



Indigenous PLC Platform

End-to-End Technical Features, Specifications, Options and Customizations

Feature-only scope

This document presents product capabilities, technical functions, integration options and commercial value. It intentionally avoids part numbers, low-level design disclosures and low-level internal design details.

1:N Ring Architecture

Scalable connector-to-power ring coordination for modular DC chargers.

Multi-interface

UART, USB Serial, CAN, RS485 meter support and optional Ethernet.

Safety-first

UV/OV, ground fault, emergency switch, SPD fault, insulation and temperature supervision.

3 Contactor Paths

Gun contactor, module ring contactor and AC contactor control per PLC.

- Built for future-ready DC fast charger platforms that need reliable EV communication, safety supervision and scalable power-path control.
- Designed for OEM customization, faster integration, improved serviceability and stronger field uptime.
- Marketing positioning: indigenous, scalable, V2G-ready, diagnostics-ready, ring-capable, secure-by-design and operations-focused.

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Executive Summary

A feature-focused PLC specification for smart DC fast chargers.

What the PLC delivers

- EV-side intelligence for plug detection, charging readiness, communication handshakes and session-state awareness.
- A safety-interfacing layer that monitors field protection inputs and supports controlled safe-stop actions.
- A ring-capable power-path controller that helps modular charger designs scale from single connector to multi-connector deployments.
- A serviceable design with diagnostics, status visibility and update-ready deployment workflows through the charging platform.

Why it matters

- Reduces integration friction between EV communication, contactor sequencing, power modules, metering and charger policy.
- Improves uptime by turning faults into actionable service information rather than generic alerts.
- Supports OEM differentiation with configurable LED behavior, communication options, safety mapping and product variants.
- Positions the charger platform for upcoming Plug & Charge and V2G workflows without locking the OEM into a black-box architecture.

| Layer | Feature promise | Operator value | OEM value |
|--------------------|--|---|--|
| EV communication | Standards-aligned plug, pilot, powerline and high-level charging communication | Reliable session start and fewer compatibility issues | Future-ready EV protocol foundation |
| Safety interface | Protection input monitoring and controlled output sequencing | Safer operation and faster fault classification | Cleaner certification and service narrative |
| Power-path control | Three contactor paths per PLC and scalable ring coordination | More flexible charger operation | Supports modular charger product families |
| Service layer | Status, diagnostics, update readiness and customized behavior | Fewer truck-rolls and better uptime | Lower warranty load and stronger brand ownership |

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PLC Product Role

The PLC acts as the EV-side brain and safety-facing control layer inside a smart DC charger.

Positioning

The PLC is not a simple relay board and not only a communication module. It is the connector-side intelligence layer that links the EV handshake, safety chain, contactor control, metering context and controller commands into one serviceable charger subsystem.

| PLC responsibility | Feature detail | Result |
|-------------------------------|---|---|
| Connector intelligence | Detects plug state, manages pilot behavior, participates in EV communication and reports connector state. | Cleaner charging start and better session visibility. |
| Safety supervision | Receives charger protection signals such as voltage fault, ground fault, emergency switch, SPD fault, insulation and temperature. | Actionable safety state rather than blind fault chains. |
| Power-path control | Controls three individual contactor paths per PLC: gun, module ring and AC path. | Structured energization and de-energization. |
| System interface | Communicates with the charger controller through configurable wired interfaces. | Flexible integration across charger models. |
| Driver feedback | Controls addressable LED indications for visible connector state, progress and faults. | Better user experience at the charger. |

- Best fit: modular DC fast chargers, dual-gun chargers, ring-based module-sharing chargers and OEM platforms requiring controllable field behavior.
- Design philosophy: connector-local safety and EV communication, controller-level policy and cloud orchestration.

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End-to-End Feature Map

A consolidated view of core features, requested capabilities and customization hooks.

| Feature group | Supported capabilities | Customization / option |
|------------------------------|--|--|
| 1:N Ring Architecture | One controller ecosystem can coordinate multiple PLC units in a ring-aware topology for shared power-path designs. | Connector count, ring depth, owner strategy, failover behavior and sharing policy. |
| Communication | UART, USB Serial, CAN, RS485 for meter connectivity and optional Ethernet for network-enabled variants. | Primary control link, service link, meter profile and network option can be configured per charger family. |
| Contactor control | Three individual contactor paths per PLC: gun contactor, module ring contactor and AC contactor. | Sequencing, interlock policy, output naming and timing profiles. |
| Safety inputs | UV/OV, ground fault, emergency switch, SPD fault, insulation feedback and temperature supervision. | Input polarity, alarm mapping, safe-stop policy and fault labels. |
| Driver feedback | Addressable LED status control for connector and session indications. | Color palette, animations, local language label behavior and fault patterns. |
| Service readiness | Diagnostic status, event history, commissioning support and update-ready maintenance flow. | OEM service process, fleet policy, remote support rules and evidence bundle format. |

Marketing keywords

Scalable, indigenous, V2G-ready, ring-capable, diagnostics-first, safety-interfacing, OEM-customizable, serviceable at scale, future-ready and operations-driven.

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1:N Ring Architecture

Ring-capable control for scalable and shared-power charger designs.

The PLC platform supports a 1:N ring architecture where one charger control ecosystem can manage N PLC units, each responsible for its connector-side communication, safety status and contactor behavior. This enables modular charger products to scale across connector counts while maintaining clear ownership of each EV-side safety chain.

| Architecture feature | Description | Benefit |
|--------------------------------|--|---|
| 1:N scalability | Multiple PLCs can operate under one charger-level control strategy. | Supports multi-gun and modular platform expansion. |
| Ring-aware power path | The module ring contactor enables controlled connection into a shared module-ring concept. | Better utilization of available power resources. |
| Per-connector isolation | Each PLC maintains its own connector-side states, safety information and output control. | Faults can be classified by connector rather than by whole charger. |
| Shared capacity logic | Ring coordination supports sharing policies while preserving safety state separation. | Improves site power utilization and product flexibility. |
| Service traceability | Each PLC can be represented as a distinct service object. | Faster commissioning, diagnostics and replacement workflows. |

Ideal use cases

Dual-gun chargers, expandable cabinet families, shared-module chargers that need multiple connector SKUs from one control architecture.

Design advantage

A ring-capable PLC avoids hardwiring every connector to a fixed power path. The charger achieves better power utilization and controlled isolation.

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EV Communication and V2G Readiness

A feature layer for modern DC charging communication and future energy services.

| Feature | What it enables | Customer-facing value |
|------------------------------|--|---|
| CP/PWM | Plug detection, EV readiness and basic charging-state negotiation. | Reliable start sequence and clear connection state. |
| Powerline link establishment | Prepares the EV-to-charger data path for DC charging communication. | Improved interoperability and standards-aligned handshake behavior. |
| High-level communication | Supports structured DC charging dialog and vehicle-reported charging requirements. | Better control over demand, readiness and session transitions. |
| Plug & Charge readiness | Architecture supports identity-oriented authorization workflows. | Future-ready authorization and user experience. |
| V2G-ready positioning | Prepared for bidirectional energy-service workflows subject to target standard scope and validation. | A platform story that can evolve beyond basic charging. |
| EV identity capture | Supports EV-side identity or session identity propagation to the controller layer. | Useful for fleet, authorization and analytics use cases. |

Commercial message

Ready for today's DC charging conversations and architected for tomorrow's energy exchange. Certification and final interoperability are validated against the selected vehicle set, charger category and target markets.

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Communication Interfaces

Flexible connectivity for controller integration, commissioning, diagnostics and metering.

| Interface | Primary purpose | Typical use |
|-------------------|---|---|
| UART | Deterministic wired communication between the PLC and charger controller. | Control commands, status exchange, session state and safety events. |
| USB Serial | Commissioning, bench bring-up, diagnostic access and controlled service operations. | Factory setup, service checks and integration debugging. |
| CAN | Charger-system communication option for product variants that require CAN-based coordination. | Integration with selected charger control networks or auxiliary systems. |
| RS485 | Meter communication for energy and electrical measurement integration. | Session energy, meter start/stop, live power values and billing evidence. |
| Optional Ethernet | Network-enabled service or integration option for variants that need wired IP connectivity. | Field service, local diagnostics, network-based deployment workflows. |

UART

Primary controller link option.

USB Serial

Commissioning and service-friendly access.

CAN

Flexible charger-network integration.

RS485

Meter data path for energy intelligence.

Ethernet

Optional wired network variant.

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Three Individual Contactors per PLC

Separate output control for connector, ring and AC-side power-path management.

Each PLC supports three individual contactor control roles. The goal is not only to switch power, but to create a controlled sequence for energization, isolation, sharing and safe stop.

| Contactor role | Feature description | Why it matters |
|------------------------------|--|--|
| Gun contactor | Controls the connector-side DC power path for the assigned charging gun. | Provides direct connector enable, disable and isolation behavior. |
| Module ring contactor | Controls participation in the shared module ring or power-sharing path. | Enables ring architecture, shared power and controlled module-path access. |
| AC contactor | Controls the relevant upstream AC-side path or enable chain for the charger configuration. | Supports safer upstream energization logic and service isolation. |

| Control feature | Specification |
|---------------------------------|--|
| Sequenced operation | Outputs can be sequenced with charger state, safety status and controller command intent. |
| Interlock-aware | Contactors can be inhibited by active safety faults or missing readiness conditions. |
| Fail-safe behavior | Designed to support controlled de-energization rather than uncontrolled interruption under load. |
| Service state visibility | Each path can be represented in diagnostics and commissioning views. |
| OEM naming | Output labels can be mapped to the OEM's charger terminology and wiring documentation. |

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Safety and Protection Supervision

Fault intelligence from the connector and charger safety chain.

| Protection feature | Supported signal / status | PLC-level response value |
|--------------------|---|---|
| UV/OV | Under-voltage and over-voltage supervision feedback. | Identifies voltage-related abnormal conditions and helps prevent unsafe energization. |
| Ground fault | Ground-fault indication from charger protection hardware. | Enables immediate classification of grounding risk and controlled shutdown policy. |
| Emergency switch | Emergency stop or emergency switch loop status. | Creates a direct, visible safety event tied to connector and charger state. |
| SPD fault | Surge protection device fault indication. | Improves service visibility for surge protection degradation or failure. |
| Insulation | Insulation monitor feedback or insulation status signal. | Supports isolation verification and safer DC charging behavior. |
| Temperature | Thermal status from the PLC area, connector path or cabinet sensor arrangement. | Supports alarm, derating, warning and service intervention workflows. |

Safety-first message

The PLC converts discrete protection states into meaningful charger intelligence. Instead of a generic 'charger fault', the operator can understand whether the issue is voltage, ground fault, emergency stop, surge protection, insulation or temperature related.

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Metering and Energy Data

RS485 meter support for live energy visibility and session evidence.

Metering features

- RS485 meter communication support for compatible energy-meter integrations.
- Live values for voltage, current, power and cumulative energy, depending on selected meter profile.
- Session start and stop meter readings for delivered-energy evidence.
- Supports billing, reconciliation, dispute handling and service diagnostics.
- Meter profile can be aligned to the charger OEM's preferred meter family and market requirement.

Business value

- Enables trustworthy session reporting.
- Helps isolate whether a field issue is EV-side, meter-side, protection-side or controller-side.
- Creates a stronger evidence trail for operators and support teams.
- Improves readiness for commercial DC charging deployments.

| Metering area | Specification |
|------------------------|---|
| Physical communication | RS485 meter connectivity. |
| Data categories | Energy, power, voltage, current and session meter positions, based on meter capability. |
| Session evidence | Meter start, meter stop and delivered energy can be included in session reports. |
| Configuration | Meter profile, reporting mode and connection behavior are configurable per charger variant. |
| Service diagnostics | Meter communication state can be surfaced to the service layer. |

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Addressable LEDs and Driver Feedback

Connector-level visual intelligence for a better charging experience.

Addressable LED support allows the PLC to drive visible connector feedback that follows charger state, EV communication progress and fault conditions. This improves field usability for drivers and gives service teams a quick visual indication of state.

| LED feature | Typical indication | Value |
|-----------------------------|---|---|
| Available | Connector is ready for the next vehicle. | Reduces driver uncertainty. |
| Plug detected | Vehicle connection or cable state detected. | Confirms physical connection. |
| Communication active | EV handshake or charging negotiation in progress. | Shows that the charger is working, not stalled. |
| Charging | Power delivery active. | Clear real-time user feedback. |
| Complete | Session complete or charger ready for unplug. | Improves turnover at public sites. |
| Fault | Safety or charger fault active. | Faster operator and technician triage. |
| Service mode | Technician or commissioning state. | Avoids confusion during maintenance. |

Customization

LED colors, patterns, animation speed, brightness, fault priority and OEM-specific status language can be customized to match the charger brand and user-experience design.

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Temperature and Thermal Monitoring

Thermal awareness for safer and more reliable field operation.

| Thermal feature | Specification | Operational outcome |
|---------------------------|---|---------------------------------------|
| Temperature input support | Temperature supervision can be included for the PLC area, connector path, cable assembly or cabinet integration depending on product variant. | Better thermal visibility. |
| Warning and alarm levels | Thresholds can support warning, service alert or stop policy. | Fewer unexplained shutdowns. |
| Derating-ready behavior | Temperature state can be used by the controller strategy to reduce stress before a hard fault. | Improved uptime and asset protection. |
| Fault classification | Thermal events can be reported separately from voltage, ground fault, SPD or insulation events. | Faster root-cause identification. |
| Service guidance | Thermal history supports site review, ventilation checks and connector inspection. | Better maintenance workflow. |

Marketing message

Thermal visibility turns hidden cabinet stress into actionable charger intelligence - a strong differentiator for high-uptime DC charging deployments.

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Diagnostics and Service Features

From black-box faults to service-ready evidence.

| Feature | Description | Service impact |
|---------------------------|---|---|
| Connector-specific status | Reports connector state, safety status, communication state and power-path status. | Service teams know where to look first. |
| Fault classification | Distinguishes voltage, ground fault, emergency switch, SPD, insulation, temperature and communication events. | Faster root cause and fewer repeat visits. |
| Event history | Important state changes can be retained by the charging platform for review. | Supports evidence-based maintenance. |
| Commissioning mode | Factory and site setup workflows can verify interfaces, contactors, LEDs and meter communication. | Faster deployment and lower integration risk. |
| Remote support ready | When paired with the controller platform, PLC status can be inspected remotely. | Reduces truck-rolls. |
| Update-ready workflow | PLC behavior can be maintained over product life through controlled update processes. | Protects deployed fleet value. |

Operator benefit

Problems become specific: connector, contactor, safety input, comm

OEM benefit

A diagnosable PLC platform lowers warranty pressure and supports premium product p

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Options and Customizations

Configurable feature set for OEM charger families and market-specific deployments.

| Customization area | Available options | Why it matters |
|--------------------|---|---|
| Architecture | Single connector, dual connector, multi-PLC and 1:N ring-based layouts. | One product foundation can serve multiple charger SKUs. |
| Communication | UART, USB Serial, CAN, RS485 meter and optional Ethernet selection. | Matches cabinet design and controller strategy. |
| Contactor naming | Gun, module ring and AC contactor outputs can be mapped to OEM terminology. | Cleaner wiring diagrams and technician training. |
| Safety mapping | UV/OV, ground fault, emergency switch, SPD fault, insulation and temperature labels can be mapped to product standards. | Market-specific compliance and documentation support. |
| LED behavior | Color, sequence, brightness, fault priority and service indication customization. | Brand-consistent driver experience. |
| Meter integration | RS485 meter profile, data reporting and session evidence behavior. | Supports regional meter choices and billing requirements. |
| Service process | Commissioning checklist, field diagnostic views, update policy and evidence bundle format. | Supports scalable fleet operations. |

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Technical Feature Specifications

Feature-level specification table without part numbers or low-level internals.

| Specification | Feature-level detail |
|-------------------------------|---|
| Architecture | 1:N ring-capable PLC architecture for scalable connector and shared-power designs. |
| Supported communication links | UART, USB Serial, CAN, RS485 for meter, and optional Ethernet for selected variants. |
| Contactors outputs | Three independent contactor functions per PLC: gun contactor, module ring contactor and AC contactor. |
| EV communication | CP/PWM, powerline communication, high-level DC charging dialog and V2G-ready architecture. |
| Safety supervision | UV/OV, ground fault, emergency switch, SPD fault, insulation and temperature monitoring. |
| Metering | RS485 meter integration for live and session-based energy information. |
| Driver feedback | Addressable LED control for connector and session-state display. |
| Optional network | Optional Ethernet variant for wired local service or integration workflows. |
| Service support | Diagnostic status, event evidence, commissioning support and controlled maintenance workflow. |
| Customization | Architecture, communication mode, safety mapping, meter profile, LED patterns and OEM documentation naming. |
| Product positioning | Indigenous, future-ready, scalable, serviceable, standards-aligned and OEM-customizable PLC platform. |

Important qualification

Final electrical ratings, operating limits, enclosure requirements and certification scope should be frozen per OEM product variant, target geography and charger power class.

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Deployment and Validation Plan

A practical path from bench validation to production rollout.

| Stage | Validation focus | Acceptance evidence |
|-------------------------------|--|---|
| Bench bring-up | PLC power-up, communication links, LED status, contactor command visibility and safety input simulation. | Commissioning checklist signed off. |
| Controller integration | Command/status exchange, connector state, 1:N mapping, ring behavior and fault propagation. | Integrated charger controller view. |
| EV communication | Plug detection, communication handshake, session start, demand reporting and stop sequence. | Vehicle or simulator session record. |
| Safety verification | UV/OV, ground fault, emergency switch, SPD fault, insulation and temperature event behavior. | Fault event log and safe-stop evidence. |
| Meter validation | RS485 meter communication, live readings, session start/stop and delivered energy evidence. | Meter trace and session summary. |
| Field trial | Thermal behavior, interoperability, service workflow and technician usability. | Pilot deployment report. |
| Production release | Configuration lock, documentation, service process, update policy and training. | Release pack and OEM approval. |

Acceptance principle

Every feature should be tested both electrically and operationally: not only does it switch or report, but it also creates the right charger state, service message and recovery path.

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Competitive Comparison

Feature-positioning matrix against common PLC categories.

The table compares market categories rather than naming specific vendors. Actual supplier capability varies by product version and integration scope.

| Capability | Basic relay PLC | Communication-only PLC | Imported closed PLC | Joulepoint PLC platform |
|-----------------------|-----------------------|------------------------|------------------------|---|
| 1:N Ring Architecture | Usually no | Usually no | Limited or proprietary | Supported as a platform feature |
| EV communication | No or external | Yes | Yes | Integrated with connector safety context |
| V2G-ready positioning | No | Varies | Varies | Architecture-ready and roadmap-aligned |
| Three contactor roles | Often generic outputs | Often limited | May be fixed | Gun, module ring and AC contactor roles |
| Safety input coverage | Limited | Limited | Vendor-defined | UV/OV, ground fault, emergency switch, SPD fault, insulation, temperature |
| Addressable LEDs | No or basic | Often no | Varies | Connector-state LED control |
| RS485 meter | External | Varies | Varies | Supported for meter integration |
| Communication options | Simple I/O | Single control link | Fixed | UART, USB Serial, CAN, RS485, optional Ethernet |
| Customization | Low | Medium | Low to medium | High - OEM mapping and feature behavior |
| Serviceability | Low | Medium | Vendor-dependent | Diagnostics-ready and field-service focused |
| OEM ownership | Low | Medium | Low | High - feature transparency and customization |

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Marketing Positioning

The PLC is a premium differentiator, not a hidden subassembly.

| | | | |
|---|---|--|--|
| <p>Scalable</p> <p>1:N ring architecture for multi-connector growth.</p> | <p>Safety-first</p> <p>Protection inputs become meaningful service states.</p> | <p>Future-ready</p> <p>Plug & Charge and V2G-ready positioning.</p> | <p>Customizable</p> <p>OEM behavior, LEDs, meter and communication options.</p> |
|---|---|--|--|

| Audience | Message | Proof point |
|-----------------------|---|--|
| Charger OEM | Launch faster with a PLC that already combines EV communication, safety supervision and power-path logic. | One feature platform across multiple charger models. |
| Charge-point operator | Fewer site visits, clearer faults and better uptime. | Diagnostics-ready safety and session state. |
| Service team | Know whether the issue is EV communication, meter, contactor, safety input or temperature. | Connector-specific event visibility. |
| Investor / buyer | Indigenous, premium, scalable charger intelligence - not a commodity relay board. | V2G-ready, ring-capable, serviceable design. |

Core statement

One PLC. Multiple interfaces. Three contactor paths. Full safety visibility. Ring-capable architecture. Future-ready DC charging intelligence.

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OEM Integration Checklist

A practical end-to-end checklist for moving the PLC into a charger program.

| Workstream | Checklist items |
|-------------------|---|
| Architecture | Confirm connector count, 1:N ring strategy, module ring behavior, power-path ownership and fault isolation targets. |
| Communication | Select UART, USB Serial, CAN, RS485 meter and optional Ethernet usage for the product variant. |
| Contactor mapping | Map gun contactor, module ring contactor and AC contactor roles into wiring, service labels and safety documentation. |
| Safety mapping | Finalize UV/OV, ground fault, emergency switch, SPD fault, insulation and temperature signal behavior. |
| Metering | Select RS485 meter profile, reporting behavior, session evidence fields and billing requirements. |
| Driver UX | Finalize addressable LED states, colors, animations and fault/service indications. |
| Service workflow | Define commissioning checklist, fault wording, remote diagnostics process and update policy. |
| Validation | Complete bench, controller, EV, safety, meter and field-pilot acceptance tests. |
| Production | Lock variant configuration, documentation, spares strategy, quality checks and technician training. |

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End-to-End Value Summary

A PLC feature platform for smarter, safer and more serviceable DC fast chargers.

Feature summary

- Supports 1:N Ring Architecture for scalable shared-power designs.
- Communicates via UART, USB Serial, CAN, RS485 for meter and optional Ethernet.
- Provides three contactor functions per PLC: gun, module ring and AC contactor.
- Supports addressable LED feedback for richer charger UX.
- Supervises UV/OV, ground fault, emergency switch, SPD fault, insulation and temperature.

Strategic value

- Turns the charger connector into an intelligent, serviceable subsystem.
- Reduces black-box integration risk for OEMs.
- Creates a strong story for uptime, safety and future-readiness.
- Lets charger brands customize behavior without losing platform discipline.
- Supports a premium market position for indigenous DC charger technology.

Closing line

Designed for today's reliable DC charging and tomorrow's smarter energy exchange - with scalable architecture, safety visibility and OEM-owned user experience.

Joulepoint Energy Solutions

Future Energy Solutions