Rectifier Hot-Swap Replacement Procedure - Official Technical Overview & Hardware Datasheet

PRODUCT IDENTIFICATION

The Rectifier Hot-Swap Replacement Procedure document defines the standardized hardware protocol for live removal and insertion of rectifier modules within active telecom power systems. This procedure is applicable to the entire family of high-efficiency, modular rectifier platforms (Models RHP-4800, RHP-5800, and RHP-7800 series) deployed in central offices, data centers, and remote telecom shelters. Designed for carrier-grade continuity, this protocol ensures zero service interruption during routine maintenance, capacity upgrades, or fault remediation. The hot-swap mechanism is fully integrated into the system's backplane, enabling true plug-and-play operation without requiring power cycling or manual bypass switching.

SYSTEM HARDWARE TOPOLOGY

The physical architecture comprises a centralized power shelf with up to six rectifier slots arranged in a horizontal or vertical orientation depending on the chassis form factor. Each rectifier module interfaces with the shelf via a high-density, blind-mate connector system that simultaneously engages DC power, AC input, and management bus signals. The management bus uses a controller area network (CAN) or Modbus protocol to facilitate real-time communication between the rectifiers and the system supervisory controller. Key topological features include:

- Dedicated input EMI filtering per rectifier slot to prevent disturbance during insertion events.

- Independent ORing diodes on the output bus to prevent reverse current flow

during module removal.

- A low-impedance backplane copper layout designed to handle transient current spikes without voltage droop.
- Color-coded guide rails and mechanical keying to prevent incorrect module insertion.

DATA & CONTROL PLANE CAPABILITIES

The control plane is governed by a master controller that continuously monitors system voltage, current, and temperature. During a hot-swap event, the controller executes a state-machine sequence to safely transition the target rectifier between operational, standby, and offline states. The data plane carries telemetry data, including individual module efficiency, output current, and internal temperature, to a network management system via SNMP v3 or a Modbus TCP/IP gateway. The hot-swap procedure is designed to interact seamlessly with both the data and control planes, ensuring that alarms, logs, and performance metrics are updated instantaneously to reflect the new system state.

COMPONENT BREAKDOWN

Rectifier Module (Hot-Swap Unit):

- Form Factor: 1U high, 4 inches wide, 12 inches deep.

- Weight: 3.2 kg (7.1 lbs).

- Connector: 60-pin blind-mate connector with sequential pin lengths for ground, power, and signal integrity.

- Handle and Ejector Mechanism: Integrated lever-action handle with a positive locking latch to ensure secure seating and safe extraction.

Power Shelf:

- Material: Cold-rolled steel with a corrosion-resistant powder coating.

- Slot Configuration: 6 slots in a 3+3 redundant arrangement.

- Backplane: Multi-layer FR4 PCB with 4 oz. copper traces for high-current paths.

Supervisory Controller:

- Processor: ARM Cortex-M7 at 300 MHz.

- Memory: 2 MB Flash, 512 KB SRAM.

- Interfaces: 1x USB-C (console), 1x RJ45 (Ethernet), 1x RS-485 (management bus).

OPERATIONAL SPECS MATRIX

The following specifications define the operational envelope within which the

hot-swap procedure is guaranteed to function:

- Input Voltage Range: 85 – 305 VAC (universal) or 190 – 400 VDC (high-voltage DC variant).
- Output Voltage Range: -40 to -72 VDC (adjustable via software).
- Maximum Output Power per Module: 4,800 W (RHP-4800), 5,800 W (RHP-5800), 7,800 W (RHP-7800).
- Efficiency (at 50% load): > 96% peak.
- Hot-Swap Recovery Time: < 10 ms for output voltage settling.
- Insertion/Removal Cycle Rating: > 5,000 cycles per connector.
- Operating Temperature: -5°C to +55°C (full power), derated above 55°C.
- Storage Temperature: -40°C to +85°C.
- Humidity: 5% to 95% RH, non-condensing.

Parameter	**Specification**
Form Factor	1RU Modular Shelf (6-slot) / Rectifier Module: 1U x 4" x 12"
Switching Capacity	Up to 28.8 kW (RHP-7800 x 6), 34.8 kW (RHP-5800 x 6), 46.8 kW (RHP-7800 x 6)
Power Supply	1+1 Redundant AC/DC (85-305 VAC / 190-400 VDC), Hot-Swappable

REGULATORY COMPLIANCE

This procedure and the associated hardware comply with the following international standards, ensuring safe and lawful deployment across global telecommunications networks:

- Safety: IEC 62368-1:2018, UL 62368-1, CSA C22.2 No. 62368-1.
- EMC: EN 55032 (Class A), EN 55024, FCC Part 15 Subpart B (Class A).
- Environmental: RoHS Directive (EU) 2015/863, REACH Regulation (EC) No 1907/2006.
- Telecom: NEBS GR-1089-CORE (Level 3), ETSI EN 300 386 V2.1.1.
- Hot-Swap Specific: IEC 60950-1 (for legacy compliance) and adherence to the PICMG 2.0 (CompactPCI) hot-swap specification guidelines for mechanical and electrical interoperability.