



ABOUT A VCSEL: CORE COMPONENT OF A LIDAR SENSOR FAMILY

SICK
Sensor Intelligence.

Dr. Eckart Gerster

SICK AG

2019-10-18

- Introduction to SICK AG
- Product Portfolio
- VCSELs for LiDAR
- Challenges

INTRODUCTION TO SICK AG

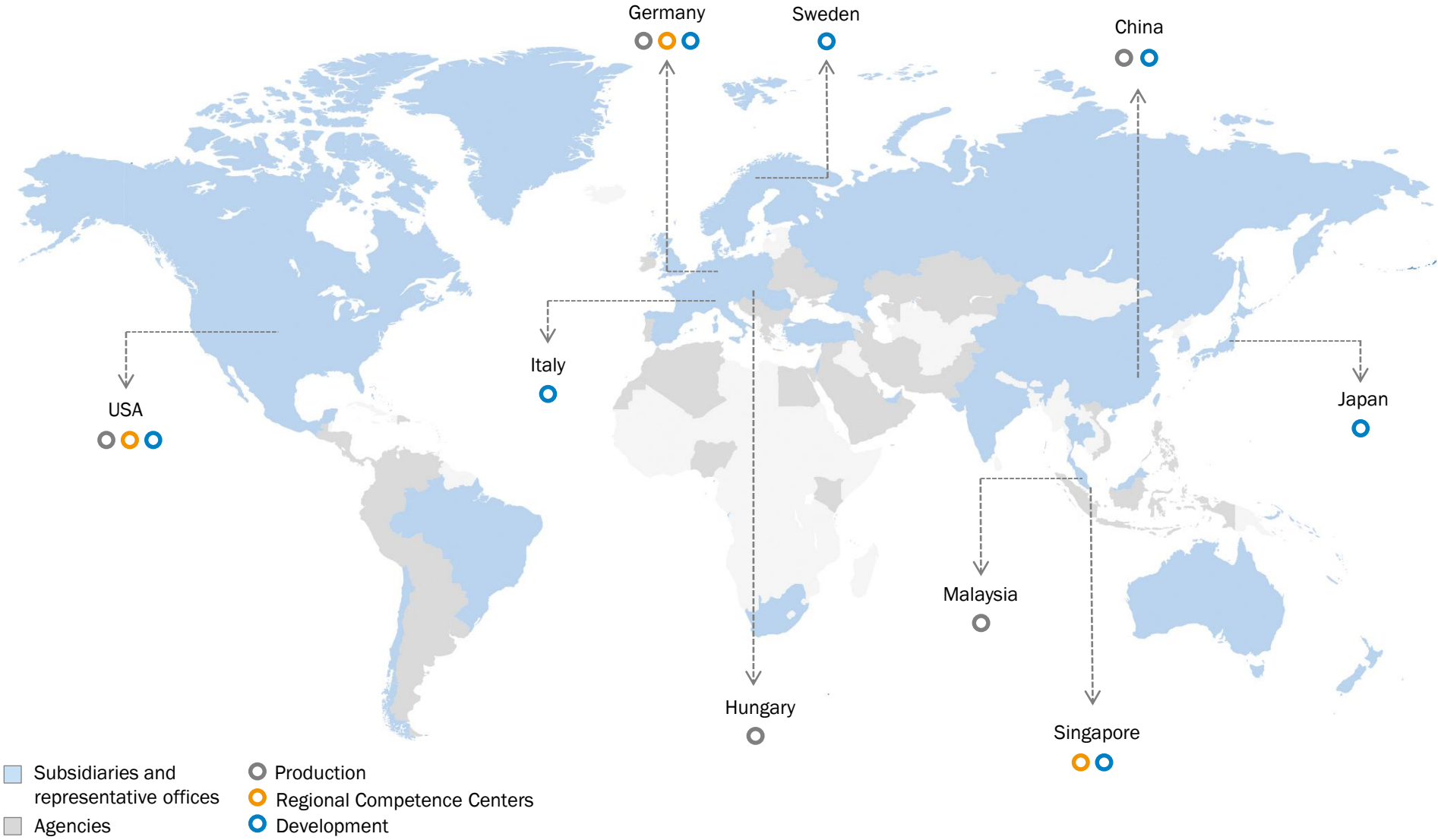
SICK AT A GLANCE (2018)



SICK – worldwide one of the leading manufacturers of sensors and sensor solutions for industrial applications

INTRODUCTION TO SICK AG

PRESENCE WORLDWIDE



INTRODUCTION TO SICK

WIDE PRODUCT RANGE



- Analyzer solutions
- Automation light grids
- Detection and ranging solutions
- Distance sensors
- Dust measuring devices
- Encoders and inclination sensors
- Fluid sensors
- Gas analyzers
- Identification solutions
- Magnetic cylinder sensors
- Motor feedback systems
- Opto-electronic protective devices
- Photoelectric sensors
- Proximity sensors
- Registration sensors
- Software products
- Safety switches
- sens:Control – safe control solutions
- System solutions
- Traffic sensors
- Ultrasonic gas flow measuring devices
- Vision

2D AND 3D LIDAR SENSORS



TiM Series



LMS Series



LD- and NAV Series



LD-MRS



MRS1000

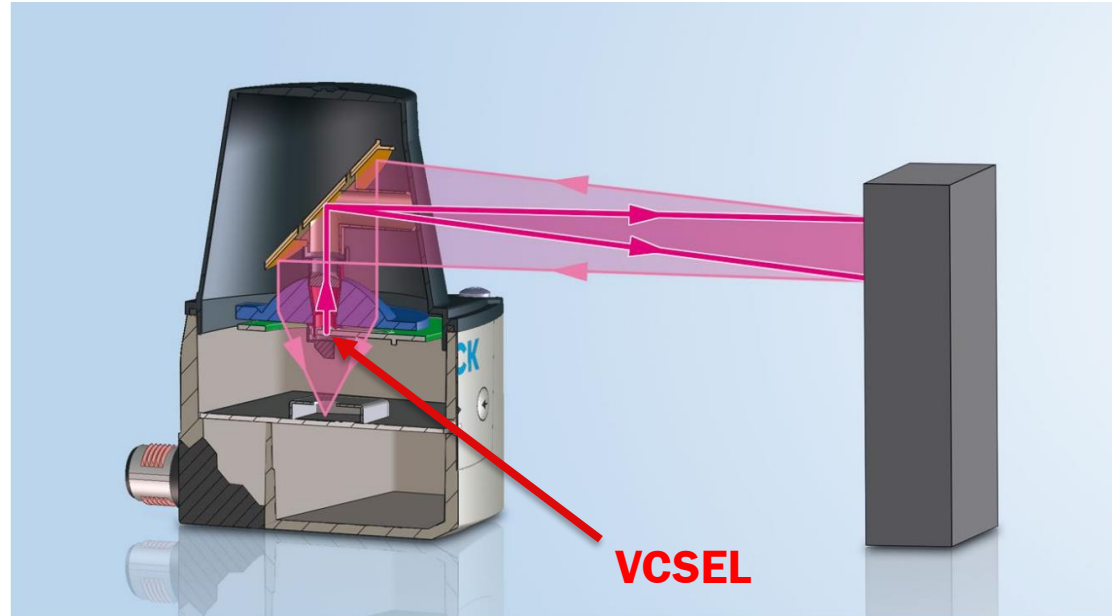


MRS6000

- Short, medium, and long working ranges
- Indoor or outdoor
- High resolution
- Industrial grade



TiMxxx



- TiMxxx: ToF LiDAR sensor, compact size, low power, low cost, **VCSEL powered**
- Sick's HDDM/HDDM+ technology (High Definition Distance Measurement, a proprietary statistical measurement method)
- ToF LiDAR system design optimizes angular resolution, measurement range, accuracy, etc.

- + testing on-wafer
- + no cleaving and facet coating (no COMD risk)
- + simple packaging (SMD, ...)
- + circular beam shape
- + low temperature sensitivity
- + short pulse capability
- + low cost

- low brightness
- power scaling difficult

d-ToF LiDAR requires very short optical pulses with very high pulse power!

Parameter	Symbol	Unit	Min	Typ	Max	Notes
Wavelength	λ_{OP}	nm	845	850	855	
Temperature	T_c	°C	-10		85	Case temperature during operation
Emitters	n		1		7	
Emission Area	\varnothing	μm		60	75	Minimal circle including all emitting area
Divergence	α	°		20	25	CW and pulsed operation
Slope Efficiency	SE	mW/mA		0.8	1	
Package	l x w	mm x mm			3 x 2	Optimized thermal conductivity
Reliability	λ	FIT			60	Confidence level: 60%

Pulse operation:

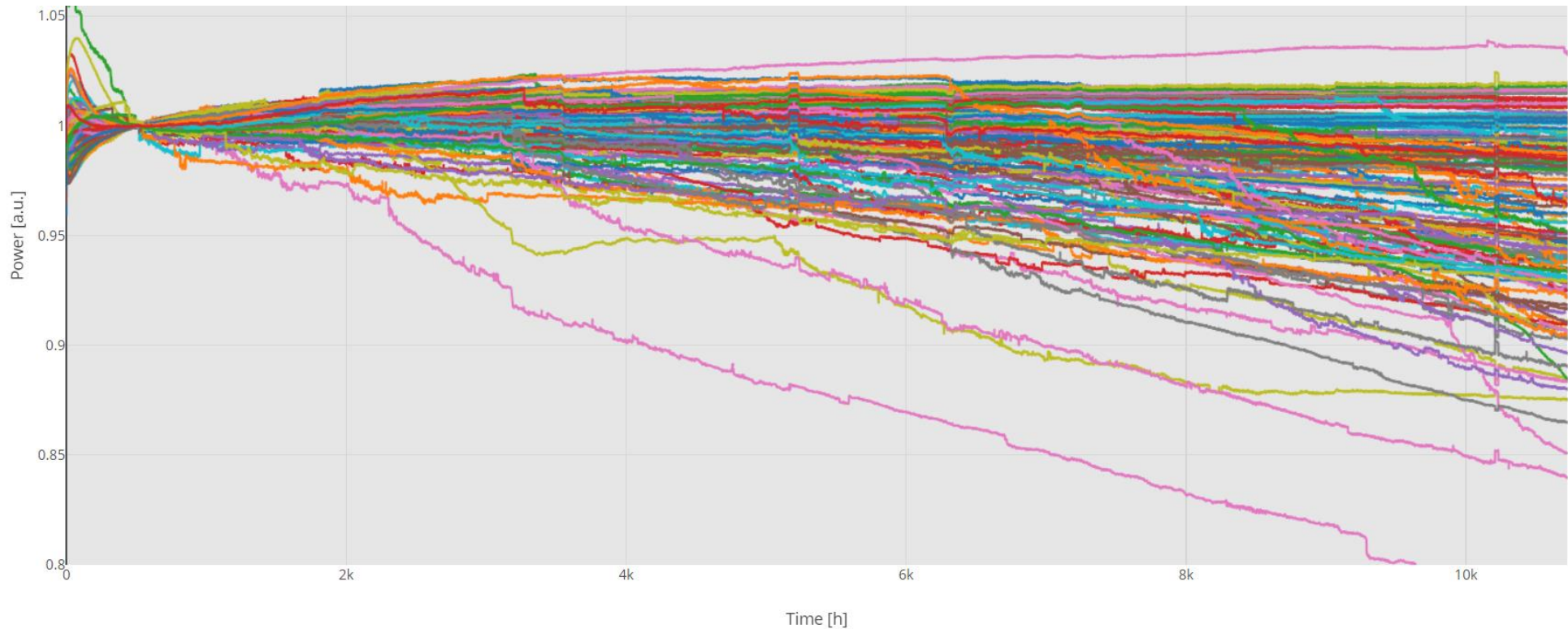
- Pulse duration: 1 – 10 ns
- Pulse current: 0.7 – 1.2 A
- Max duty cycle: 0.75 %
- Maximum average current: 5 mA
- Maximum voltage drop over diode: 17 V

*Issue:
Large emitter diameter contrast to
beam quality and divergence due to
limited internal current spreading!*

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144 DUTs, $t=10.7\text{kh}$, $E_a=0.35\text{eV}$, $CL=60\%$ → **116 FIT**

Test condition: 0.7A, 5ns pulse, 660ns repetition, 85 °C

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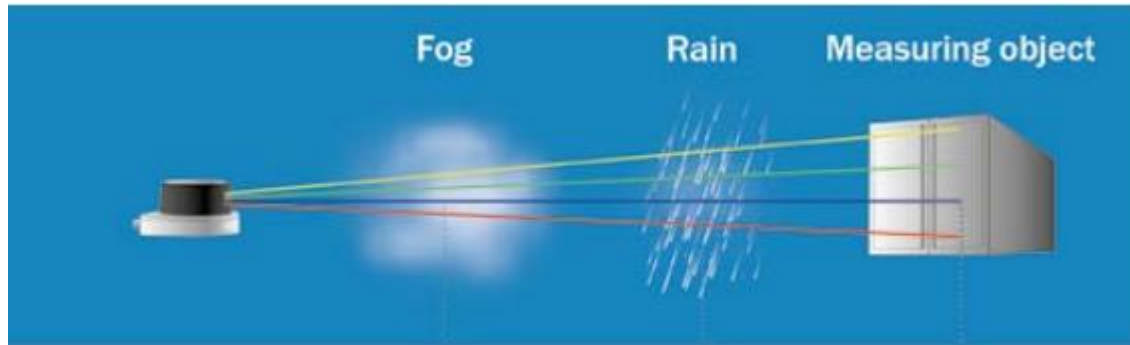
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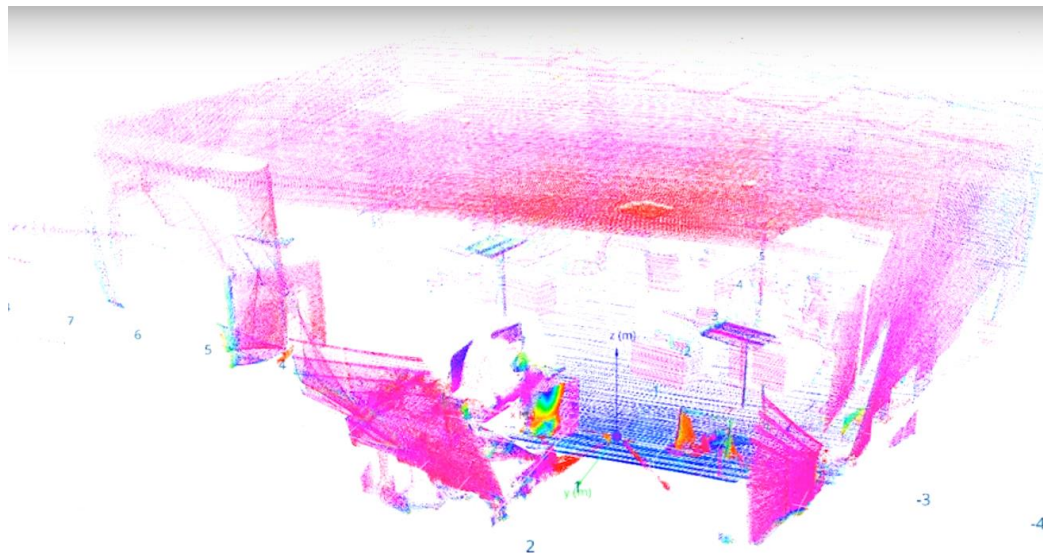
more pulse power needed!

pulse current of >5A possible? (@0.1% dc)

2D LIDAR → 3D LIDAR



3D LiDARs with many layers require many VCSELs...



MANY THANKS FOR YOUR ATTENTION.

SICK
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