



# C&K<sup>®</sup> Switches for Two-Wheelers & Recreational vehicles

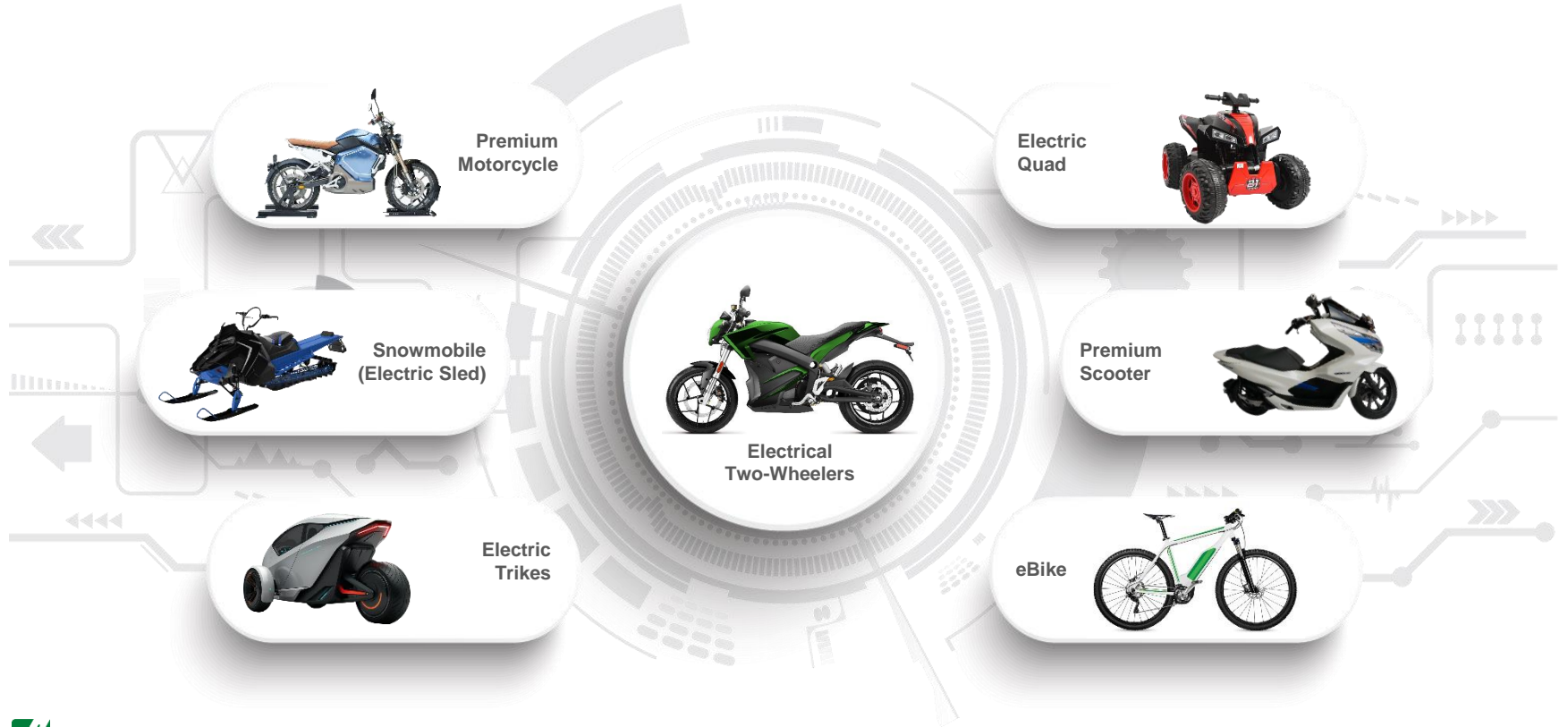


Transportation



Expertise Applied | Answers Delivered

# Recreational vehicles



# By fulfilling zero-emission mandates, electric two-wheelers and three-wheelers help improve air quality

Battery capacity 500 Wh

1,000 Wh

3,000 Wh

5,000 Wh

7,000 Wh

10,000 Wh



**e-Kick scooter**  
(600 W–1.5 kW)



**Electric bike**  
(250–900 W)



**Electric motorcycle**  
Asia: (3–25 kW)  
Rest of the world: (20–200 kW)



**Electric two-wheeler**  
(400 W–4 kW)



**Electric utility vehicle**  
(5–20 kW)



**Electric three-wheeler**  
(2–8 kW)

Battery voltage range: 24–96 V

# Electric two-wheeler and three-wheeler market trends and drivers

## Market trends and drivers

The global electric two-wheeler and three-wheeler market is projected to grow from 1.05 M units in 2021 to 19.11 M units by 2031, at a CAGR of ~34%

The global electric two-wheeler and three-wheeler Li-ion battery pack market has shown double-digit growth. The limited life cycle and usable capacity are likely to shift the focus from lead acid batteries to Li-ion batteries

Li-ion batteries are lightweight, which helps maintain the energy-to-weight ratio of the vehicle

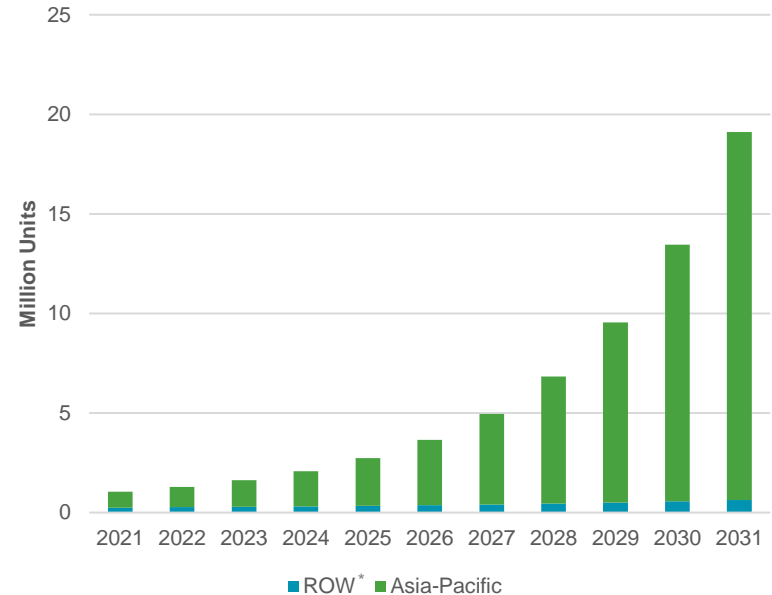
Most battery packs are 48 V; higher-end models (> 20 kW) also come with 60–96 V battery pack

Asia Pacific is expected to be the largest market. China spent about \$2.4 B by 2020 to improve its charging facility infrastructure

The Indian government has undertaken initiatives, such as FAME-II, offering subsidies and tax exemptions to encourage buyers to change from ICE bikes to electric two-wheeler and three-wheeler to reduce Carbon emissions

Currently, 27 European countries have imposed taxes on carbon dioxide emissions related to vehicles

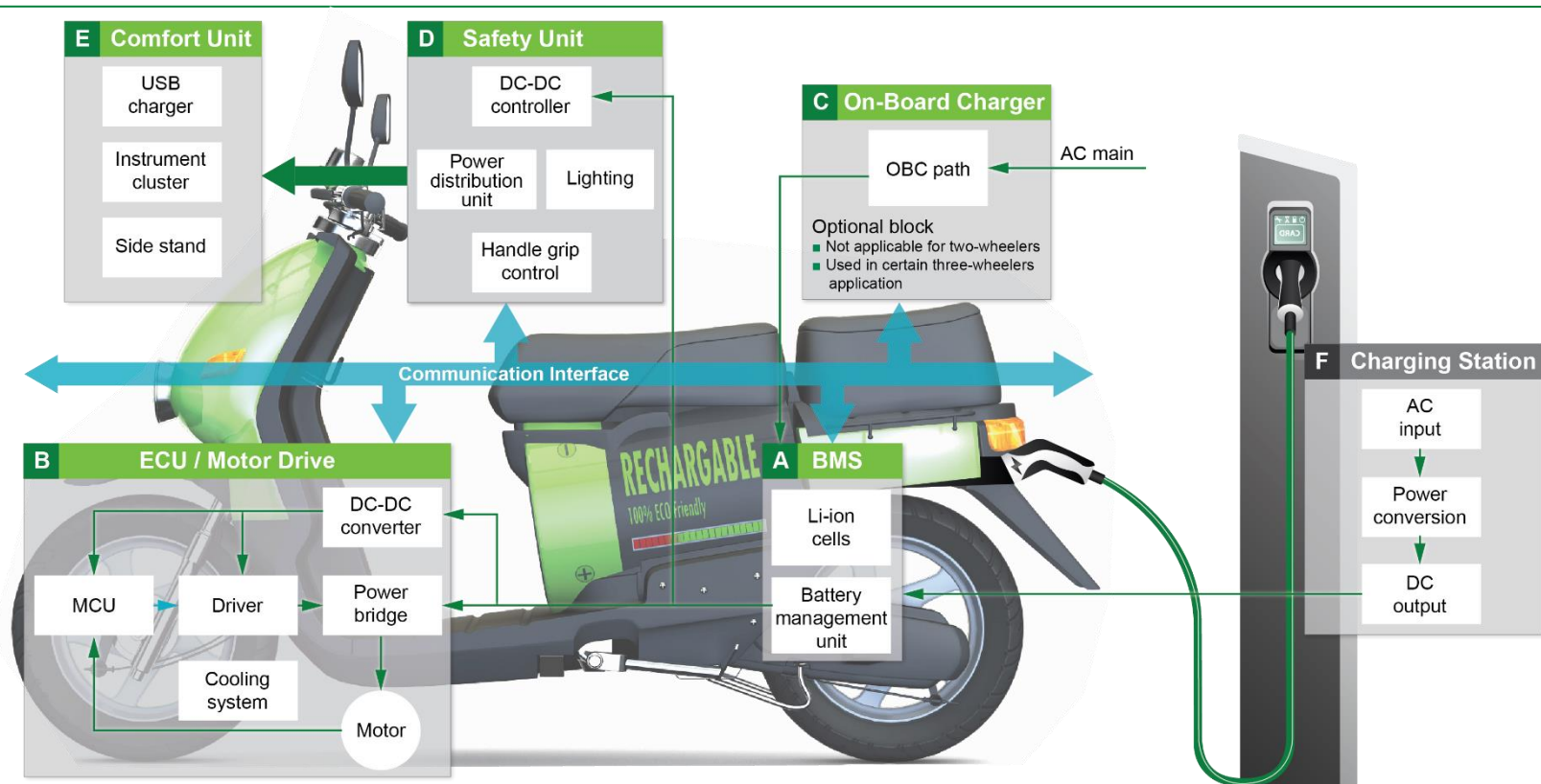
## Rapid growth of electric two-wheelers and three-wheelers



Source: CEEW, Littelfuse estimates (does not include kick scooter, electric bike, or Chinese electric two-wheeler forecast)

\* Rest of the world

# Electric two-wheeler and three-wheeler system architecture



# Littelfuse solutions for electric two-wheelers

## Comfort Unit (USB/Charging Port, Cluster, Side Stand)

TVS Diode, PPTC, Reed Switch



## ECU/Motor Drive

TVS Diode Array, Si MOSFET  
Hall Effect Sensor, NTC



## Safety Unit (Lighting, PDU, Handle Grip Control)

Fuse, TVS Diode, MOV, Switch



## EV Charging

Fuse, MOV, GDT, Diode,  
MOSFET, Gate Driver



## Battery detection

Snap-acting, Key Switch



## Battery Management System

Fuse, TVS Diode, TVS Diode Array,  
NTC, Reed Switch, Switch



## On-Board Charger

Fuse, MOV, TVS Diode, SiC Diode, NTC



## Handle grip control


Tactile, Snap-acting, Key Switch



Click on the link to learn more about Littelfuse solutions for 'Two/Three Wheelers'



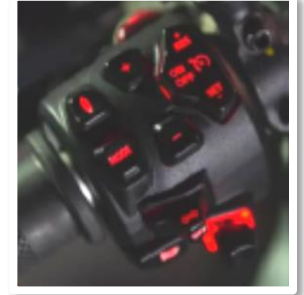
# C&K Switches features and benefits for two-wheelers

 Click the product series in the table below for more info

	Switch type	Function in application	Product series	Benefits	Features
1	Snap Switch	Enables battery detection switching	<a href="#">ZMS</a> , <a href="#">ZMSM</a> , <a href="#">LCS</a> , <a href="#">ZMV</a> , <a href="#">ZMW</a>	Mini size snap-acting switches are known for their reliable snap-acting mechanisms, precisions, compact sizes, and long electrical and mechanical lifespans, making them ideal space is limited	Compact size; IP65/IP67; SPST NO/SPST NC/SPDT; Value add solutions available: encapsulation of wires, wire harness; Integrated resistors for diagnostics; automotive grade products
	Tactile Switch	Handle grip control	<a href="#">KSC</a>	With its versatility, the KSC series boasts a high number of actuations, haptic selection and haptic homogeneity integration support; rated IP67 and above; features a new <a href="#">Electrical Height (EH version)</a> , for easier integration calculations	Possible to combine high force (4-10N), high tactile ratio and long lifetime (up to 10M cycles); range of possible haptics to best fit the targeted use; IP67; Electrical Height (EH) version available
<a href="#">EL2</a>			Entry level series of mid-size sealed tactile switch; features basic characteristics with operating life at 200K cycles; ruggedness and IP67 rating are mainly recommended for basic application	6.2 x 6.2 mm form factor; heights 3.5 & 5.2 mm; actuation forces 2 & 3.5N; IP67; life expectancy 200K cycles	
<a href="#">RK</a>			A low-profile, microminiature SMT top-actuated tactile switch, offering various actuation force options and a long lifespan; it is perfect for applications requiring a high component density in limited PCB space	Low profile and microminiature package (RKA2: 4.5 x 4.5 x 0.55 mm/ RKB2: 4.2 x 3.2 x 2.5 mm/ RKC: 3.5 x 2.6 x 1.4 mm); SMT termination; hard actuator; life expectancy up to 500k life cycles	
2	Key Switch		<a href="#">K12S</a>	Offers an abuse-proof design; a wide range of travel and actuator forces providing strong tactile feedback; integrated illumination simplifies the design; can be sealed for environmental protection and are available in double stroke or detector versions; adapted to ride with gloves	Long travel and high actuation force; adapted to ride with gloves; multiple contact configurations (SPST, DPST, NO/NC) ; large range of actuation forces (from 3.5N (Detect) to 12N (Tactile effect)); illumination option; IP67 sealed; suitable for switching low-level signal circuits and CAN-BUS technology

# Handle grip controls

- These are electro-mechanical switches, used underneath the buttons to provide the user with haptic feedback
- All buttons need to be ergonomic for the driver, including when wearing gloves
- All functions must be intuitive
- Correct illumination required



# Handle grip controls for premium motorcycles

## Keyswitch K12S Series

- Abuse-proof design
- SMD soldering
- Sealing option
- Small form factor
- Long travel and high actuation force, adapted to ride with gloves
- Multiple contact configurations (SPST, DPST, NO/NC)
- Large range of actuation forces (from 3.5N (Detect) to 12N (Tactile effect))
- Illumination option
- Suitable for switching low-level signal circuits and CAN-BUS technology

Its unique design separates the electrical and mechanical functions of the switch

## Actuation

- Large actuation surface: Ø5 mm
- Able to operate with 3° rocking angle
- Not sensitive to off-centered actuation: 0.5 mm max

## Environment

- High sealing level for wet/harsh environment
- Robust design: overload 100N with abuse-proof contacts, and self-cleaning contacts



# Handle grip controls solutions

## Tactile Switches

### KSC Series

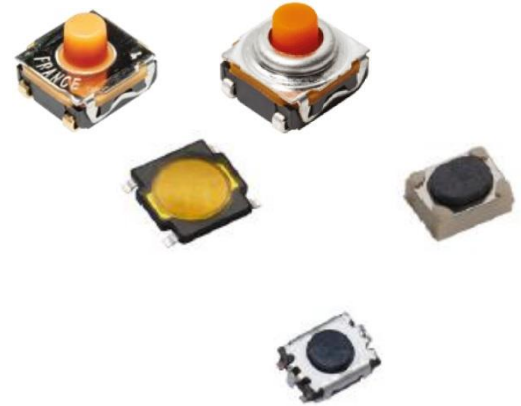
- IP 67
- Long life up to 2 million cycles
- Detect versions
- SPDT version suitable for self-diagnosis
- Overload-friendly configurations
- Forces up to 9.8N
- Silver or gold plating
- Different sounds and haptics available

### EL2 Series

- Actuation forces 2 & 3.5N
- IP67
- Life expectancy 200K cycles

### RKX Series

- Low profile
- IP40
- Three compact form factors
- Up to 5.4N actuation force



# Battery detection solutions

## Snap Switches

### ZMS & ZMSM Series

- IP 65
- SPST NO / SPST NC / SPDT
- Long electrical and mechanical life
- Compact size: ideal when space is limited
- Various PCB terminals and actuators
- Specific lever on demand



## ZMV & ZMW Series

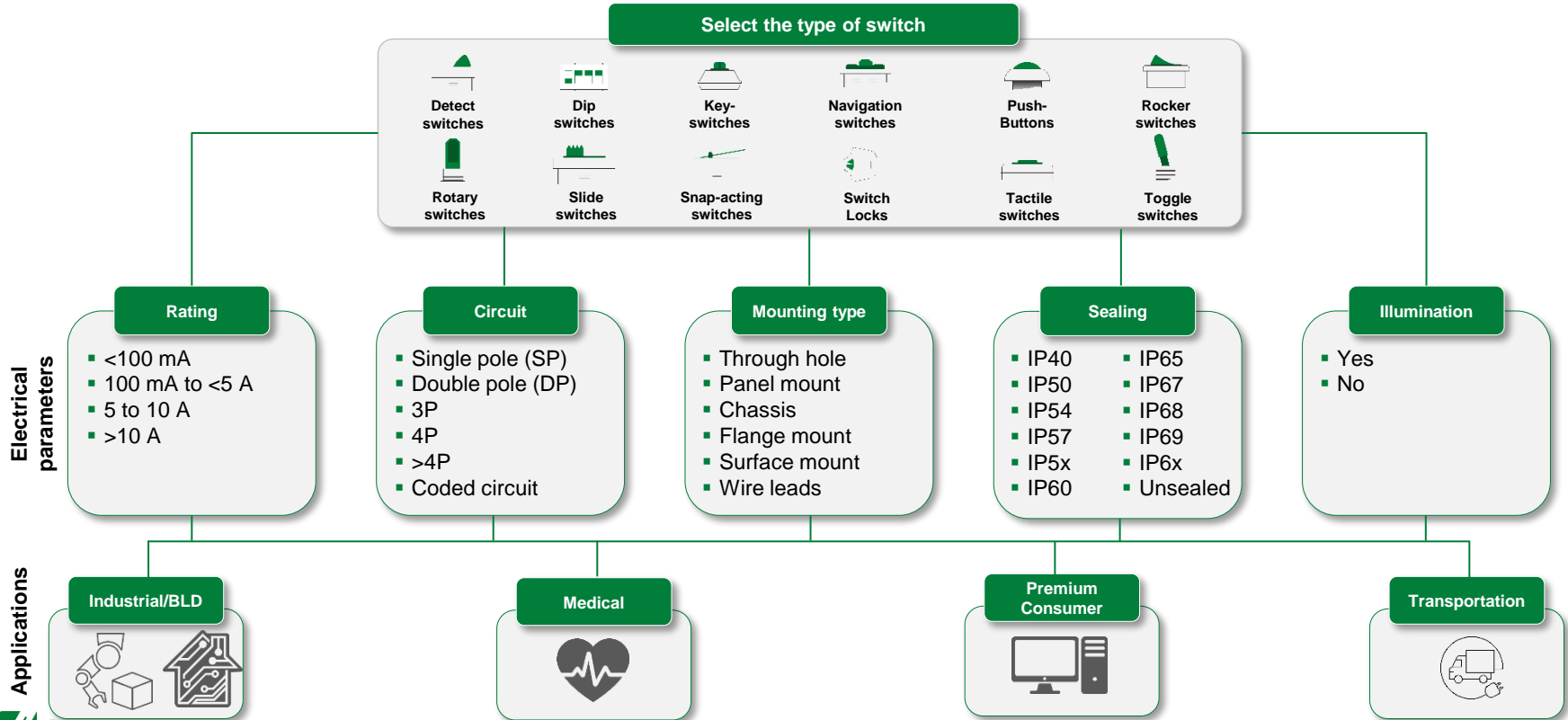
- IP 67 (except terminal part; fully IP67 on potted wire versions)
- SPST NO / SPST NC / SPDT
- Silent actuation for reduced audible click
- Up to 3 mm stroke
- Twin sliding contacts design
- Lever option

## LCS Series

- IP67
- SPST NO / SPST NC / SPDT
- Quick connect, solder, and PC terminals
- Wide variety of levers and actuators
- Long life and high electrical capacity



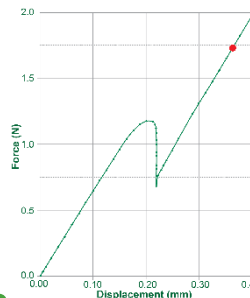
# Selecting a Switch



# C&K customization expertise

## Enhance user experience

- Customized Haptic Switches
  - Desirable appearance, feel & sound
- Decorative solutions
  - Custom graphics, logos, & textures
- Lighting
  - Backlight accenting & light piping to enhance your product appearance

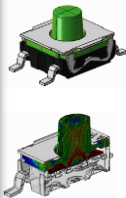


## Design & manufacturing tools

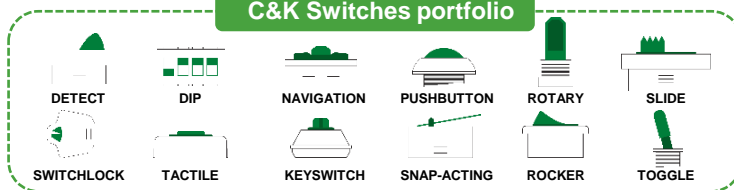
- 3-D CAD modeling
- Mold flow analysis
- FEA
- Dynamic motion analysis
- High-speed photography
- Fixed & dynamic X-ray
- Thermal imaging
- SEM/FTIR
- Sound chamber and force/displacement tester

## Value added services

- Designing switches into modules & assemblies
- Multi-function & multi-axis switching
- Integrating switches and electronics
- Provides wire harnesses, terminated wires, integrated connectors, or header pins



## C&K Switches portfolio



## Quality & reliability

- Develop & manufacture sealed switches to meet either IP67 or IP68 standard
- Harsh environmental compatibility
- Sweat resistance testing
- SO<sub>2</sub> and SO<sub>4</sub> gas testing



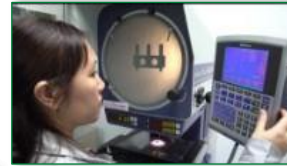
*Design products to meet customer requirements for haptic touch, look, sound, & other unique features*



# C&K manufacturing excellence

## Dole, France

- Vertically integrated, R&D (400 employees, defect rate < 0.5ppm)
- Proprietary equipment & methods
- Custom molds, dies & assembly machines
- Quality certifications (ISO 9001:2008, ISO 14001:2004, ISO 50001, TS 16949:2009, ESCC - MIL-NASA)



## Huizhou, China

- Vertically-integrated, R&D capabilities (800 employees, 60 lines, defects rate < 2ppm)
- Auto-assembly & Auto-inspection machines (80 sets, 90% In-house designed, cycle time 0.8s to 2s)
- Quality certifications (ISO 9001:2008, ISO 14001:2004, TS 16949:2009)

## Workshops

- 90% tooling designed and manufactured internally
- Stamping Workshops (Dole and Huizhou)
- Molding Workshops (Dole and Huizhou)
- Plating Workshops (Dole)
- Assembly Workshops (Dole and Huizhou)



## Hung Yen, Vietnam

- Built in 2019 (47 lines, 250 employees, and defects rate < 2ppm)
- Manual assembly lines with semi-automated machines and tools (Cycle time 2s, lean work cells, in-line QA processes)
- Quality certifications (ISO 9001:2015)

*Striving for complete customer satisfaction through state of art manufacturing facility & defect free performance*

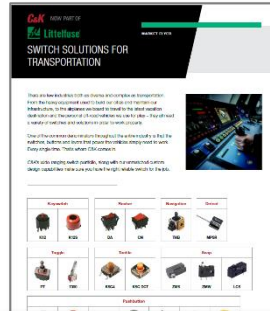


# Additional information can be found at [Littelfuse.com](https://www.littelfuse.com)

Explore the world of Littelfuse products and applications with ecatalogs ([ecatalogs.littelfuse.com](https://ecatalogs.littelfuse.com))



C&K Switches Selection Guide



C&K Transportation Flyer



Electric Two-/Three-Wheeler Spotlight



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# Local resources supporting our global customers



## Legend

- Sales
- R&D
- Manufacturing

# Partner for tomorrow's electronic systems

## Broad Product Portfolio

We are an industrial technology manufacturing company empowering a sustainable, connected, and safer world.

## Testing Capabilities

We help customers get products to market faster, and we offer certification testing to global regulatory standards.

## Application Expertise

Our engineers partner directly with customers to help speed up product design and meet their unique needs.

## Compliance and Regulation

We help customers during the design process to consider requirements set by global regulatory authorities.

## Global Customer Service

Our global customer service team is with you to anticipate your needs and ensure a seamless experience.

## Global Manufacturing

Our high-volume manufacturing is committed to the highest quality standards.





Expertise Applied | Answers Delivered

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