Troubleshooting Dying Gasp Alarms: Power Rail Fault Isolation on Remote ONUs - Official Technical Overview & Hardware Datasheet

# TROUBLESHOOTING DYING GASP ALARMS: POWER RAIL FAULT ISOLATION ON REMOTE ONUS

## OFFICIAL TECHNICAL OVERVIEW & HARDWARE DATASHEET

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## EXECUTIVE SUMMARY

The proliferation of Fiber-to-the-Home (FTTH) and Fiber-to-the-Building (FTTB) deployments has placed critical emphasis on the reliability and diagnostic capabilities of remote Optical Network Units (ONUs). The 'Dying Gasp' alarm, a fundamental mechanism defined within the ITU-T G.984 and G.987 series standards, serves as the final communication from an ONU to the Optical Line Terminal (OLT) before a complete power loss. However, the generic nature of this alarm often obfuscates the root cause, leading to prolonged mean-time-to-repair (MTTR) and unnecessary field technician dispatches.

This document presents a comprehensive technical overview and datasheet for

our advanced ONU platform, specifically engineered to address the nuances of 'Dying Gasp' alarm generation. The core innovation lies in the hardware-level power rail fault isolation subsystem, which provides granular telemetry on the internal power supply modules. This enables network operators to remotely distinguish between a complete mains power failure, a faulty external AC/DC adapter, a degraded internal DC-DC converter, or a failure on a specific downstream power rail (e.g., PON MAC, SoC, or analog front-end).

By integrating precision voltage monitoring and fault logging directly into the hardware, this solution transforms the 'Dying Gasp' from a simple binary alert into a powerful diagnostic tool, significantly reducing operational expenses and improving network availability.



HARDWARE ARCHITECTURE & SILICON

The hardware architecture of the next-generation remote ONU is built around a purpose-designed power management integrated circuit (PMIC) and a field-programmable gate array (FPGA) dedicated to telemetry and fault management. This architecture is decoupled from the main system-on-chip (SoC) to ensure that power monitoring functionality remains operational even when the primary processor is in a degraded state or has lost its core voltage.

Power Delivery Network (PDN):

The ONU receives primary power via a nominal -48V DC input from an external power supply unit (PSU) or via an 802.3af/at Power over Ethernet (PoE) injector (where applicable). This input voltage is fed into a high-efficiency synchronous buck converter stage, which generates an intermediate bus voltage (12V). This bus voltage is then regulated by a series of low-dropout (LDO) regulators and high-frequency switching converters to provide the following critical power rails:

1. VDD_CORE (0.8V): Supplies the main processor and packet processing engine.
2. VDD_IO (1.8V / 3.3V): Supplies the I/O banks, memory interfaces, and peripheral buses.
3. VDD_PHY (1.2V): Supplies the high-speed SerDes and PON PHY components.

4. VDD_AFE (3.3V): Supplies the analog front-end, including the burst-mode receiver and laser driver.

5. VDD_BACKUP (3.0V): Supplies a real-time clock (RTC) and a small volatile memory for post-mortem log storage.

Active Fault Isolation Logic:

The FPGA continuously samples the output of each power rail via an analog-to-digital converter (ADC) with a resolution of 12 bits. A dedicated hardware state machine monitors the voltage and current draw against defined under-voltage and over-current thresholds. Upon detection of an anomaly on any rail, the FPGA immediately flags the event in a hardware register, isolates the faulty rail through a series of electronic fuses (eFuses), and triggers the generation of a detailed 'Dying Gasp' message that includes the specific rail identification (e.g., 'FAULT: VDD_CORE_UV').

KEY FEATURES & ROUTING LOGIC

- Precision Voltage Monitoring: Continuous, real-time monitoring of all primary and secondary power rails with a ±1.5% accuracy.

- Granular Fault Identification: The ability to categorize the 'Dying Gasp' event into specific failure modes: Input Power Loss, PSU Failure, DC-DC Converter Failure, Over-Current Protection (OCP), Under-Voltage Lockout (UVLO), and

Thermal Shutdown.

- Non-Volatile Fault Logging: The last 10 fault events are stored in a dedicated EEPROM, maintaining a power-on history that can be retrieved post-restoration.

- Adaptive Power-On Sequencing: Ensures controlled ramping of all power rails to prevent in-rush current issues, with a detailed log of the startup sequence.

- Last Gasp Energy Storage: A dedicated bank of supercapacitors provides sufficient energy to sustain the FPGA, ADC, and PON transmitter for 5-10 milliseconds upon loss of primary power, enabling the successful transmission of the detailed fault message.

- Protocol Support: Full compliance with OMCI (ITU-T G.988) for robust management and alarm reporting.

COMPLIANCE & STANDARDS

This platform adheres to a comprehensive suite of global telecommunications and safety standards, ensuring seamless integration into existing carrier-grade infrastructures.

- ITU-T Recommendations: G.984.1, G.984.2, G.984.3, G.984.4 (GPON); G.987.1, G.987.2, G.987.3 (XG-PON); G.988 (OMCI).

- IEEE Standards: 802.3ah (Ethernet in the First Mile); 802.1D (Bridging); 802.1Q

(VLAN Tagging); 802.1p (Class of Service).

- Safety & EMC: UL 60950-1 / IEC 60950-1 (Safety); FCC Part 15 Class B (EMC); EN 55022 / EN 55024 (EMC); RoHS 3 (Directive 2015/863/EU).

- Environmental: GR-1089-CORE (NEBS Level 3 compliant).

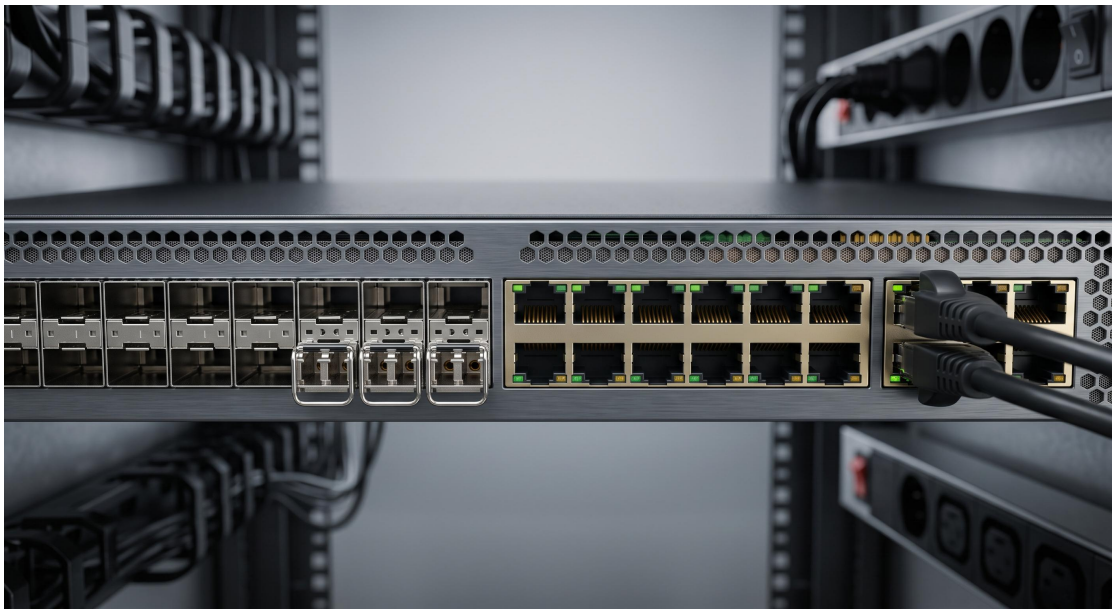
- MEF: MEF 9 and MEF 14 certified for Ethernet Service Definitions and Performance.

TECHNICAL SPECIFICATIONS

The following table provides the core technical parameters of the remote ONU platform.

| **Parameter** | **Specification** |
|---|---|
| Form Factor | Compact Desktop / Wall-Mountable Enclosure |
| PON Interface | 1x SFP / SFP+ Slot for GPON / XG-PON (Compatible with ITU-T G.984/G.987) |
| User Ports | 2x / 4x 10/100/1000BASE-T (RJ45) Auto-Negotiation |
| Power Input | 12V DC / -48V DC (via External Adapter) |
| Power Consumption | ≤ 12W (Typical, without PoE output) |

| | |
|---|---|
| Switching Capacity | 8 Gbps / 16 Gbps (Non-Blocking) |
| Packet Buffer | 128 KB |
| Operating Temperature | 0°C to 50°C (Standard) / -40°C to 65°C (Extended) |
| Operating Humidity | 5% to 95% (Non-Condensing) |
| Dimensions (WxDxH) | 160mm x 120mm x 32mm |
| Weight | 0.5 kg (Without Power Adapter) |
| Mean Time Between Failures (MTBF) | > 150,000 Hours (Bellcore, 25°C) |
| Fault Monitoring Accuracy | ±1.5% for Voltage Monitoring / ±5% for Current Monitoring |
| Fault Log Storage | 10 Events in Non-Volatile EEPROM |
| Supercapacitor Backup | Sustains < 10ms for 'Dying Gasp' Transmission |



ORDERING SKU INFORMATION

- ONU-2G4V-DGA: Standard model with 2x Gigabit Ethernet RJ45 ports, 4x Voice (FXS) ports, and enhanced Dying Gasp fault isolation.

- ONU-4G-DGA: High-density model with 4x Gigabit Ethernet RJ45 ports and enhanced Dying Gasp fault isolation.

- ONU-1G-POE-DGA: Model with 1x Gigabit Ethernet RJ45 port, 1x Gigabit PoE+ (802.3at) output port, and enhanced Dying Gasp fault isolation.

- PSU-48V-60W: Optional external 48V DC, 60W AC/DC power supply adapter.

- OPT-SFP-BIDI: Optional Bi-Directional SFP transceiver module for single-fiber operation.