

# Emulex® Gen 7 Fibre Channel HBAs

## LPe35000/LPe36000-Series

### Next-Gen HBAs for the Modern Data Center

The Emulex® Gen 7 Fibre Channel (FC) host bus adapters (HBAs) by Broadcom are designed for demanding mission-critical workloads and emerging applications. Applications continue to grow in size and scale, and to support them, enterprises are increasingly turning to new server technologies that contain hundreds of processor cores as well as high-performance storage solutions including low-latency NVMe, all-flash arrays (AFAs). NVMe can significantly increase the performance of storage area networks (SANs), making the selection of high-speed networking technology the critical element for achieving maximum system-wide performance. Fibre Channel is purpose-built for storage networks, meeting the requirements for high availability, scalability, predictable performance, and low latency.

Compared to the previous generation, Emulex Gen 7 FC HBAs offer up to 2x higher bandwidth, 3x better latency, enhanced security, and operational efficiency for 32GFC and 64GFC SANs. Emulex LPe35000-series HBAs are available with single, dual, or quad 32GFC optics. The single-port and dual-port models can be upgraded with 64GFC optics to tackle the toughest workloads, including NVMe deployments. Gen 7 32GFC provides seamless backward compatibility to 16GFC and 8GFC networks. Emulex LPe36000-series HBAs are available with single and dual 64GFC optics and provide seamless backward compatibility to 32GFC and 16GFC networks.

Emulex fully supports new industry standards that further enhance Broadcom's autonomous SAN<sup>1</sup> innovations to self-learn, self-optimize, and self-heal, proactively keeping the SAN running at maximum speed and avoiding downtime. The new industry standards supported by Emulex around Fabric Performance Impact Notifications (FPINs) include Link Integrity notification (FPIN-LI), Congestion notification (FPIN-CN), Peer Congestion notification (FPIN-PN), and Delivery notification (FPIN-DN). The Emulex SAN Manager application is the first application in the industry to automatically identify, minimize, and mitigate application performance problems caused by SAN congestion by utilizing the FPIN-CN standard.

### Performance

The Emulex Dynamic Multi-core architecture delivers unparalleled performance and the most efficient port utilization with 8 processing cores and 16 threads that dynamically apply ASIC resources to any port that requires them, ensuring that SLAs are met. Compared to Gen 6 HBAs, Emulex Gen 7 HBAs can support 64GFC to deliver up to 2x greater bandwidth. The Gen 7 HBAs deliver 12,800 MB/s (two 32GFC ports) or 25,600 MB/s (two 64GFC ports) full duplex, they deliver 3x better hardware latency, and the 64GFC LPe36000-series HBAs deliver industry-leading performance up to 10 million IOPS.<sup>2</sup>

Emulex Gen 7 solutions have achieved this unprecedented performance by enhancing their Emulex Dynamic Multi-core architecture with fastpath hardware acceleration, reducing latency for each transaction. This

<sup>1</sup> <https://docs.broadcom.com/docs/broadcom-autonomous-self-healing-sans>

<sup>2</sup> [Tolly Test Report LPe36000-series, 2021](#)



Emulex LPe35004, LPe35000, and LPe35002

### Accelerate Workload Performance for NVMe Data Centers

- Accelerate workloads with up to 3x better latency than the previous generation.
- Speed up applications and AFAs and handle peak workload I/O spikes with up to 10M IOPS—3x more than the previous generation.
- Get faster data transfer speed with the industry's first single- and dual-port PCIe 4.0 HBAs delivering 2x more bandwidth per lane.

### Easily Deploy, Manage, and Upgrade SANs

- Save time with no server reboots for firmware updates, queue depth changes, and optics replacements.
- Meet SLAs with industry-leading HBA reliability—10M hours MTBF.
- Upgrade performance easily from 32GFC to 64GFC with Emulex-approved hot-plug optics kits.
- Utilize the industry-standard INCITS/T11 specification, which includes full FPINs and signaling support to collaborate with the fabric to identify and address performance problems.

## Fully Protect Data

- Thwart malicious firmware with a Silicon Root of Trust and digitally signed firmware.
  - Complies with the NIST 800-193 framework.
  - Verifies the digital signature during firmware download and power-on.
- Guarantee driver security with Broadcom digitally signed drivers.
- Secure Boot guarantees UEFI boot code security with digitally signed boot code.
- Data Integrity Field (T10 DIF) protects data from corruption.

## Simplify HBA Management and Remediate Network Performance Problems with the new Emulex SAN Manager (ESM)<sup>3</sup>

Emulex Gen 7 HBAs work with the Emulex SAN Manager application to reduce operational cost and complexity via the following:

Visibility into the endpoints of the fabric:

- Captures complete SAN HBA host inventory; host names; and OS, software, and firmware versions.
- Identifies multipath misconfiguration errors via the multipath validation tool.

Centralized in-band access to managed HBAs across the SAN:

- Configures the Adaptive Congestion Management feature.
- Enables optical transceiver statistics to be downloaded for analysis to help detect optic degradation; lists queue depths by port.

Automatic identification and mitigation of application performance problems with direct communication between Emulex HBAs and Brocade fabric switches and directors:

- Visualizes SAN congestion with a dashboard that presents congestion and bandwidth graphs.
- Remediate congestion automatically via the Adaptive Congestion Management feature.

enhancement results in significant increased performance compared to legacy software-based solutions. These performance advances enable Emulex Gen 7 HBAs to handle demanding workloads and I/O spikes experienced under peak workload conditions like no other Fibre Channel HBA in the industry.

Emulex Gen 7 HBAs support NVMe over Fibre Channel (NVMe/FC), providing significantly lower latency versus the traditional Fibre Channel SCSI protocol (SCSI FCP). Testing by independent performance labs has shown that NVMe/FC can deliver up to 50% more IOPS, 30% lower latency,<sup>4</sup> and up to 3.4x higher online transaction processing (OLTP) transactions per minute<sup>5</sup> than traditional SCSI FCP. Emulex Gen 7 HBAs also support NVMe/FC and SCSI FCP concurrently, providing investment protection and allowing data centers to transition to end-to-end NVMe over FC SANs at their own pace.

Emulex Gen 7 HBA port aggregation (also known as trunking) provides a method to aggregate physical ports to form a single logical port. Aggregating physical ports to make a single high-bandwidth datapath increases the logical connection bandwidth for applications that need it, such as data warehousing and virtual machine migration.

## Operational Efficiency

Emulex Gen 7 HBAs offer enhanced reliability, availability, and serviceability (RAS) including port isolation and port-based error isolation that enables users to easily detect, isolate, and recover from errors.

Emulex Gen 7 HBAs are managed HBAs—intelligent adapters designed to work with Emulex SAN Manager<sup>3</sup> to reduce the complexity of managing enterprise-class SANs. Unlike other adapters, managed HBAs are designed to perform

many operational tasks without the intervention of the host on which they reside. Managed HBAs differ from other adapters because they:

- Communicate to the Emulex SAN Manager application and register as a managed HBA.
- Utilize the industry-standard INCITS/T11 specification, which includes full FPINs and signaling support to collaborate with the fabric to identify and address performance problems.
- Monitor and record performance data and fabric notifications for analysis.

Emulex Gen 7 HBAs are easy to manage and save administrators time and operating costs with features such as no reboots for firmware updates, queue depth changes, or optics replacements. Emulex Gen 7 hot-plug (hot-swappable) optics enable optics to be removed and replaced without shutting down the system, allowing for uninterrupted service.

The Emulex HBA Manager application, formerly known as Emulex OneCommand™ Manager, provides centralized management of current and previous generations of Emulex FC HBAs. Emulex HBA troubleshooting is simplified with Emulex HBA Capture, an Emulex utility that gathers system, adapter, and device driver information. Data collected by HBA Capture is compressed into a single file and can be sent to Broadcom Technical Support for analysis when debugging system issues or for diagnostic purposes.

Emulex HBAs fully support the Brocade® Fabric Vision® suite of features, facilitating a solution from the switch to the server endpoints that have Emulex HBAs installed. Supported features include ClearLink™ (D\_Port), Link Cable Beaconing, Host Name Registration, Read Diagnostic Parameters, VMID, BB\_Credit Recovery,

<sup>3</sup>The Emulex SAN Manager application is available separately. Contact Broadcom sales for information.

<sup>4</sup>[Emulex labs/Demartek, 2018](#)

<sup>5</sup>[Tolly Test Report # 220122, 2020](#)

Fabric-assigned Boot LUN, Fabric-assigned PWWN, FC Trace Route, FC Ping, Rest APIs, and more.

Visit [www.broadcom.com](http://www.broadcom.com) for additional information on supported Fabric Vision features.

## Security

One of the key initiatives for enterprises is to safeguard their infrastructure from network attacks. Fibre Channel has field-proven security in protecting the world's most sensitive data in banking, finance, health care, government, and military for over 20 years. Fibre Channel offers "air gap" protection with no connectivity to vulnerable IP networks. For this reason, IT managers continue to rely on FC for their most sensitive data.

Emulex Gen 7 HBAs provide unmatched security features for Fibre Channel environments. They feature Silicon Root of Trust security embedded into the hardware itself. Firmware digital signatures are verified each time the system is booted as well as before installing any new firmware, providing a tamper-proof solution.

The Emulex digitally signed drivers are integrated with all the major enterprise operating systems. Drivers are digitally signed and are verified to be authentic code written by Broadcom before they can be installed.

## Standards

### General Specifications

- The Gen 7 FC HBAs are powered by the XE601 controller and use an eight-lane (x8) PCIe 4.0 bus on the single-port and dual-port models (with backward compatibility to PCIe 3.0 supported) and a PCIe 3.0 x 16 bus on the quad-port model. The architecture enables resources to be applied to any port that needs them, delivering up to 10M IOPS for Gen 7 64GFC HBAs.

### Industry Standards

- Current ANSI/INCITS standards: FC-PI-7; FC-FS-5 (Class 3); FC-LS-5 INCITS 569-202x rev 5.0; FC-LS-4; FC-GS-8; FCP-4; FC-SP-2; SPC-4; SBC-3; SSC-4; FC-NVMe-2

- Legacy ANSI/INCITS standards: FC-PI-1/2/3/4/5/6; FC-FS-1/2/3/4; FC-LS-1/2/3; FC-GS-1/2/3/4/5/6/7; FC-PH-1/2/3; FC-DA-1/2; FCP-2/3; FC-HBA; FC-TAPE; FC-MI; SPC-3; SBC-2; SSC-2/3; FC-NVMe with AM1
- PCIe base spec 4.0
- PCIe card electromechanical spec 4.0
- PCI Hot Plug (PHP)
- UEFI 2.7

### HBA Port Virtualization

- NPIV, SR-IOV

### Logins

- Supports 12,288 concurrent logins and active exchanges per port.

## Architecture

### Single-Port LPe35000, Dual-Port LPe35002, and Quad-Port LPe35004

- Supports 32GFC, 16GFC, and 8GFC link speeds, automatically negotiated.

### Single-Port LPe36000, Dual-Port LPe36002

- Supports 64GFC, 32GFC, and 16GFC link speeds, automatically negotiated.

## Comprehensive OS and Hypervisor Support

- Microsoft Windows
- Red Hat Enterprise Linux
- SUSE Linux Enterprise Server
- VMware vSphere
- Oracle Linux; Oracle Linux with the Unbreakable Enterprise Kernel (UEK)
- Oracle Solaris
- Citrix
- Ubuntu
- OpenEuler

For the latest operating system support, visit [www.broadcom.com/support](http://www.broadcom.com/support). Additional support is available from OEMs and partners.

## Hardware Environments

- AMD, Intel x64; AMD, Intel x86; ARMv8 64-bit; and PowerPC

## Throughput

- 32GFC: 6,400MB/s full duplex line rate per port
- 64GFC: 12,800MB/s full duplex line rate per port

## Optical

- Data rates: 64GFC (28.9 GBaud PAM4), 32GFC (28.05 GBaud NRZ), 16GFC (14.025 GBaud NRZ), 8GFC (8.5 GBaud NRZ), automatically detected (8GFC supported for LPe35000-series HBAs only)
- Optics: Short-wave lasers with LC-type connector
- Cable:
  - 0.5m to 70m at 64GFC/32GFC on 50/125-μm OM3 MMF
  - 0.5m to 100m at 64GFC/32GFC on 50/125-μm OM4 MMF
  - 0.5m to 100m at 64GFC/32GFC on 50/125-μm OM5 MMF
  - 10 km at 32GFC/16GFC on 9/125-μm single-mode fiber when long-wave transceivers approved by Emulex are used

## Physical Dimensions

- Short, low-profile PCIe card
- 167.64 mm x 68.91 mm (6.60 in. x 2.71 in.)
- Standard bracket (low-profile bracket ships in box)
- LPe35004: 167.64 mm x 111.15 mm (6.60 in. x 4.37 in.) with a standard bracket

## Environmental Requirements

- Operating temperature: 0°C to 55°C (32°F to 131°F)
- Airflow requirements:
  - 150 LFM for PCIe 3.0
  - 200 LFM for PCIe 4.0
  - 250 LFM for 64GFC operation of HBAs
  - 275 LFM for the LPe35004-M2 (4-port 32G)
- Storage temperature: -20°C to 85°C (-4°F to 185°F)
- Relative humidity: 5% to 95% non-condensing

## Agency and Safety Approvals

### North America

- FCC/ICES Class A
- UL/CSA Recognized

### Europe

- CE Mark
- UKCA Mark

- EU RoHS Compliant
- EU Low Voltage Directive

## Australia

- RCM Class A

## Japan

- VCCI Class A

## Korea

- KCC Class A

## China

- China RoHS Compliant

## Taiwan

- BSMI Class A
- BSMI RoHS Compliant

## Ordering Information

### LPe35000-M2 (Upgradeable to 64GFC)<sup>6</sup>

- 1-Port 32GFC Short Wave Optical LC SFP+, low profile

### LPe35002-M2 (Upgradeable to 64GFC)<sup>6</sup>

- 2-Port 32GFC Short Wave Optical LC SFP+, low profile

### LPe35004-M2 (Not upgradeable to 64GFC; OEM models may differ)

- 4-Port 32GFC Short Wave Optical LC SFP+, full height

### LPe36000-M64

- 1-Port 64GFC Short Wave Optical LC SFP+, low profile

### LPe36002-M64

- 2-Port 64GFC Short Wave Optical LC SFP+, low profile

## Options

Only options approved by Emulex are warranted and fully supported by Technical Support. Emulex options are denoted by a “-ELX”, “-EM”, “-EL1”, or “-EL5” in the transceiver part number.

### LP32-SW-OPT-1

- 32GFC Optic (short-wave laser with LC connector SFP+ transceiver): 1 piece

### LP32-SW-OPT-2

- 32GFC Optics (short-wave laser with LC connector SFP+ transceiver): 2 pieces

### LP32-LW-OPT-1

- 32GFC Optic (long-wave laser with LC connector SFP+ transceiver): 1 piece

### LP32-LW-OPT-2

- 32GFC Optics (long-wave laser with LC connector SFP+ transceiver): 2 pieces

### LP64-SW-OPT-1

- 64GFC Optic (short-wave laser with LC connector SFP+ transceiver): 1 piece

### LP64-SW-OPT-2

- 64GFC Optics (short-wave laser with LC connector SFP+ transceiver): 2 pieces

### LP64-LW-OPT-1

- 64GFC Optic (long-wave laser with LC connector SFP+ transceiver): 1 piece

## Additional Features

### Performance Features

- The LPe35000-series HBAs double the maximum FC link rate from 16GFC to 32GFC and again to 64GFC with a 64GFC optics upgrade.<sup>6</sup>
- Support for NVMe/FC for low-latency, high-performance, end-to-end NVMe/FC storage networks.
- Registration and support for FPINs and congestion signaling.
- Buffer-to-buffer credit recovery—automatic buffer credit loss detection and recovery for reliable performance.
- Frame-level multiplexing increases link efficiency and maximizes HBA performance.
- N\_Port ID Virtualization (NPIV) increases network scalability by enabling a single FC adapter port to provide multiple virtual ports.

### Data Protection Features

- End-to-end data protection using hardware parity, CRC, ECC, and other advanced error checking and correction algorithms ensures that data is safe from corruption.
- Enhanced data protection is provided by T10 PI with high-performance offload. T10 PI provides additional data protection in environments such as Oracle Unbreakable Linux.

### Deployment and Management Features

- Universal boot capability allows the appropriate boot environment to be automatically selected for any given hardware.
- Boot from SAN capability reduces system management costs and increases uptime.
- Detailed, real-time event logging and tracing enables quick diagnosis of SAN problems.
- The beaconing feature flashes the HBA LEDs, simplifying their identification within server racks.
- The environmental monitoring feature helps optimize SAN availability.

### Management Features

- The Emulex HBA Manager application<sup>7</sup> enables centralized discovery, monitoring, reporting, and administration of HBAs provided by Emulex on local and remote hosts. Powerful automation capabilities facilitate remote driver parameter, firmware, and boot code upgrades.
- Advanced diagnostic features, such as adapter port beaconing and adapter statistics, help optimize management and network performance, while the environmental monitoring feature helps to maintain optimum host-to-fabric connections. In addition to the GUI interface, management functions can also be performed via a scriptable command line interface (CLI).
- Troubleshoot optics and cables before critical errors affect your system with Brocade ClearLink-supported switches and Emulex HBAs.
- Emulex HBA Manager supports role-based management to facilitate administration of adapters throughout the data center without compromising security. Management privileges can be assigned based on LDAP and AD group memberships.
- The Emulex management instrumentation complies to open management standards, such as SMI-S and common HBA API support, which enables seamless upward integration into enterprise storage and server management solutions.

<sup>6</sup> Only Emulex-approved options are warranted and fully supported by Technical Support.

<sup>7</sup> The Emulex OneCommand Manager application has been renamed the Emulex HBA Manager application.