NETRONOME

ISA-4000 Series
Agilio® CX
SmartNICs

Hardware User Manual
Version 007

- Proprietary -

Product code
130-00011-007

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ISA-4000 Series Agilio CX SmartNIC Products
Hardware User Manual

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Revision History

Date	Revision	Description
19-Nov-2015	001	Initial Release.
21-Jan-2016	002	Updated with new company logo and product branding
19-Feb-2016	003	Added ISA-4000-10S-20-CB-2
26-May-2016	004	Added ISA-4000-10-2-x part number
28-July-2016	005	Added ISA-4000-40-2-2
20-December-2016	006	Added ISA-4000-25-2-2 Added ISA-4000-40-1-2
06-July-2018	007	Updated with SmartNIC branding

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1 Introduction

Model Number	Part Number	Description
ISA-4000-40Q-10-BB-2 ISA-4000-40-1-2	AMDA0081-0001 AMDA0081-0001	PCIe-compatible Half-Height SmartNIC with 1x40G port
ISA-4000-10S-20-CB-2 ISA-4000-10-2-2	AMDA0096-0001 AMDA0096-0001	PCIe-compatible Half-Height SmartNIC with 2x10G port
ISA-4000-40-2-2	AMDA0097-0001	PCIe-compatible Half-Height SmartNIC with 2x40G port
ISA-4000-25-2-2	AMDA0099-0001	PCIe-compatible Half-Height SmartNIC with 2x25G port

This document covers the Netronome Agilio CX Intelligent Server Adapter (ISA) PCIe SmartNICs identified above. It includes part number, model number, product description, and power ratings for each model. Fields containing an "x" in the above table have more than one applicable variant that is covered by this manual, as described by the relevant product section.

Information in this document refers to all versions except as noted. Additional fields may appear on the end of any of the model numbers shown above, however these are strictly for software-defined configuration aspects only, and do not denote any hardware differences.

This document is intended for persons experienced with networking equipment and the installation of PCI Express (PCIe) cards in particular. It is very important to ensure your host platform's compatibility, both in terms of hardware and software, prior to starting the installation process.

Additional safety information is found in the ISA-4000 Series Agilio CX SmartNIC Safety Notice. Software, I/O configuration and operation are not covered in this document. If you should have any questions about the use of this product, please don't hesitate to contact Netronome, as described in Section 5.

Illustrations shown in this document are representative of these products, though not necessarily of currently-available colors and cosmetic finishes. For information about currently-available colors and cosmetic finishes for these products, please contact Netronome.

This document contains **Warnings!** and **Cautions!** Warnings are safety related. Failure to follow warnings may lead to injury or equipment damage. Cautions are requirements for proper function. Failure to follow cautions may result in improper operation.

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Descriptions, warnings and/or cautions applicable to all cards of a particular type may be found at the beginning of the appropriate document section. Please read these, as well as the particular subsection applicable to your specific card's model number.

All products are low voltage PCIe cards (12V-, 3.3V-supplied per PCIe standard).

All lasers in optional transceiver plug-ins are Class 1 or Class 1M. See Laser Caution statements that follow.

Warning! No user serviceable parts are present, except for the interchangeable faceplates provided.

Warning! Replacements must be performed by qualified personnel only. All installation instructions and requirements specified for the end-use system must be followed.

Caution! None of the units in this document are hot-swappable. Damage may result. Please disconnect all system power feeds before attempting to install or replace any of these products in a system. Optional transceiver plug-ins and cables may be installed or removed while the products are energized.

Caution! These products may be vulnerable to static electricity (ESD). ESD mitigation controls (e.g. static straps) must be used while handling and installing these products. These products should be stored in antistatic bags or containers when not in use.

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2 ISA-4000 Series Agilio CX SmartNICs

ISA-4000 Series Agilio CX SmartNICs are half-length, half-height, x8 PCIe 3.0 ("PCIe gen 3") cards based on the Netronome 4000 Network Flow Processor. The currently available models are:

- ISA-4000-40Q-10-BB-2 / ISA-4000-40-1-2 1x40G (accepts QSFP plug-ins)
- ISA-4000-10S-20-CB-2 / ISA-4000-10-2-2, 2x10G (accepts SFP, SFP+ plug-ins)
- ISA-4000-40-2-2, 2x40G (accepts QSFP plug-ins)
- ISA-4000-25-2-2, 2x25G (accepts zSFP+, SFP28, SFP+ plug-ins)

Illustrations of the above cards are shown overleaf in Figure 1 through Figure 5. These illustrations show the card equipped with a Full-Height PCIe slot faceplate: both full-height and half-height faceplate options are included with the card to suit a variety of server installations.

Power and Ratings Information:
All Agilio CX SmartNICs use 3.3V and 12V (25W max) supplied through the host system's PCIe slot only.

Environmental rating for all Agilio CX SmartNICs is 0-55°C.
Operating humidity rating for all ISA-4000 series cards is 5-85% (non-condensing).
Minimum required airflow at 55°C across each card type during operation is as follows:

- 1x40G: 250 lfm (1.25 m/s) linear, or 23 cfm (0.65 m^3/minute) by volume.
- 2x10G: 250 lfm (1.25 m/s) linear, or 23 cfm (0.65 m^3/minute) by volume.
- 2x40G: 300 lfm (1.5 m/s) linear, or 26 cfm (0.74 m^3/minute) by volume.
- 2x25G: 350 lfm (1.75 m/s) linear, or 30 cfm (0.85 m^3/minute) by volume.

Caution! Agilio CX SmartNICs are only available with a passive (fanless) heatsink. A passive heatsink-equipped card must be installed in a system with its own active cooling system, providing at least the rated amount of directed airflow across the card during operation. Otherwise, the card may not function correctly, or may even be damaged.

Consult your system specifications as to whether sufficient cooling is provided by the system to permit the use of a passive heatsink card. Generally, cards equipped with a passive heatsink are suitable for rackmount server systems, but not for "tower"-style workstations. Cards that are mounted with the heatsink face-down, adjacent to other heat-generating components, and/or with partially obstructed air flow paths may require applied airflow that is greater than the minimum rating. Netronome is not responsible for Agilio CX SmartNICs that fail due to insufficient system cooling.

Self-monitoring and self-limiting capabilities of the SmartNIC's operating temperature and power consumption are described in Section 4.

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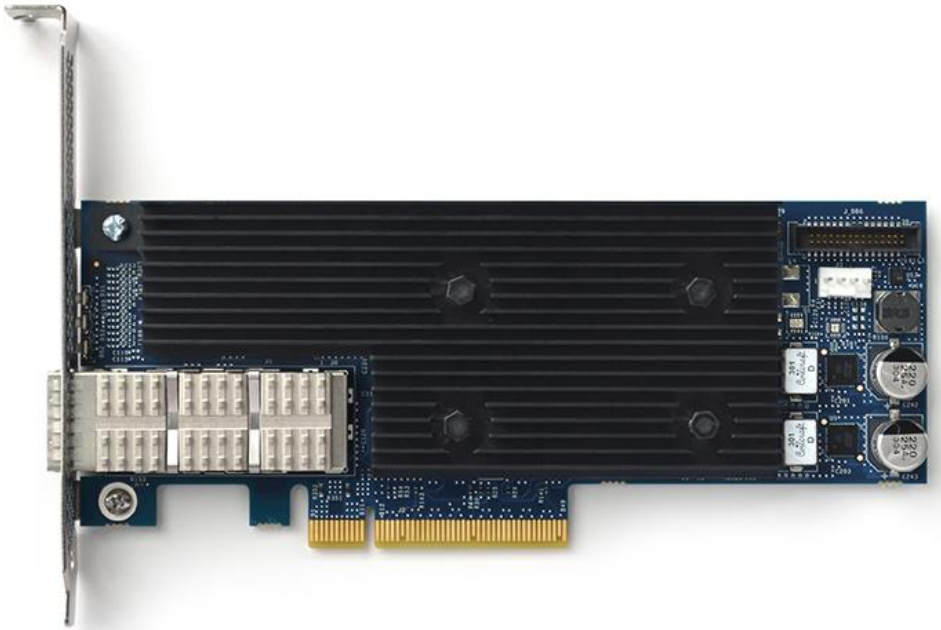

Figure 1 1x40G Agilio CX SmartNIC

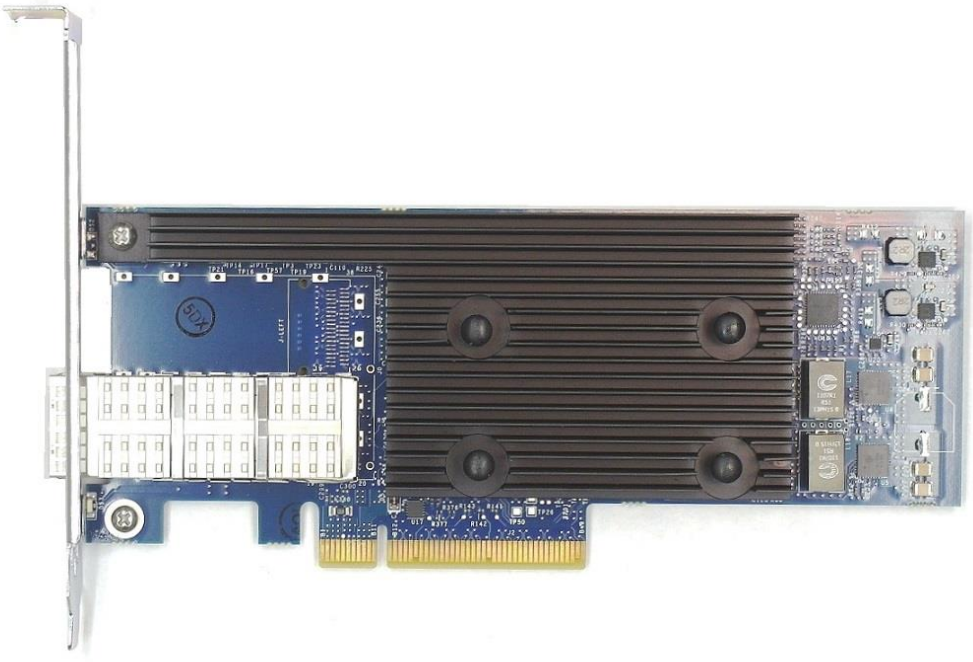

Figure 2 1x40G Agilio CX SmartNIC (alternate)

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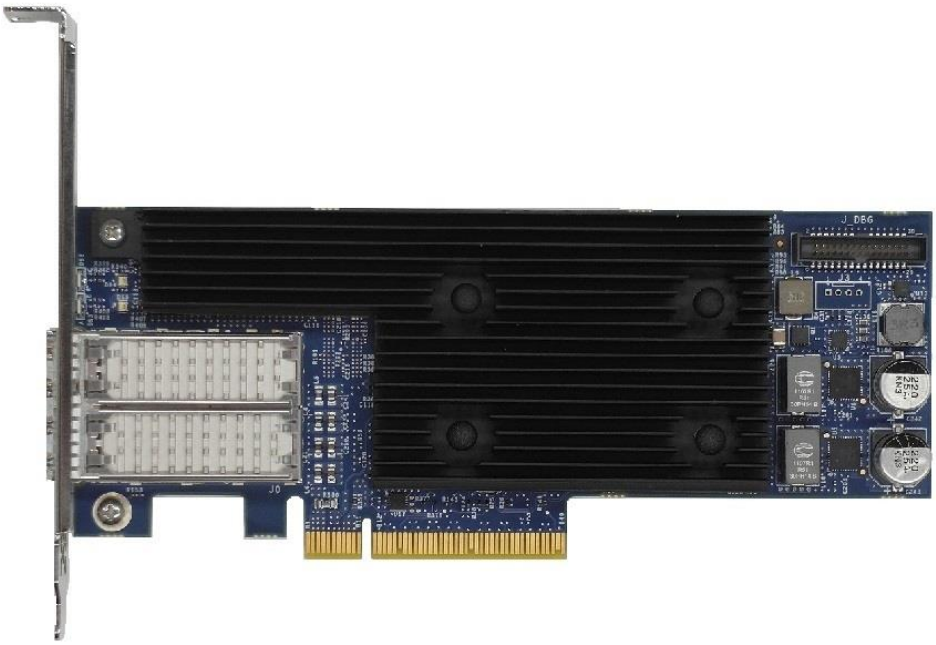

Figure 3 2x10G Agilio CX SmartNIC

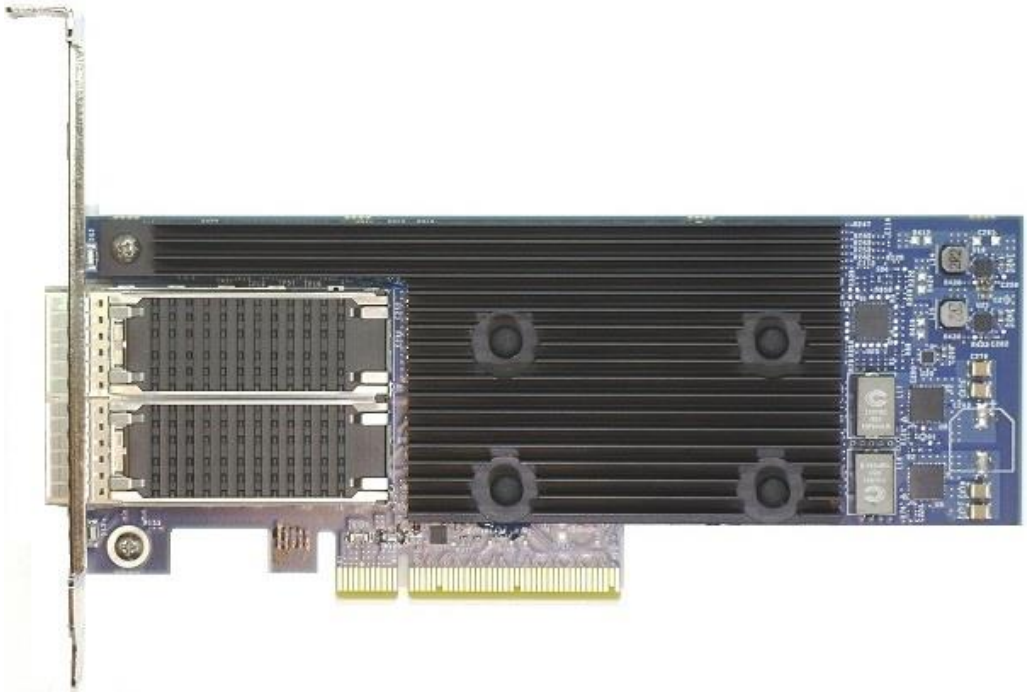

Figure 4 2x40G Agilio CX SmartNIC

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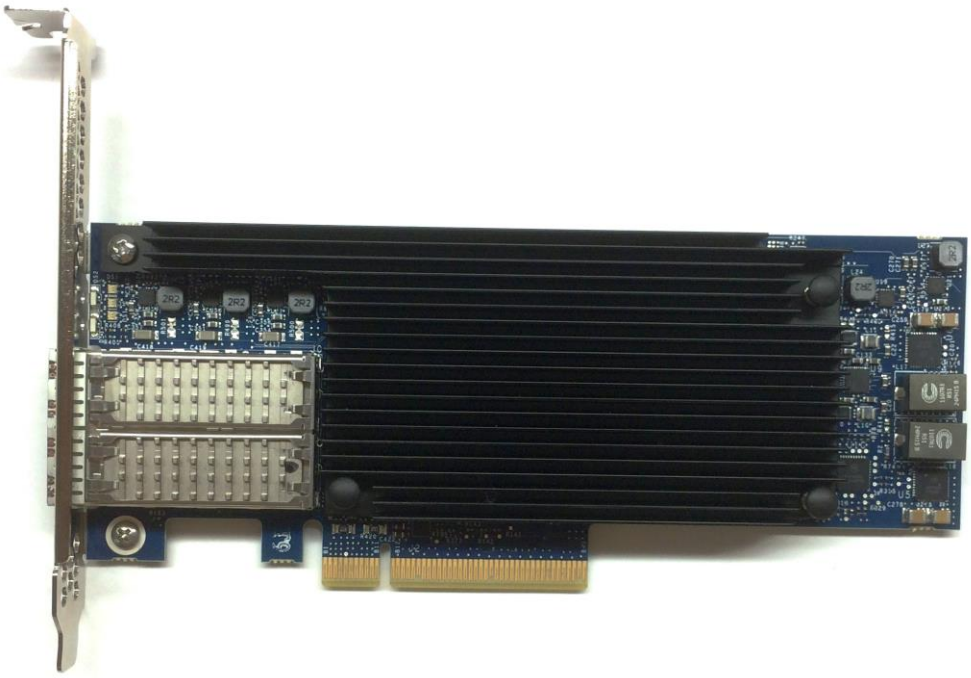

Figure 5 2x25G Agilio CX SmartNIC

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2.1 ISA-4000-40Q-10-BB-2 / ISA-4000-40-1-2; 1x40G

ISA-4000-40Q-10-BB-2 / ISA-4000-40-1-2 cards have one 40Gbps QSFP interface port.

An illustration of a 1x40G Full-Height faceplate, with connector and indicator locations, is shown below in Figure 6. An alternate 1x40G Full-Height faceplate is shown in Figure 7. Please refer to Section 4 for further information regarding the configuration of this connector and these indicators for the target application.

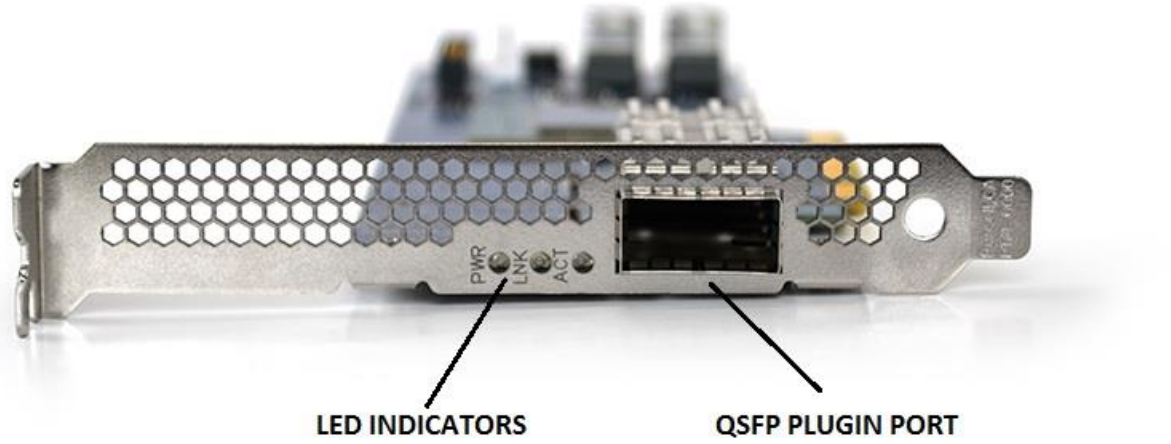

Figure 6 1x40G Agilio CX SmartNIC faceplate illustration

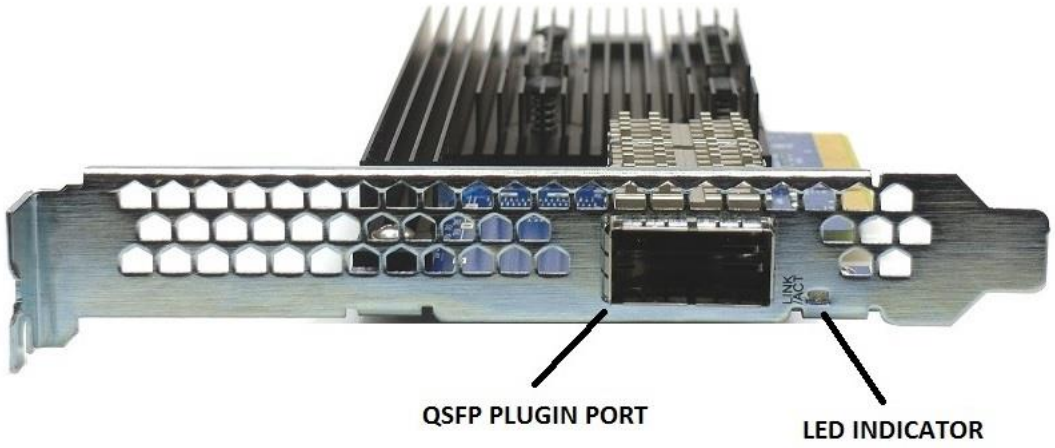

Figure 7 1x40G Agilio CX SmartNIC faceplate illustration (alternate)

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2.2 ISA-4000-10S-20-CB-2 / ISA-4000-10-2-2; 2x10G

ISA-4000-10S-20-Cx-2 / ISA-4000-10-2-2 cards have two 10Gbps SFP+ interface ports. These interface ports also support direct-attach cables and certain multi-rate media down to 1Gbps, though default to the highest speed until configured. Please refer to the software configuration documents identified in Section 4 for further information on configuring multi-rate media at different speeds.

An illustration of a 2x10G Full-Height faceplate with connector and indicator locations is shown below in Figure 8. Please refer to Section 4 for further information regarding the configuration of these connectors and indicators for the target application.

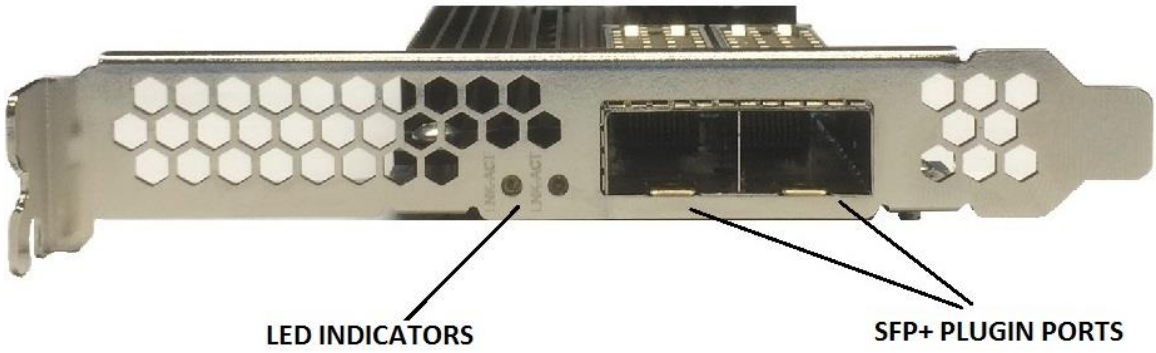

Figure 8 2x10G Agilio CX SmartNIC faceplate illustration

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2.3 ISA-4000-40-2-2; 2x40G

ISA-4000-40-2-2 cards have two 40Gbps QSFP interface ports.

An illustration of a 2x40G Full-Height faceplate, with connector and indicator locations, is shown below in Figure 9. Please refer to Section 4 for further information regarding the configuration of these connectors and indicators for the target application.

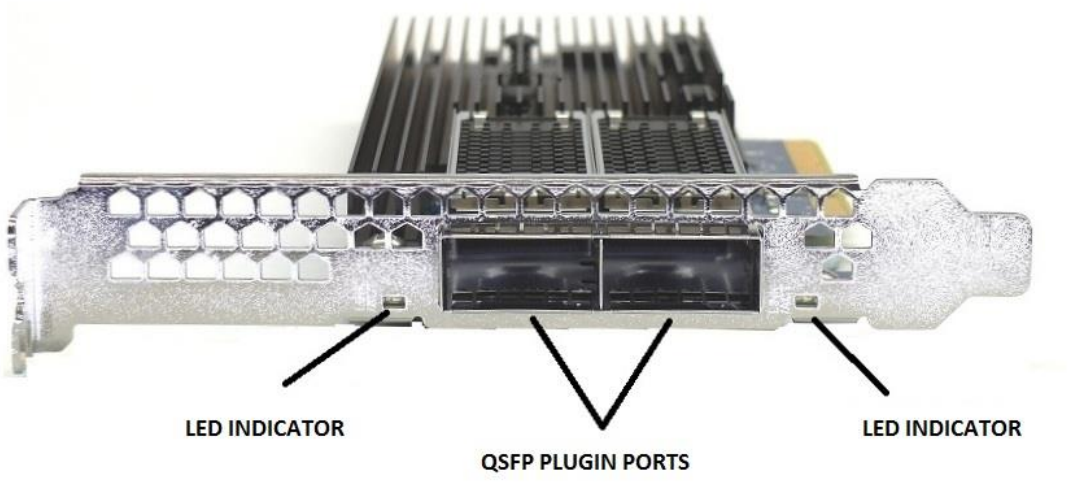

Figure 9 2x40G Agilio CX SmartNIC faceplate illustration

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2.4 ISA-4000-25-2-2; 2x25G

ISA-4000-25-2-2 cards have two 25Gbps (z)SFP+ / SFP28 interface ports. These interfaces also accept SFP+ plugins, certain multi-rate media, and direct-attach cables to support 10Gbps data rates, though default to the highest speed until configured. Please refer to the software configuration documents identified in Section 4 for further information on configuring multi-rate media at different speeds.

An illustration of a 2x25G Full-Height faceplate, with connector and indicator locations, is shown below in Figure 10. Please refer to Section 4 for further information regarding the configuration of these connectors and indicators for the target application.

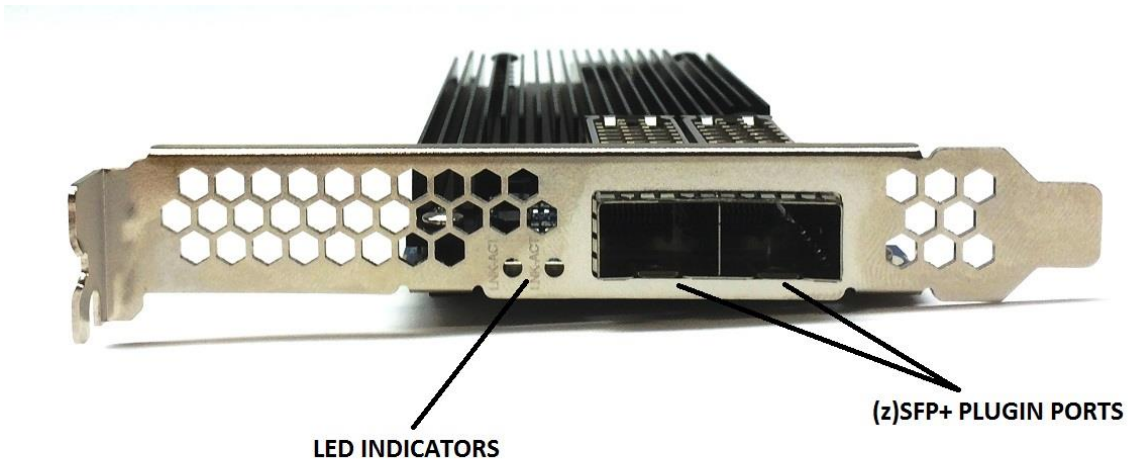

Figure 10 2x25G Agilio CX SmartNIC faceplate illustration

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3 Installation

Agilio CX SmartNICs are based on the Netronome 4000 Network Flow Processor. These cards are PCIe compatible, and can be used in systems that support a half-length, half-height, x8 PCIe 3.0 ("PCIe gen 3") card.

Transceiver plug-in modules are not currently supplied with Agilio CX SmartNICs. A user may also use their own transceiver modules, provided they are sufficiently compatible. Contact Netronome, as described in Section 5, if you require any assistance in determining whether your host system and/or transceiver modules are compatible with the Agilio CX platform.

Lists of platform chipsets, operating systems and transceiver modules with which the Agilio CX platform has been tested are available upon request.

Caution! A suitable host system must support SR-IOV Virtualization, and have that enabled in the system BIOS.

Caution! When handling Agilio CX SmartNICs, please take care to only touch the outer edges of the hardware and not any of the components.

Caution! The exact steps required for installation will vary depending on the intended host system. Please familiarize yourself with the installation required for PCIe add-in card installation in your target system's documentation before attempting the installation of an Agilio CX card. Power should be disconnected from the system until installation is complete, and ESD mitigation precautions should be employed throughout.

Caution! Please ensure the necessary slots/bays are unoccupied in the target system before attempting to install the Agilio CX SmartNIC(s) into the desired slot(s). Cover-plates may need to be removed from the installation slots/bays prior to installation. An Agilio CX SmartNIC physically occupies a single PCIe slot.

Caution! Unimpeded airflow must be maintained around and across the card at all times. Please ensure that other components and cables obstruct neither the airflow path to the card nor the card outlet vent, and that the host system is properly re-sealed after card installation. Please refer to Section 2 for ratings information and additional cautions for maintaining sufficient system airflow across the card.

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4 Configuration

Typically a Netronome-provided driver is required for accessing the SmartNIC's Network Flow Processor (NFP) and to serve as an endpoint for the packet datapath. The standard driver for SmartNICs is kernel module `nfp.ko`. This driver may be found:

- In-tree (as of Linux Kernel Version 4.11)
- On the Netronome `nfp-drv-kmods` page on GitHub
- In the Netronome DKMS package, available from Netronome

Note that the in-tree version disables `nfp_dev_cpp`, one of the ways to access the SmartNIC. In this mode, the SmartNIC can be used only with the standard network management tools like `ifconfig` and `ethtool`. Temperature and power monitoring information can be obtained using the `sensors` command from the `lm-sensors` package.

Both the GitHub- and Netronome-provided packages enable `nfp_dev_cpp` access by default. Please see `modinfo nfp` for a list of options. With `nfp_dev_cpp` enabled, tools and libraries from the `nfp-bsp-6000-b0` package provided with your application software can be used. Temperature and power monitoring can be performed as described later in Sections 4.1 and 4.2.

The following system tools are generally very useful:

- `lspci -vvv -d 19ee:` to confirm PCIe configuration of SmartNIC(s)
- `dmesg | grep nfp` to check for system-generated messages the SmartNIC
- `ethtool` for basic SmartNIC management

Netronome SmartNIC applications have been integrated into several popular distributions like RHEL 7.6 and Ubuntu 18.04. Please refer to CoreNIC user manual or OVS-TC user manual for more information.

For advanced application guidance, please refer to the following, all available from Netronome, for installing and using platform software:

- For Agilio OvS-based applications
  - Agilio OvS Getting Started Guide
  - Agilio OvS User's Guide
- For custom applications
  - Netronome Software Development Kit and Programmer's studio (SDK)
  - NFP BSP Release Notes

It is critical to use Optics or Direct Attach Cables that have been tested and certified by **Netronome** to work with **Netronome** Agilio CX SmartNICs. A list of certified Optics and Direct Attach cables can be found on our website at the following URL: https://www.netronome.com/products/cable-matrix/

Contact Netronome Systems, as described in Section 5, if you require any assistance with obtaining or using any of the resources described in this section.

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4.1 Integrated Temperature Monitoring

Agilio CX SmartNICs have a feature whereby the SmartNIC monitors its thermal condition and takes action if needed. Up to two forms of action may be taken, depending on the operating condition:

1. If the SmartNIC is approaching its critical operating temperature, it will automatically start recording thermal events once it senses that an internal junction temperature of 95°C has been reached. This recording will stop this once this temperature returns below 95°C.
2. If the SmartNIC reaches or exceeds its critical internal operating temperature of 103°C, the SmartNIC will initiate some internal self-mitigating actions. This will result in degraded performance and undefined behavior. The most likely symptom is the loss of traffic and access to the NIC from PCIe. In this situation, the user is advised to shut down the host system and address the cause of the thermal condition before normal operation can resume.

The integrated temperature monitoring and self-mitigation is independent of the user's platform application software. It is strongly recommended that, however the user is operating the card, the operating temperature is periodically checked using either `lm-sensors` or `nfp_cpp_dev` enabled tools, with system-level actions taken accordingly to ensure the SmartNIC stays well below its critical operating temperature. Examining the temperatures logged in step 1 above does require `nfp_cpp_dev` support to be enabled in order to run `nfp-temp --displaylog`.

4.2 Integrated Power Monitoring and Throttling

Agilio CX SmartNICs have an additional feature whereby the SmartNIC monitors its power consumption between a setpoint (24.5W) and the allowable limit (25W). It automatically takes actions to limit power consumption to the allowable limit. No user intervention is required.

If `nfp_cpp_dev` support is enabled, the current power consumption can be examined via the command `nic-power` (`--help` if needed). The default setpoint is 24.5W and can be examined by the `--pwr-control-status` flag.

Caution! SmartNIC performance might be reduced when operating under a high power condition between the setpoint (e.g. 24.5W) and the allowable limit (25W). Please make sure the airflow and operating requirements are met.

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5 Technical Support

To obtain additional information, or to provide feedback, please email help@netronome.com, visit Netronome's SmartNIC support site at https://help.netronome.com, or contact your nearest **Netronome Systems, Inc.** technical support representative.

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6 Reference Drawings

This section contains copies of reference drawings for each of the Agilio CX SmartNICs described by this document. Standalone copies of these drawings may be requested from **Netronome** technical support.

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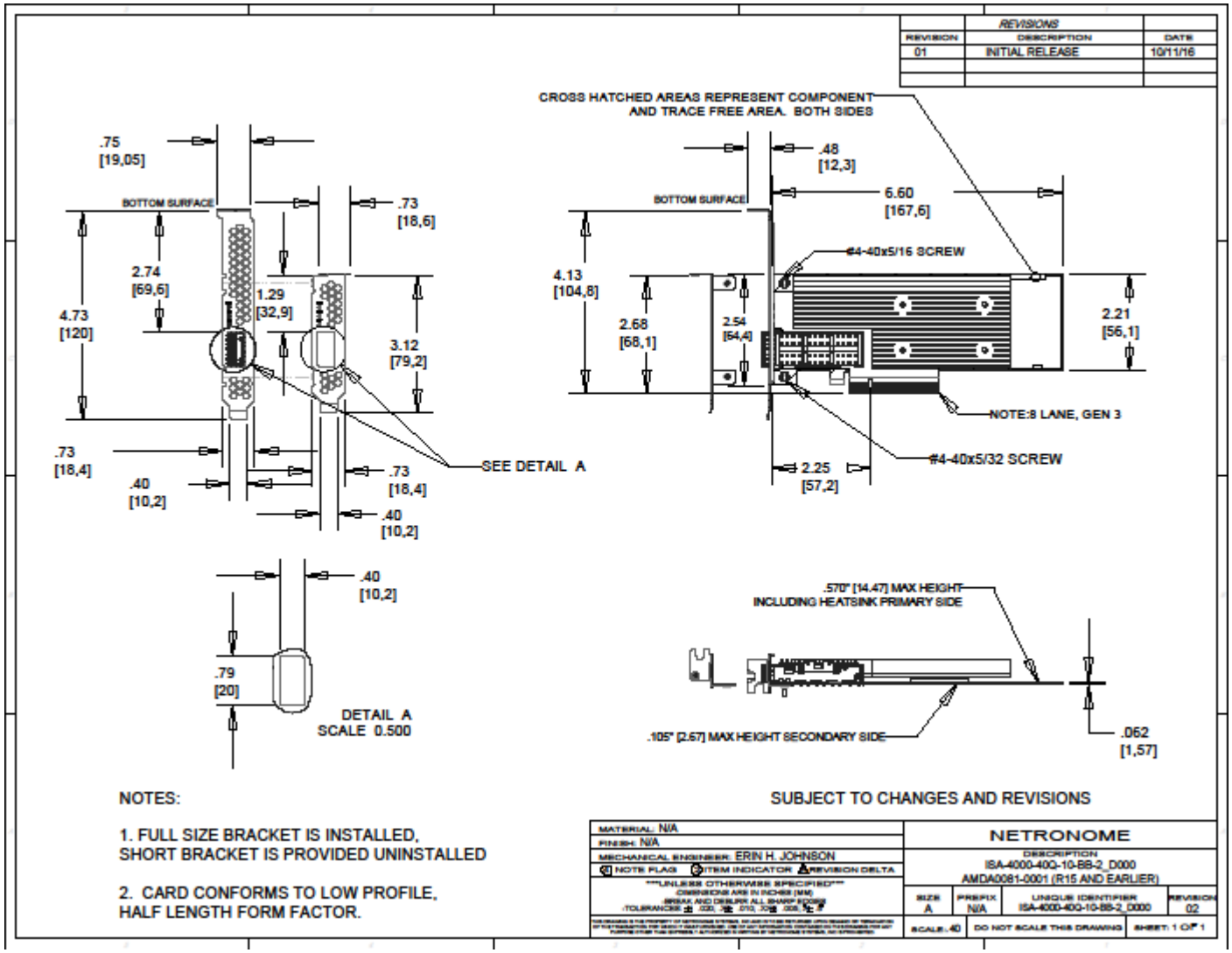

Figure 11 ISA-4000-40Q-10-BB-2 1x40G reference drawing

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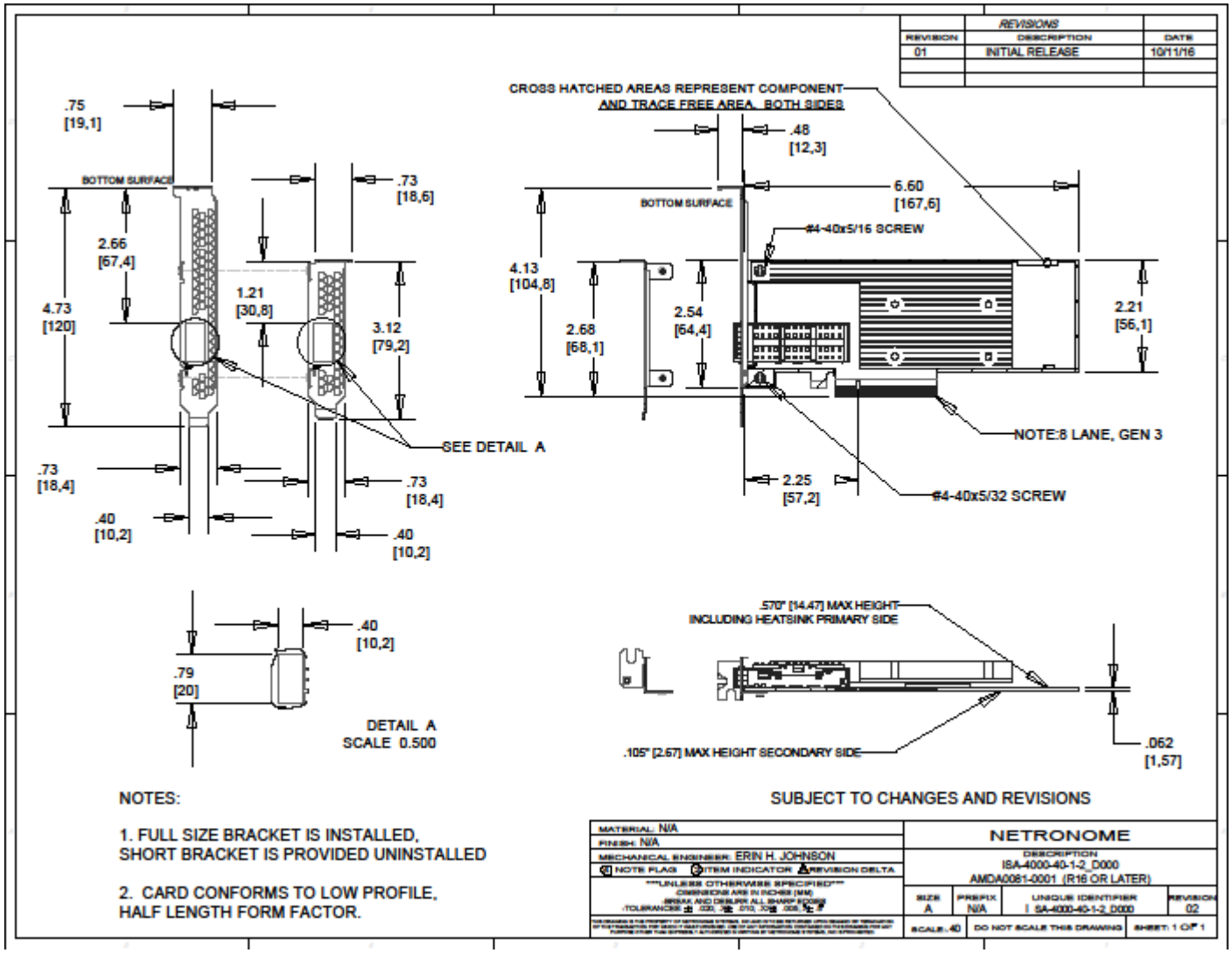

Figure 12 ISA-4000-40-1-2 1x40G reference drawing

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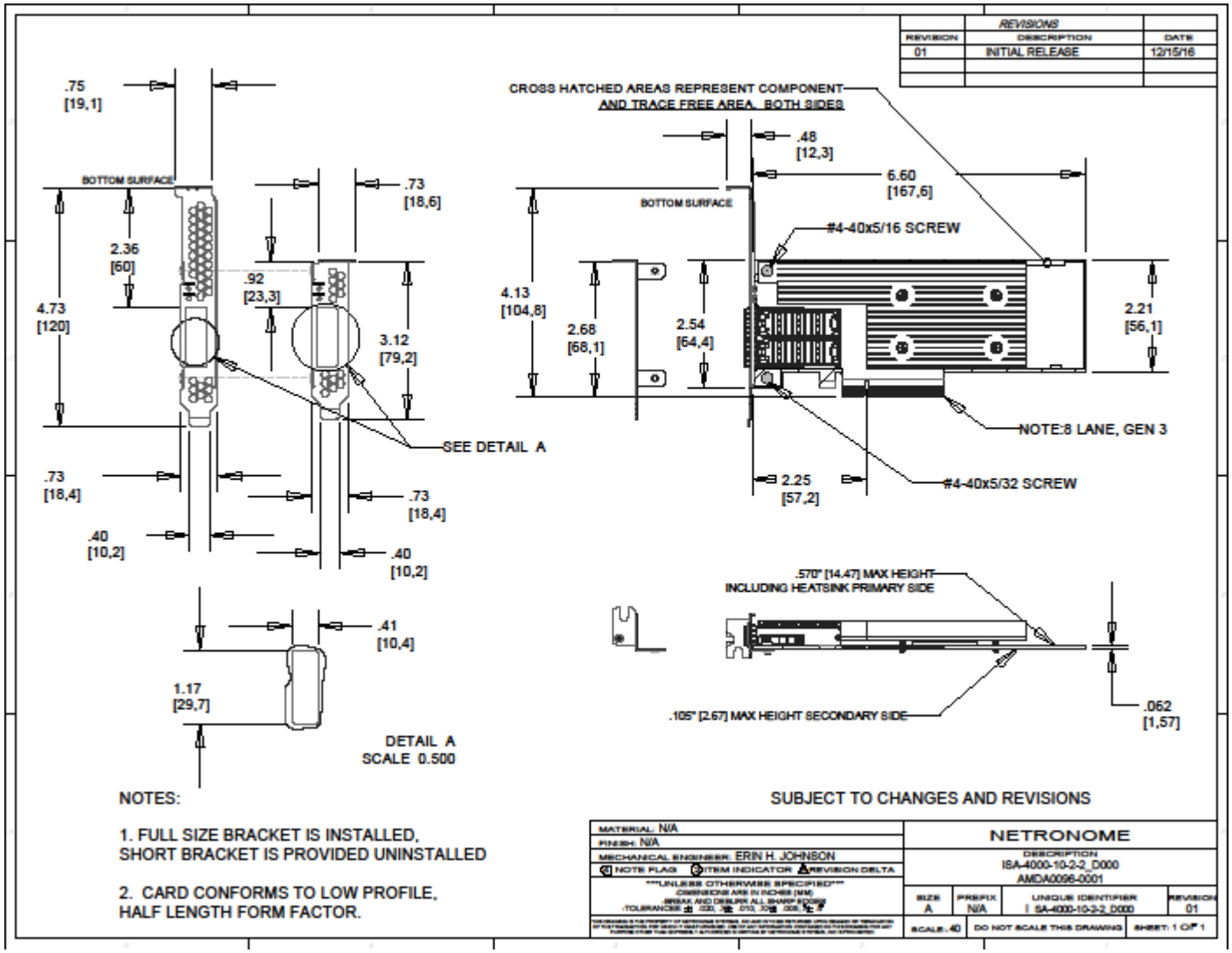

Figure 13 ISA-4000-10-2-2 2x10G reference drawing

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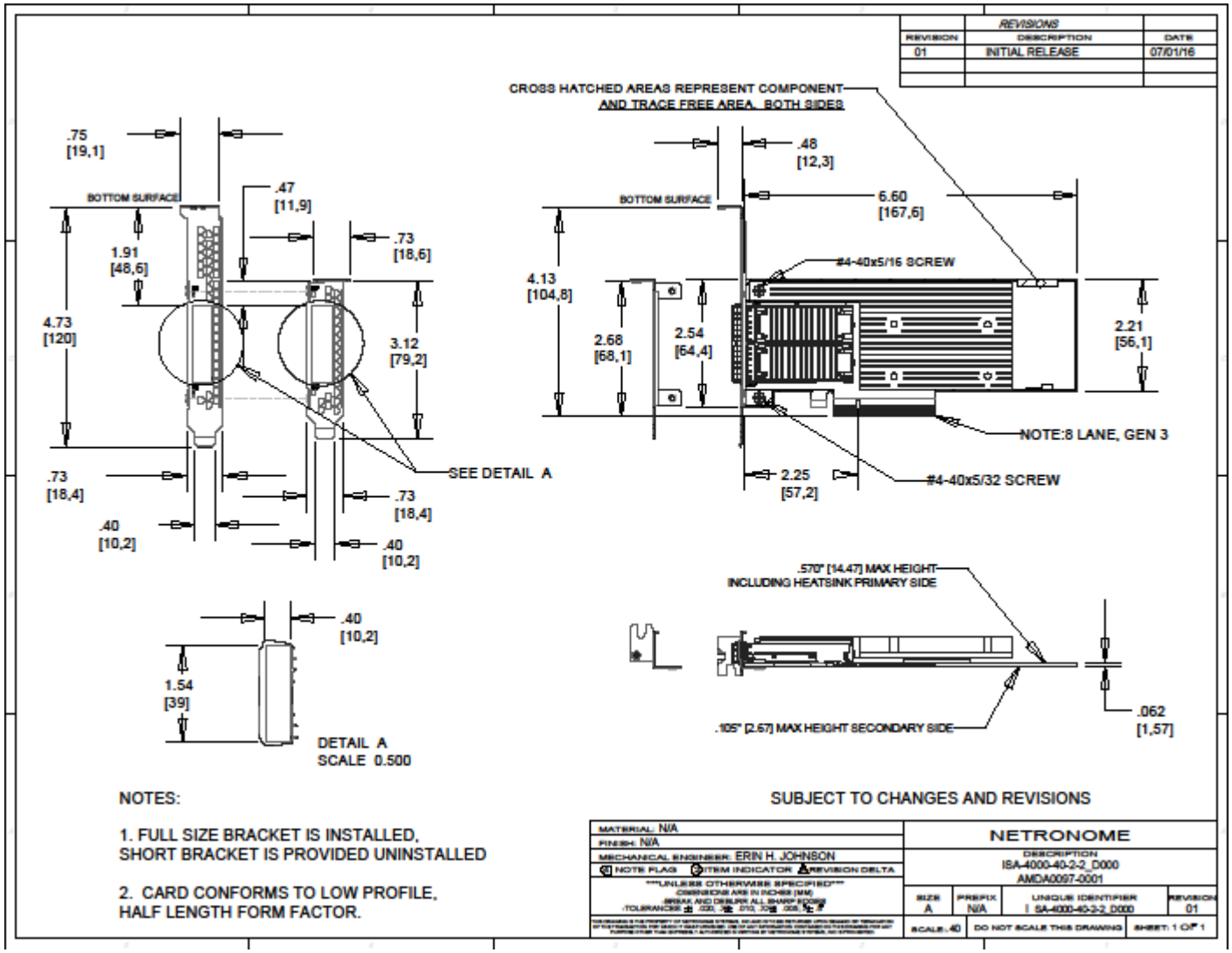

Figure 14 ISA-4000-40-2-2 2x40G reference drawing

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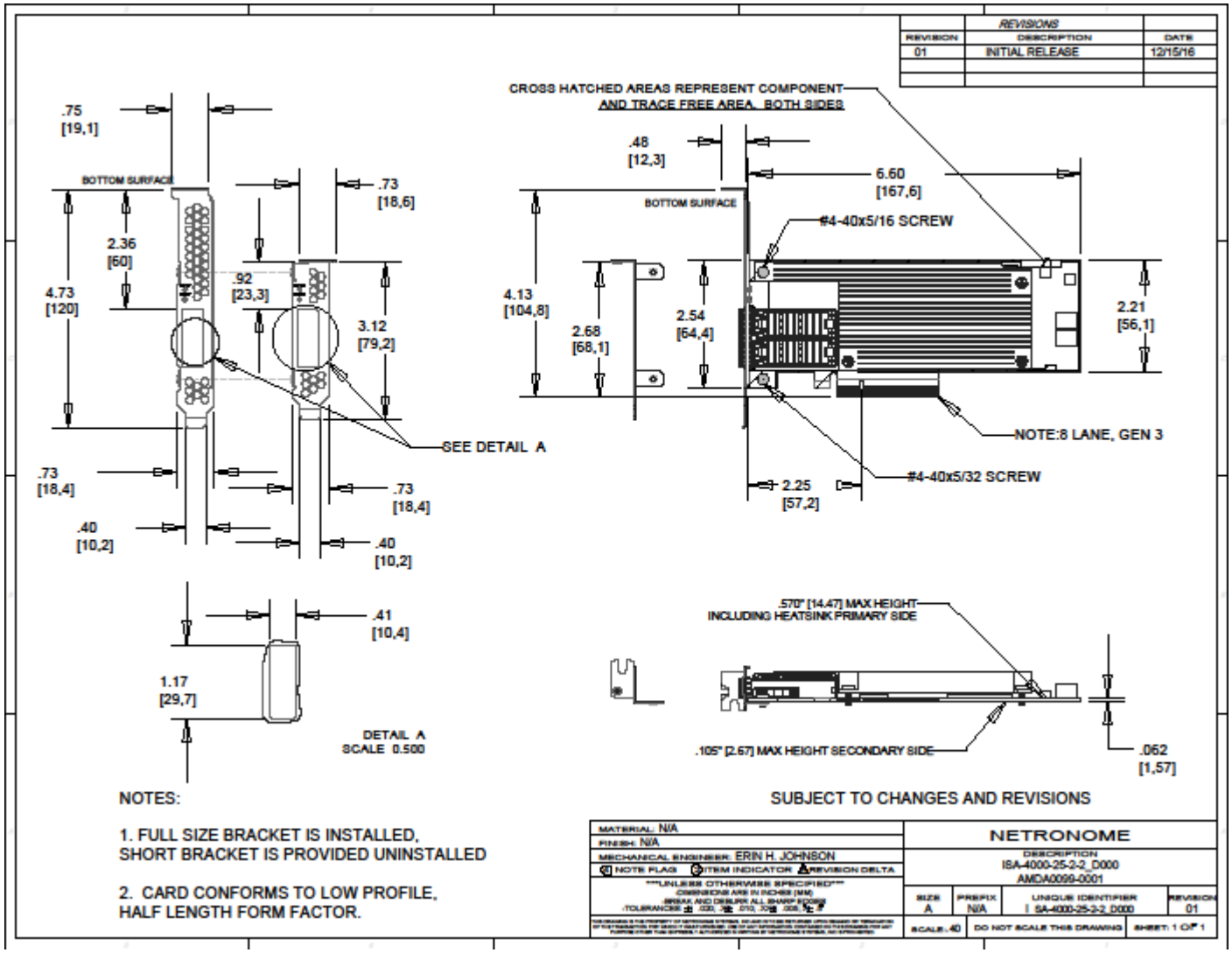

Figure 15 ISA-4000-25-2-2 2x25G reference drawing

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