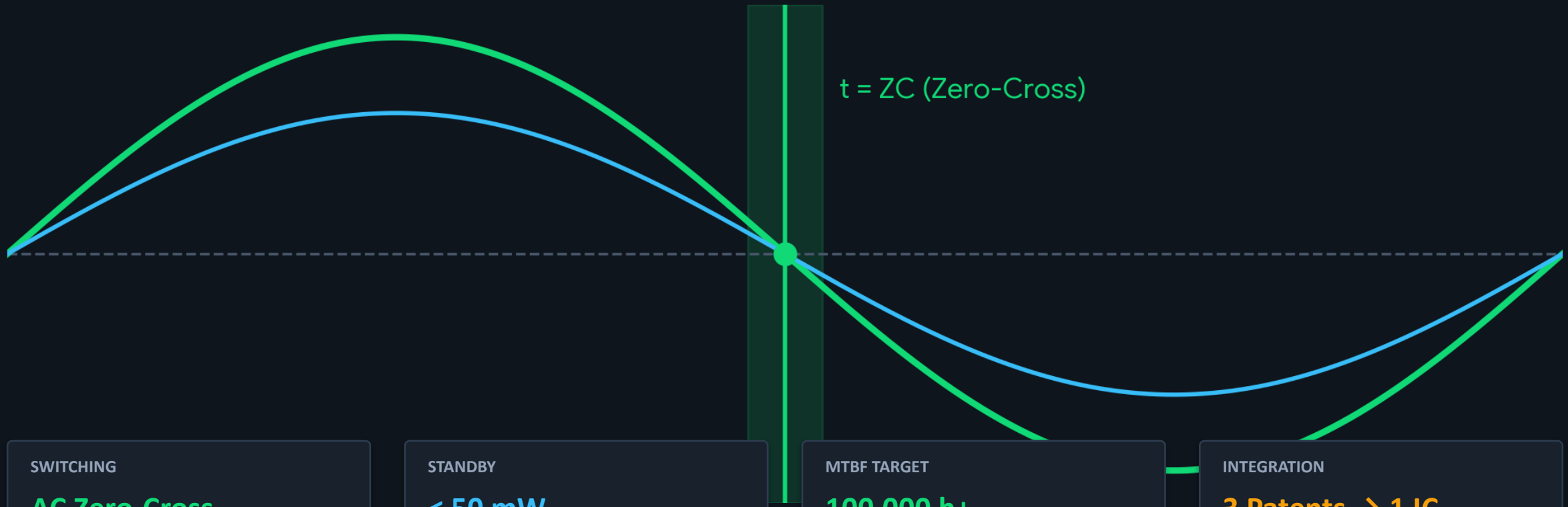
Zero-Crossing Puts an End to Charger Failures.

Flush-Mount Billing AC Slow EV Charger — Eliminating the three structural defects of AC slow charging (contact welding, inrush current, and standby power) at the source.



SWITCHING

AC Zero-Cross

Zero-Voltage Synchronous Switching

STANDBY

< 50 mW

vs. Conventional 1W+ (1/20th)

MTBF TARGET

100,000 h+

Electrolytic Capacitor-Free

INTEGRATION

3 Patents → 1 IC

Single-Chip EV-PMIC Integration

Why Slow Charging (Level 1–2) Dominates

Fast charging is for backup; slow charging is the backbone of EV infrastructure.

AVERAGE DAILY DRIVING DISTANCE

38.5 km

Just 1 hour of 16A slow charging is enough.

Overnight slow charging at home or apartment parking lots is the standard EV driving pattern. However, chargers capable of supporting this pattern fail to scale due to high costs and frequent field breakdowns.

GLOBAL EV CHARGING

2024 Global Market Size

$232 B

GLOBAL CAGR

Compound Annual Growth Rate

30.3%

KOREA SLOW-CHARGER DEMAND

Domestic Slow Charger Demand (2024)

500,000 Units

STRATEGIC OPPORTUNITY FOR OEMs & INFRASTRUCTURE OPERATORS

Eliminating bulky installation costs via direct wall-outlet retrofits while removing hardware failure bottlenecks unlocks mass adoption across residential apartments, commercial buildings, and fleet depots.

Every Field-Reported Defect Stems from Two Circuits

Slow charger failure is not an accident; it is structural.

FAULT A · AC POWER SWITCH

Contact Welding · Arcing · Flutter

• Closing relay contacts at AC peak voltage triggers severe inrush current and electrical arcing.

• NOx accumulates and corrodes inside sealed relays, while unpredictable flying time prevents guaranteed zero-crossing.

• Replacing mechanical relays with SSRs makes miniaturization and cost reduction impossible due to heat generation and bulky heatsinks.

Target Contact Life Improvement: ×50,000 cycles

FAULT B · DC SMOOTHING FILTER

Aluminum Electrolytic Capacitor Lifespan Limit

• Most electronic equipment failures originate in the AC-DC power supply circuit.

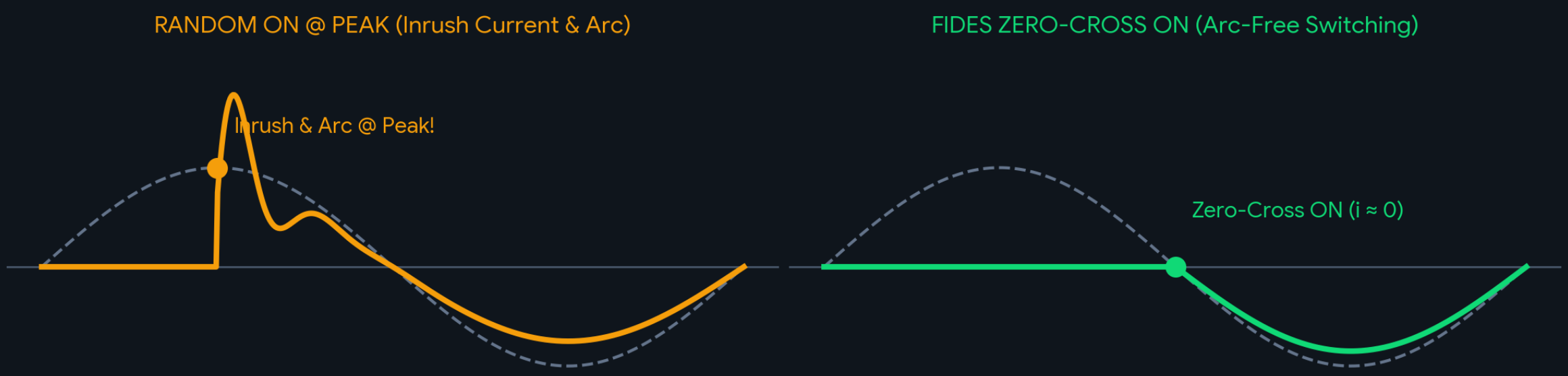
• Smoothing electrolytic capacitors have short lifespans and high temperature sensitivity, leading to venting/explosion, open circuits, or short circuits.

• Destroys the internal DC power rail, causing complete charger shutdown and costly field replacement.

Core Prescription: 100% Electrolytic-Free (Ceramic)

Jumping onto a Car Moving at 220 km/h vs. a Parked Car.

Why Contacts Melt — Mechanical relay switching timing constantly drifts due to temperature, wear, and flying time.



CORE PRINCIPLE

FIDES uses the zero-crossing of the input waveform as a precision clock, driving the relay coil strictly at the exact zero-voltage instant (i ≈ 0).

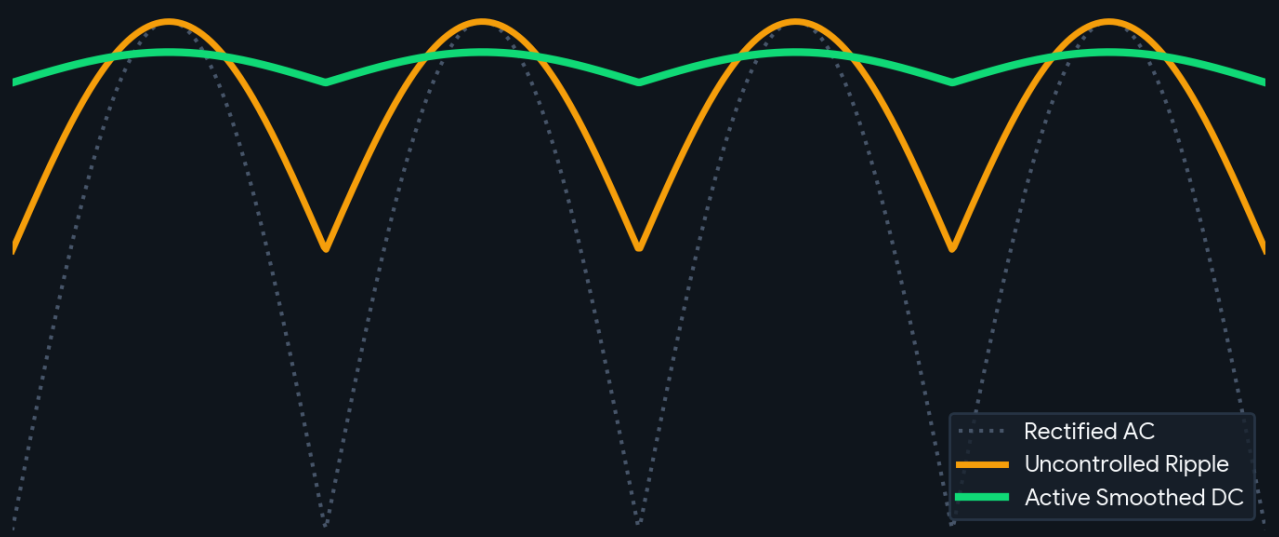
SIMULTANEOUS EFFECT

Zero Arcing · Zero Contact Welding · Zero Inrush Current · EMI/ESD Suppression — A single switching principle eliminates three defects simultaneously.

When Internal Power Dies First, the Entire Charger Stops.

Hidden Lifespan Bottleneck of the DC Link — Electrolytic capacitor lifespan is halved for every 10°C rise in temperature.

SPECIFICATION	Al Electrolytic	FIDES Active
Lifespan	2,000 h	**100,000 h**
Operating Temp	-20 ~ 85°C	**-40 ~ 125°C**
Power Factor (PF)	~0.5	**~0.85**
Required Cap.	10 µF	**3 µF (-70%)**



WHY IT MATTERS

In parking lots, outdoors, and across seasonal temperature swings, the internal power supply fails first, triggering a cascading shutdown across all digital circuits. FIDES active smoothing releases energy at the minimum voltage point, controlling ripple using ceramic components alone.

Even If the Command Is Random, Contacts Always Close at Zero Voltage.

Switching Timing Verified by Measured Data — Synchronization accuracy holds steady despite temperature and wear variations.

01 · AC Input Waveform Detection

Real-time detection of zero-crossing points on the 60Hz AC input voltage waveform.

02 · Relay ON Command (Random Timing)

Holds execution without immediate engagement when an ON command arrives at an arbitrary phase angle.

03 · Flying Time Compensation

Automatically calculates mechanical actuation delay to determine optimal coil excitation timing.

04 · Zero-Cross Sync Signal Output

The drive coil receives energy strictly at the exact zero-cross point after compensating for flying time.

ADAPTIVE CLOSED-LOOP SYNC

Mechanical relay flying time shifts by several milliseconds over lifetime wear and ambient heat (-40°C to +85°C).

FIDES dynamically tracks actual contact closure feedback on every cycle, recalibrating coil trigger timing to maintain sub-microsecond zero-voltage accuracy.

TRIP RESPONSE	CONTACT RESISTANCE	ELECTRICAL LIFE	LEAKAGE CURRENT
< 200 µs	< 10 mΩ	1×10^5 cycles	< 600 µA
Ultra-fast fault interruption	Ultra-low contact resistance	Rated load endurance	Leakage current suppression

How to Control Ripple Without Electrolytic Capacitors

70% Capacitance Reduction · 50x Lifespan Extension

VOLUME REDUCTION

1 / 3

Smoothing Section Volume

Removing bulky cylindrical aluminum electrolytic capacitors shrinks the power stage footprint by two-thirds, enabling ultra-slim flush-mount wall chargers.

OPERATING PRINCIPLE

Releases stored energy the exact instant ripple reaches its lowest voltage valley — preventing the capacitor from ever entering deep discharge.

MEASURED RESULT

Replaces 22 µF aluminum electrolytic capacitors with 3 µF ceramic capacitors. Achieves Power Factor ≥ 0.85 without a dedicated PFC circuit.

TEST CONDITION

AC 220V/60Hz Input · DC 12V/500Ω Load · Verified smoothing capacitance: 2.8 µF with stable low-ripple DC output.

Reduction Beyond IEC 62301-2 Regulatory Compliance

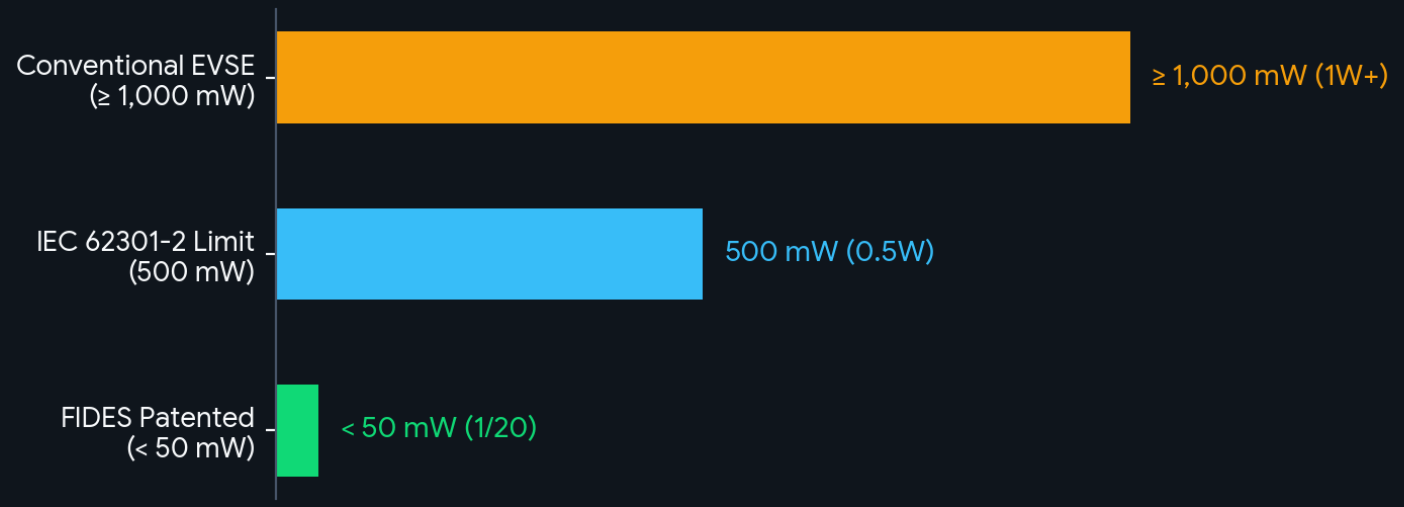
1/20th the standby power of conventional slow chargers — 10x lower power draw than the 0.5W regulatory limit.

STANDBY REDUCTION

1 / 20

FIDES Patented Circuit: < 50 mW

- Conventional EVSE: ≥ 1 W
- IEC 62301-2 Limit: 0.5 W (Legacy: 1 W)
- FIDES Patented Circuit: < 50 mW



FLEET SCALE IMPACT · PER 1 MILLION UNITS (12H/DAY STANDBY)

4,380 MW·h/yr → 219 MW·h/yr (-95%)

Chargers spend most of the day in standby mode. Standby power is not merely a regulatory checkbox; it is a structural variable governing grid peak loads and recurring OPEX in large-scale deployments.

EV-PMIC — Integrating the Heart of the Slow Charger into a Single IC

Three Patents on One Chip — Flush-Mount Billing AC Slow Charger (Direct Retrofit into Existing Wall Outlets)

AC INPUT

220V · 16/32A

Direct retrofit into existing wall outlet boxes without heavy civil work.

ZERO-CROSS HEMR

Arc-Free Switching

Zero-voltage synchronous actuation eliminates contact welding at the source.

ACTIVE SMOOTHING

Ceramic-Only DC Rail

Complete elimination of electrolytic capacitors enables ultra-slim enclosure.

DIGITAL CORE

BT 4.0+ IPv6 · QR Billing

Energy metering, GFCI / overcurrent / temp protection, standby mgmt, OCP A–K/Z.

CHARGING SPECIFICATION & BILLING ARCHITECTURE

AC 220V · 16~40A · Max 8.8 kW — Fully IEC 61851 compliant with built-in GFCI, overload, and thermal protection. Automatic billing conversion via existing utility meters eliminates separate sub-metering infrastructure.

Beyond Simulation: Hardware-Validated Switching Devices

Physical Demo Board & Mass-Production Driver IC

DEMO BOARD

FIDES-ZERO MCCB (HEMR) Demo Board

- Equipped with AC 220V / 50A Zero-Crossing Hybrid Relay module.
- Built-in overload detection and active fault protection circuitry.
- Galvanically isolated communication control interface implemented.
- Target Applications: e-mobility BMS / DC charging stations, PV / ESS inverters, UPS, and smart building AC distribution.

DRIVER IC

FIDES-Z1 Zero-Crossing MCB Driver IC

Isolation Voltage	**> 4,000 V**
Contact Response	**< 100 µs**
Load Current	**50A (100A+ custom)**
Operating Temp	**-40°C to +85°C**
OCP Settings	**Class A / B / C / D / K / Z**
EMI Performance	**Arc-Free Switching**

10 Core Patents — Licensable Technology Assets

Partnership-Ready IP Portfolio (10 Total IPs: 5 KR · 2 PCT · 2 US · 1 EP)

PATENT 01

Zero-Crossing Hybrid Relay

KR · PCT · US · EP

PATENT 02

Active Smoothing Circuit (Electrolytic Replacement)

KR (1564004)

PATENT 03

Standby Power Reduction Circuit

KR · PCT · US · EP

PATENT 04

Electronic Watt-Hour Meter Billing Measurement

KR · PCT · US

PHASE 1

Tech Completion · Demo Validation

Core circuit design, FIDES-Z1 IC development, and empirical hardware validation on HEMR demo board.

PHASE 2

KC · IEC 61851 Certification · Pilot

Safety and metrology certification alongside field pilot operation for flush-mount billing AC slow chargers.

PHASE 3

IC Supply · Global OEM · IP Export

Mass-production IC supply, OEM joint development programs, and global IP licensing for EV & EVSE manufacturers.

Not a charger that breaks down, a charger built never to fail.

01 SWITCHING

Zero-Cross Switching

Eliminates arcing, contact welding, and inrush current via precision zero-crossing actuation.

02 POWER RAIL

Active Smoothing

Eliminates electrolytic capacitor lifespan bottlenecks via active ceramic ripple smoothing.

03 STANDBY

Ultra-Low Standby Power

Sub-50mW standby draw — 1/10th of international regulatory limits.

TECHNICAL CONSULTATION · IC LICENSING · JOINT DEVELOPMENT INQUIRIES

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