

Ensemble® 6000 Series OpenVPX Intel 3rd Generation Core i7 LDS6523 Processing Module



*New Low-Density Server Combines Ivy Bridge Performance
With Ultra-High Bandwidth Data Plane*



- 6U OpenVPX™ single 1-inch slot module
- Intel® 3rd Generation Core™ i7 (Ivy Bridge mobile-class) Quad-Core™ processor at up to 2.3 GHz with 147 GFLOPS peak performance
- 40 Gigabit Ethernet or InfiniBand high bandwidth switching:
 - Ethernet ecosystem; 40GBASE-KR4 and 10GBASE-KX4
 - Or InfiniBand ecosystem; FDR-10, QDR, DDR and SDR
- Gen3 PCIe® co-processing and I/O expansion plane communications
- Air-cooled, rugged conduction-cooled and Air Flow-By™ OpenVPX™ packaging options

The Ensemble™ 6000 Series OpenVPX™ Intel 3rd Generation Core i7 Quad-Core LDS6523 Module from Mercury Systems combines a powerful Ivy Bridge mobile-class quad-core Intel processor, the new Mellanox ConnectX-3 bridge for unsurpassed fabric data rates, and configurable mezzanine I/O in a single 6U OpenVPX slot. The LDS6523, as Mercury's latest low-density server, provides a next-generation architecture that balances the disruptive computational capabilities of the AVX-enabled Core i7 processor with disruptive QDR InfiniBand or 40 Gigabit Ethernet data paths. The combination provides a powerful and scalable computing architecture that is well aligned with high-end radar, electronic warfare and image processing applications.

Intel 3rd Generation Core i7 Ivy Bridge Mobile-Class Processor

At the heart of the LDS6523 is the Intel 64-bit 3rd Generation Core i7 3615QE processor, running at up to 2.3 GHz. This processor is based on the Ivy Bridge processor architecture, which includes the revolutionary Intel Advanced Vector Extensions (AVX) instruction set and is produced using a 22 nm manufacturing process. The AVX instruction set doubles the width of the processor's SIMD engine from 128 bit to 256 bit, delivering a significant improvement in floating-point processing.

Simultaneously, the 3615QE processor delivers a higher operating clock frequency than the preceding 2nd Generation Core i7 processor without any increase in power dissipation due to the 22 nm manufacturing process. The combination of these two architectural advancements results in the LDS6523 delivering approximately 147 peak GFLOPS.

The 3615QE includes a large 6 MB cache shared between the cores, allowing many high-performance calculations to remain cache resident. This accelerates processing by eliminating the potential latency required to access DRAM to fetch upcoming data.

The Intel 3rd Generation Core i7 3615QE processor supports dual high-speed DDR3-1600 memory controllers, providing up to 25 GB/s of raw memory bandwidth. 8 GB of DDR3-DRAM with ECC support is populated on the LDS6523. The LDS6523 makes use of the Panther Point Platform Controller Hub (PCH) chipset, which provides integrated graphics capabilities along with I/O bridging between the Intel processor and external devices.

Unparalleled Data Plane Bandwidth

The LDS6523 is the first embedded processing module to utilize dual Mellanox ConnectX-3 host adaptors for data plane communications. Bridging between the native Gen3 PCIe® interfaces on the Intel processor and the OpenVPX data plane, the ConnectX-3 can be configured to support SDR, DDR, QDR, FDR10, 10GbE or 40GbE as the data plane

Mercury Systems is a best-of-breed provider of commercially developed, open sensor and Big Data processing systems, software and services for critical commercial, defense and intelligence applications.



ACQUIRE



DIGITIZE



PROCESS



STORAGE



EXPLOIT



DISSEMINATE

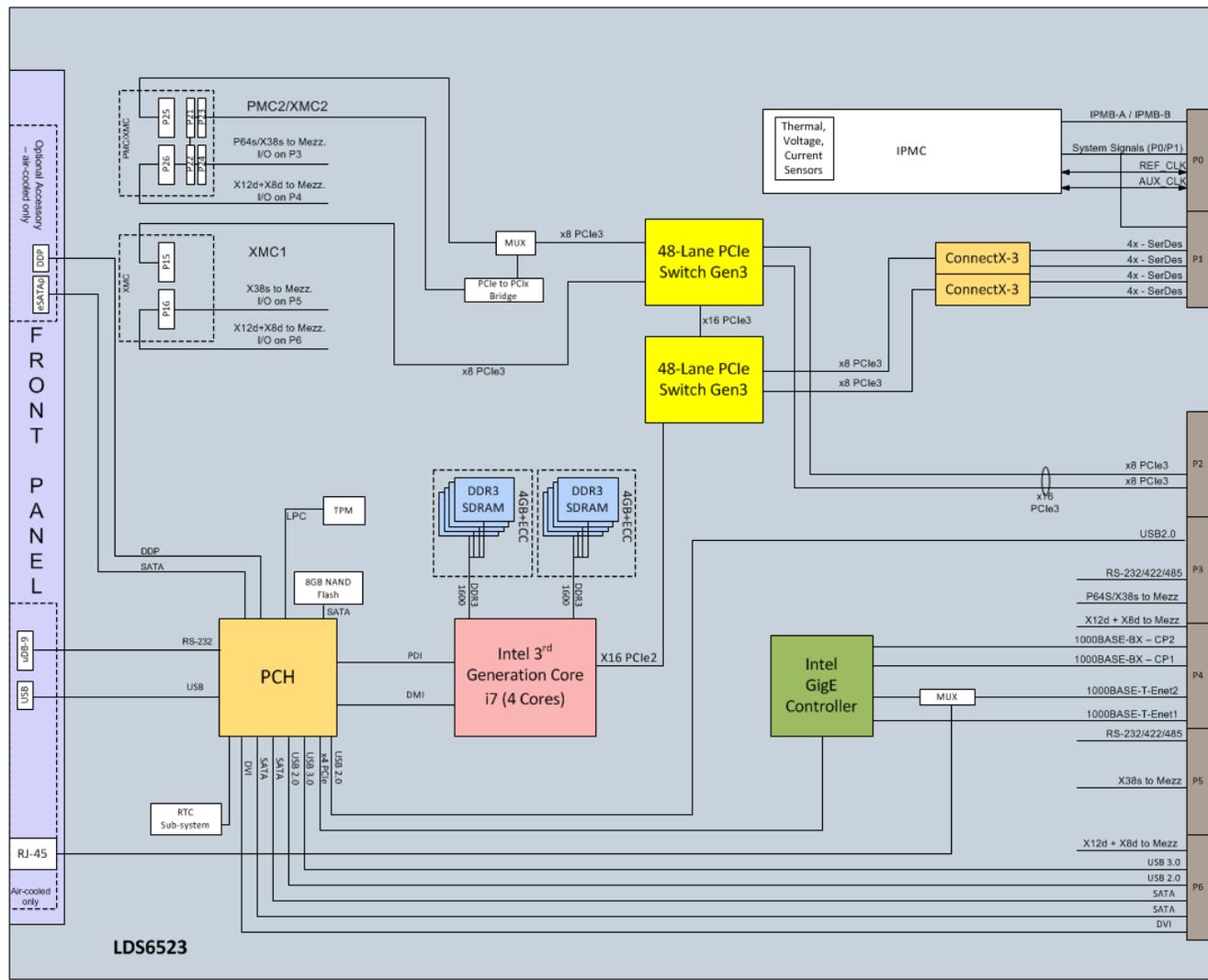


Figure 1. LDS6523 functional block diagram

protocol. This advancement scales the data plane bandwidth up to a peak theoretical rate of 5 GB/s per port, or 20 GB/s aggregate across the entire four-port OpenVPX data plane. By scaling the data plane bandwidth to match the increase in processing performance, the LDS6523 architecture ensures that the processor is never starved for data.

By utilizing the Mellanox ConnectX-3 device, the LDS6523 is a model for open architecture high-performance computing throughout the embedded industry.

The LDS6523 module is compliant to the VITA 65 module profile MOD6-PAY-4F1Q2U2T-12.2.1-n, where n can vary based on the ConnectX-3 configuration. The LDS6523 is supported in chassis slots that are compliant with VITA 65 slot profile SLT6-PAY-4F1Q2U2T-10.2.1.

PCI Express Architecture

The LDS6523 provides dual 48-lane Gen3 PCIe switches for both on-board switching and off-board expansion. This switch complex provides an x8 PCIe interface to each of the two XMC sites, as well as an x4 connection to a PCIe to PCI-X bridge for the single PMC site. This allows mezzanines to operate at full bandwidth, optimizing the flow of I/O into the processing subsystem. Additional Gen3 x8 interfaces are provided to the ConnectX-3 devices, allowing bridging to the data plane without bottlenecking.

Externally, the LDS6523 implements a full Gen3 x16 PCIe connection to the OpenVPX expansion plane on the P2 VPX connector. This expansion-plane interface enables the LDS6523's compatibility with Mercury's GPU or FPGA based co-processing modules. The x16 PCIe connection can be user-configured as dual x8 connections. These configuration options let the module effectively act as an upstream/downstream PCIe switch to allow the "chaining" of PCIe devices.

Mezzanine Card Flexibility

The LDS6523 provides two mezzanine sites: one PMC/XMC and one XMC-only. Each of the standard mezzanine sites on the LDS6523 module can be configured with off-the-shelf mezzanine cards to bring additional I/O into the system for processing or control. PMC cards are supported with a 32-bit or 64-bit PCI/PCI-X interface at up to 133 MHz on the PMC/XMC site, with PMC user-defined I/O mapped to the backplane. XMCs are supported with x8 PCIe

supported on the J15/J25 connector per the VITA 42.3 standard. There are 20 differential pairs and 38 single-ended signals of XMC user I/O mapped to the backplane via the J16/J26 connector.

Multiple I/O Options

In addition to the flexibility offered via the on-board mezzanine sites, the LDS6523 offers a variety of additional built-in I/O options:

- One 10/100/1000BASE-T Gigabit Ethernet connection can be routed to the front panel on air-cooled configurations or to the backplane.
- One additional 10/100/1000BASE-T Gigabit Ethernet connection is routed to the backplane.
- Two 1000BASE-BX SERDES Ethernet connections are routed to the backplane per the OpenVPX control-plane specification.
- One DisplayPort interface is routed to an optional I/O adaptor, supporting front-panel graphical display if required.
- One DVI graphics interface is provided to the backplane.
- One TIA-232 serial port is routed to the front panel on air-cooled configurations, or to the backplane on conduction-cooled configurations. When routed to the backplane, the serial interface can be configured for either TIA-232 or TIA-422/TIA-485 signaling.
- One front panel USB 2.0 interface is available on air-cooled configurations, with an additional USB provided via an optional I/O adaptor
- Two backplane USB interfaces are available (one 2.0, one 3.0) with both air-cooled and conduction-cooled configurations.
- One front-panel eSATA interface is provided on air-cooled configurations via an optional I/O adaptor.
- Two SATA interfaces to the backplane are provided to easily interface with storage devices.
- Eight GPIO lines act as discrete I/O usable as input, output, or to generate interrupts on the module.
- Several additional bused signals enhance the functionality of the LDS6523 module.

System Management

The LDS6523 module implements the advanced system management functionality architected in the OpenVPX specification to enable remote monitoring, alarm management, and hardware revision and health status.

Using the standard I2C bus and IPMI protocol, the on-board system-management block implements the Intelligent Platform Management Controller (IPMC) in accordance with the VITA 46.11 draft standard.

This allows the LDS6523 module to:

- Read sensor values
- Read and write sensor thresholds, allowing an application to react to thermal, voltage or current variations that exceed those thresholds
- Reset the entire module
- Power up/down the entire module
- Retrieve module Field Replaceable Unit (FRU) information
- Be managed remotely by a Chassis Management Controller at the system level, such as implemented on Mercury's 6U OpenVPX switch fabric modules

Additional Features

The LDS6523 module provides all the features typically found on a single-board computer. In addition to the sophisticated management subsystem and fabric interconnect, the LDS6523 module provides users with a toolkit enabling many different application use cases.

Features include:

- Real-time clock with granularity to 1 ms and time measurement of up to 30 years
- General-purpose timers for synchronization
- Watchdog timer to support processor interrupt or reset
- Multiple boot paths, including netboot, USB boot, and boot from SATA or the on-board 8 GB flash device

Open Software Environment

Mercury leverages over 25 years of multicomputer software expertise, including recent multicore processor expertise, across its many platforms. This strategy is fully applied to the LDS6523 module. The same Linux® development and run-time environment is implemented on the LDS6523 module as on other Intel-based Mercury platforms across the Ensemble 3000, 5000 and 6000 Series. Off-the-shelf open software such as OFED and OpenMPI are fully supported by the Mellanox ConnectX-3 data plane.

Mercury OpenVPX Ecosystem

Sensor processing chain awareness, building blocks and ecosystem

Sensor chain awareness is having the technical expertise and resources to design and build capable, compatible solutions along the whole sensor processor chain. From RF/Microwave, digital/analog signal manipulation to dense, Size, Weight, and Power (SWaP) optimized processing resources to Big Data analysis and actionable intelligence dissemination; Mercury's rugged compute subassemblies leverage the best commercial-item technology, enabling prime contractors to win more business.

Modern sensor compute subassemblies are customized assemblies of interoperable building blocks built to open standards. Mercury's hardware and software portfolio of building blocks are physically and electrically interoperable as defined by international industrial standards, including OpenVPX.

System bandwidth – the effect of interconnect performance

Bandwidth is critical and especially applicable to switched fabric resources which dictate the responsiveness of the entire subsystem. All modular solutions, including OpenVPX are to some degree or another, interconnect-bound; they are restricted by the limitations of the best industry interconnect technology. To address this, Mercury fabricates system interconnections with innovative technology which mitigates insertion-loss and cross-talk while maintaining full VITA/OpenVPX compliance. The resulting and significant system performance boost is especially discernible as subsystems scale larger.

Flexible, modular system configurations

Mercury OpenVPX subsystems are designed from a suite of sophisticated open architecture building blocks that are combined and scaled to meet a broad range of advanced sensor chain processing requirements. Mercury subsystems may include analog, digital and mixed-signal receiver modules, single-board computers and signal processing payload modules. Payloads may have acquisition, digitization, processing, and exploitation and dissemination elements and include FPGA, CPU, GPU or ADC/DAC technology.

Module packaging

VPX-REDI

The VPX (VITA 46) standard defines 6U and 3U board formats with a high performance interconnects capable of supporting today's high speed fabric interfaces. VPX may be paired with the ruggedized enhanced design implementation standard — REDI (VITA 48). SFM6104 modules when implemented as conduction-cooled or Air Flow-By™ are VPX-REDI compatible. Air-cooled equivalents conform to the same OpenVPX form factor and are suitable for less challenging environments. Targeted for harsh embedded environments, VPX-REDI supports higher functional density and Two-Level Maintenance (2LM). 2LM allows relatively unskilled maintenance personnel to replace a failed module.

Rugged air cooling, Air Flow-By

Air-cooled and conduction-cooled subsystems rely on filtration to remove contaminants from their cooling air streams. Mercury's Air Flow-By technology eliminates filtration with the most elegant cooling solution available within a sealed and rugged package. Fully compliant to VITA standards (including VITA 48.5), Air Flow-By maintains OpenVPX's 1-inch pitch requirement, is highly resilient to liquid and particle contamination, boosts SWaP, reduces operating temperature, extends MTBF by an order of magnitude and enables embedded deployment of the most powerful and reliable processing solutions.

LDS6523 modules are available as air-cooled (various levels of ruggedness), and rugged Air Flow-By and conduction-cooled variants.

Specifications

Intel® 3rd Generation Core™ i7 Ivy Bridge Processor

Quad-core with Advanced Vector Extensions (AVX)

2.3 GHz 3615QE

Peak performance	147 GFLOPS (peak theoretical)
Threads per core	2
Intel Virtualization Technology	
DDR3-1600	8 GB with ECC
Raw memory bandwidth	25 GB/s (total)
Local SATA flash	8 GB
BIOS SPI flash	

Mellanox ConnectX-3 VPI Host Card Adaptors

Provides fabric bridging to data plane

Supports DDR or QDR InfiniBand, or 40 Gigabit Ethernet protocols*

*The LDS6523 currently supports DDR InfiniBand. Planned variants will support QDR InfiniBand or 40 GigE. Variants may require changes to the system infrastructure such as connectors, backplane, etc.

IPMI (System Management)

On-board IPMI Controller

Voltage and temperature monitor

Geographical address monitor

Power/reset control

On-board FRU EEPROM interface

FPGA, CPU and CPLD interfaces

Ethernet Connections

1000BASE-BX Ethernet to P4 connector	2
OpenVPX control plane	
10/100/1000BASE-T Ethernet to P4 connector	1
Accessible via OpenVPX RTM or external chassis interface	
10/100/1000BASE-T Ethernet connection	1
To front panel (air-cooled module) or backplane P4 connector (conduction-cooled module)	

Ethernet functions supported by the chipset include:

UDP, TCP, SCTP, ARP, IPv4, IPv6, IEEE1588, flow control, 802.1P (priority) and 802.1Q (VLAN)

OpenVPX Multi-Plane Architecture

System management via IPMB-A and IPMB-B link on P0 management plane
InfiniBand or 40 Gigabit Ethernet interfaces on P1 data plane
Full x16 or dual x8 Gen3 PCIe expansion plane to P2 connector
Dual 1000BASE-BX Ethernet control plane

PMC-X/XMC Sites

Mezzanine sites	1 PMC/XMC, 1 XMC only
PCI-X-to-PCIe bridge	Connects PMC site to on-board PCIe switch
PMC PCI support	33 and 66 MHz
PMC PCI-X support	66, 100, and 133 MHz
PMC user-defined I/O from J14 to backplane	
PCIe XMC sites per VITA 42.3 with XMC user-defined I/O from Jn6 to backplane	

Additional I/O Capabilities

One RS-232 serial interface to front panel (air-cooled) or backplane (conduction-cooled)
Configurable for RS-232 or RS-422 signaling when routed to backplane
One additional RS-232/RS-422 serial interface to backplane
One front-panel USB 2.0 interface (air-cooled configurations only)
One USB 2.0 interface to backplane
One USB 3.0 interface to backplane
One front-panel DisplayPort interface (with optional I/O adaptor)
One DVI interface to backplane
One front-panel eSATA interface (with optional I/O adaptor)
Two SATA interfaces to backplane
Eight single-ended GPIO interfaces to backplane
System signals to backplane
NVMRO, ChassisTest, Environmental Bypass, MemoryClear

Mechanical

6U VPX (air-cooled and conduction-cooled)
1.0" slot pitch
OpenVPX and VPX-REDI

Compliance

OpenVPX System Specification encompasses VITA 46.0, 46.3, 46.4, 46.6, 46.11
Compatible with VITA 65
VITA 46/48.1/48.2 (REDI)
Serial RapidIO®, PCIe, 10 Gigabit Ethernet

Environmental

Environmental Qualification Levels

		Air-cooled				Air Flow-By	Conduction-cooled
		Commercial L0	Rugged L1	Rugged L2	Rugged L4	Rugged L3	
Ruggedness		•	••	••	•••	•••	
Moisture/dust protection		•	••	••	•••	•••	
Typical cooling performance		~140W*	~140W*	~150W*	~200W*	~150W**	
Temperature	Operating*	0°C to +40°C	-25°C to +55°C	-45°C to +70°C	-40°C to +60°C	-40°C to +71°C	
Operating temperature maximum rate of change		N/A	5°C/min	10°C/min	10°C/min	10°C/min	
Temperature	Storage	-40°C to +85°C	-55°C to +85°C	-55°C to +125°C	-55°C to +125°C	-55°C to +125°C	
Humidity	Operating*	10-90%, non-condensing	5-95%, non-condensing	5-95%, non-condensing	5-95%, non-condensing 100% condensing	5-95%, non-condensing 100% condensing	
	Storage	10-90%, non-condensing	5-95%, non-condensing	5-95%, non-condensing	5-95%, non-condensing 100% condensing	5-95%, non-condensing 100% condensing	
Altitude	Operating*‡	0-10,000ft	0-30,000ft	0-30,000ft	0-30,000ft	0-70,000ft	
	Storage	0-30,000ft	0-50,000ft	0-70,000ft	0-70,000ft	0-70,000ft	
Vibration	Random	0.003 g ² /Hz; 20-2000 Hz, 1 hr/axis	0.04 g ² /Hz; 20-2000 Hz, 1 hr/axis	0.04 g ² /Hz; 20-2000 Hz, 1 hr/axis	0.1 g ² /Hz; 5-2000 Hz, 1 hr/axis	0.1 g ² /Hz; 5-2000 Hz, 1 hr/axis	
	Sine	N/A	N/A	N/A	10G peak; 5-2000 Hz, 1 hr/axis	10G peak; 5-2000 Hz, 1 hr/axis	
	Shock	z-axis: 20g; x and y-axes: 32g; (11ms 1/2-sine pulse, 3 positive, 3 negative)	z-axis: 50g; x and y-axes: 80g; (11ms 1/2-sine pulse, 3 positive, 3 negative)	z-axis: 50g; x and y-axes: 80g; (11ms 1/2-sine pulse, 3 positive, 3 negative)	z-axis: 50g; x and y-axes: 80g; (11ms 1/2-sine pulse, 3 positive, 3 negative)	z-axis: 50g; x and y-axes: 80g; (11ms 1/2-sine pulse, 3 positive, 3 negative)	z-axis: 50g; x and y-axes: 80g; (11ms 1/2-sine pulse, 3 positive, 3 negative)
Salt/Fog		N/A	Contact Factory	Contact Factory	10% NaCl	10% NaCl	
VITA 47		Contact Factory					

* Customer must maintain required cfm level. Consult factory for the required flow rates.

** Card edge should be maintained below 71°C

Storage Temperature is defined per MIL-STD-810F, Method 502.4, para 4.5.2, where the product under non-operational test is brought to an initial high temperature cycle to remove moisture. Then the unit under non-operational test will be brought to the low storage temperature. The low temperature test is maintained for 2 hours. The product is then brought to the high storage temperature and is maintained for 2 hours. The product is then brought back to ambient temperature. All temperature transitions are at a maximum rate of 10°C/min. One cold/hot cycle constitutes the complete non-operational storage temperature test. This assumes that the board level products are individually packaged in accordance with ASTM-D-3951 approved storage containers. These tests are not performed in Mercury shipping containers, but in an unrestrained condition. Please consult the factory if you would like additional test details.

All products manufactured by Mercury meet elements of the following specifications: MIL-STD-454, MIL-STD-883, MIL-HDBK-217F, and MIL-I-46058 or IPC-CC-830, and various IPC standards. Mercury's inspection system has been certified in accordance with MIL-I-45208A.

Additional Services

Optional Environmental Screening and Analysis Services		Standard Module, Optional Services	
<ul style="list-style-type: none"> • Cold Start Testing • Cold Soak Testing • Custom Vibration • CFD Thermal Analysis • Finite Element Analysis 	<ul style="list-style-type: none"> • Safety Margin Analysis • Temperature Cycling • Power Cycling • Environmental Stress Screening 	<ul style="list-style-type: none"> • Engineering Change Order (ECO) Notification • ECO Control • Custom Certificate of Conformity (CofC) • Custom UID Labeling 	<ul style="list-style-type: none"> • Alternate Mean Time Between Failure (MTBF) Calculations • Hazmat Analysis • Diminished Manufacturing Sources (DMS) Management • Longevity of Supply (LOS) • Longevity of Repair (LOR)
Contact factory for additional information			

EchoCore, Echotek, Ensemble and MultiCore Plus are registered trademarks and Air Flow-By, AFB, Innovation That Matters, Mercury Systems, POET, SecureConfig and StreamDirect are trademarks of Mercury Systems, Inc. Other product and company names mentioned may be trademarks and/or registered trademarks of their respective holders. Mercury Systems, Inc. believes this information is accurate as of its publication date and is not responsible for any inadvertent errors. The information contained herein is subject to change without notice.

Copyright © 2014 Mercury Systems, Inc.

2932.06E-0214-DS-lds6523



INNOVATION THAT MATTERS™

CORPORATE HEADQUARTERS

201 Riverneck Road
Chelmsford, MA 01824-2820 USA
(978) 967-1401 • (866) 627-6951
Fax (978) 256-3599
www.mrcy.com

EUROPE MERCURY SYSTEMS, LTD.

Unit 1 - Easter Park, Benyon Road
Silchester, Reading
RG7 2PQ United Kingdom
+ 44 0 1189 702050 • Fax + 44 0 1189 702321
www.mrcy.com