EVBUM2635/D

X-Cube Imaging System X-Cube HiSPi-to-MIPI Converter Board User's Manual

ON Semiconductor®

www.onsemi.com

EVAL BOARD USER'S MANUAL

HISPI−TO−MIPI CONVERTER BOARD OVERVIEW

The X−Cube Imaging System (X−Cube) is designed to demonstrate the features of ON Semiconductor's XGS family of image sensors in machine vision applications.

The X−Cube is designed to conform to the machine vision industry standard 29 mm × 29 mm form factor.

This HiSPi−to−MIPI Converter Board is designed to be compatible with the X−Cube Imaging System's family of XGS imager boards. The function of this HiSPi−to−MIPI Converter Board is to convert HiSPi Packetized−SP mode format image data output from an X−Cube XGS Imager Board to MIPI CSI−2 image data format. The XGS sensor image data in MIPI format can then be connected to a host via the output connector on the HiSPi−to−MIPI Converter Board.

For more information about the X−Cube, please refer to the X−Cube Imaging System Developer Guide. (AND9891/D)

FEATURES

- HiSPi−to−MIPI Convertion Process Implemented in a Lattice LIF−MD6000 FPGA
- HiSPi Packetized−SP Mode Image Data Input (12 Lane Implementation)
- MIPI CSI−2 Image Data Output (4 Lane Implementation)
- 26 mm × 26 mm PCB Sized to Fit the Machine Vision Industry Standard 29 mm × 29 mm Camera Case and Lens Mount
- Operates Off of a Single Power Supply Supplied by the Host
- A Host Controlled I^2C Interface is used to Configure and Operate the Imaging System

All of the PCB design files (schematic and PCB layout files) are available to customers (NDA is required) to enable and accelerate the design of a customized camera based on the XGS family of image sensors.

The file required to program the Lattice FPGA is provided in binary format (.bit file) and therefore no modifications to the FPGA code are possible. Customers can request support directly from Lattice if they wish to develop an alternative implementation of this FPGA code. Another option is for the customer to develop their own code to perform the function(s) they desire.

For information on how to obtain the design files for this board please contact the ON Semiconductor technical support team in your region.

Figure 1. HiSPi−to−MIPI Converter Board Shown Connected to the X−Cube XGS 12000 Imager Board and Installed in the C−Mount Lens Housing

© Semiconductor Components Industries, LLC, 2018

BLOCK DIAGRAM

The board block diagram is shown in Figure 2.

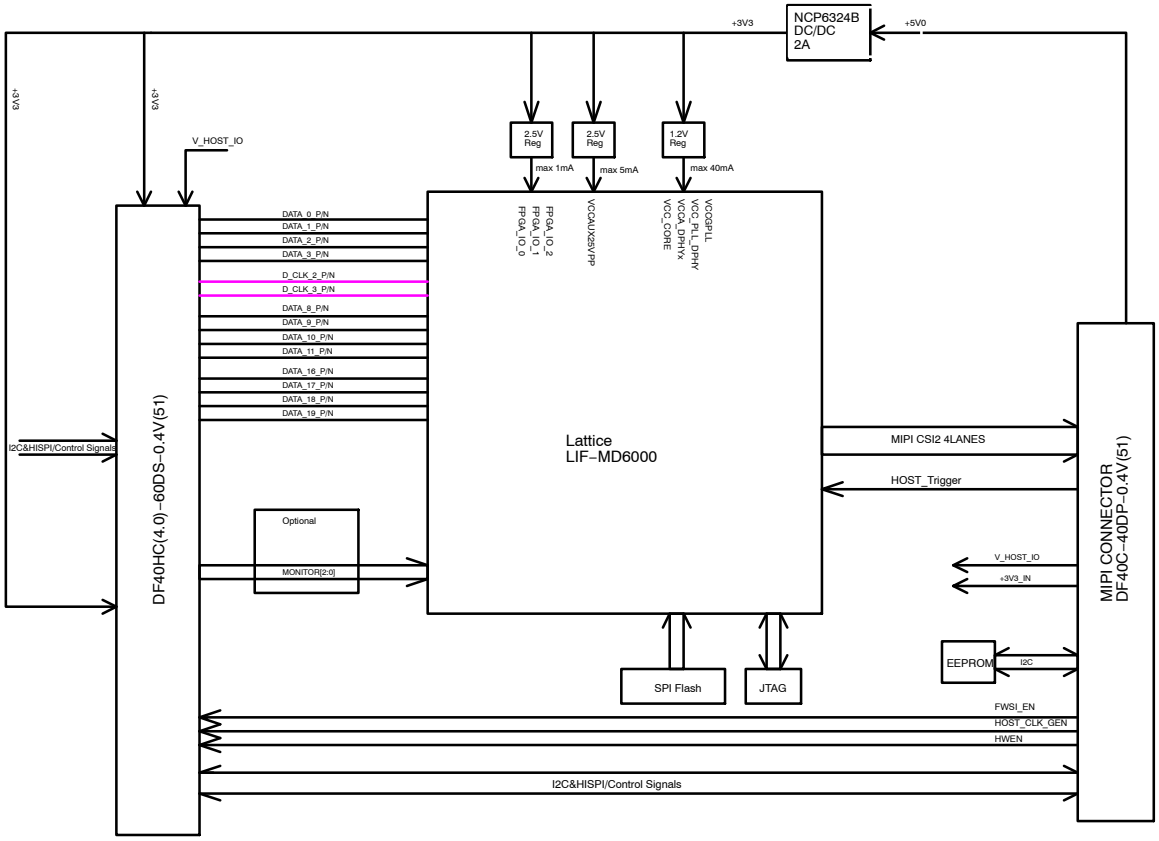
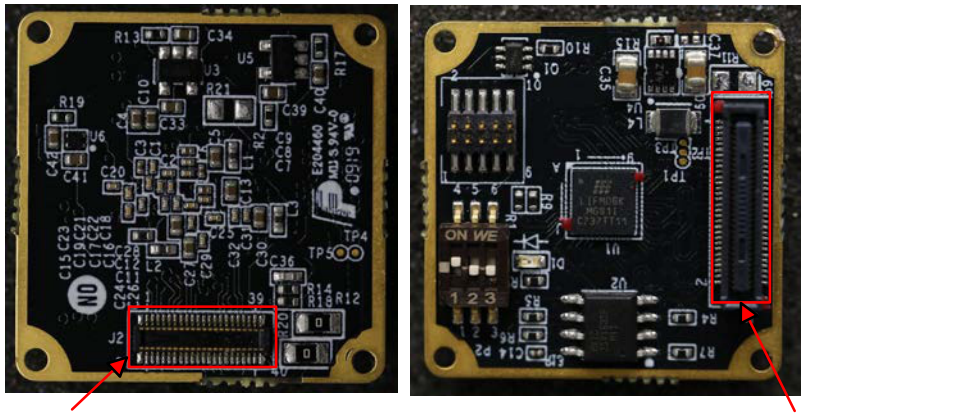


Figure 2. HiSPi−to−MIPI Converter Board Block Diagram

HISPI−TO−MIPI CONVERTER BOARD

The HiSPi−to−MIPI Converter Board is shown in Figure 3. The board is designed to be connected to an X−Cube compatible imager board. The board is sized to conform to the X−Cube Lens Mount Housing's form factor.



MIPI CSI−2 Mode Data Output Connector

HiSPi Packetized−SP Mode Data Input Connector

Figure 3. HiSPi−to−MIPI Converter Board: Top and Bottom View

Specification

The HiSPi−to−MIPI Converter Board requires only a single +5 V power supply input that is provided by the Host. The HiSPi−to−MIPI Converter Board utilizes on−board power regulators designed by ON Semiconductor to generate all of the power supplies voltages required by the FPGA from the single power supply provided by the Host. In addition, the HiSPi−to−MIPI Converter Board includes a LDO regulator to generate a +3.3 V power supply that can be used to power an X−Cube Imager Board when the boards are connected together. Please refer to the HiSPi−to−MIPI Converter Board schematic for detailed information on these circuits.

Upon power−up, the HiSPi−to−MIPI Converter Board will be initialized.

After initialization, the Lattice FPGA on the HiSPi−to−MIPI Converter Board can then begin to receive image data in HiSPi Packetized−SP Mode format from the X−Cube Imager Board. The FPGA will first buffer, and then re−order the incoming image data. The re−order process converts the incoming HiSPi formatted data to the MIPI CSI−2 four lane data format. The HiSPi−to−MIPI Converter Board then outputs the four lane MIPI data to the Host.

It is the Host's responsibility to then buffer the incoming MIPI data stream and to process this image data as desired (color interpolation etc..). The HiSPi−to−MIPI Converter Board can be connected to a number of X−Cube compatible Imager Boards. Note however, that the FPGA on the HiSPi−to−MIPI Converter Board requires unique firmware programming for each image sensor resolution.

Table 1. HISPI−TO−MIPI CONVERTER BOARD SPECIFICATIONS

Item	Definition	Min	Typ	Max	Unit
Input Image Data Format	**HiSPi Packetized – SP – SLVS mode**				
Number of HiSPi Lanes	Configurable via FPGA Firmware options	6	12	12	Lanes
Input Data Bitdepth	Configurable: 10−Bit Raw Data or 12−Bit Raw Data	10	12	12	Bits
Input Resolution	Configurable: Typical Resolution = 4176 H × 3102 V		12		Mpix
Output Image Data Format	**MIPI – CSI2 – 4 data lanes (one clock) D−Phy**				
Bandwidth	Per lane		1.5	1.5	Gbps
Output Resolution	4176 H × 3102 V		12		Mpix
Frame rate	At full resolution video input (4176 H × 3102 V)		21	41	fps
Power Supply					
VDD	Single power supply input to the HiSPi−to−MIPI Converter Board	+4.9	+5	+5.1	V
IDD	Total current load at max frame rate operation		400		mA
POWER	Power dissipation at max frame rate operation		2		W

REFERENCES

[1] AND9891/D (n.d.) X−Cube Imaging System X−Cube Machine Vision Reference Module Developer Guide.

ON Semiconductor is licensed by the Philips Corporation to carry the I^2C bus protocol.

onsemi, ONSEMI, and other names, marks, and brands are registered and/or common law trademarks of Semiconductor Components Industries, LLC dba "**onsemi**" or its affiliates and/or subsidiaries in the United States and/or other countries. **onsemi** owns the rights to a number of patents, trademarks, copyrights, trade secrets, and other intellectual property. A listing of **onsemi**'s product/patent coverage may be accessed at www.onsemi.com/site/pdf/Patent−Marking.pdf. **onsemi** is an Equal Opportunity/Affirmative Action Employer. This literature is subject to all applicable copyright laws and is not for resale in any manner.

The evaluation board/kit (research and development board/kit) (hereinafter the "board") is not a finished product and is not available for sale to consumers. The board is only intended for research, development, demonstration and evaluation purposes and will only be used in laboratory/development areas by persons with an engineering/technical training and familiar with the risks associated with handling electrical/mechanical components, systems and subsystems. This person assumes full responsibility/liability for proper and safe handling. Any other use, resale or redistribution for any other purpose is strictly prohibited.

THE BOARD IS PROVIDED BY ONSEMI TO YOU "AS IS" AND WITHOUT ANY REPRESENTATIONS OR WARRANTIES WHATSOEVER. WITHOUT LIMITING THE FOREGOING, ONSEMI (AND ITS LICENSORS/SUPPLIERS) HEREBY DISCLAIMS ANY AND ALL REPRESENTATIONS AND WARRANTIES IN RELATION TO THE BOARD, ANY MODIFICATIONS, OR THIS AGREEMENT, WHETHER EXPRESS, IMPLIED, STATUTORY OR OTHERWISE, INCLUDING WITHOUT LIMITATION ANY AND ALL REPRESENTATIONS AND WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, TITLE, NON−INFRINGEMENT, AND THOSE ARISING FROM A COURSE OF DEALING, TRADE USAGE, TRADE CUSTOM OR TRADE PRACTICE.

onsemi reserves the right to make changes without further notice to any board.

You are responsible for determining whether the board will be suitable for your intended use or application or will achieve your intended results. Prior to using or distributing any systems that have been evaluated, designed or tested using the board, you agree to test and validate your design to confirm the functionality for your application. Any technical, applications or design information or advice, quality characterization, reliability data or other services provided by **onsemi** shall not constitute any representation or warranty by **onsemi**, and no additional obligations or liabilities shall arise from **onsemi** having provided such information or services.

onsemi products including the boards are not designed, intended, or authorized for use in life support systems, or any FDA Class 3 medical devices or medical devices with a similar or equivalent classification in a foreign jurisdiction, or any devices intended for implantation in the human body. You agree to indemnify, defend and hold harmless **onsemi**, its directors, officers, employees, representatives, agents, subsidiaries, affiliates, distributors, and assigns, against any and all liabilities, losses, costs, damages, judgments, and expenses, arising out of any claim, demand, investigation, lawsuit, regulatory action or cause of action arising out of or associated with any unauthorized use, even if such claim alleges that **onsemi** was negligent regarding the design or manufacture of any products and/or the board.

This evaluation board/kit does not fall within the scope of the European Union directives regarding electromagnetic compatibility, restricted substances (RoHS), recycling (WEEE), FCC, CE or UL, and may not meet the technical requirements of these or other related directives.

FCC WARNING − This evaluation board/kit is intended for use for engineering development, demonstration, or evaluation purposes only and is not considered by **onsemi** to be a finished end product fit for general consumer use. It may generate, use, or radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment may cause interference with radio communications, in which case the user shall be responsible, at its expense, to take whatever measures may be required to correct this interference.

onsemi does not convey any license under its patent rights nor the rights of others.

LIMITATIONS OF LIABILITY: **onsemi** shall not be liable for any special, consequential, incidental, indirect or punitive damages, including, but not limited to the costs of requalification, delay, loss of profits or goodwill, arising out of or in connection with the board, even if **onsemi** is advised of the possibility of such damages. In no event shall **onsemi**'s aggregate liability from any obligation arising out of or in connection with the board, under any theory of liability, exceed the purchase price paid for the board, if any.

The board is provided to you subject to the license and other terms per **onsemi**'s standard terms and conditions of sale. For more information and documentation, please visit www.onsemi.com.

ADDITIONAL INFORMATION

TECHNICAL PUBLICATIONS:
Technical Library: www.onsemi.com/design/resources/technical−documentation
onsemi Website: www.onsemi.com

ONLINE SUPPORT: www.onsemi.com/support
For additional information, please contact your local Sales Representative at www.onsemi.com/support/sales