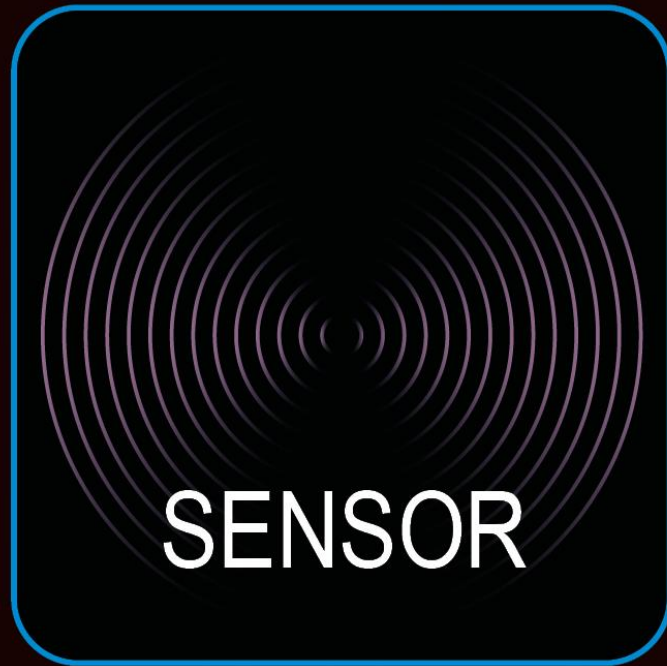


# RUTRONIK TECHTALK MEETS



08.06. - 10.06.2021 | **ONLINE**

## Off-Board Chargers for E-Mobility

Juergen Gewinner  
Field Application Engineer





The DNA of tech.™

# Industry 4.0

Juergen Gewinner Field Application Engineer

[Juergen.Gewinner@Vishay.com](mailto:Juergen.Gewinner@Vishay.com)

0049 171 67 989 12

# Agenda Industry 4.0

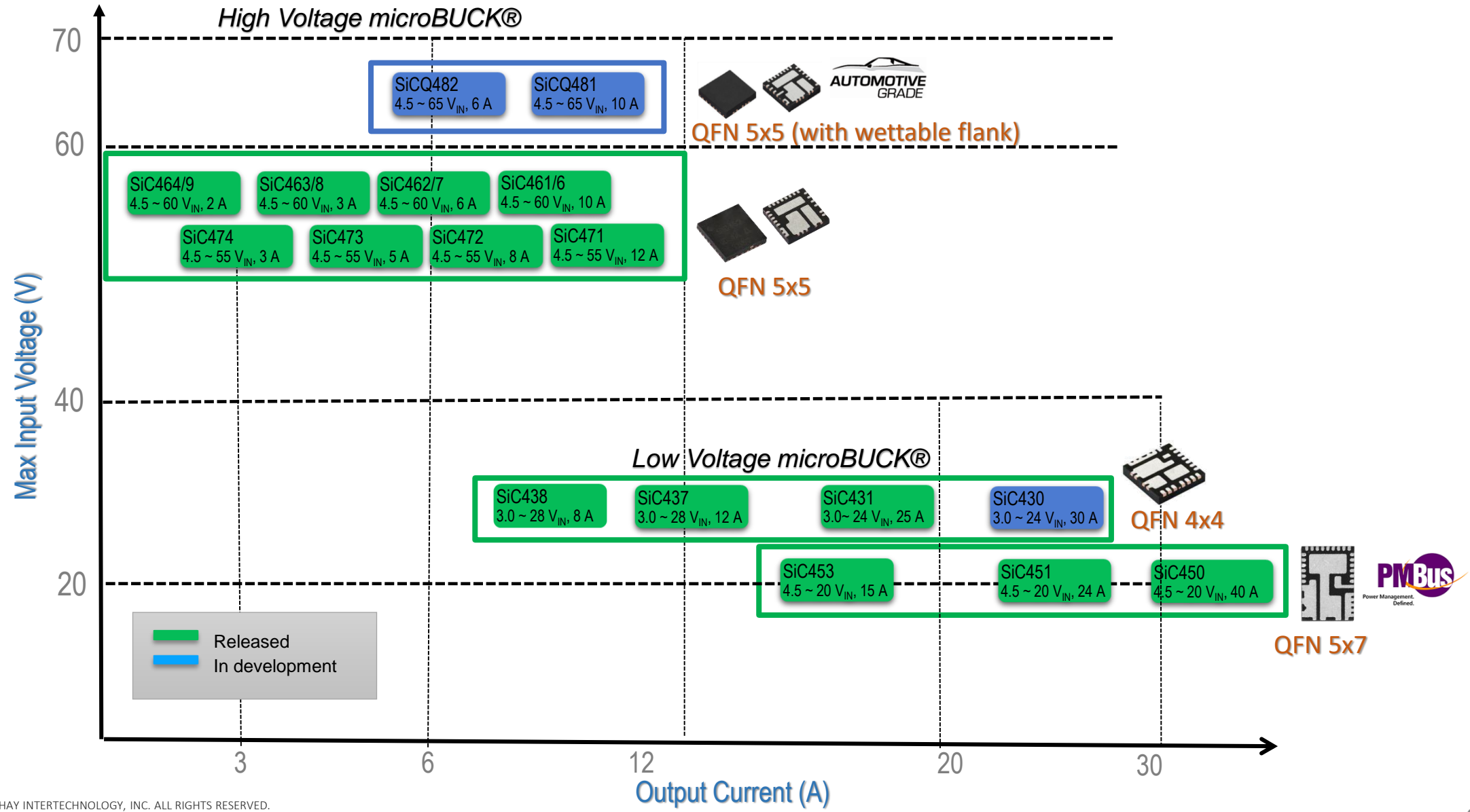
## Powering Industry 4.0

- Point of Load converters
  - Buck regulators
    - $\mu$ Buck
    - $\mu$ Brick
- Power Inductors
  - IHxx:
    - Vertical
    - EMI Shielded
    - Low DCR

## Feeling VR with Vishay

- Optical:
  - Sensors:
    - Force, Illumination, Proximity
  - Emitters:
    - New Generations of IR-LEDs
- Haptic Feedback:
  - Magnetic Actuator

# microBUCK® Product Family

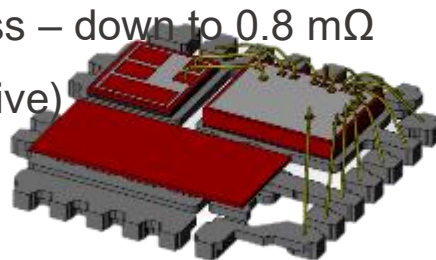


# Vishay POL Solutions

## microBUCK® Key Advantages

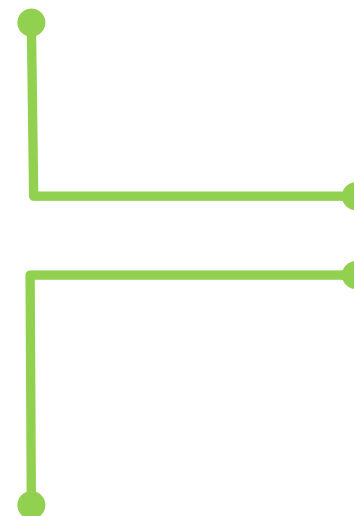
### High Side and Low Side MOSFETs

- Vishay's state of the art TrenchFET® technology
- Very low on-resistance with high density process – down to 0.8 mΩ
- 150 °C operating temperature (160 °C Automotive)



### High Side MOSFET

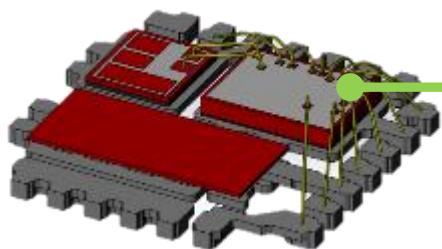
- Very low QSW and QGD reduce switching-related power loss in fast-switching designs
- Rugged MOSFET with wider safe operating area



### Low Side MOSFET

- Low gate capacitance ratio (QGD / QGS) improves switching characteristics
- Enhanced immunity to gate coupled noise and shoot-through
- Monolithic Schottky improves reverse recovery characteristics (Qrr)

# microBUCK® Key Advantages



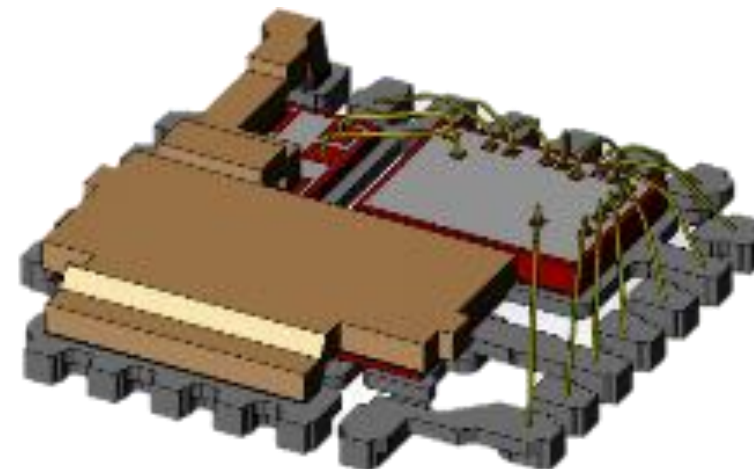
## IC CoT Controller

- Wide operating voltage (4.5 V – 65 V)
- Low quiescent current => high efficiency at light loads
- Internal/external compensation options
- Lower component counts and design complexity
- Full protection set (OC, OV, OT, and UV)
- Fast transient response
- PMBus 1.3 interface

# microBUCK® Key Advantages

## Package

- Thermally enhanced QFN package
- Highest power density
- Large power ground pad with improved coupling to the PCB
- A single clip forms the SW node connection
  - reduced source inductance (100 pH versus 250 pH)
  - lower switching losses

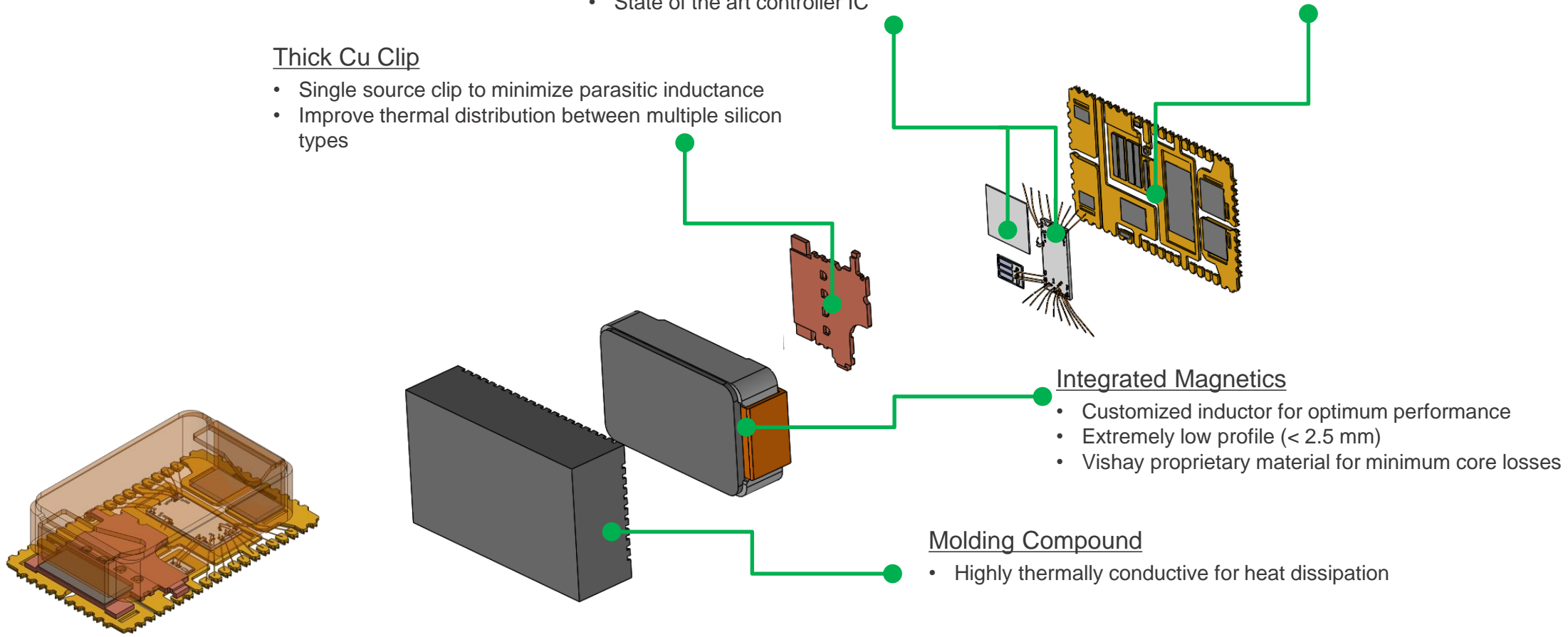


# microBUCK® Advantages Summary

- Highly efficient – up to 98 %
- Superior thermal performance
- Highly configurable –
  - adjustable frequency (to 2MHz), current limit, soft start, EN threshold
- Robust and reliable –
  - over voltage, under voltage, short circuit protection & over temperature
- High power density – up to 200 W
  - 4 x 4 mm & 5 x 5 mm package, 0.75 mm profile
  - Fast switching frequency = smaller, lower cost inductor
- Fast transient response = smaller output caps
- Versatile
  - configurable to numerous application requirements
- Scalable families
  - same package & pin out, with various current capabilities



# microBRICK® 3D Package Technology at a Glance



### Thick Cu Clip

- Single source clip to minimize parasitic inductance
- Improve thermal distribution between multiple silicon types

### IC and MOSFETs

- Leveraging silicon from microBUCK® product families
- Latest trench MOSFET technology
- State of the art controller IC

### Lead Frame

- Thermally enhanced lead frame
- Mechanically rugged for MCM package
- Minimize conduction losses

### Integrated Magnetics

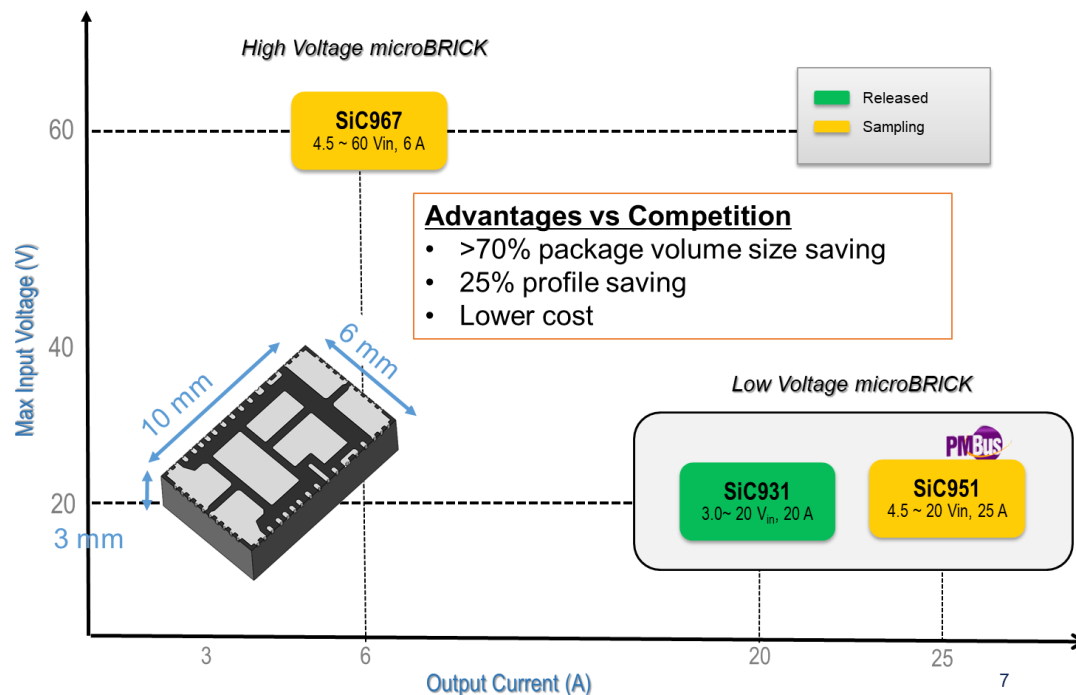
- Customized inductor for optimum performance
- Extremely low profile (< 2.5 mm)
- Vishay proprietary material for minimum core losses

### Molding Compound

- Highly thermally conductive for heat dissipation

# Vishay microbrick® Modules

## POL regulator with MOSFETs, IC and Integrated Magnetics



- Why choose DC/DC modules over discrete, or integrated solutions?

- Significantly reduces converter real-estate
- Reduction in design cycle cost
- Significant reduction in design cycle time
- Power design expertise not required
- Easy of design, requiring few peripheral components
- Robust and reliable
- Versatile and configurable, with PMBus

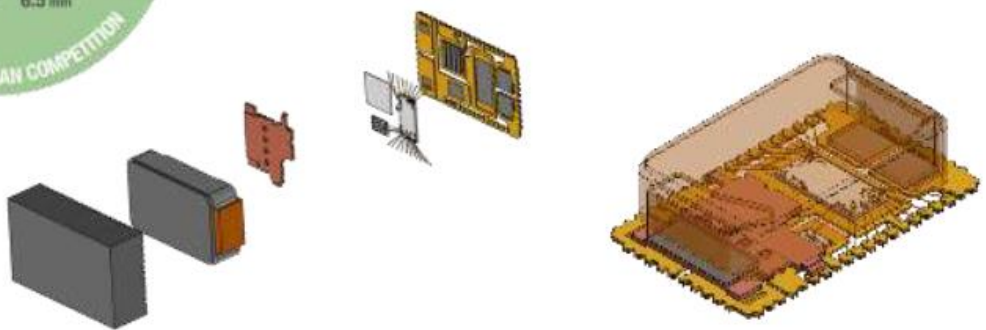


- Why choose microBRICK® over competition modules?

- Significantly smaller, lower profile package
  - Achievable with a thermally superior package lead-frame
- Lowest price
  - Affordable modular solution
  - Competition modules will cost considerably more
- Low operating temperature
  - Improved reliability
  - Supports higher ambient temperatures
- Tight ripple regulation at light loads
  - Up to 2 MHz switching frequency



# microBRICK<sup>®</sup> Featured Product Families



Device	V <sub>IN</sub> range	V <sub>OUT</sub> down to	Current	Package dimensions in mm
SiC931	4.5 V to 18 V	0.6V	20 A	10.6 x 6.5 x 3.0
SiC951	4.5 V to 20 V	0.3V	20 A	10.6 x 6.5 x 3.0
SiC967	4.5 V to 60 V	0.8 V	6 A	10.6 x 6.5 x 3.0



## MicroBRICK Key Advantages

### Compact & power dense

- smallest modules on the market, with lowest 3 mm profile (60% smaller than competition)

### Ease of design

- Integrated modular design, requiring little power expertise

### Price competitive

- below \$10 for low volume

### Low peripheral component count

- integrated controller, MOSFETs & inductor

### Robust and reliable

- PowerPAK<sup>®</sup> package, multiple protection features

# Agenda Industry 4.0

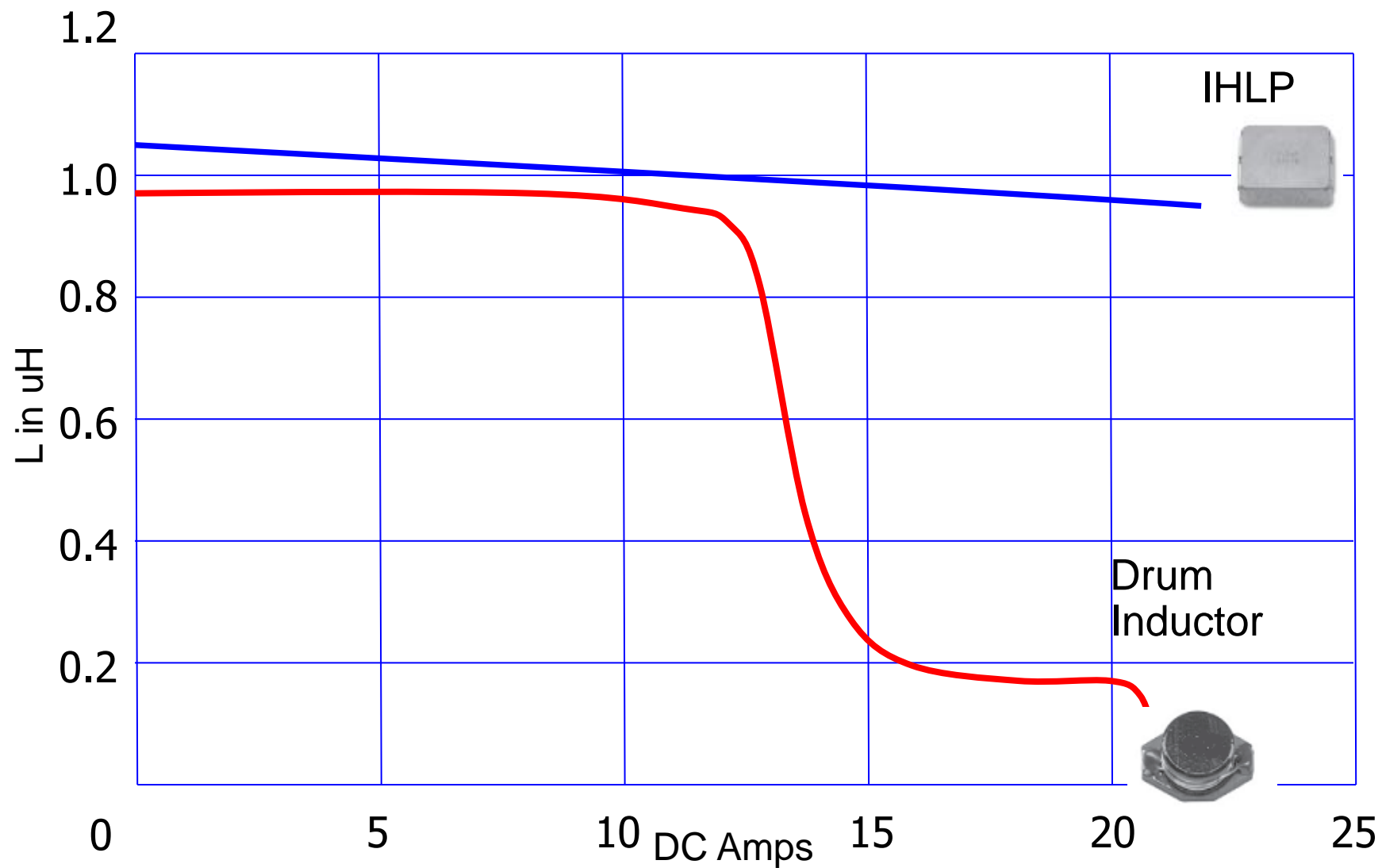
## Powering Industry 4.0

- *Point of Load converters*
  - *Buck regulators*
    - $\mu$ Buck
    - $\mu$ Brick
- **Power Inductors**
  - **IHxx:**
    - **Vertical**
    - **EMI Shielded**
    - **Low DCR**

## Feeling VR with Vishay

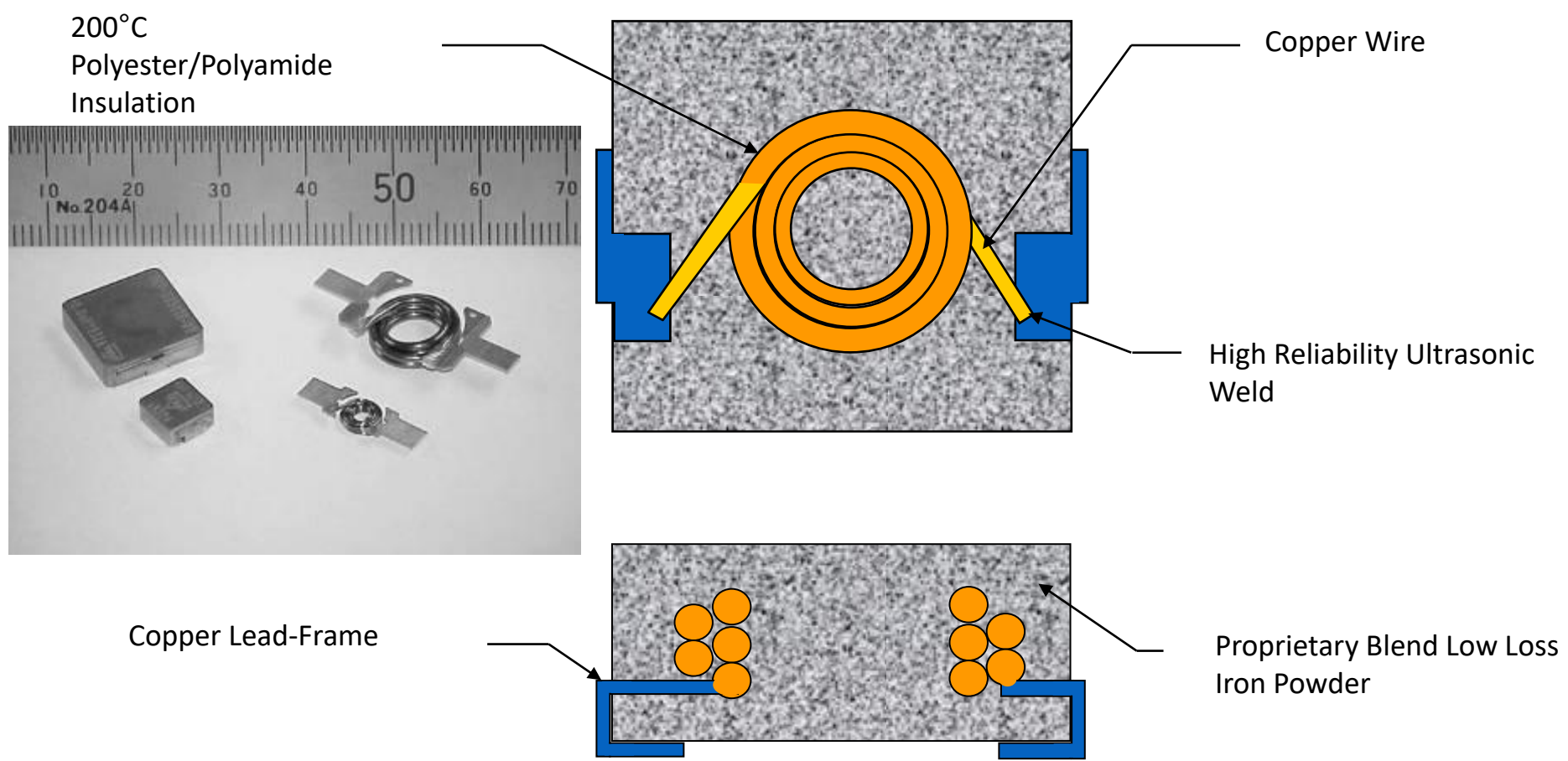
- Optical:
  - Sensors:
    - Force, Illumination, Proximity
  - Emitters:
    - New Generations of IR-LEDs
- Haptic Feedback:
  - Magnetic Actuator

## Important Parameters of Inductors - Saturation



# IHLP Construction

**100% RoHS Compliant**



Power Inductors from 5A to over 300A are the major focus of Vishay Standard Inductor products. Largest selection of size, inductance values, and materials available

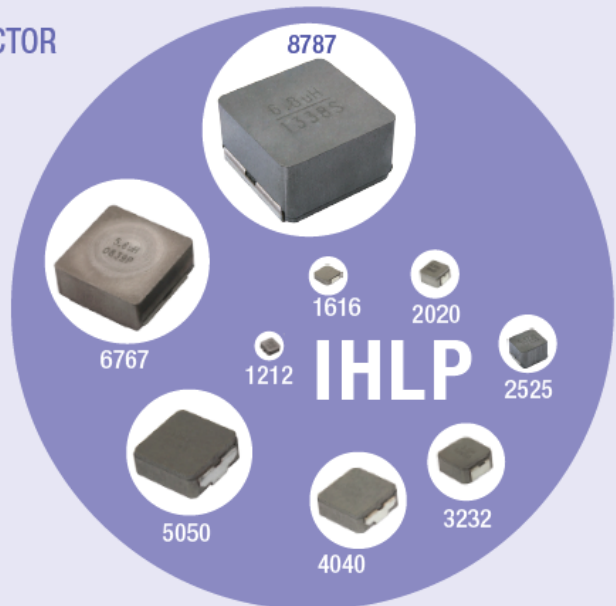
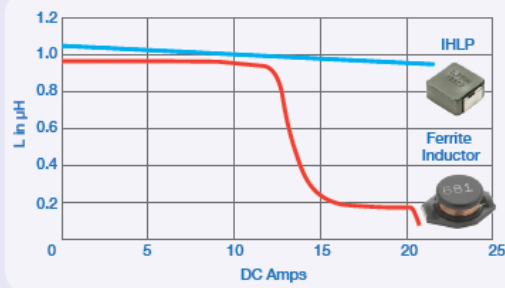


# IHLP® POWER INDUCTORS

## LOW-PROFILE POWER INDUCTORS

# IN A NUTSHELL

### SATURATION – IHLP VS. FERRITE INDUCTOR



### NINE FOOTPRINTS AVAILABLE WITH A VARIETY OF HEIGHT OPTIONS

Size	Current rating for 1 µH (A)	Foot-print (mm)	Profile	Profile height (mm)
1212	4.5	3 x 3	AZ, AB, BZ	AZ = 1.0 AB = 1.2
1616	4.5	4 x 4	AB, BZ	AH = 1.8 BZ = 2.0
2020	9.2	5 x 5	AB, BZ, CZ	BD = 2.4 CZ = 3.0
2525	13.0	6 x 6	AH, BD, CZ, EZ	CE = 3.5 DZ = 4.0
3232	18.0	8 x 8	CZ, DZ	EZ = 5.0 FD = 6.4
4040	20.0	10 x 10	DZ	GZ = 7.0
5050	32.0	13 x 13	CE, EZ, FD	MZ = 13.0
6767	48.0	17 x 17	DZ, GZ	
8787	69.0	22 x 22	MZ	

### APPLICATIONS

- DC/DC converters**
  - Power supplies for computers, notebooks, graphic cards, servers
- Class "D" amplifiers**
  - LCD TVs and portable MP3 speakers
- LED driver power**
  - Commercial LED lighting
  - LCD display backlights
- Automotive**
  - DC/DC converters
  - Filters for noise suppression

All currently available IHLP footprints meet or exceed AEC-Q200 Grade 0 and Grade 1 requirements

Four Different Material Types	Commercial Series	Automotive Grade Series
Original Series	IHLP - 01	IHLP - A1
Low DCR Series	IHLP - 11	IHLP - 1A
High Temp Series (+155 °C)	IHLP - 51	IHLP - 5A
High Temp Series (+180 °C)	IHLP - 81	IHLP - 8A

**IHLP 2525 CZ ER 1R0 M 01**

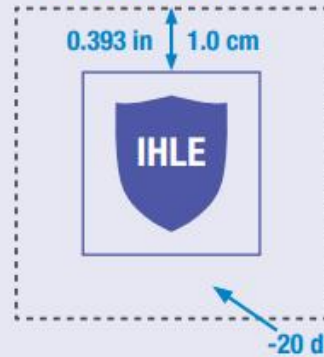
Series    Footprint (in)    Profile (mm)    Pb free/ Packaging    L(µH)    L Tol    Material/Special



# IHLE HIGH CURRENT INDUCTORS

## WITH INTEGRATED E-FIELD SHIELD

**Reduced** noise



**High** temperature operation to **+155 °C**

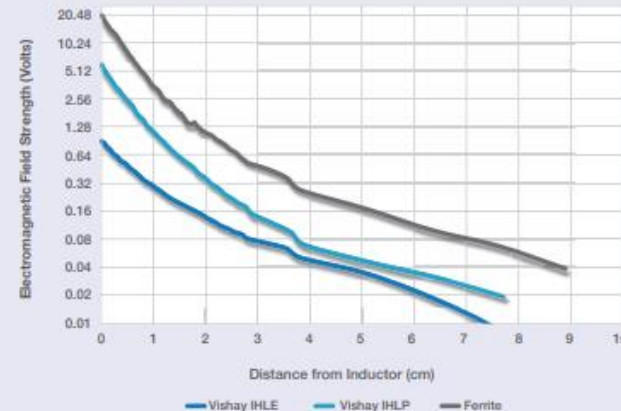


**Compact** size with **no additional external EMI shielding** required



This is an IHLP with an integrated E-Shield for an additional reduction in radiated EMI – up to 20dB

ELECTROMAGNETIC FIELD STRENGTH VS. DISTANCE FROM INDUCTOR



### APPLICATIONS



### FOOTPRINT AND PROFILE CAPABILITY

IHLE-2525	IHLE-3232	IHLE-4040	IHLE-5050
3.4 mm	4.4 mm	4.4 mm	6.8 mm

**Shown at actual size**  
(when viewed or printed at 100 %)





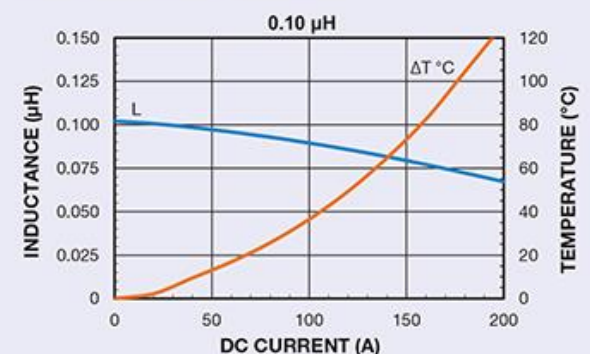
# Ultra Low DCR Inductors

## High Current, Vertical-Mount

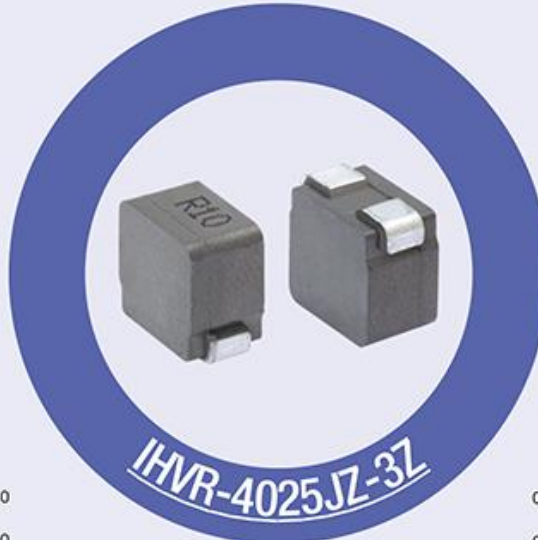
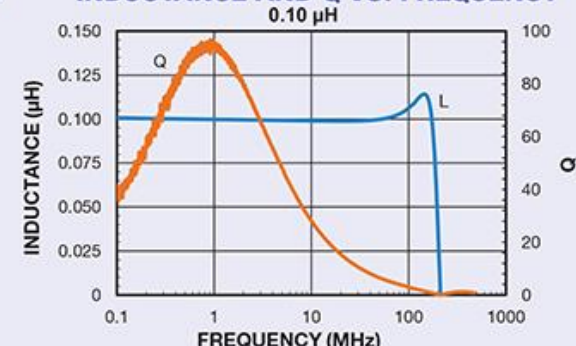
### KEY FEATURES

- High temperature up to 155 °C
- Shielded construction
- Excellent DC/DC energy storage up to 5 MHz
- Lowest DCR/μH in this package size
- Handles high transient current spikes without saturation
- Ultra low buzz noise due to composite construction

### PERFORMANCE GRAPHS



### PERFORMANCE GRAPHS: INDUCTANCE AND Q VS. FREQUENCY

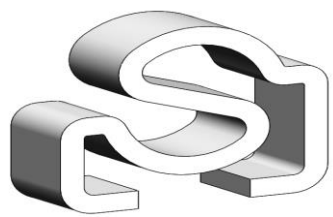


### APPLICATIONS

- Desktop / server applications
- High current POL converters
- Low profile, high current power supplies



This is an IHLP lower DCR and vertical mounting



### GLOBAL PART NUMBER



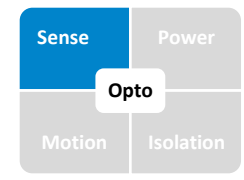
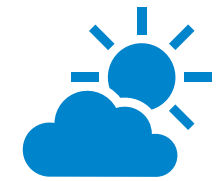
# Agenda Industry 4.0

## Powering Industry 4.0

- *Point of Load converters*
  - *Buck regulators*
    - *μBuck*
    - *μBrick*
- *Power Inductors*
  - *IHxx:*
    - *Vertical*
    - *EMI Shielded*
    - *Low DCR*

## Feeling VR with Vishay

- **Optical:**
  - **Sensors:**
    - **Force, Illumination, Proximity**
  - **Emitters:**
    - **New Generations of IR-LEDs**
- Haptic Feedback:
  - Magnetic Actuator



# VR: Light Sensors

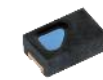
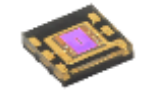
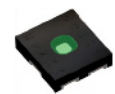
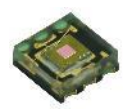


**Vishay position :**

- Technology leader for digital solutions by Filtron™ technology
- Strong market player with analog solutions
- available for automotive, industrial and consumer

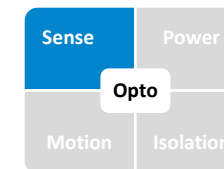
**Benefits :**

- Vishay can offer full range of solutions
- Analog & Digital
- Analog : Photo Pin Diodes and transistors
- Digital : 16 bit / I2C interface

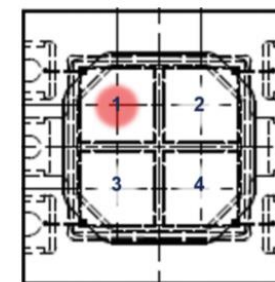
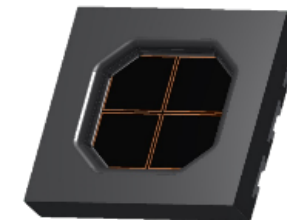
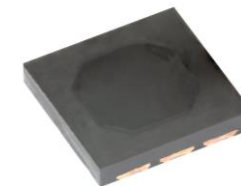


ALS	ALS	ALS	RGBW	ALS	ALS	ALS	ALS
2.0 x 2.0 x 0.85	2.7 x 2.5 x 0.6	2.0 x 1.25 x 1.0	2.0 x 2.0 x 0.4	2.0 x 1.25 x 0.85	2.0 x 1.25 x 0.7	5.0 x 4.0 x 0.9	5.0 x 4.0 x 0.9
Digital	Digital	Digital	Digital	Analog	Analog	Analog	Analog
VEML6030	VEML6031X01 VEML6030X00	VEML3235 VEML3235SL	VEML6035	TEMD6200FX01 TEMD6200FITX01 TEMT6200FX01	VEMD4200FX01	VEMD5510C VEMD5510CF	VEMD5510FX01
	SOP 2021						

# Photo Pin diodes



- K857PE is the industry's first 4-quadrant silicon PIN photodiode
  - Featuring FAM Package Technology
  - [Datasheet](#)
  - [Sensorstechsupport@vishay.com](mailto:Sensorstechsupport@vishay.com)



PRODUCT SUMMARY			
COMPONENT	$I_{ra}$ ( $\mu A$ ) ( $E_e = 1.0 \text{ mW/cm}^2, \lambda = 850 \text{ nm}, V_R = 5 \text{ V}$ )	$\psi$ ( $^\circ$ )	$\lambda_{0.1}$ (nm)
K857PE	8.5	$\pm 60$	690 to 1050

## Features :

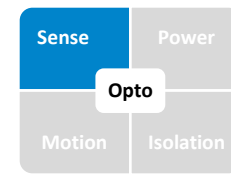
- 4 quadrant Photo Pin Diode
- Complete active area of  $6.4 \text{ mm}^2$
- Single Photo pin Diode with  $1.6 \text{ mm}^2$
- Epitactical PD with high linearity
- $4.72 \times 4.72 \times 0.8$
- $\pm 60^\circ$
- FAM package technology
- with  $8.5 \mu A$  reverse light current per segment

## Benefits :

- Combining high photo sensitivity with low 0.1 % crosstalk
- FAM package featuring excellent signal to noise ratio
- Virtually no tolerance between the segments

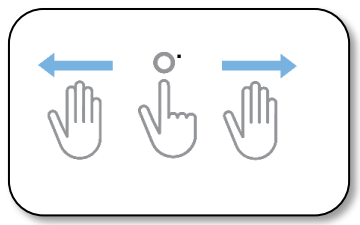
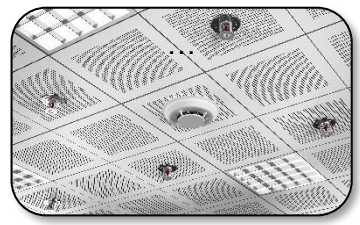
## Applications :

- Rain-Light-Tunnel-Sensor → Solar load function
- Laser position feedback
- Index Finger As Mouse → Up, down, left, right



# VR: High power Infrared

- <http://www.vishay.com/ir-emitting-diodes/>

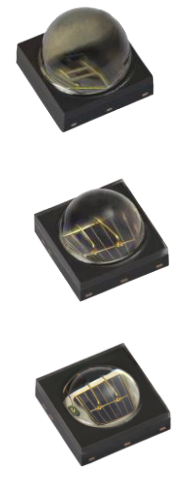


Vishay position :

- Strong market position in EUROPE
- Major player in industrial and automotive
- Single Stack process available
- Double Stack die technology available

Benefits:

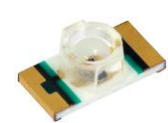
- Broad base portfolio
- Flexibility for customized products
- Vishay offers matching detectors



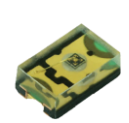
3 mm  
VS LY3..



5 mm  
VS LY5..



Inner Lens  
VS MY12..



0805  
VS MY1...



0805 FAM  
VS MY4



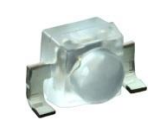
0805 FAM  
VS MY5



VSMY14...



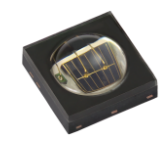
Dome lens  
VS MY2...



Dome lens  
VS MY2..SL

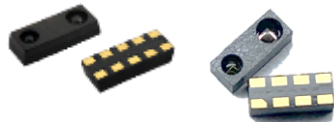


PLCC-2  
VS MY3...



„Astral“  
QFN  
VS MA...  
SOP 2021

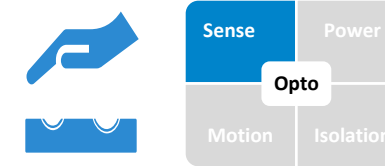
# VR: Proximity



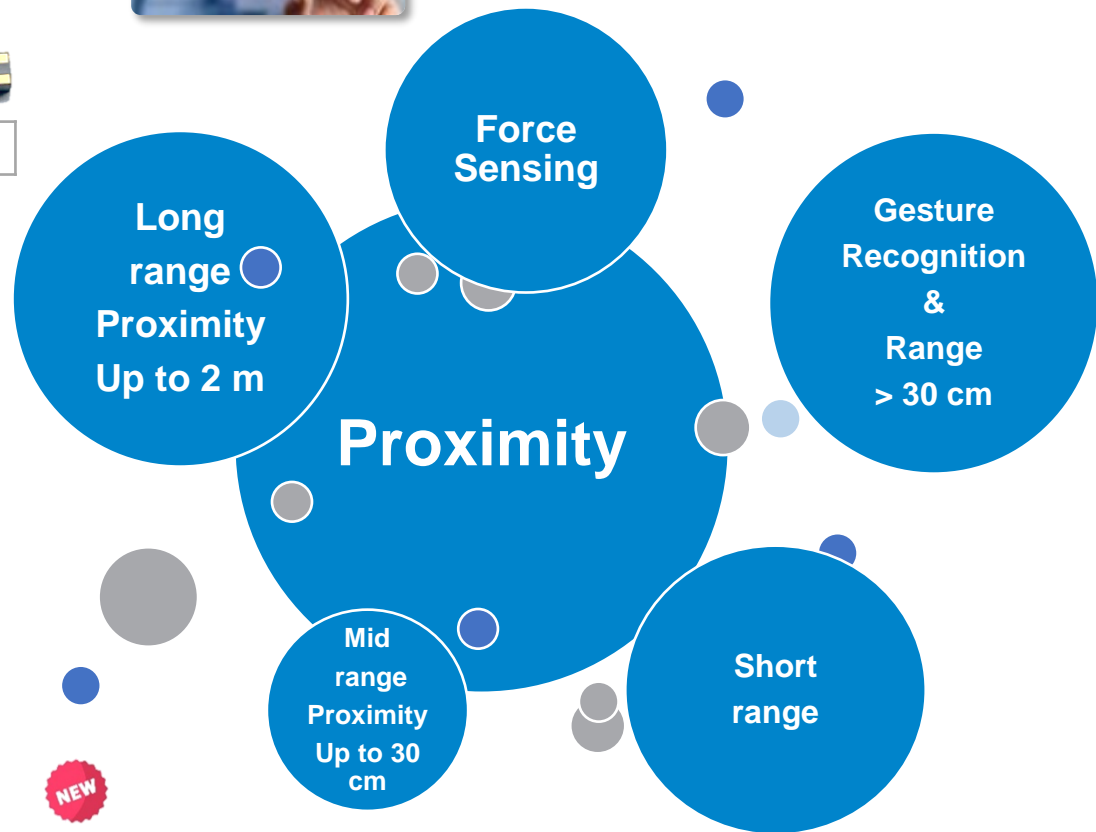
VCNL4200	VCNL4300 SOP 2022
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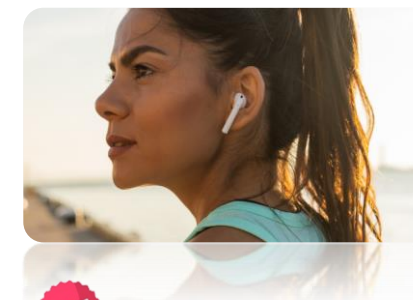
VCNL4030X01	VCNL3030X01
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VCNL4035X01	VSMY2890...	VSMY5890X01
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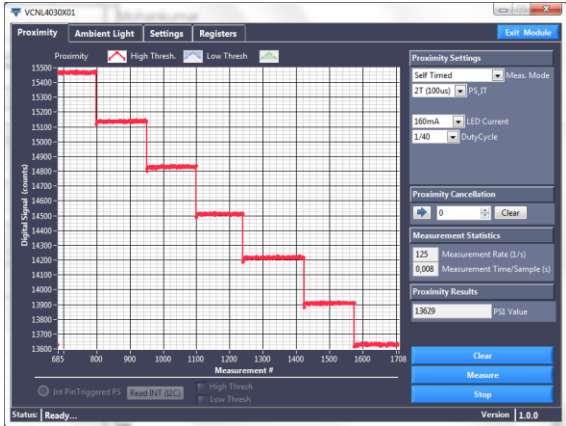
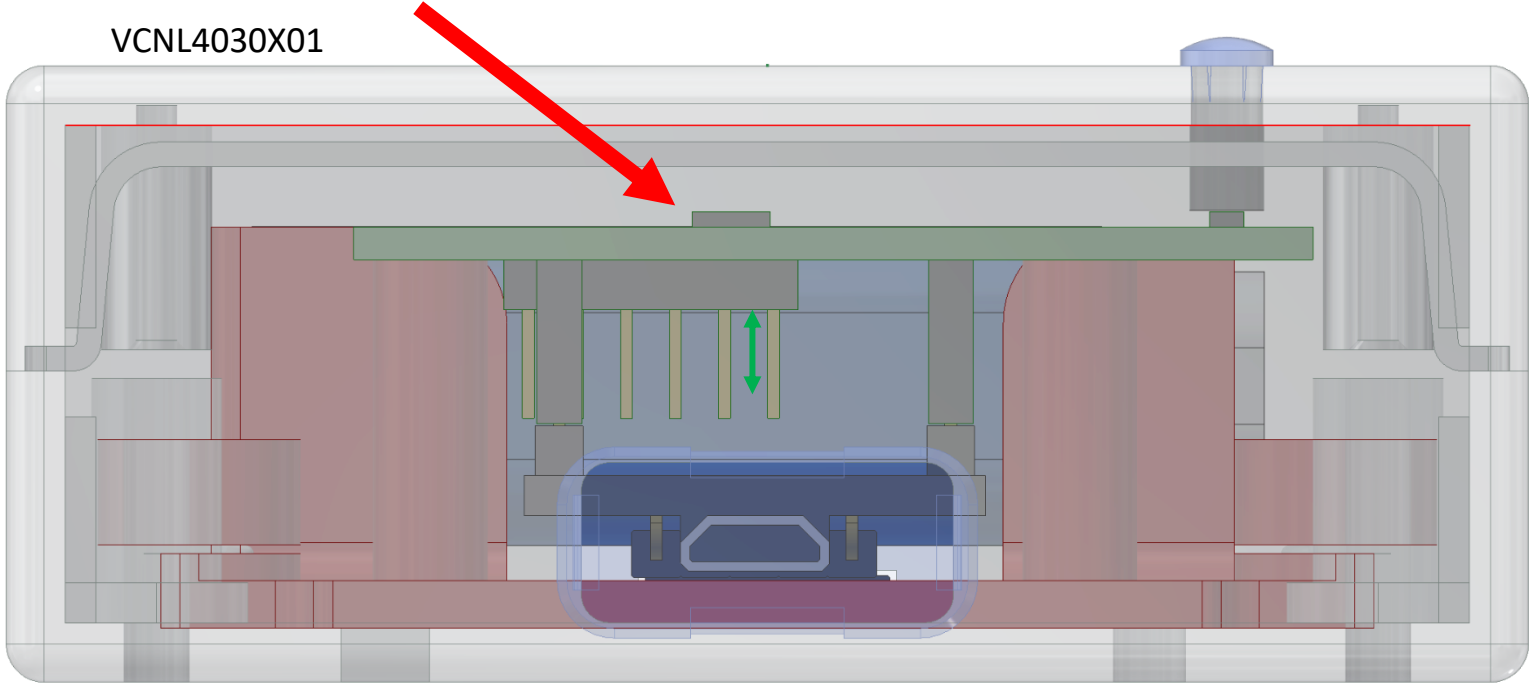


VCNL4030X01	VCNL4035X01	VCNL36687S	VCNL36826S
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VCNL36826S	VCNL36825T	VCNL36828P SOP 2021
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# Force sensing Demo Box Operation



d [mm]	Counts	Delta
3	16.860	366
3,05	16.494	334
3,10	16.160	370
3,15	15.790	318
3,20	14.472	337
3,25	15.135	298
3,30	14.837	325
3,35	14.512	297
3,40	14.215	302
3,45	13.913	284
3,50	13.629	

# Agenda Industry 4.0

## Powering Industry 4.0

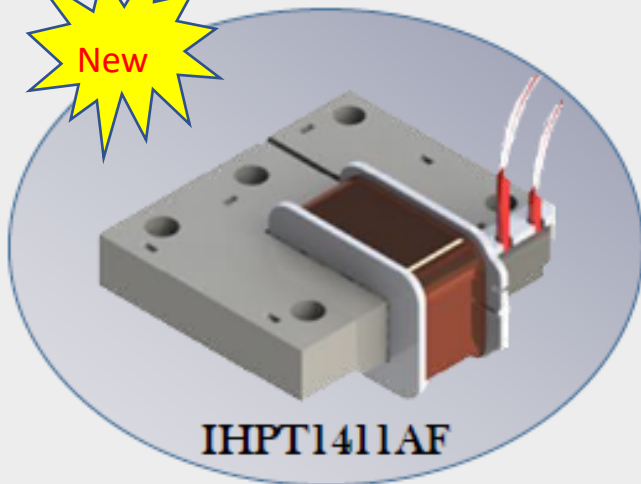
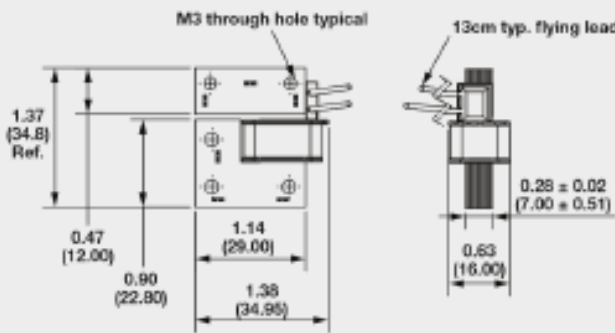
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    - *μBuck*
    - *μBrick*
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    - *Vertical*
    - *EMI Shielded*
    - *Low DCR*

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- *Optical:*
  - *Sensors:*
    - *Force, Illumination, Proximity*
  - *Emitters:*
    - *New Generations of IR-LEDs*
- **Haptic Feedback:**
  - **Magnetic Actuator**



## IHPT

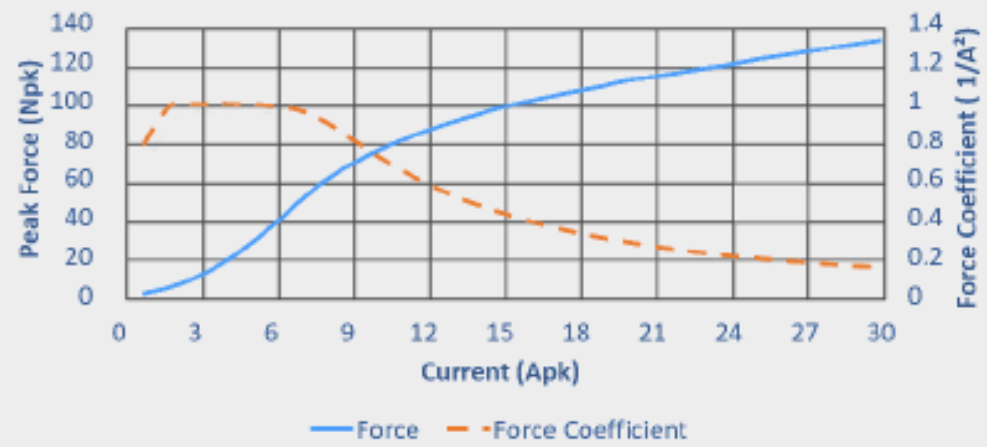


IHPT1411AF

### FEATURES

- Solenoid construction provides high impulse vibration for clear feedback in noisy environments
- Standard lead terminations include tinned self-lead and Molex connectors
- Available in a 2-piece open construction for direct application of force
- Easily customizable

### IHPT PEAK FORCE RESPONSE



Applied force, in newtons, can be estimated by the following:


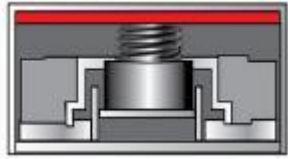

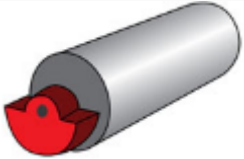
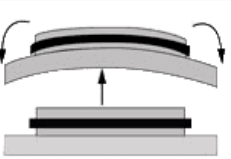

$$F = \text{Force Coefficient} \times I_A^2$$

### APPLICATIONS

- Automotive dashboards and center consoles
- physical feedback for electronic shift transmissions
- touch screens for human-machine interfaces



# COMPARISON OF HAPTIC ACTUATOR TECHNOLOGIES

	Linear Solenoid	Linear Resonant	Linear Wideband	Eccentric Rotating Mass	Piezos
					
<b>Principle of Operation</b>	Electromagnetic device that converts electrical energy into linear motion	Magnet attached to a spring that modulates	Similar to an LRA but will accelerate over a wide range of frequencies	DC motor attached to an off-center mass	Thin layers of piezo-electric material that bend
<b>Response Time</b>	<5msec	20-30msec	<10msec	40-80msec	<1msec
<b>Force</b>	 Highest	Lowest	Lowest	Low	Low
<b>Voltage</b>	8-16Vdc	2Vrms	2Vrms	2.5V-5.5Vdc	50-200Vp-p
<b>Cost</b>	Low	High	High	Lowest	High
<b>Noise</b>	Good	High	High	High	Best
<b>Durability</b>	Good	Good	Good	Good	Poor

**Solenoid offers Highest Force and Quick Response**



# Thank you so much for your attention Questions?

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