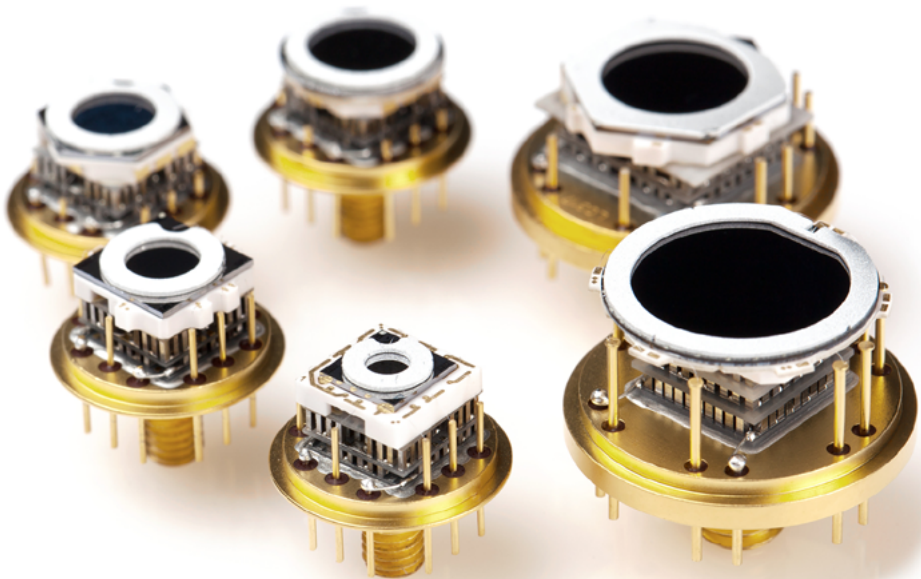


CREATIVE
DETECTOR
SOLUTIONS



KETEK



**THE GOLD STANDARD IN
SILICON DRIFT DETECTORS**

KETEK GMBH FOUNDED

by Dr. Josef Kemmer

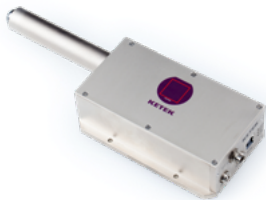


1989 1995

1980s 1990s

1ST GENERATION SDDS

First electronics product with the KETEK Analytical X-ray Acquisition System (AXAS)



AXAS PRODUCT LAUNCH

AXAS

NEW MANAGEMENT
Dr. Reinhard Fojt and Silvia Wallner

INTRODUCTION OF VITUS SDD

2002 2005 2007 2008

AXAS-D PRODUCT LAUNCH

AXAS with digital pulse processor (DPP)



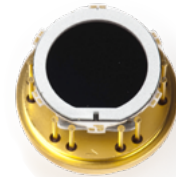
VIAMP MODULE PRODUCT LAUNCH

VIAMP = VITUS SDD + pre-AMPLifier



QUALIFIED BY TÜV MANAGEMENT SERVICES
according to ISO 9001:2000

2010 2012 2013



WORLD'S LARGEST CIRCULAR SDD
with 150 mm² collimated area

NEW DIGITAL PULSE PROCESSOR (DPP2)

NEW VITUS CUBE SDD SERIES
An ultra-low-capacitance ASIC replaces the classical FET

VITUS SDD LANDS ON MARS
on board Mars rover Curiosity

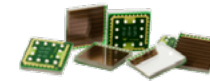
FIRST SiPM DETECTORS PRESENTED

NEW MANAGEMENT
Dr. Jürgen Knobloch joins KETEK management

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

TÜV CERTIFICATION
according to ISO 9001:2015

SiPM WB-SERIES LAUNCHED
sets new standards in performance, mass volume production and cost effectiveness



NEXT GENERATION VITUS SDD
with improved cooling and KETEK's patented graphene window



ELECTRONICS GENERATION 2.0 VICO-DV 2.0 & AXAS 2.0
with improved technology and small dimensions



SiPM TIA MODULE LAUNCHED
SiPM with transimpedance amplifier (TIA) and bias supply



CSA
Introduction of KETEK's first in-house developed charge sensitive amplifier for SDD

4TH MARS MISSION FOR KETEK SDDS
on board Mars rover Perseverance



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.“

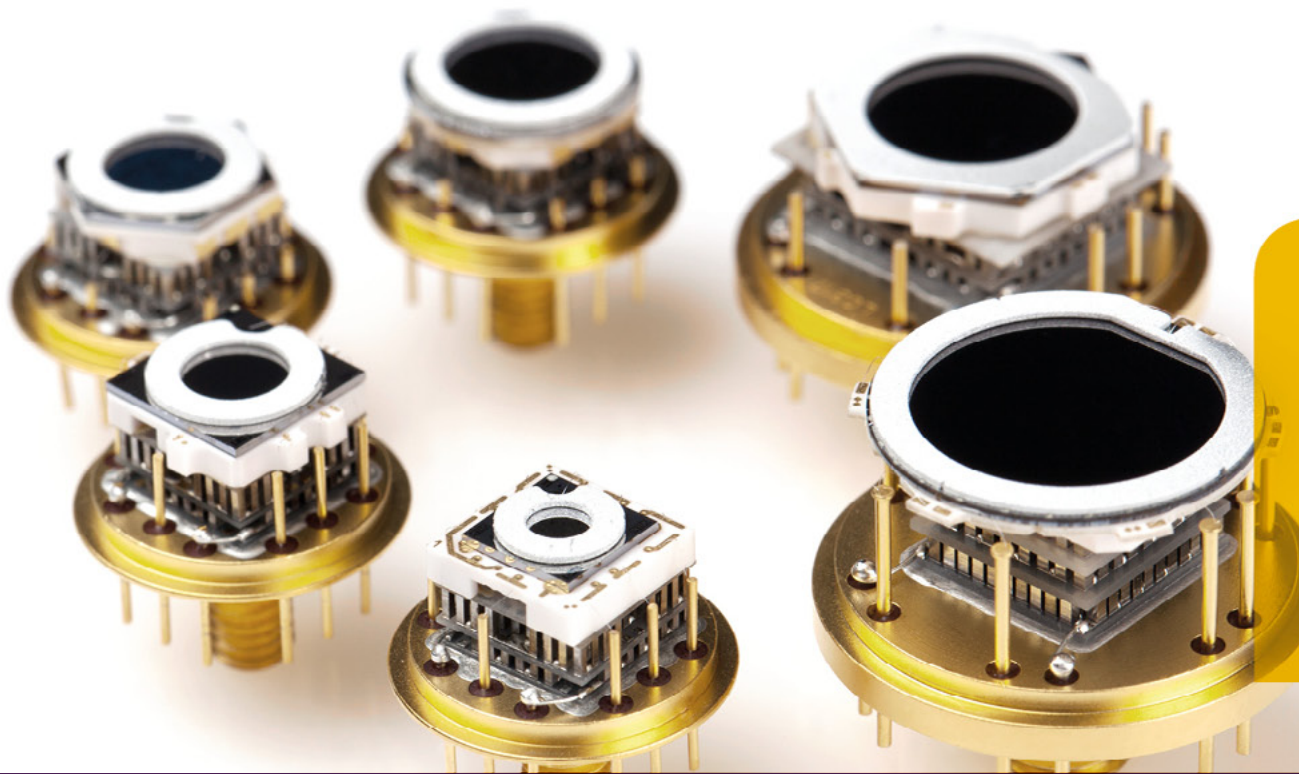
Aurelius Augustinus (354 – 430)



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, μ XRF, 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.



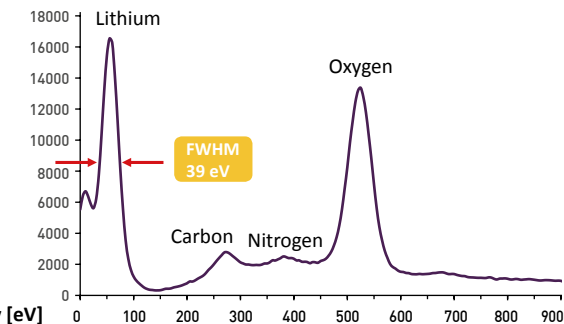
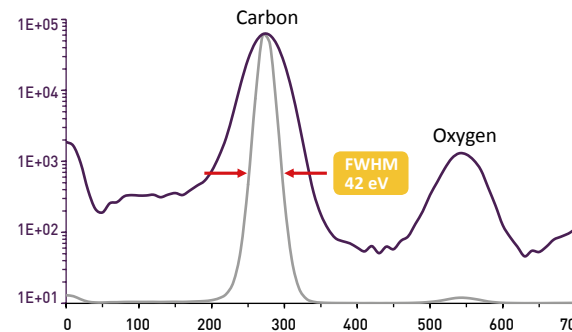
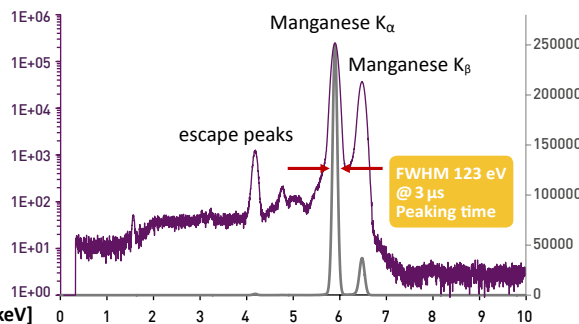
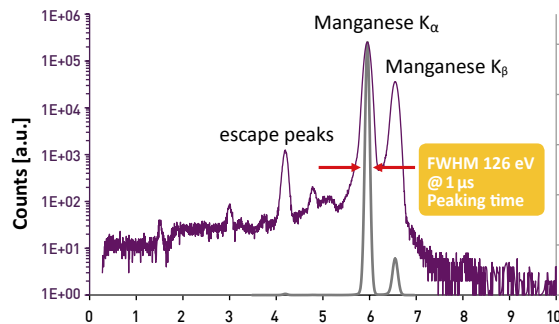
UNPRECEDENTED
LOW-ENERGY
PERFORMANCE
DOWN TO
Li @ 53 eV

Energy resolution FWHM down to 126 eV for Mn K_{α} at 1 μ s peaking time even for H150

Energy resolution FWHM down to 123 eV for Mn K_{α} at 3 μ s peaking time

Excellent performance at low energies: FWHM of 42 eV for Carbon K_{α} line

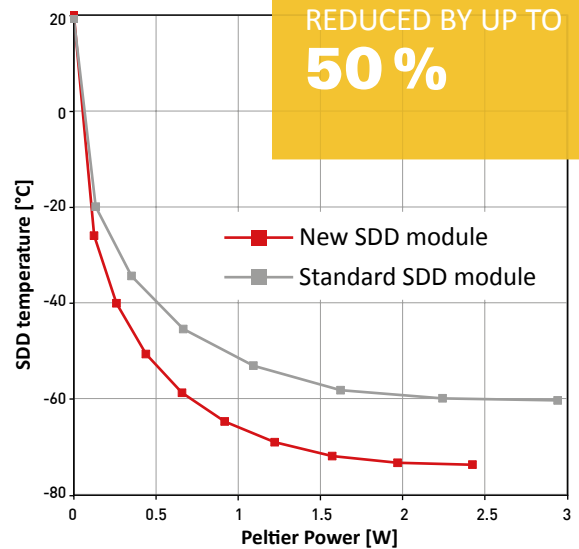
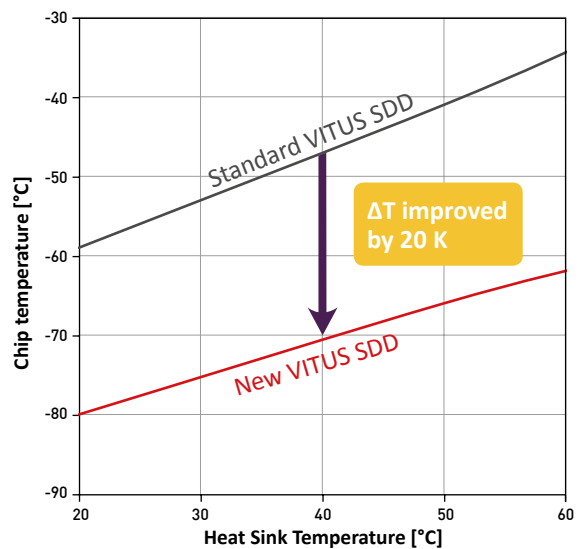
Low-energy spectrum acquired with VITUS SDD showing the Lithium and Oxygen K_{α} lines



VITUS SDD INNOVATION

KETEK's R&D team constantly works on improving the VITUS SDD. The latest generation combines two recent developments: improved cooling performance and KETEK's patented graphene window. These modules have a significantly lower power consumption and an improved long-term stability, but also a better photon transmission compared to the previously used Beryllium window.

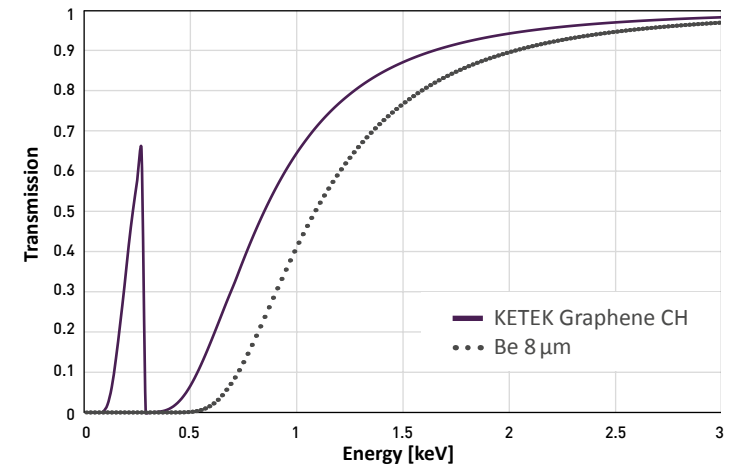
- >20 K lower chip temperatures over the whole temperature range
- -60 °C at +65 °C heat sink temperature achievable
- Drastically increased efficiency of the thermoelectric cooling
- Improved heat management within module
- Ultra stable vacuum integrity for many years of operation



POWER CONSUMPTION DRASTICALLY REDUCED BY UP TO **50%**



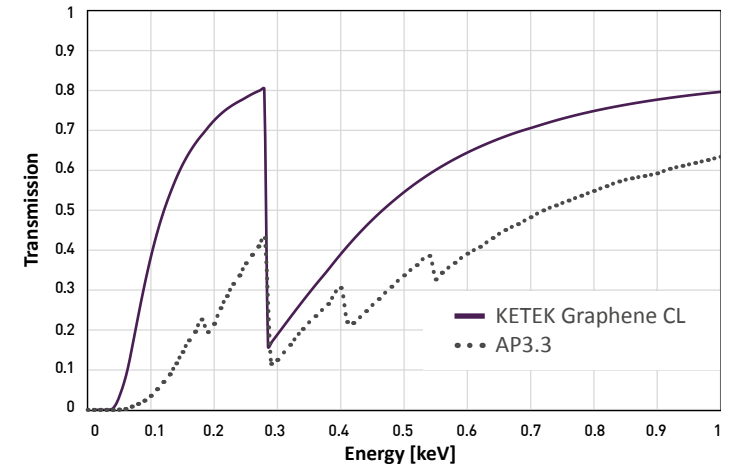
CH



- CH window: 900 nm Carbon without support grid (replaces the 8μm Beryllium window)
- CL window: 150 nm Carbon with Si support grid (86% open area) for low-energy applications
- No fluorescence lines (pure Carbon window)
- Both window types compatible with vacuum encapsulation process
- Transmission better than conventional window types over the whole energy range



CL



VITUS

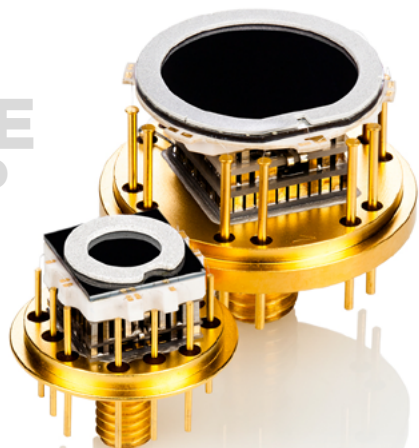
PORTFOLIO STANDARD

VALID FOR ALL SDDS

Amplification stage: ASIC
 Guaranteed P/B: > 15000
 Guaranteed P/T: > 2000
 Max. ICR @ 50 % DT: 1 Mcps
 Absorption depth Si: 450 μm
 On-chip collimator: Multilayer

LARGE
COLLIMATED
AREA

COMPACT
HOUSING



H7



H20



H30



H50



H80



H150

COLLIMATED AREA [mm²]

7	20	28	47	80	143
---	----	----	----	----	-----

ACTIVE AREA [mm²]

13	30	41	65	100	170
----	----	----	----	-----	-----

WINDOW

CH	CH	CH	CH	25 μm Be	25 μm Be
----	----	----	----	---------------------	---------------------

GUARANTEED FWHM
Mn K α @ 5.9 keV [eV]

≤ 129	≤ 129	≤ 129	≤ 129	≤ 136	≤ 136
------------	------------	------------	------------	------------	------------

COOLING PERFORMANCE [K]
(max. ΔT @ 20 °C heat sink)

90	90	90	90	90	90
----	----	----	----	----	----

PORTFOLIO LOW ENERGY

VITUS

KETEK'S UNIQUE
GRAPHENE
WINDOW

VERY LARGE
SOLID
ANGLE

SENSITIVE
DOWN TO BORON K α
at 185 eV



H7LE



H20LE



H30LE



H50LE

COLLIMATED AREA [mm²]

7	20	28	47
---	----	----	----

ACTIVE AREA [mm²]

13	30	41	65
----	----	----	----

WINDOW

CL	CL	CL	CL
----	----	----	----

GUARANTEED FWHM
Mn K α @ 5.9 keV [eV]

≤ 129	≤ 129	≤ 129	≤ 129
------------	------------	------------	------------

COOLING PERFORMANCE [K]
(max. ΔT @ 20 °C heat sink)

90	90	90	90
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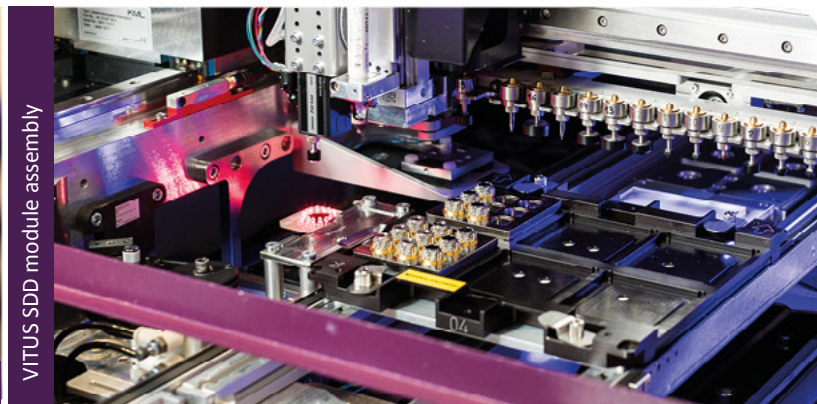
SDD

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.



Semiconductor chip production



VITUS SDD module assembly



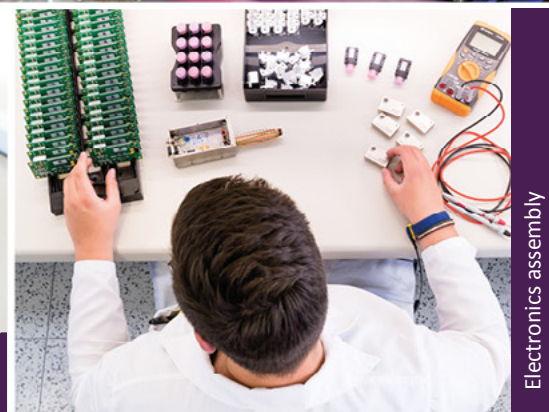
Clean room



Parallel processing for high volumes



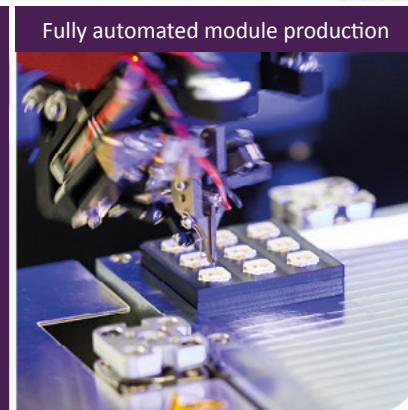
MANUFACTURED IN MUNICH



Electronics assembly



Vacuum encapsulation



Fully automated module production

SDD

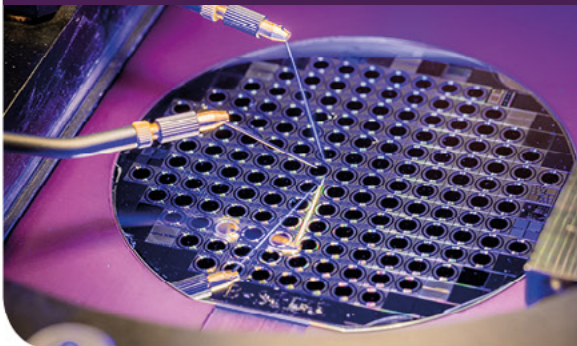
TESTING

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.

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



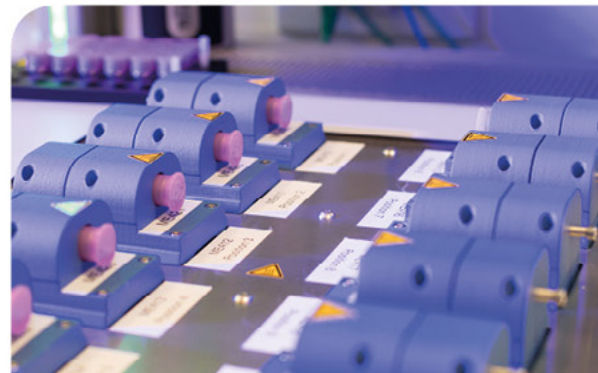
TEST OF OPEN SDD MODULES

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



Test of leak-tight 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 test of complete systems



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 acquired data.

Fully automated final testing





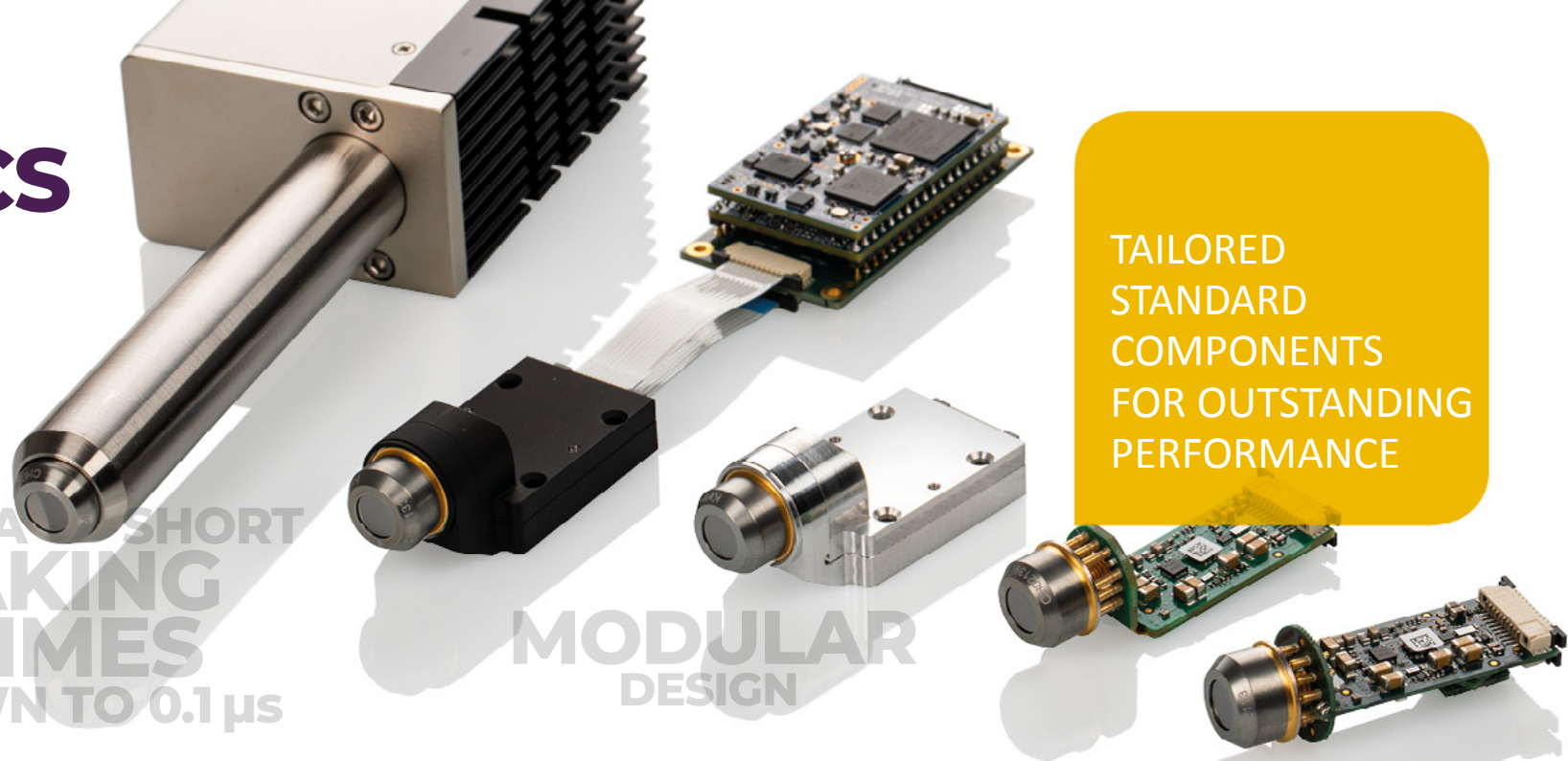
ELECTRONICS

KETEK offers electronics engineered particularly for operating VITUS SDDs. The portfolio ranges from single components as the preamplifier 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 0.1 μ s as well as input count rates up to 1 Mcps at 50% dead time.

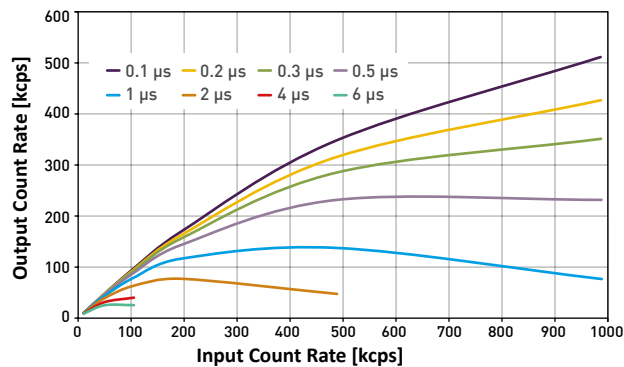
ULTRA SHORT
PEAKING
TIMES
DOWN TO 0.1 μ s

MODULAR
DESIGN

TAILORED
STANDARD
COMPONENTS
FOR OUTSTANDING
PERFORMANCE



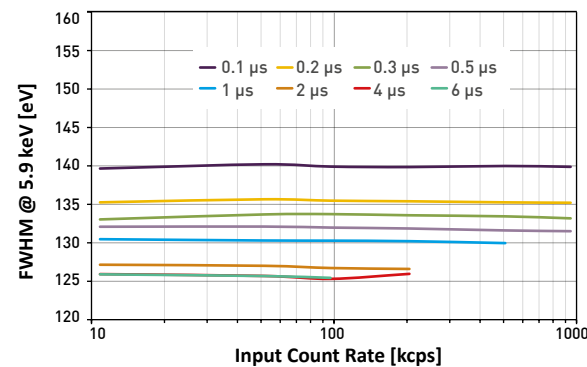
Throughput with KETEK signal processing electronics at various peaking times and dead time < 50%



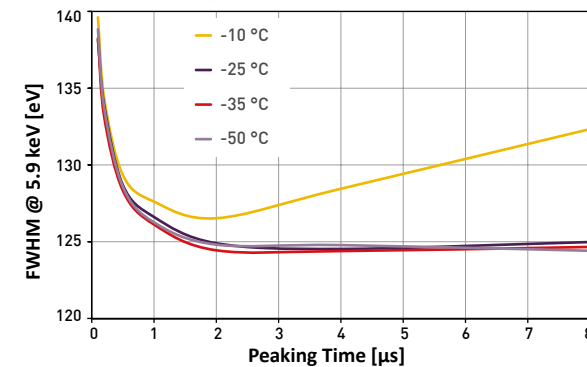
The energy resolution of a system with KETEK's DPP is independent from the input count rate, no matter which peaking time is chosen. This is essential for stable performance of a spectroscopic system.

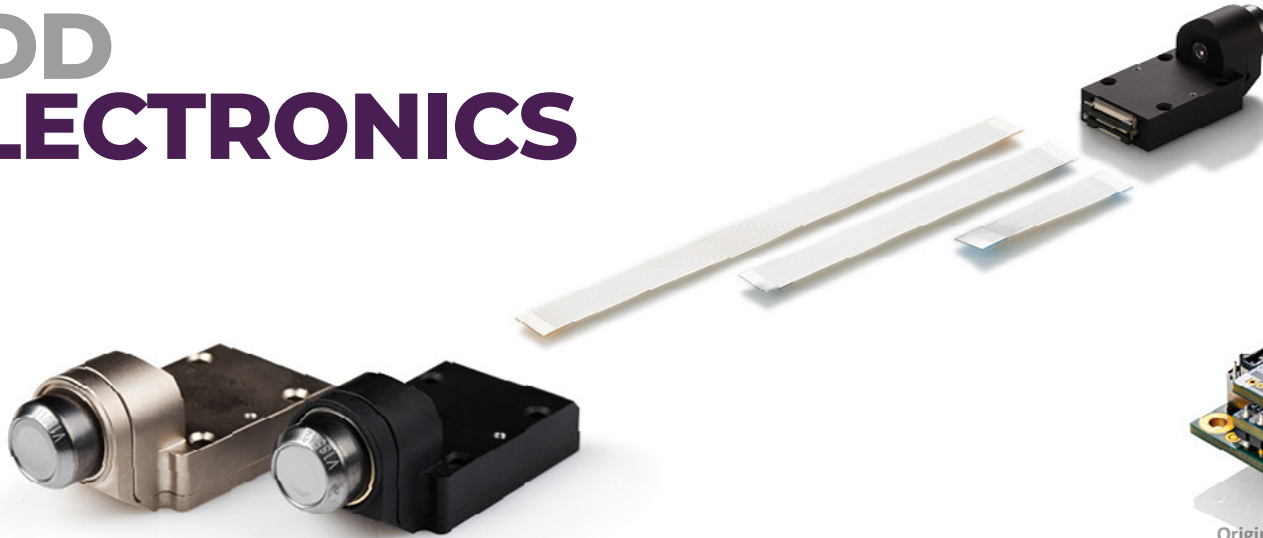


Energy resolution versus input count rate acquired with KETEK DPP

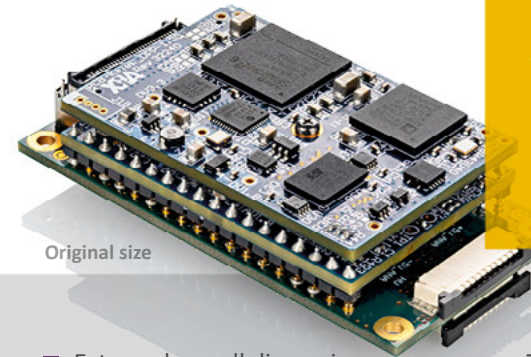


Energy resolution at various chip temperatures acquired with VICO-DV 2.0 and VIAMP-KC H20





MATCHBOX
SIZE SIGNAL
PROCESSING
ELECTRONICS
FOR SDDS



Original size

The VIAMP-KC module is the combination of a low noise preamplifier and a VITUS SDD, matching all types from 7 mm² (H7) up to 50 mm² (H50) collimated area. The Al housing is functioning as an appropriate heat sink. Dual FFC cable connection for readout and parameter settings.

- Ultra-low-noise preamplifier
- Ramped reset type output signal
- Configurable via FFC interface
- SDD temperature readout
- Customized solutions available on request



VIAMP-KC and VICO-DV 2.0
with FFC cable connection

- Extremely small dimensions 60 × 32 × 17 mm³
- Access to analog preamplifier signal and SDD temperature monitor
- Very low typical power consumption < 2 W
- Wide unipolar voltage input range: +5 V to +12 V
- USB 2.0, SPI and RS232 interfaces
- SDD operating temperature setting, spectrum readout and power save mode accessible via software

The complement of the VIAMP module is the VICO-DV 2.0, comprising KETEK's proven digital pulse processor (DPP), a temperature controller and all voltage supplies for the SDD. Various parameters can be set and read out via software interface (DLL included). Its small dimensions allow an easy system integration. Also an analog version without DPP is available.

2.0
AXAS

SDD COMPLETE SYSTEM

2.0
AXAS

OPERABLE AT
AMBIENT TEMPERATURES
UP TO +50°C

Original size

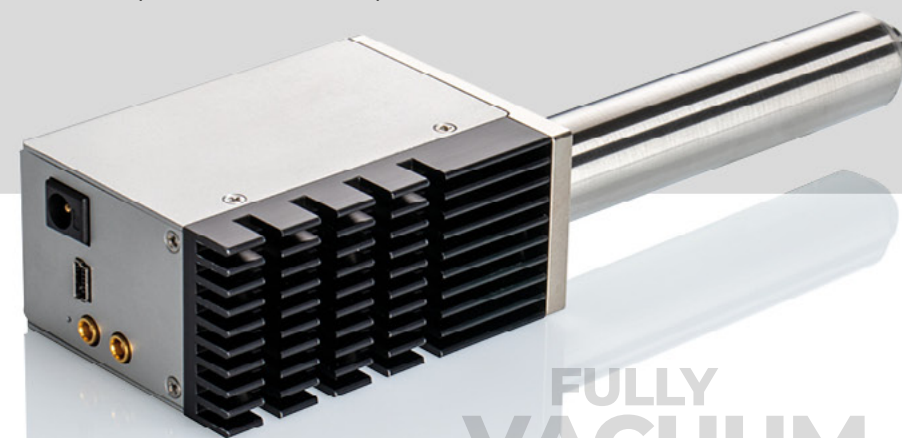
The AXAS 2.0 is KETEK's new complete system for VITUS SDDs in a very compact housing. It includes all power supplies, the low-noise preamplifier, a high precision temperature controller and KETEK's fast DPP. Beside the digital signal also the analog preamp output is accessible. The AXAS 2.0 is available with all sizes of VITUS SDDs from H7 to H150 and different lengths of the vacuum tight finger.

- Smallest complete XRF system on the market: 80×60×36 mm³
- Low weight: < 300 g
- Wide input voltage range: +5 V to +12 V / 1 A max.
- Excellent cooling performance even at ambient temperatures up to 50°C
- Software interface for parameter setting, spectrum readout and power save mode



NEW
AXAS
2.0

SMALLEST
XRF SYSTEM ON THE
MARKET



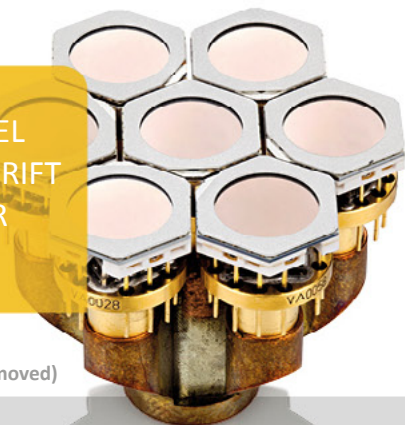
FULLY
VACUUM
COMPATIBLE

VA560
ARRAY

SDD MULTI-CHANNEL

Complete XRF multi-channel system including seven fast VITUS H80 SDDs, ultra-low-noise preamplifiers and seven high-performance digital pulse processors. Also part of the system is an external control unit with all power supplies and a cooling circuit. The whole architecture is very service friendly and allows an easy exchange of single channels.

7-CHANNEL
SILICON DRIFT
DETECTOR
ARRAY



View on the SDD array head (cap removed)

- $7 \times 80 \text{ mm}^2 = 560 \text{ mm}^2$ collimated area
- FWHM < 139 eV @ 1 μs peaking time for Mn K_{α} -line (typ. < 132 eV)
- Operable at short peaking times down to 0.1 μs
- Up to 7 Mcps detection rate of the full system @ 50% dead time
- For X-ray energy range from 1.5 keV to 30 keV



560 mm²
AREA

INDIVIDUAL
CHANNEL READOUT

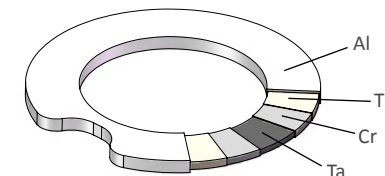
SDD ACCESSORIES

EMLCOL EXTERNAL COLLIMATOR

The clip-on mount for external multi-layer collimators is suitable for all VITUS SDDs up to the H50. Different collimator apertures are available. The EMLCOL prevents the X-ray fluorescence of the SDD's cap material.

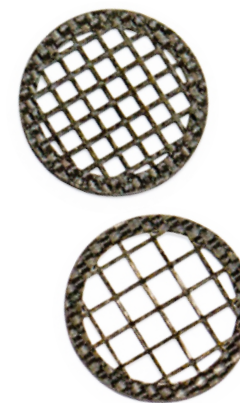


- No stray lines from SDD cap
- Improved P/B and P/T
- Additional protection for the VITUS entrance window



ECGRID CARBON PROTECTION GRID

The pure carbon grid can be mounted within an instrument in front of the SDD in order to protect its fragile window from mechanical impact.



- Open area 75%
- Thickness 0.5 mm
- Withstands a static stress up to 50 N
- No fluorescence lines from grid material
- Customized shapes available on request



KETEK

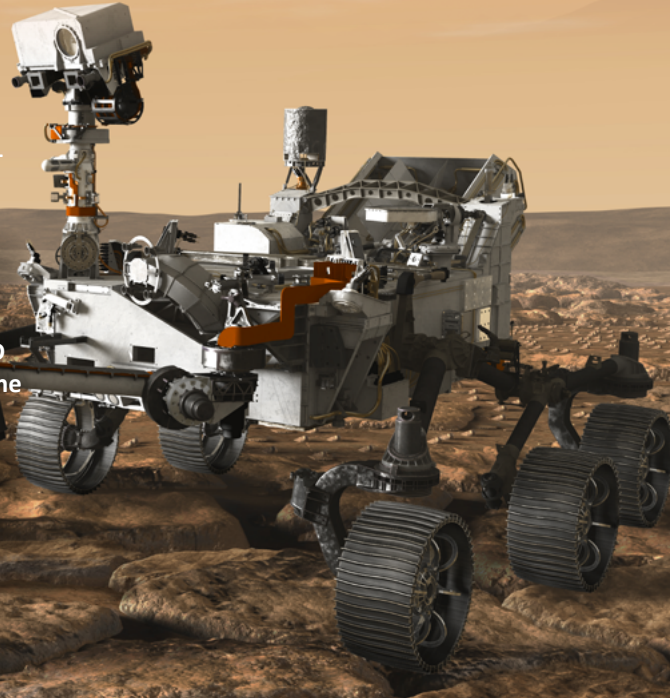
KETEK LANDS ON MARS

In Februar 2021, on board of Mars rover Perseverance, KETEK's Silicon Drift Detectors have arrived on the Red Planet once again. This is already the fourth space mission a VITUS SDD has been chosen by the NASA as XRF detector:

- Spirit 2004 - 2011
- Opportunity 2004 - 2018
- Curiosity landed 2012
- Perseverance landed 2021

MARS 2020 PERSEVERANCE

- Two KETEK H50-CUBE 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



KETEK

**FULL
COMMITMENT
TO QUALITY OF ALL
EMPLOYEES**

Quality is the basis of all activities at KETEK and every employee contributes significantly to quality.

**CLOSE
COOPERATION
WITH KEY
CUSTOMERS**

KETEK

HEADQUARTERS IN MUNICH

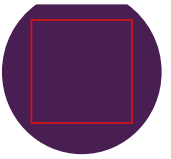


KETEK GmbH

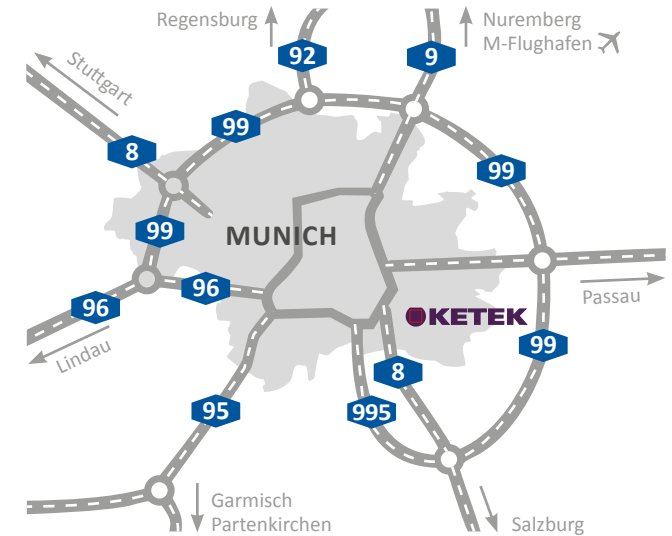
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KETEK



ISO 9001:2015
Certified



EN 55016
EN 61000

KETEK

