Chillventa Specialist Forums 2024
Chillventa Fachforen 2024

CONNECTING EXPERTS.

STAND 5 - 230

CHILLVENTA

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REFRIGERANTS LEAKAGE DETECTION:

THE LAST TECHNOLOGY FOR MASS PRODUCTION SENSOR

Oscar De Vita
Business development director
GVZ Components

AGENDA

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1. Refrigerant leakage detection: why?

2. Introduction to **MPS™** by NevadaNano, the latest technology for gas detection

3. Presentation of **MLD (Molecular Leakage Detector)** made by GVZ and designed to fulfill the requirements of HVAC-R manufacturers

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1. Refrigerant leak detection

WHY?

SAFETY COMPLIANCE AND SYSTEM EFFICENCY

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ENVIRONMENT

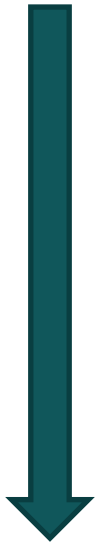
Reducing the emission of HFCs (<GWP) and environmental footprint

RULES

To respect the current regulations and latest updates (F-GAS, ASHRAE, EN378..)

SAFETY

The safety of people and property in relation to fixed and mobile refrigeration systems, applied to products with A2L and A3 category gas.



To maintain a system in **perfect conditions.**

CUSTOMER COSTS

By reducing refill, maintenance and repair costs.

IMPROVING LIFE SPAN

To offer a high level of product reliability

ENERGY SAVING

To maintain refrigerant charge full time to avoids energy waste

TO IMPROVE BUSINESS

Manufacturing **competitive, high quality and reliable** products

NEW TRENDS, NEW STANDARDS, AND NEW REFRIGERANTS LEAD TO NEW SYSTEM DESIGN

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F Gas

PFAS

Standards

OEMs Manufacturer

Monitoring of refrigerants leakages

Semiconductor

MPS™

GVZ PORTFOLIO

Market

Leakages sensors/detectors compliant to the standards

2. Introduction of MPS™ technology developed by:

MPS™ technology by NevadaNano

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NevadaNano

MPS™ Gas Sensor Family
MOLECULAR PROPERTY SPECTROMETER

MPS Flammable Gas Sensor

MPS Methane Gas Sensor

MPS A2L & A3 Refrigerant Sensor

'S4' Intrinsically Safe (ATEX)

'Mini' Non ATEX

NEXT-GENERATION MULTI-GAS SENSORS FOR A BETTER AND SAFER ENVIRONMENT

- **Refrigerant Leak Detection**
- **Industrial Safety**
- **Methane Leak Detection**
- **Other Leak Detection**
- **IoT/AQ Smart Homes** In Development

MPS™ technology by NevadaNano

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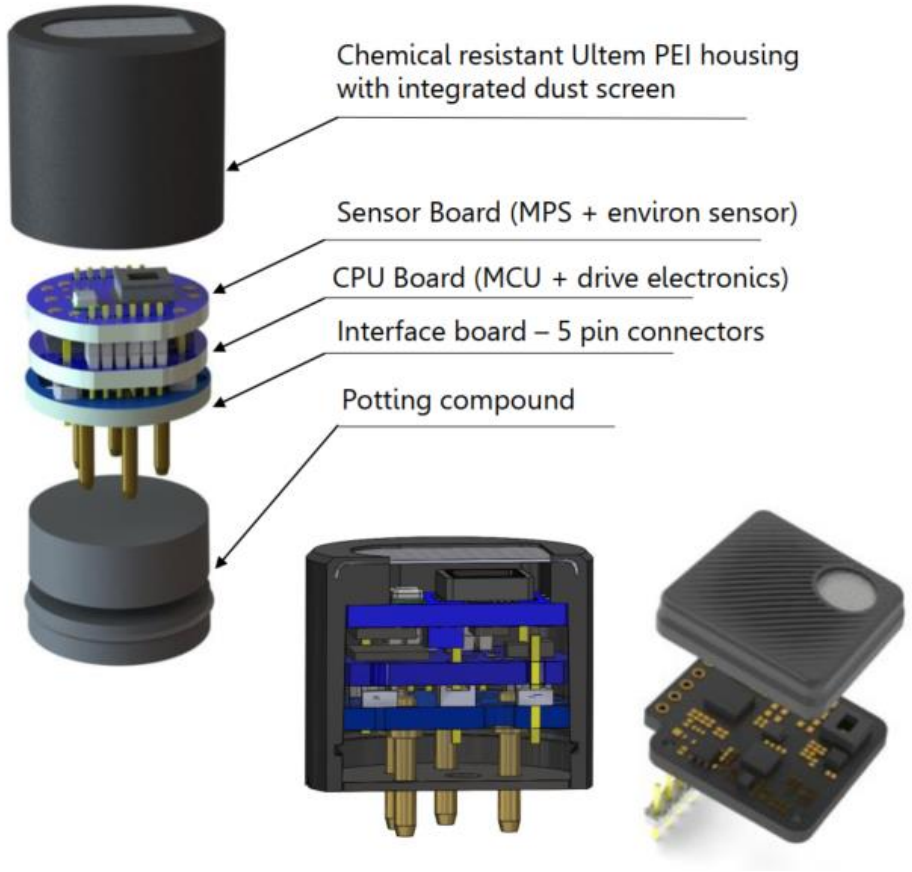
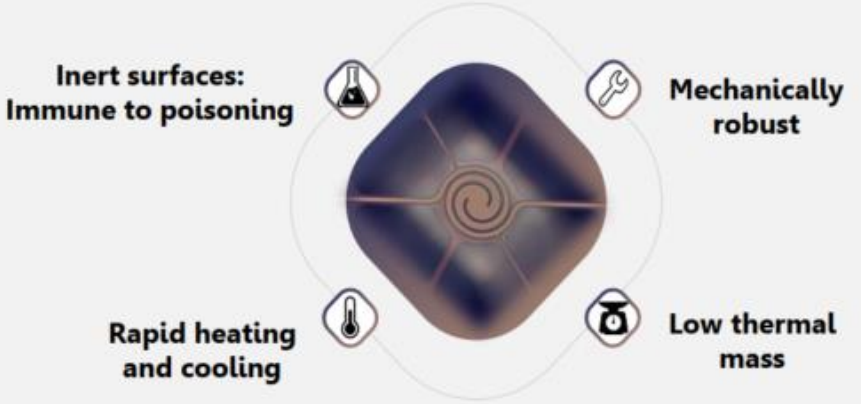


OPERATING PRINCIPLE



- Transducer is a micro-machined membrane with an embedded Joule heater and resistance thermometer.
- The MEMS transducer is mounted on a PCB within a rugged enclosure open to ambient air.
- Measurements of the thermodynamic properties of the air/gas mixture
- Sensor data are processed by patent-pending algorithms to report accurate concentration and classify the flammable gas

Software Enables MPS Versatility to Accurately Target Specific Applications

MPS™ technology by NevadaNano

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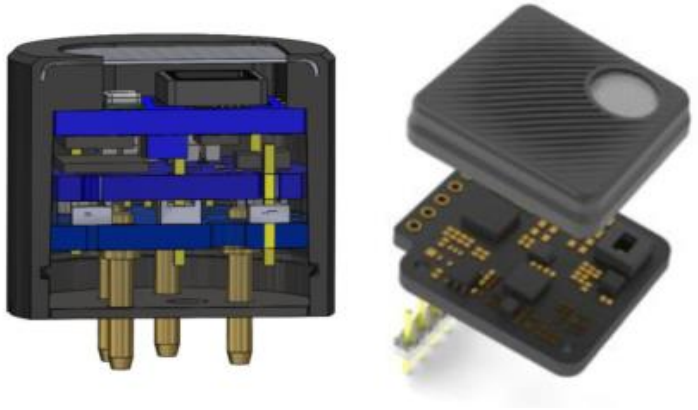
Molecular Property Spectrometer (MPS™)

A Micro-electromechanical systems (MEMS) transducer (inert membrane with embedded heater & resistance thermometer) measures changes in the thermal properties of air & gas. Multiple measurements, akin to a thermal 'spectrum' plus environmental data are processed to classify the refrigerant gas concentration.

Advantages

- Very Long Life – 15+ years
- No field calibration for the life of the sensor
- Lower power
- On board environmental sensor with compensation
- Very wide environmental range -40 - +75C, 100% RH
- Resistant to Poisoning & saturation
- Fail safe/diagnostics



Limitations

- Higher initial cost

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Which is the best technology for leakage detection ?

REFRIGERANT SENSOR DETECTION TECHNOLOGIES

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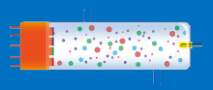
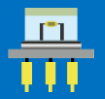
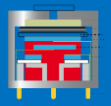
Main features	MPS 	Infrared 	Semiconductor 	Electrochemical 	Catalytic 
Lower detection level	3% LFL −	1ppm +	10ppm	1ppm +	0,1%LFL
Cost (sensor)	$$$ −	$$$	$ +	$$	$ +
Response Time	Fast (<20s) =	Fast (<20s)	Very Fast (<5s)	Medium (<60s)	Very Fast (<5s)
Maintenance	None +	Calibration	Calibration or Replacement	Calibration or Replacement	Calibration or Replacement
Lifespan	+15 years +	5-10 years	3-7 years	2-3 years	3-5 years
Higher detection level	100% LFL =	100% LFL	20.000ppm	5000ppm	100% LFL
Press/Temp/Humidity Effects	No effect Fully compensated widest operational range +	Small effect Dual=> fully compensated	Some effects	Some effects	Some effects
Resistance to Poisoning	Strong =	Strong	Week	Week	Week
Selectivity	High Selectivity =	High Selectivity	Low selectivity	Target gas	Low selectivity

New sensors/detectors are coming based on *Thermal Conductivity* and *Speed of Sound*

LET'S LISTEN THE EVALUATION OF AN INDIPENDENT VOICE

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MPS™ PROVEN BEST IN CLASS

NevadaNano

No.	Priority	Requirement	Underlying Standard: IEC 60335-2-40 (Ed. 6)	UL/CSA 60335-2-40 (Ed. 3)	ASHRAE 15-2019	ASHRAE 15.2P	JRA 4068T: 2016R	Candidate Sensors: A	B	C	D	E	F	G	H	I	J	K
		Sensing principle						MMM[1]	xcite[2]	TC[3]	NDIR	MOS[4]	MOS	SS[5]	MOS	NDIR	MOS	NDIR
1	primary	Capable of sensing presence of refrigerant (for A2L group)	•	•	•	•	•	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	NO	Yes
2	secondary	Capable to be installed "within the unit" when required	•	•	•	•	•	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
3	secondary	Capable to be installed "remote from unit" when permitted	•	•	•	•	•	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
4	secondary	Capable to be installed "indoor coil cased assembly" when required		•				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
5	secondary	Capable to be installed "in air supply duct work" when permitted				•		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
6	primary	Comply with UL60335-2-40 Annex LL	•	•				Yes	Yes	Yes	NS[6]	NO	NO	Yes	NO	NS		NS
7	secondary	Sensor should work when the voltage applied is varied by ±10% rated voltage					•	Yes	Yes	Yes	Yes	NO	Yes	Yes	Yes	Yes		Yes
8	primary	Capable of number of cycles of operation (300 for self-resetting, 30 for non-self-resetting)	•	•				Yes	Yes	Yes	Yes	Yes	NS	Yes	Yes	Yes		Yes
9	primary	Sensor should not be a multiport-type device			•			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
10	primary	Capable of using a setpoint less than 25% of LFL[8]	•	•	•	•	•	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
11	primary	Sensor should have an output to indicate the presence of a refrigerant concentration exceeding the set point	•	•	•			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
12	secondary	For indicating type, setpoint should be preset (e.g. Factory set)	•	•				yes	yes	yes	yes	yes	yes	yes	yes	NS		yes
13	secondary	Pre-set setpoint level should not be adjustable by user		•				Yes	Yes	Yes	NO	Yes	Yes	Yes	Yes	NS		NO
14	primary	Complies with the requirements IEC 60079-29-1 for Group II equipment		•				Yes	Yes	Yes	Yes	NO	NS	NS	Yes	NS		NS
15	primary	Sensor should still function after 100% refrigerant exposure for 480-490 min (used for long term stability Group II test)		•				Yes	Yes	Yes	Yes	NS	NO	Yes	NO	NO		Yes
16	primary	Sensor should not show false or nuisance trips or show signs of poisoning after being subjected to the gas and vapor types specified by Table LL.4A.1DV		•				Yes	Yes	Yes	Yes	Yes	NS	Yes	Yes	NO		Yes
17	primary	Capable of meeting response time requirement	•	•	•	•	•	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		NO
18	primary	Sensor should withstand condensation condition					•	Yes	Yes	Yes	Yes	Yes	NO	Yes	NO	NO		NO
19	primary	Shall comply with the requirements over the full range of operating temperature and humidity as specified by the HVACR equipment manufacturer		•			•	Yes	yes	NO	NO	NO	Yes	NO	NO	NO		NO
20	primary	Accuracy of setpoint meets requirements	•	•			•	Yes	Yes	Yes	Yes	NA[7]	NA	Yes	Yes	NS		Yes
21	primary	Includes output for signal or trigger of mitigation and ventilation	•		•		•	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
22	primary	Resistance to vibration, can pass required vibration test	•					Yes	NS	NS	NS	Yes	NS	Yes	NS	NS		NS
23	primary	Includes means for self-testing	•	•	•	•	•	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
24	primary	Self-test at least every hour	•	•		•		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
25	primary	Active trouble alarm if a failure is detected	•	•	•	•	•	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes
26	primary	Does refrigerant sensor have a defined life?	•	•		•		Yes	Yes	No	No	Yes	No	Yes	Yes	No		No
27	primary	If there is a defined life, sensor should have end of life indication meeting the requirements	•			•		Yes	Yes	No	No	No	No	No	Yes	Yes		Yes
28	secondary	Sensor marking and identification meets requirements	•	•				Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		Yes

MPS™ A2L – Only sensor that achieves

- IEC 60335-2-40 Edition 6 (Jan-2018)
- UL/CSA 60335-2-40 Edition 3 (Nov-2019)
- ASHRAE Standard 15-2019,
- ASHRAE proposed Standard 15.2P (Advisory Public Review)
- JRA Standard 4068T: 2016R

AHRTI Air-Conditioning, Heating and Refrigeration Technology Institute

Final Report

AHRTI Report No. 9014

- Refrigerant detector characteristics for Use in HVACR
- Equipment-Phase I Final Report March 2020

Letter Code	Sensor Type	% of Requirements Passed	Ave. time delay, θ [sec]	Ave. time constant, τ [sec]	T63.2 = θ + τ [sec]
A	MMM (MPS™)	100 %	4.5	0.25	4.75
B	NDIR	96 %	1.6	15.8	17.4
C	TC	86 %	0.0	0.1	0.1
D	NDIR	79 %	0.1	13.7	13.8
E	MOS	75 %	Cannot be determined.		
F	MOS	64 %	Cannot be determined.		

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Presentation of the **MLD**
(Molecular Leakage Detector)

The choice of GVZ for the new leakage detector

MPS™ technology inside
by NevadaNano

MLD MAIN FEATURES

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TARGET GAS
(A1) R404A, R407C, R-410a
(A2L) R32, R454A, R454B, R454C, R455A, R1234ze/yf,
(A3) R290, R600, R600a, R170, R1270

ACTIVE COMPENSATION
Readings are compensated in pressure, temperature and humidity

ACCURACY
Comply with IEC/UL 60335-2-40

RESPONSE TIME
1st detection < 12 s
T90 < 20 s

LIFETIME
More than 15year
Without maintenance

CROSS SENSITIVITY
High gas selectivity
No false positive from fouling gases

Working temperatures
-40°C +70°C

POISONING IMMUNE

IP Grade
IP65

4 OUTPUT SIGNALS
Modbus RTU
Analog 4-20mA,
Analog 0,4-2V
Relays (2x)

OUTPUT ALARMS
Relay 1 – Low concentration Leaks
Relay 2 – High concentration Leaks & Malfunctions

Fail Safe SW
Built-in diagnostic and watch dog

CERTIFICATIONS
CE, EMC, RoHS
IEC60335-2-40
EN60079-0,
EN60079-11
ATEX
SIL1 / SIL2

CERTIFICATIONS

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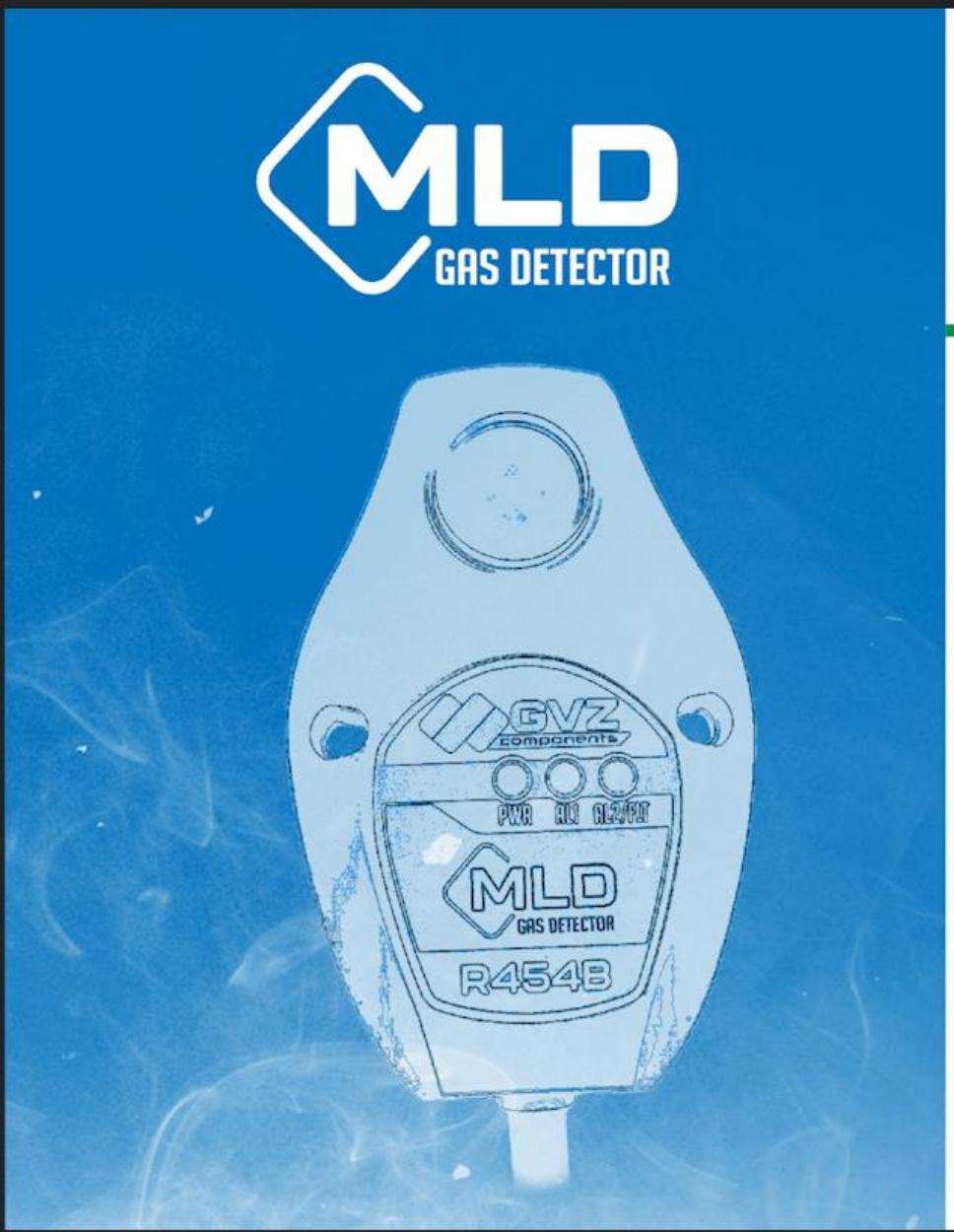

Certifications & Approvals

- CE
- EMS
- RoHS
- REACH
- ATEX
- SIL
- IEC 60335-2-40

GVZ commitment for Low Environmental Impact Products

GVZ collaborated with Meliconi Engineering and *Politecnico di Torino* (Engineering University of Turin) in order to calculate the overall impact on *CO2 emissions* due to the production of MLD DETECTOR

The calculation of the energy impact started focusing on all components with the analysis of all sources by tracing the entire raw material supply chain, from the mine to the entire transformation process, especially considering the nation where the process took place (i.e. one gram of copper extracted in India has a different impact on CO2 than the same gram of copper coming from EU). All the transports in between have been considered.

=> <u>The result is that, for every detector, nearly 1.6kg of CO2 has been produced</u>

Carbon Footprint:

The CO2 equivalent emissions in the production of a single MLD device is 1,588 kg.
The carbon footprint of the MLDs is calculated by using the cradle-to-gate LCA (Life Cycle Assessment) method.
This means that the system boundary include all greenhouse gas emissions that occur from the input of raw materials (cradle) to the end of the product's production (gate).

INSTALLATION EXAMPLES

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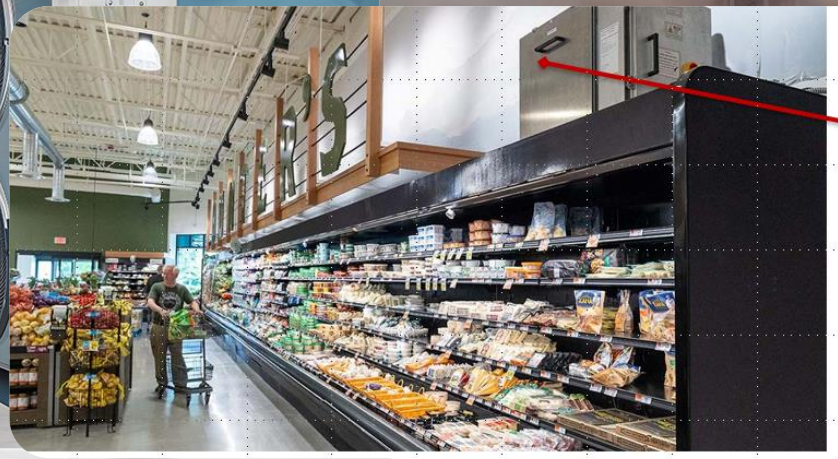
- HEATING PUMPS
- CHILLERS
- ROOFTOP
- DATA CENTERS
- COLD ROOMS
- FRIDGES
- VENDING MACHINES
- SUPERMARKET REFRIGERATOR



MLD SERIES IS AVAILABLE ON THE MARKET SINCE JANUARY 2024

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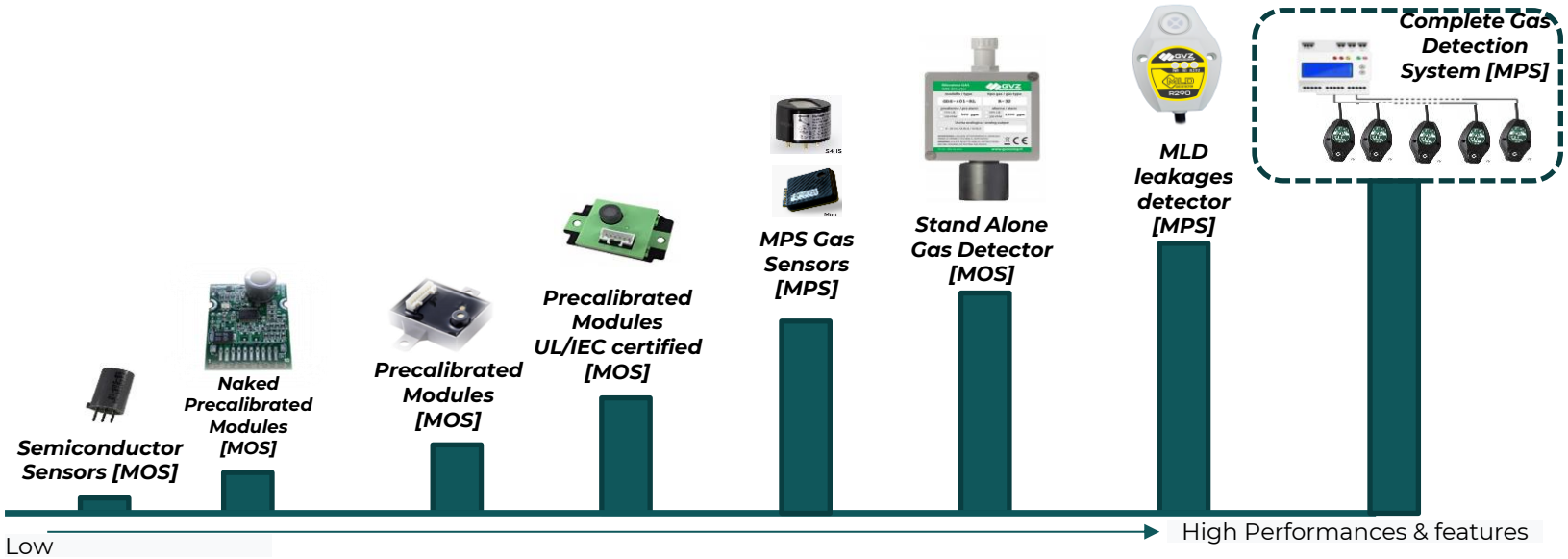
Thanks for your attention!

You are welcome at our booth: hall 5 – stand 230

Oscar De Vita

GVZ Components

Mail: o.devita@gvzcomp.it



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