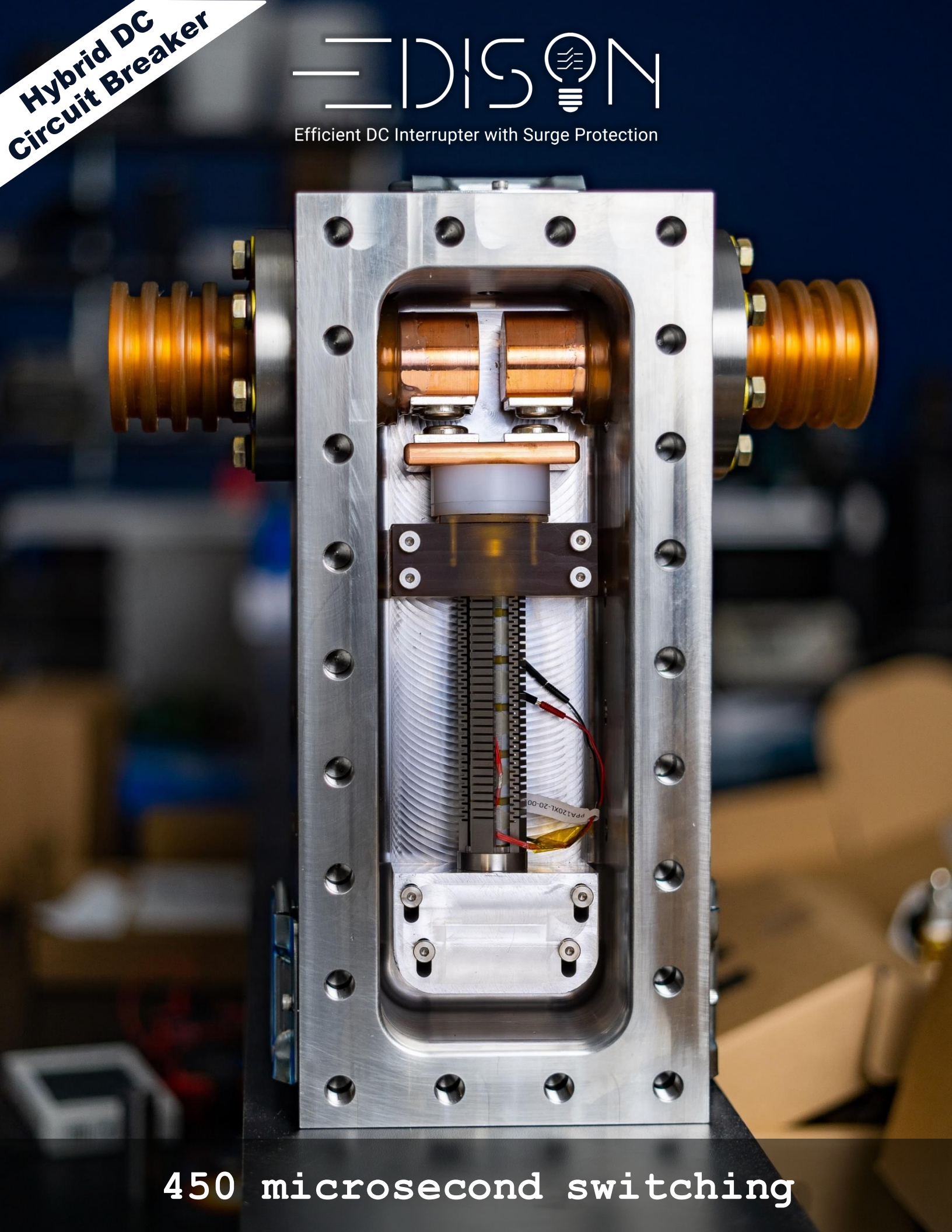
Hybrid DC Circuit Breaker

EDISON

Efficient DC Interrupter with Surge Protection



450 microsecond switching

Technical Details

EDISON breaker compared to typical values for mechanical breakers, solid-state breakers, and other hybrid breakers that we could either find described in the literature or actual products on the market.

	Mechanical	Solid State	Hybrid (a)	Hybrid (b)	EDISON
ON-state power loss	< 0.01%	> 0.3%	< 0.1%	< 0.01%	**< 0.01%**
Switching speed	10 – 100 ms	< 100 µs	< 2 ms	< 1 ms	**< 500 µs**
DC voltage limit	3 kV	Scalable	Scalable	Scalable	**Scalable**
Rel. power density	High	Low	High	Medium	**High**

Product Specifications

Specifications	Units	Value
Rated Voltage (DC)	kV	12
Peak Interruption Voltage	kV	24
Rated Continuous Current	kA	2
Peak Fault Current	kA	8
Minimum Source Inductance	µH	300
Maximum Energy Absorbed	kJ	30
Fault Clearing Time	µs	450
Trip Slew Rate	A/µs	40
	kA	3
FMS Volume	L	270
Power Density	MW/m³	60
Efficiency	-	99.97%
Power Density	MW/m³	60
Arc Energy in an incident*	cal/cm²	0.01
	J/cm²	0.04

* Calculation is based on an 8-kA fault current in 500 µs

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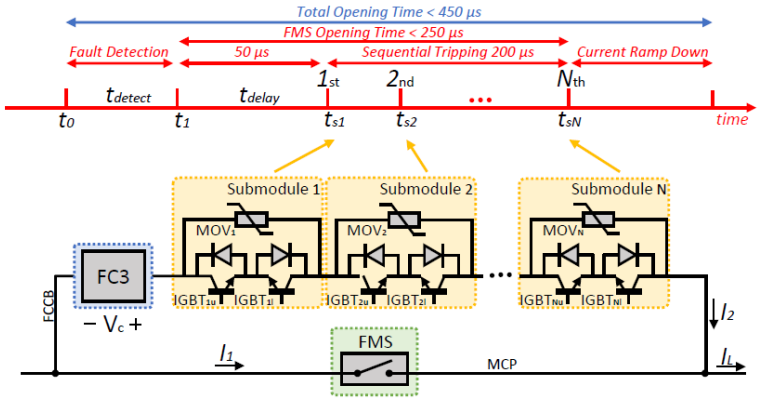
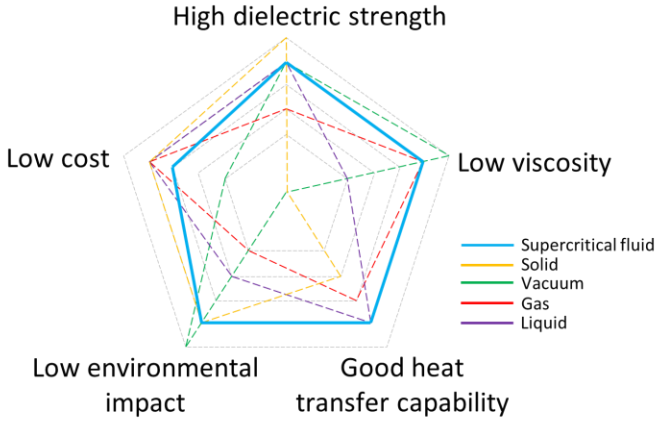
Key Innovations

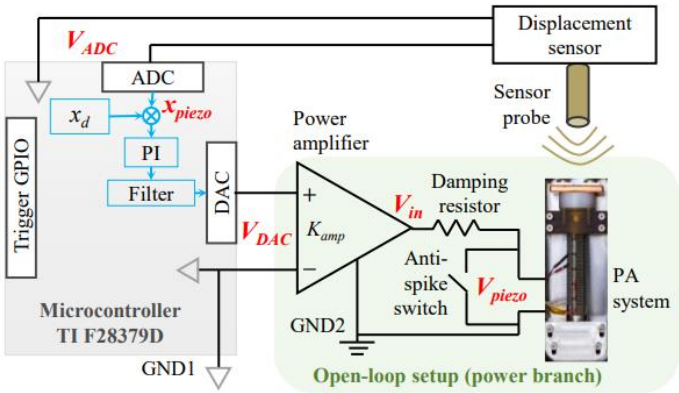
+ Sequential Insertion[1]



+ Supercritical Fluid Dielectric[2]



+ Fast Mechanical Switching Technology[3]



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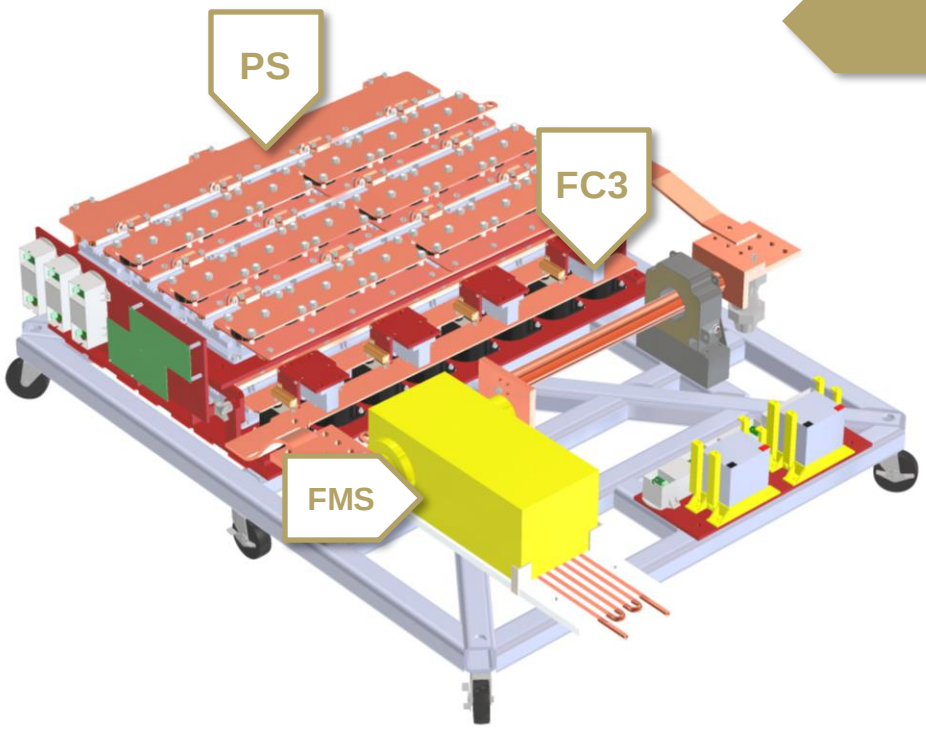
[1]Graber, L et al.., 2020. EDISON: A New Generation DC Circuit Breaker. CIGRE Paris Exhibition.
[2]Wei, Jia. "Supercritical dielectric fluids for high power density applications." PhD diss., Georgia Institute of Technology, 2021.
[3] Schematic closed-loop control system of the fast mechanical switch (C. Xu et al. IEEE Transactions on Power Delivery, 2022)

Designed to Fit

EDISON is customizable and scalable to fit any novel application scenario.

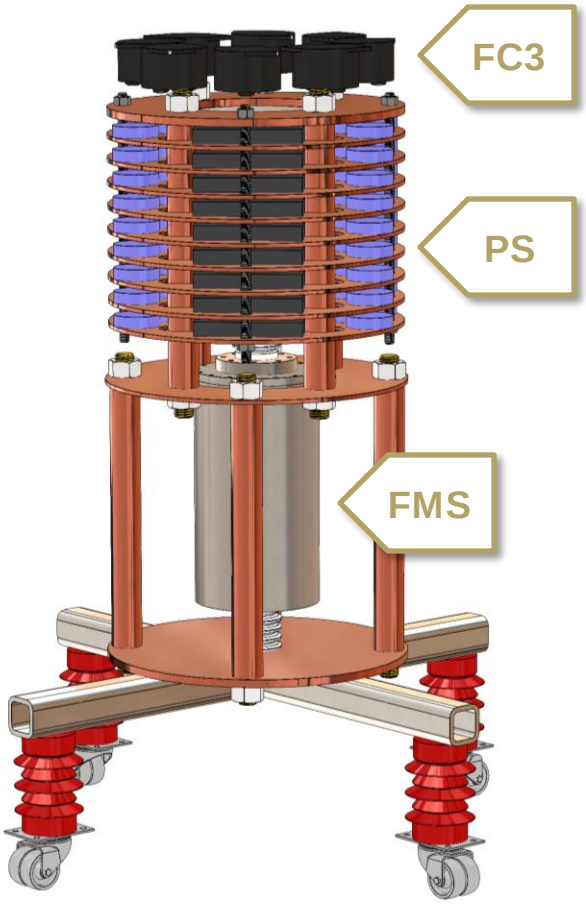


Blade

+ **OPEN Failure Mode**
+ **Scalable & Modular**
+ **Volume 0.4 m^3**
+ **Potential Application: Data Centers, All-Electric Ships, etc.**

Octopus

+ **Pres-pack IGBTs**
+ **SHORT Failure Mode**
+ **Light Weight FMS**
+ **Volume 0.35 m^3**
+ **Potential Application: Utilities, Industrial Arc Protection, etc.**



FC3 | Fault Current Commutation Circuit
FMS | Fast Mechanical Switch
PS | Power Stacks

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Applications

EDISON boasts innovative features that will enable novel applications. Industries we are currently exploring include the following.

Current Limiting | Fast Disconnection | Highly Meshed

High Efficiency | Energy Dense | Arc Mitigation | Battery Protection

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Applications

Arc Flash mitigation is crucial as these electrical explosions cause severe injuries and equipment damage.

Wildfire Prevention

Arc Flash Mitigation

Data Center Safety

All-Electric Ships

Off-shore Wind Farms

Utility

> *"Electrical exposure is one of OSHA's fatal four – leading causes of workplace fatalities. In 20 years, the recordable case rate of injuries and illness per 100 full-time workers has declined from 6.7 in 1999 to 2.8 in 2019. Fatalities have increased from 4,836 in 2015 to 5,333 in 2019."*
> *-Industrial Safety and Hygiene, 2021*

The Workplace Safety Awareness Council (WSAC) determined three key factors that characterize the severity of arc flash incidents

+ The proximity of the worker to the hazard
+ Temperature, which is a function of available energy
+ Time for the circuit to break

Fault Clearing Time
450 µs
Incident Arc Energy
0.01 cal/cm²

EDISON

Level 1 1.2 - 4.0

Level 2 4.0 - 8.0

Level 3 8.0 - 25

Level 4 25 - 40

ENERGY cal/cm²

*Energy data and icons from:
Incident Energy Assessments Aschinger Electric https://aschinger.com/wp-content/uploads/2020/11/Incident_Energy_PPE_Selection_11062020.pdf

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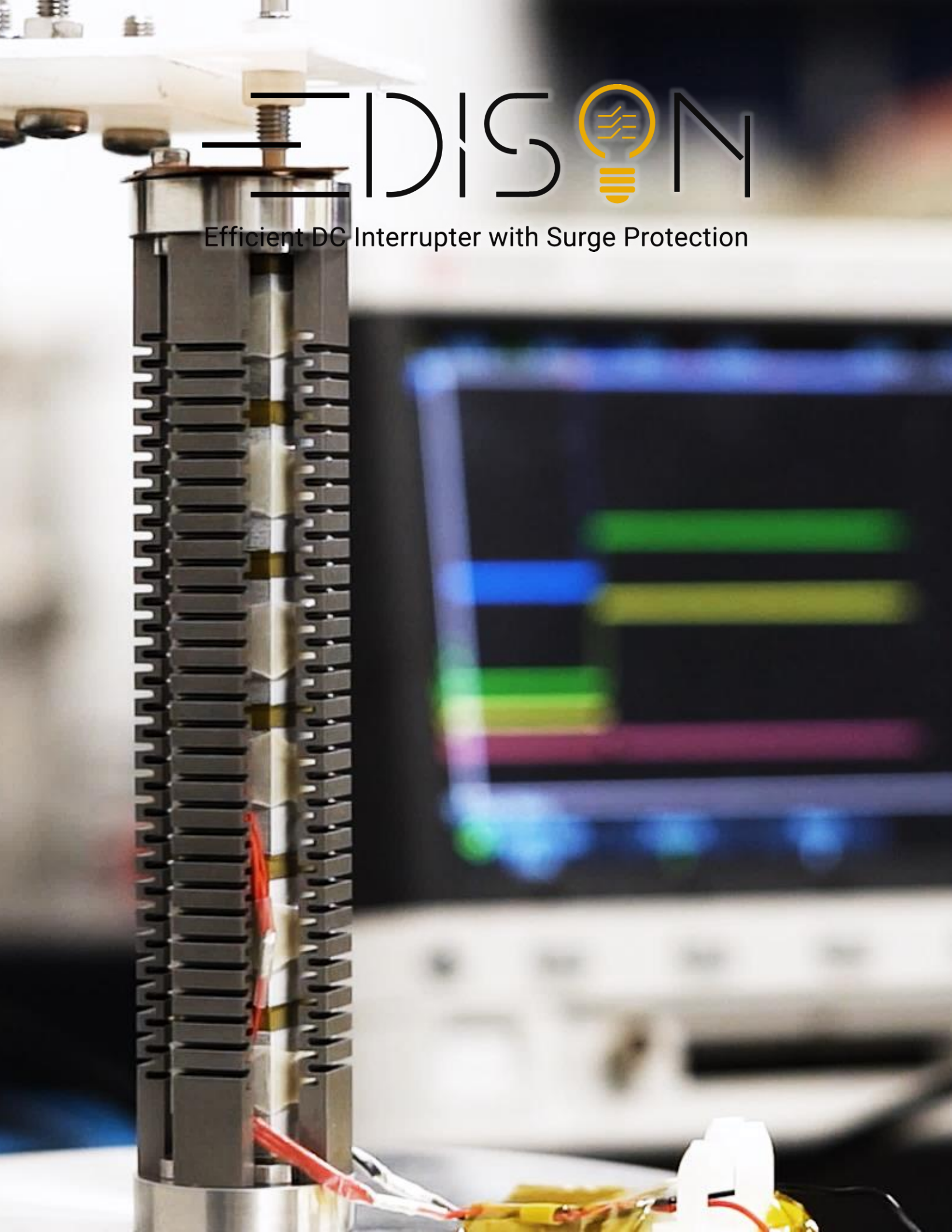
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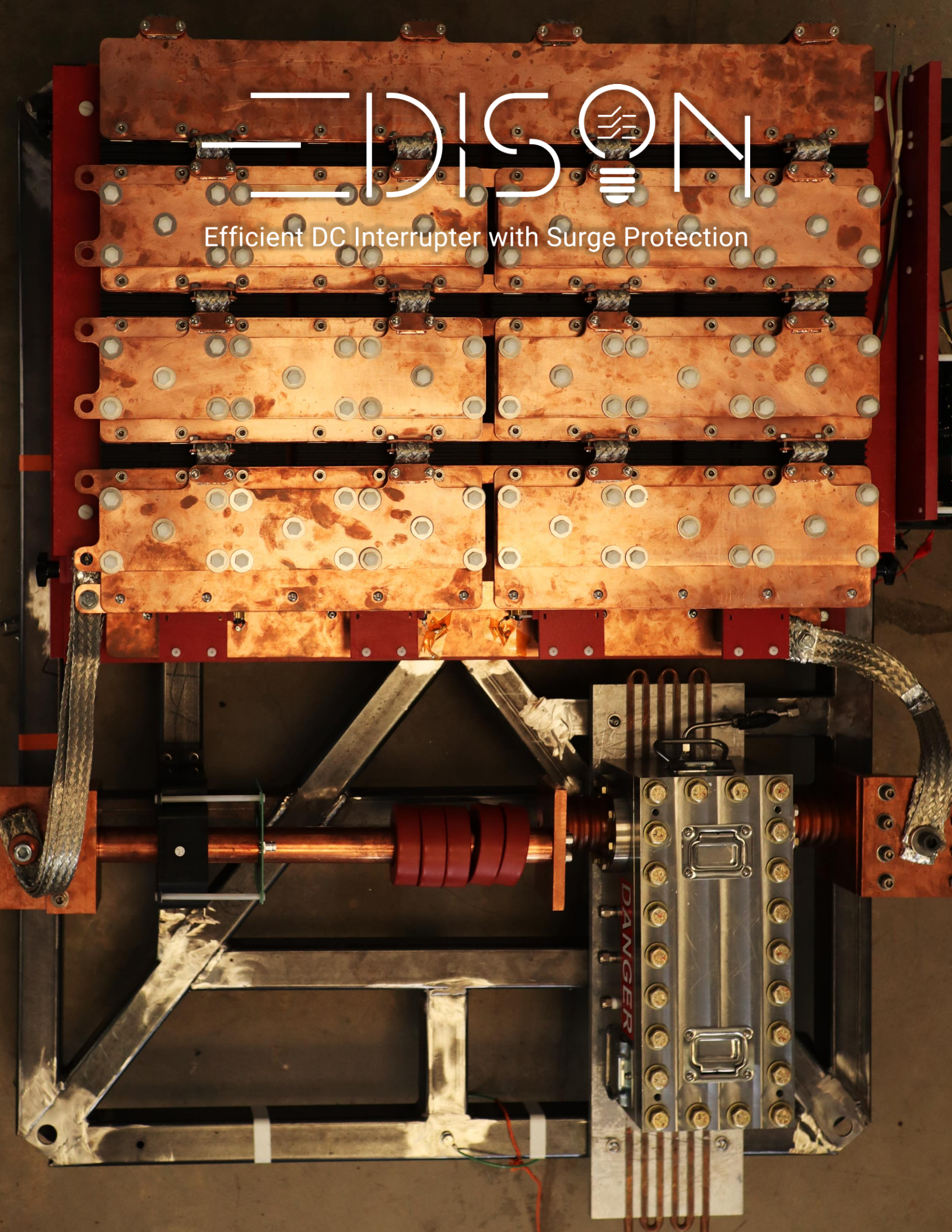
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DANGER

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