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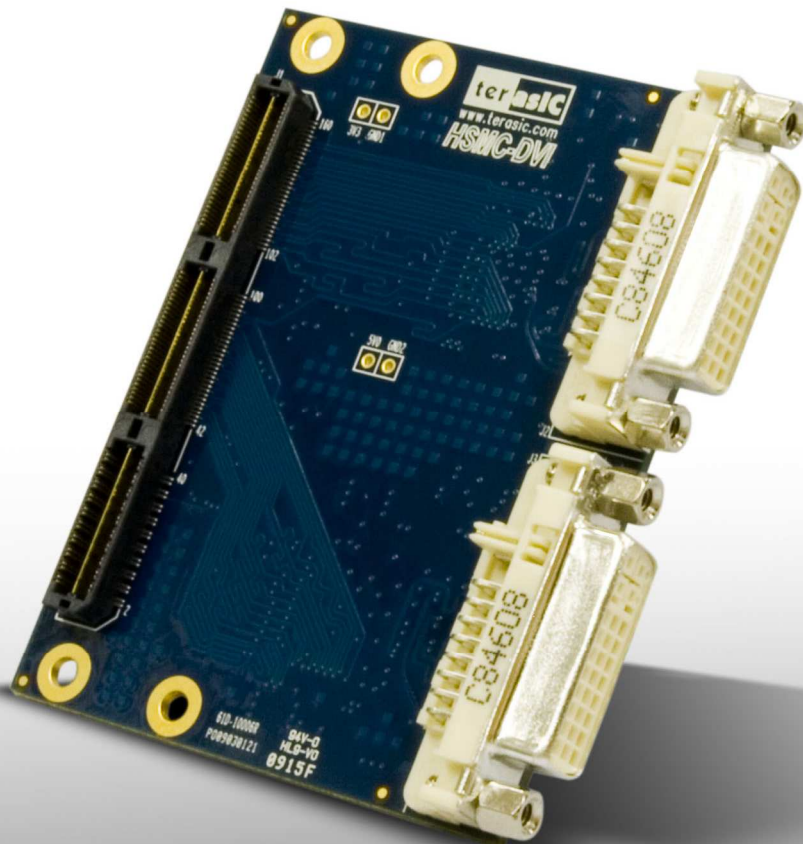
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HSMC-DVI

Terasic HSMC-DVI Daughter Board

User Manual



INTRODUCTION.....	1
1.1 1.1 FEATURES.....	1
1.2 1.2 ABOUT THE KIT	2
1.3 1.3 ASSEMBLE THE HSMC-DVI BOARD.....	6
1.4 1.4 GETTING HELP	6
ARCHITECTURE.....	8
2.1 2.1 LAYOUT AND COMPONENTS.....	8
2.2 2.2 BLOCK DIAGRAM	10
BOARD COMPONENTS.....	11
3.1 3.1 THE HSMC-DVI CONNECTOR.....	11
3.2 3.2 GENERATE PIN ASSIGNMENTS.....	17
DEMONSTRATION	26
4.1 4.1 INTRODUCTION	26
4.2 4.2 SYSTEM REQUIREMENTS	26
4.3 4.3 HARDWARE SETUP.....	27
4.4 4.4 CONFIGURE FPGA	27
4.5 4.4 DEMO OPERATION.....	28
4.6 4.5 DESIGN CONCEPT	29
4.7 4.6 SOURCE CODE LOCATION.....	31
APPENDIX.....	32
5.1 5.1 REVISION HISTORY.....	32
5.2 5.2 ALWAYS VISIT HSMC-DVI WEBPAGE FOR NEW MAIN BOARD	32

The Terasic HSMC-DVI is a DVI transmitter/receiver board with a High Speed Mezzanine Connector (HSMC) interface. It is designed to allow developers to access high quality and high resolution video signals in their FPGA. It gives the flexibility required in high resolution image processing systems by combining both the DVI transmitter and receiver onto the same card. Lastly, the HSMC-DVI daughter board can be connected to any HSMC/HSTC interface host boards.

1.1 Features

Figure 1.1 shows the photo of the HSMC-DVI board. The important features are listed below:

Digital Transmitter

- One DVI transmitter with single transmitting port
- Digital Visual Interface (DVI) Compliant
- Supports resolutions from VGA to UXGA (25 MHz – 165 MHz Pixel Rates)
- Universal Graphics Controller Interface
 - ✓ 12-Bit, Dual-Edge and 24-Bit, Single-Edge Input Modes
 - ✓ Adjustable 1.1 V to 1.8 V and Standard 3.3 V CMOS Input Signal Levels
 - ✓ Fully Differential and Single-Ended Input Clocking Modes
 - ✓ Standard Intel 12-Bit Digital Video Port Compatible as on Intel™ 81x Chipsets
- Enhanced PLL Noise Immunity
 - ✓ On-Chip Regulators and Bypass Capacitors for Reducing System Costs
- Enhanced Jitter Performance
 - ✓ No HSYNC Jitter Anomaly
 - ✓ Negligible Data-Dependent Jitter
- Programmable Using I²C Serial Interface
- Single 3.3-V Supply Operation

Digital Receiver

- One DVI receiver with single receiving port
- Supports UXGA Resolution (Output Pixel Rates Up to 165 MHz)
- Digital Visual Interface (DVI) Specification Compliant
- True-Color, 24 Bit/Pixel, 16.7M Colors at 1 or 2-Pixels Per Clock
- Laser Trimmed Internal termination Resistors for Optimum Fixed Impedance Matching
- 4x Over-Sampling
- Reduced Ground Bounce Using Time Staggered Pixel Outputs
- Lowest Noise and Best Power Dissipation Using TI PowerPAD™ Packaging



Figure 1.1. The HSMC-DVI board

1.2 About the KIT

This section describes the package content

- HSMC-DVI board x 1
- System CD-ROM x 1

The CD contains technical documents of the HSMC-DVI, and one reference design along with the source code.



Figure 1.2 HSMC-DVI Package

Introduction

The source code of reference design are available for the following FPGA main board:

- DE3

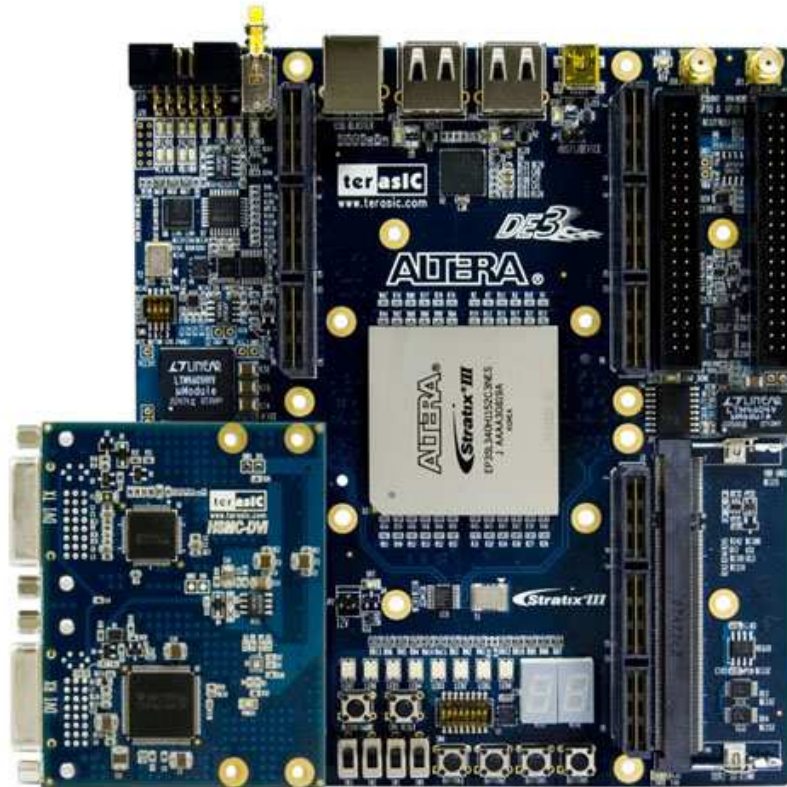


Figure 1.2.1 The HSMC-DVI board connects with DE3

- Arria II GX Development Board

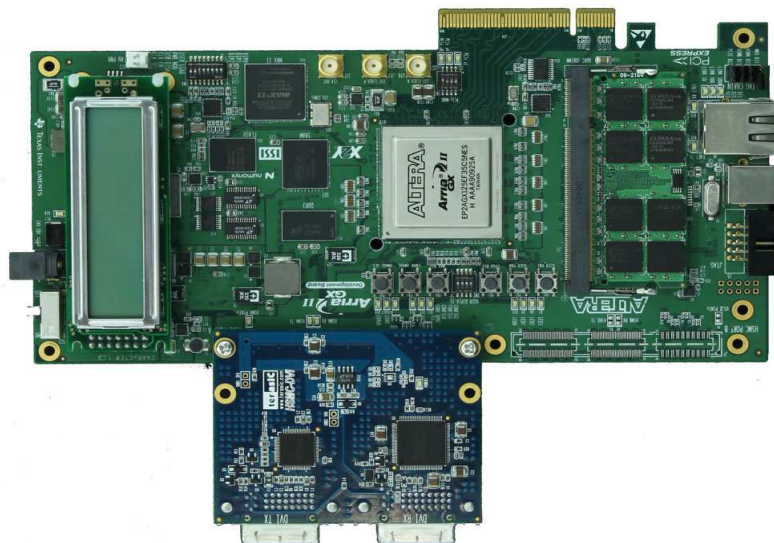


Figure 1.2.2. The HSMC-DVI board connects with Arria II Development Board

- Cyclone III Starter Board

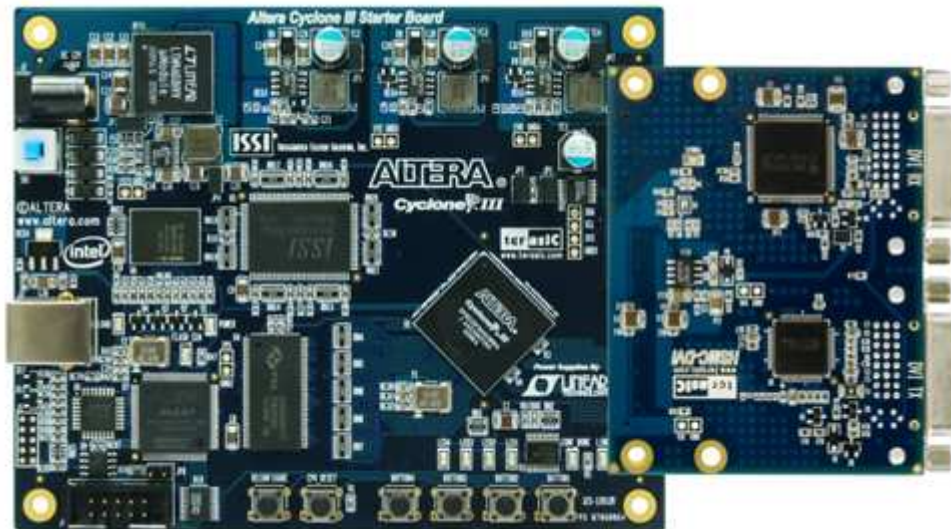


Figure 1.2.3. The HSMC-DVI board connects with Cyclone III Starter Board

- Cyclone III FPGA Development Kit



Figure 1.2.4 The HSMC-DVI board connects with Cyclone III Development Board

Introduction

- Stratix III FPGA Development Kit



Figure 1.2.5. The HSMC-DVI board connects with Stratix III Development Board

- DE2-115 Development Board

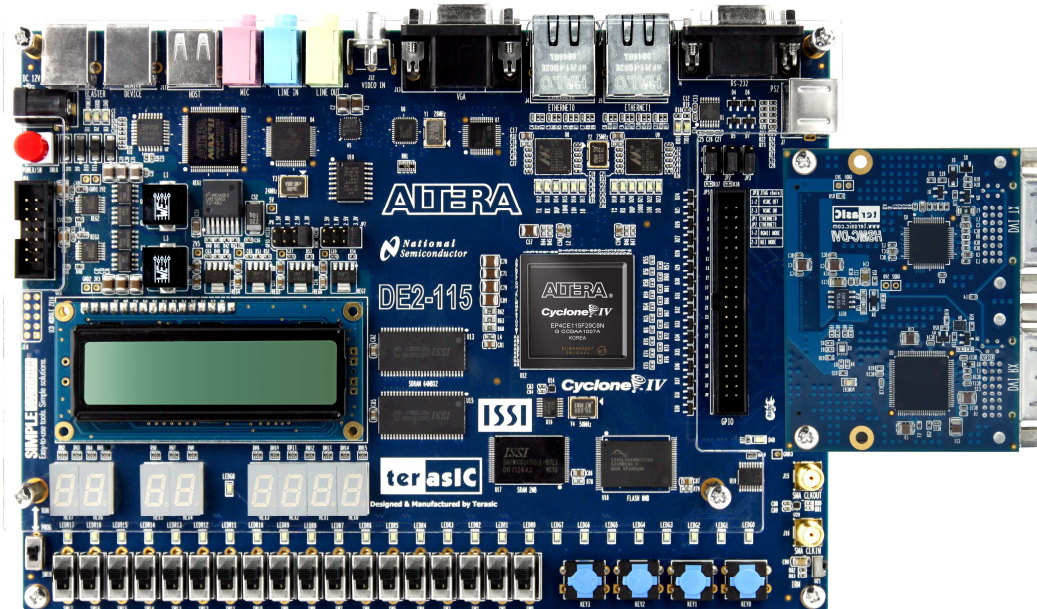


Figure 1.2.6. The HSMC-DVI board connects with DE2-115 Development Board

- DE4 Development Board

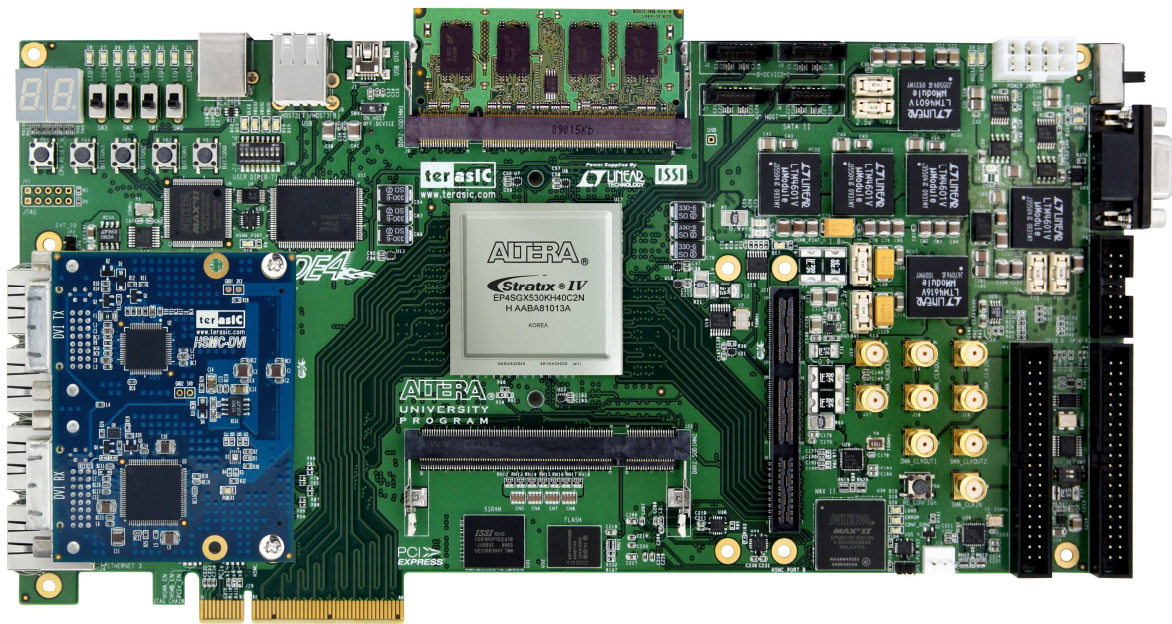


Figure 1.2.7. The HSMC-DVI board connects with DE4 Development Board

1.3 Assemble the HSMC-DVI Board

This section describes how to connect the HSMC-DVI daughter board to a main board, and using DE3 as an example.

The HSMC-DVI daughter board connects to the main boards through the HSTC interface. For the DE3, the HSMC-DVI can be connected to any DE3's four HSTC connectors using a THCB-HFF adapter card (Figure 1.3.1) which can be found in the DE3 package.

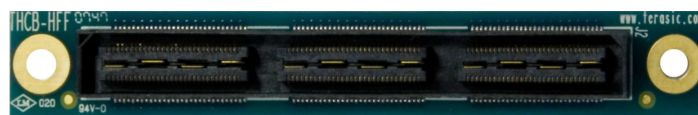


Figure 1.3.1 THCB-HFF adapter card

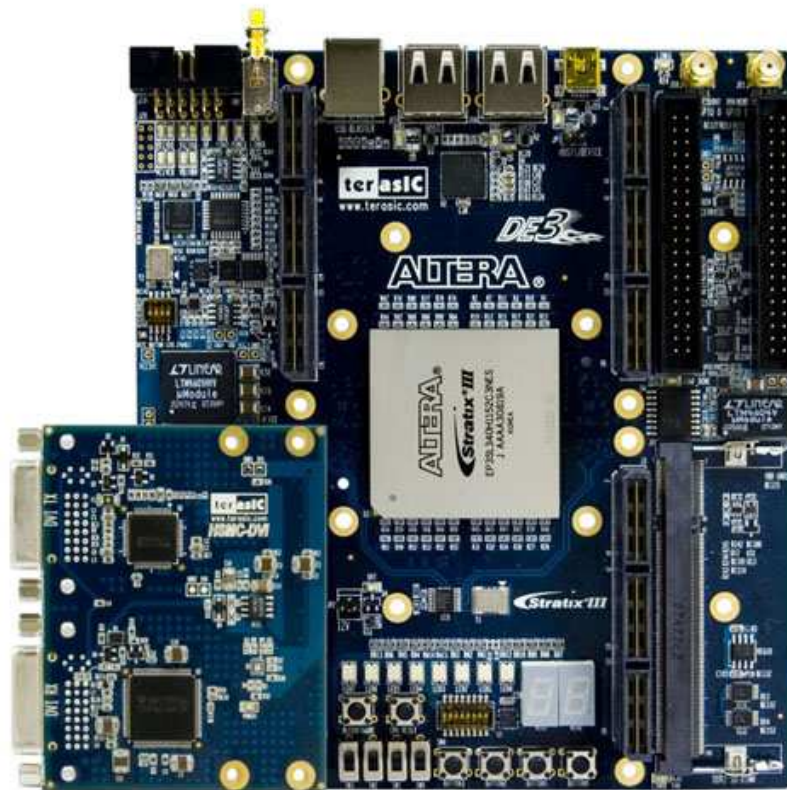


Figure 1.3.2 The HSMC-DVI board connects with DE3

Note. Do not attempt to connect/remove the HSMC-DVI daughter board to/from the main the main board when the power is on, or else the hardware could be damaged.

1.4 Getting Help

Here are some places to get help if you encounter any problem:

- ✓ Email to support@terasic.com
- ✓ Taiwan & China: +886-3-550-8800
- ✓ Korea : +82-2-512-7661
- ✓ Japan: +81-428-77-7000

2 Architecture

This Chapter covers the architecture of the HSMC-DVI board including its PCB and block diagram.

2.1 Layout and Components

The picture of the HSMC-DVI board is shown in Figure 2.1.1 and Figure 2.1.2 It depicts the layout of the board and indicates the location of the connectors and key components.

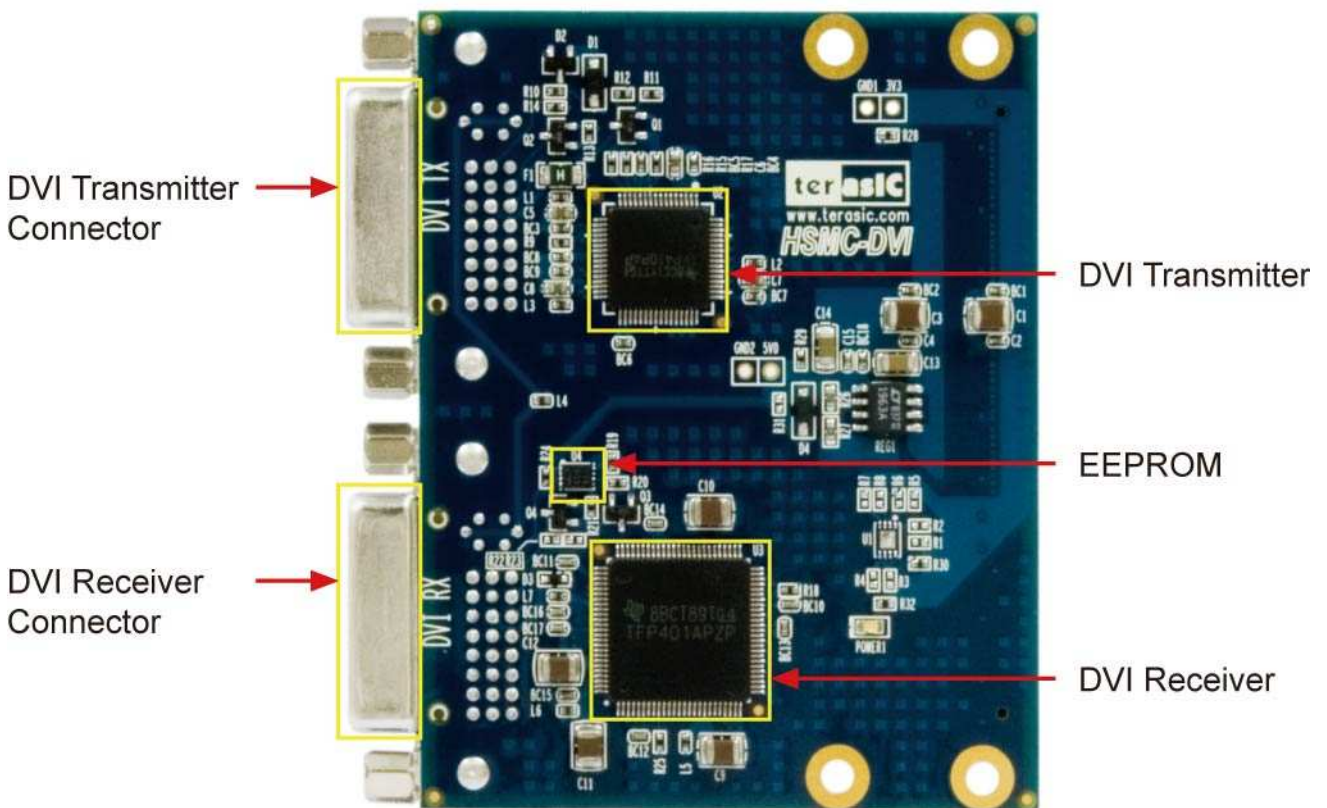


Figure 2.1.1 The HSMC-DVI PCB and component diagram

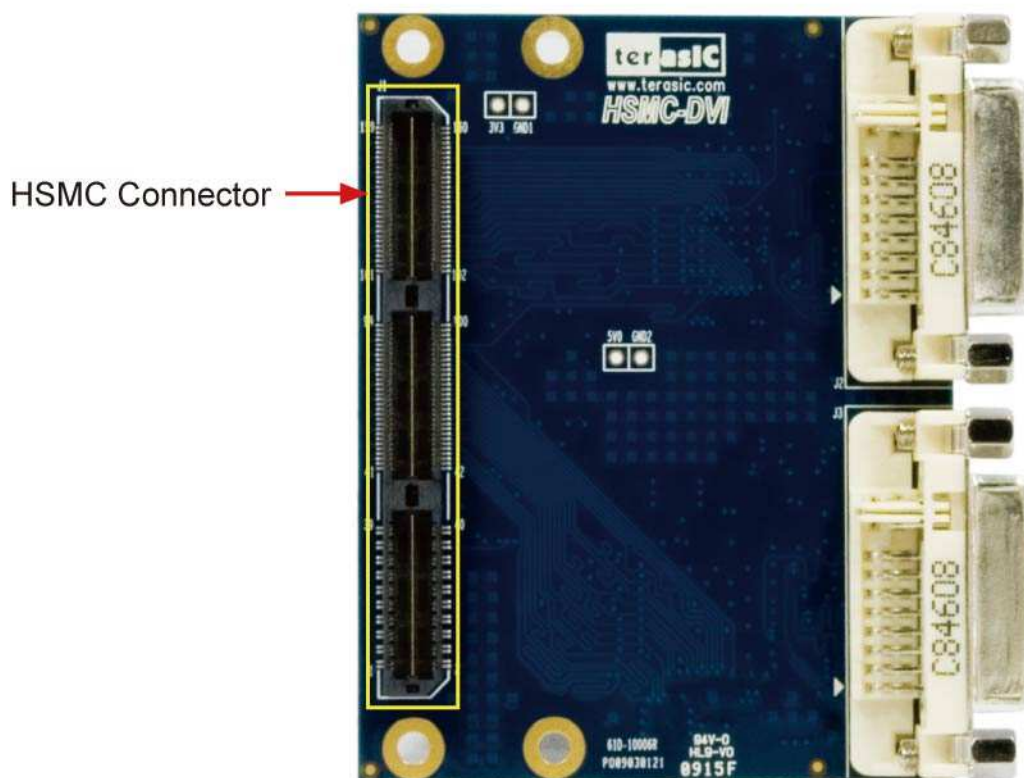


Figure 2.1.2 The HSMC-DVI Back side – HSMC connector view

The following components are provided on the HSMC-DVI board :

- DVI Transmitter (U2)
- DVI Receiver (U3)
- I2C EEPROM (U4)
- DVI Transmitter Connector (J2)
- DVI Receiver Connector (J3)
- HSMC Connector (J1)

2.2 Block Diagram

Figure 2.2.1 shows the block diagram of the HSMC-DVI board

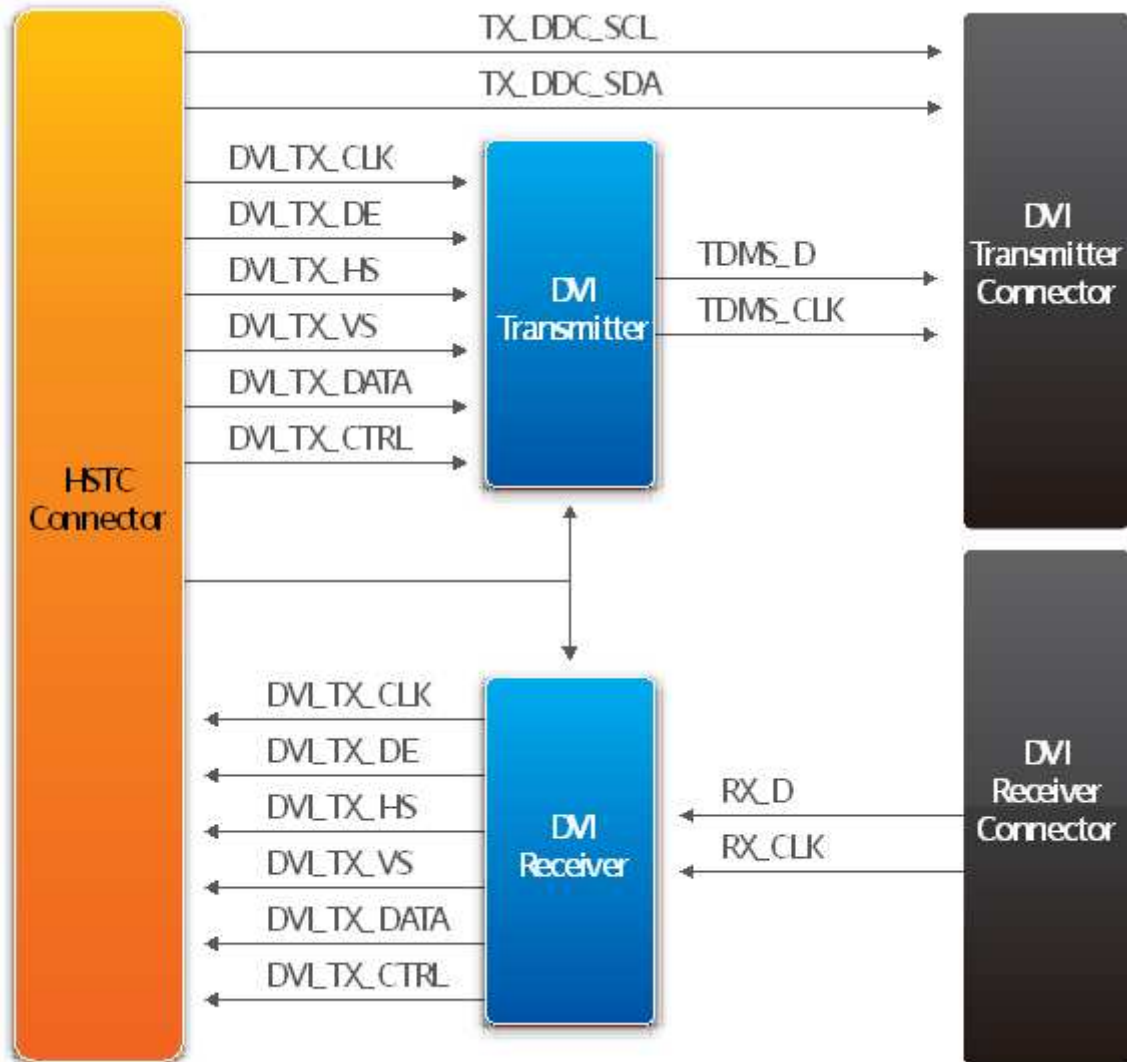


Figure 2.2.1 The block diagram of the HSMC-DVI board

This section illustrates the detailed information of the components, connector interfaces, and the pin mapping tables of the HSMC-DVI board

3.1 The HSMC-DVI Connector

This section describes pin definition of the HSMC-DVI interface onboard

All the control and data signals of the DVI transmitter and receiver are connected to the HSMC connector, so users can fully control the HSMC-DVI daughter board through the HSMC interface. Power is derived from 3.3V and 12V of the HSMC connector.

Board Components

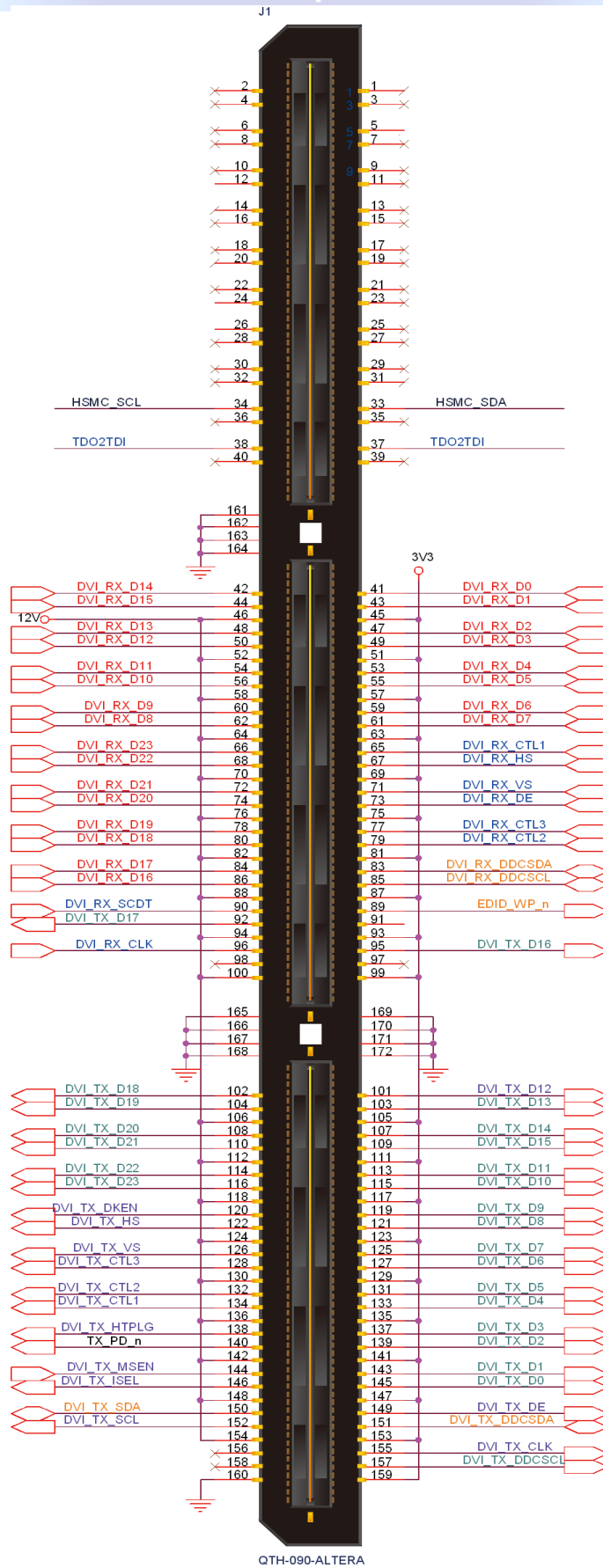


Figure 3.1. The pin-outs on the HSMC connector

Board Components

The table 3.1 below lists the HSMC signal direction and description.

Note. The power pins are not shown in the table

Table 3.1

Pin Numbers	Name	Direction	Description
1	N.C.	N/A	Not Connect
2	N.C.	N/A	Not Connect
3	N.C.	N/A	Not Connect
4	N.C.	N/A	Not Connect
5	N.C.	N/A	Not Connect
6	N.C.	N/A	Not Connect
7	N.C.	N/A	Not Connect
8	N.C.	N/A	Not Connect
9	N.C.	N/A	Not Connect
10	N.C.	N/A	Not Connect
11	N.C.	N/A	Not Connect
12	N.C.	N/A	Not Connect
13	N.C.	N/A	Not Connect
14	N.C.	N/A	Not Connect
15	N.C.	N/A	Not Connect
16	N.C.	N/A	Not Connect
17	N.C.	N/A	Not Connect
18	N.C.	N/A	Not Connect
19	N.C.	N/A	Not Connect
20	N.C.	N/A	Not Connect
21	N.C.	N/A	Not Connect
22	N.C.	N/A	Not Connect
23	N.C.	N/A	Not Connect
24	N.C.	N/A	Not Connect
25	N.C.	N/A	Not Connect
26	N.C.	N/A	Not Connect
27	N.C.	N/A	Not Connect
28	N.C.	N/A	Not Connect
29	N.C.	N/A	Not Connect
30	N.C.	N/A	Not Connect
31	N.C.	N/A	Not Connect
32	N.C.	N/A	Not Connect
33	HSMC_SDA	Inout	I ² C data

Board Components

34	HSMC_SCL	Output	I ² C clock
35	N.C.	N/A	Not Connect
36	N.C.	N/A	Not Connect
39	N.C.	N/A	Not Connect
40	N.C.	N/A	Not Connect
41	DVI_RX_D0	Input	DVI receiver pixel data
42	DVI_RX_D14	Input	DVI receiver pixel data
43	DVI_RX_D1	Input	DVI receiver pixel data
44	DVI_RX_D15	Input	DVI receiver pixel data
45	3V3	Power	Power 3.3V
46	12V	Power	Power 12V
47	DVI_RX_D2	Input	DVI receiver pixel data
48	DVI_RX_D13	Input	DVI receiver pixel data
49	DVI_RX_D3	Input	DVI receiver pixel data
50	DVI_RX_D12	Input	DVI receiver pixel data
51	3V3	Power	Power 3.3V
52	12V	Power	Power 12V
53	DVI_RX_D4	Input	DVI receiver pixel data
54	DVI_RX_D11	Input	DVI receiver pixel data
55	DVI_RX_D5	Input	DVI receiver pixel data
56	DVI_RX_D10	Input	DVI receiver pixel data
57	3V3	Power	Power 3.3V
58	12V	Power	Power 12V
59	DVI_RX_D6	Input	DVI receiver pixel data
60	DVI_RX_D9	Input	DVI receiver pixel data
61	DVI_RX_D7	Input	DVI receiver pixel data
62	DVI_RX_D8	Input	DVI receiver pixel data
63	3V3	Power	Power 3.3V
64	12V	Power	Power 12V
65	DVI_RX_CTL1	Input	Control signal
66	DVI_RX_D23	Input	DVI receiver pixel data
67	DVI_RX_HS	Input	DVI receiver horizontal sync
68	DVI_RX_D22	Input	DVI receiver pixel data
69	3V3	Power	Power 3.3V
70	12V	Power	Power 12V
71	DVI_RX_VS	Input	DVI receiver vertical sync
72	DVI_RX_D21	Input	DVI receiver pixel data
73	DVI_RX_DE	Input	DVI receiver data enable

Board Components

74	DVI_RX_D20	Input	DVI receiver pixel data
75	3V3	Power	Power 3.3V
76	12V	Power	Power 12V
77	DVI_RX_CTL3	Input	Control signal
78	DVI_RX_D19	Input	DVI receiver pixel data
79	DVI_RX_CTL2	Input	Control signal
80	DVI_RX_D18	Input	DVI receiver pixel data
81	3V3	Power	Power 3.3V
82	12V	Power	Power 12V
83	DVI_RX_DDCSDA	Inout	DDC I ² C data
84	DVI_RX_D17	Input	DVI receiver pixel data
85	DVI_RX_DDSCL	Inout	DDC I ² C clock
86	DVI_RX_D16	Input	DVI receiver pixel data
87	3V3	Power	Power 3.3V
88	12V	Power	Power 12V
89	EDID_WP_n	Output	I ² C write protect enable
90	DVI_RX_SCDT	Input	Receiver sync detect
91	N.C.	N/A	Not Connect
92	DVI_TX_D17	Output	DVI transmitter data bus
93	3V3	Power	Power 3.3V
94	12V	Power	Power 12V
95	DVI_TX_D16	Output	DVI transmitter data bus
96	DVI_RX_CLK	Input	DVI receiver clock
97	N.C.	N/A	Not Connect
98	N.C.	N/A	Not Connect
99	3V3	Power	Power 3.3V
100	12V	Power	Power 12V
101	DVI_TX_D12	Output	DVI transmitter data bus
102	DVI_TX_D18	Output	DVI transmitter data bus
103	DVI_TX_D13	Output	DVI transmitter data bus
104	DVI_TX_D19	Output	DVI transmitter data bus
105	3V3	Power	Power 3.3V
106	12V	Power	Power 12V
107	DVI_TX_D14	Output	DVI transmitter data bus
108	DVI_TX_D20	Output	DVI transmitter data bus
109	DVI_TX_D15	Output	DVI transmitter data bus
110	DVI_TX_D21	Output	DVI transmitter data bus
111	3V3	Power	Power 3.3V

Board Components

112	12V	Power	Power 12V
113	DVI_TX_D11	Output	DVI transmitter data bus
114	DVI_TX_D22	Output	DVI transmitter data bus
115	DVI_TX_D10	Output	DVI transmitter data bus
116	DVI_TX_D23	Output	DVI transmitter data bus
117	3V3	Power	Power 3.3V
118	12V	Power	Power 12V
119	DVI_TX_D9	Output	DVI transmitter data bus
120	DVI_TX_DKEN	Output	Data de-skew enable
121	DVI_TX_D8	Output	DVI transmitter data bus
122	DVI_TX_HS	Output	DVI transmitter Horizontal sync
123	3V3	Power	Power 3.3V
124	12V	Power	Power 12V
125	DVI_TX_D7	Output	DVI transmitter data bus
126	DVI_TX_VS	Output	DVI transmitter vertical sync
127	DVI_TX_D6	Output	DVI transmitter data bus
128	DVI_TX_CTL3	Output	Multifunction
129	3V3	Power	Power 3.3V
130	12V	Power	Power 12V
131	DVI_TX_D5	Output	DVI transmitter data bus
132	DVI_TX_CTL2	Output	Multifunction
133	DVI_TX_D4	Output	DVI transmitter data bus
134	DVI_TX_CTL1	Output	Multifunction
135	3V3	Power	Power 3.3V
136	12V	Power	Power 12V
137	DVI_TX_D3	Output	DVI transmitter data bus
138	DVI_TX_HTPLG	Output	Edge select/hot plug input
139	DVI_TX_D2	Output	DVI transmitter data bus
140	TX_PD_n	Output	Power down (active low)
141	3V3	Power	Power 3.3V
142	12V	Power	Power 12V
143	DVI_TX_D1	Output	DVI transmitter data bus
144	DVI_TX_MSEN	Input	Monitor sense/programmable output
145	DVI_TX_D0	Output	DVI transmitter data bus
146	DVI_TX_ISEL	Output	I ² C interface select/I ² C reset
147	3V3	Power	Power 3.3V
148	12V	Power	Power 12V
149	DVI_TX_DE	Output	DVI data enable

Board Components			
150	DVI_TX_SDA	I/O	DSEL/I ² C data
151	DVI_TX_DDCSDA	I/O	DDC I ² C data
152	DVI_TX_SCL	Output	Input bus select/I ² C clock
153	3V3	Power	Power 3.3V
154	12V	Power	Power 12V
155	DVI_TX_CLK	Output	DVI transmitter clock
156	N.C.	N/A	Not Connect
157	DVI_TX_DDCSCL	Output	DDC I ² C clock
158	N.C.	N/A	Not Connect
159	3V3	Power	Power 3.3V
160	GND	Power	Power Ground
161	GND	Power	Power Ground
162	GND	Power	Power Ground
163	GND	Power	Power Ground
164	GND	Power	Power Ground
165	GND	Power	Power Ground
166	GND	Power	Power Ground
167	GND	Power	Power Ground
168	GND	Power	Power Ground
169	GND	Power	Power Ground
170	GND	Power	Power Ground
171	GND	Power	Power Ground
172	GND	Power	Power Ground

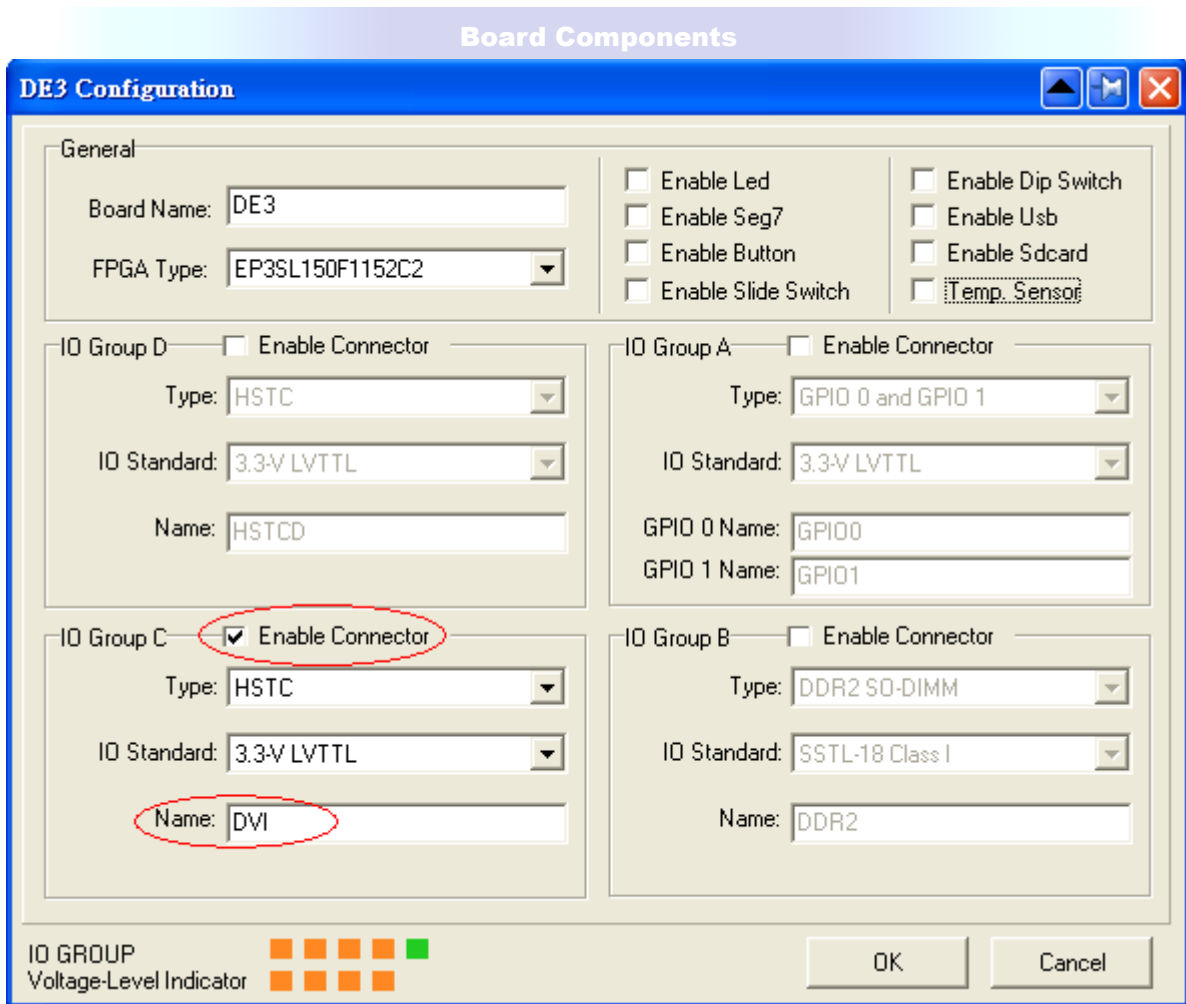
3.2 Generate Pin Assignments

This section describes how to automatically generate a top-level project, including DVI pin assignments

For the DE3 main board:

Users can easily create the HSMC-DVI board pin assignments by utilizing the DE3_System Builder V 1.4.3 or later (DE3_System Builder is available on the DE3 System CD or can be downloaded from the website <http://de3.terasic.com>). Here are the procedures to generate a top-level project for HSMC-DVI.

- 1) Launch DE3-System Builder
- 2) Add a DE3 board. Enable the HSTC-C connector and type desired pin pre-fix name in the dialog of DE3 Configuration.



3) Add HSMC-DVI Board.



4) Connect DE3 and HSMC-DVI Board by drag-and-drop the mouse

System Configuration		
Connection	Board Configuration	Board Description
	DE3	DE3 Board
	DVI Male (3.3-V LVTTTL)	HSTC Male (J5, HSTC-C TOP)
	DVI Female (3.3-V LVTTTL)	HSTC Female (J6, HSTC-C BOTTOM)
	DVI	DVI
	DVI TX/RX (3.3-V LVTTTL)	HSTC Female (J2)

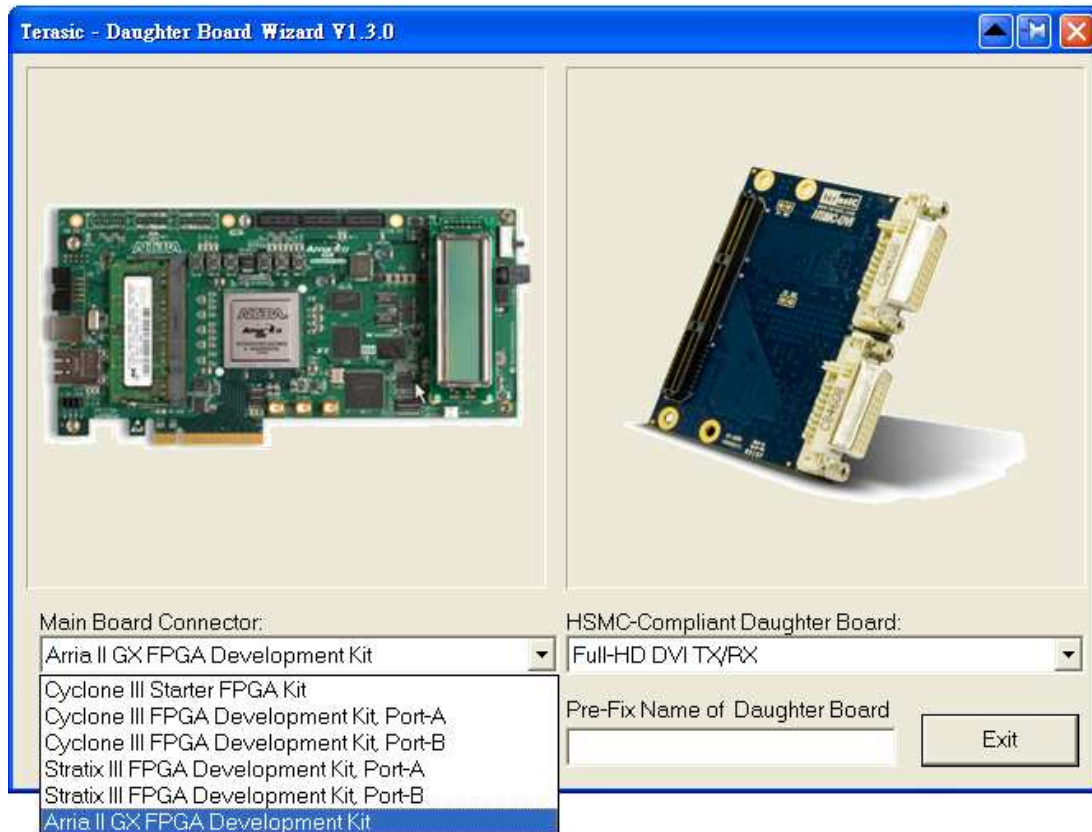
Board Components

5) Click “Generate” to generate the desired top-level and pin assignments for the HSMC-DVI project.

For the Cyclone III starter board, Cyclone III development board, Arria II GX development board and Stratix III development board:

Users can easily generate HSMC-DVI pin assignments onto their main board by utilizing the Daughter Board Wizard V1.2.0 or later (Daughter Board Wizard is available on the DVI CD-ROM located in the “Tool” folder). Here are the procedures to generate a top-level project for HSMC-DVI.

- 1) Launch Daughter Board Wizard.
- 2) Select the Main Board Connector



- 3) Select the HSMC-Compliant Daughter Board



- 4) Enter the signal Pre-fix name of Daughter Board and Click 'Generate' to generate the desired top-level and pin assignments for the HSMC-DVI project.

For the DE4 development board:

- 1) Launch the DE4 System Builder.

Board Components

Terasic - DE4 System Builder V 1.0.0

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System Configuration

Board Type: DE4_230
Project Name: DE4

<input checked="" type="checkbox"/> CLOCK	<input checked="" type="checkbox"/> Slide Switch x 4
<input checked="" type="checkbox"/> LED x 8	<input checked="" type="checkbox"/> 7-Segment x 2
<input checked="" type="checkbox"/> Button x 4	<input checked="" type="checkbox"/> DIP Switch x 8
<input type="checkbox"/> SMA	<input checked="" type="checkbox"/> Temperature
<input checked="" type="checkbox"/> USB OTG	<input checked="" type="checkbox"/> Power Measurement
<input checked="" type="checkbox"/> Fan Control	<input checked="" type="checkbox"/> SD CARD
<input checked="" type="checkbox"/> Flash (64MB)	<input checked="" type="checkbox"/> EEPROM
<input checked="" type="checkbox"/> SSRAM (2MB)	<input checked="" type="checkbox"/> RS-232
<input checked="" type="checkbox"/> Programmable PLL	<input checked="" type="checkbox"/> Ethernet x 4
<input type="checkbox"/> DDR2 SODIMM_1	<input type="checkbox"/> DDR2 SODIMM_2
<input type="checkbox"/> SATA Host 0	<input type="checkbox"/> SATA Host 1
<input type="checkbox"/> SATA Device 0	<input type="checkbox"/> SATA Device 1
<input type="checkbox"/> PCIe	

Programmable PLL

HSMA_REFCLK: 100 MHz
HSMB_REFCLK: 100 MHz
PLL_CLKIN/SATA_REFCLK: 100 MHz

GPIO Expansion

GPIO-0 Header
D5M - 5M Pixel Camera
Prefix Name:

GPIO-1 Header
LTM - 4.3" LCD and Touch
Prefix Name:

HSMC Expansion

HSMC-A (Transceiver x 4)
ADA - High Speed ADC/DAC
Prefix Name:

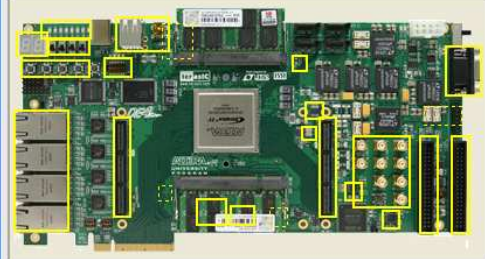
HSMC-B (Transceiver x 8)
DVI - FullHD TX/RX
Prefix Name:

Default Setting Load Setting... Save Setting... Generate... Exit

2) Select the appropriate Stratix IV GX device of the DE4 under 'Board Type', as well as the 'Project Name'.

Terasic - DE4 System Builder V 1.0.0

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System Configuration

Board Type: DE4_230
Project Name: DE4

<input checked="" type="checkbox"/> CLOCK	<input checked="" type="checkbox"/> Slide Switch x 4
<input checked="" type="checkbox"/> LED x 8	<input checked="" type="checkbox"/> 7-Segment x 2
<input checked="" type="checkbox"/> Button x 4	<input checked="" type="checkbox"/> DIP Switch x 8
<input checked="" type="checkbox"/> SMA	<input checked="" type="checkbox"/> Temperature
<input checked="" type="checkbox"/> USB OTG	<input checked="" type="checkbox"/> Power Measurement
<input checked="" type="checkbox"/> Fan Control	<input checked="" type="checkbox"/> SD CARD
<input checked="" type="checkbox"/> Flash (64MB)	<input checked="" type="checkbox"/> EEPROM
<input checked="" type="checkbox"/> SSRAM (2MB)	<input checked="" type="checkbox"/> RS-232
<input checked="" type="checkbox"/> Programmable PLL	<input checked="" type="checkbox"/> Ethernet x 4
<input type="checkbox"/> DDR2 SODIMM_1	<input type="checkbox"/> DDR2 SODIMM_2
<input type="checkbox"/> SATA Host 0	<input type="checkbox"/> SATA Host 1
<input type="checkbox"/> SATA Device 0	<input type="checkbox"/> SATA Device 1
<input type="checkbox"/> PCIe	

Programmable PLL

HSMA_REFCLK: 100 MHz
HSMB_REFCLK: 100 MHz
PLL_CLKIN/SATA_REFCLK: 100 MHz

GPIO Expansion

GPIO-0 Header
D5M - 5M Pixel Camera
Prefix Name:

GPIO-1 Header
LTM - 4.3" LCD and Touch
Prefix Name:

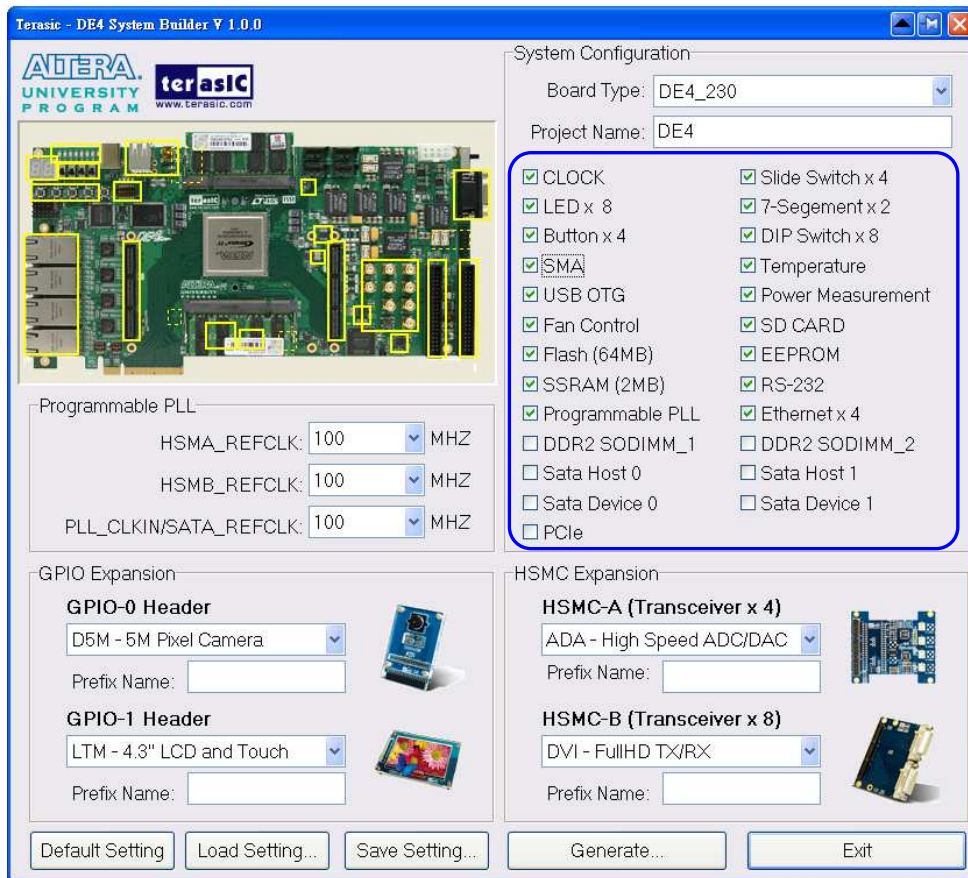
HSMC Expansion

HSMC-A (Transceiver x 4)
ADA - High Speed ADC/DAC
Prefix Name:

HSMC-B (Transceiver x 8)
DVI - FullHD TX/RX
Prefix Name:

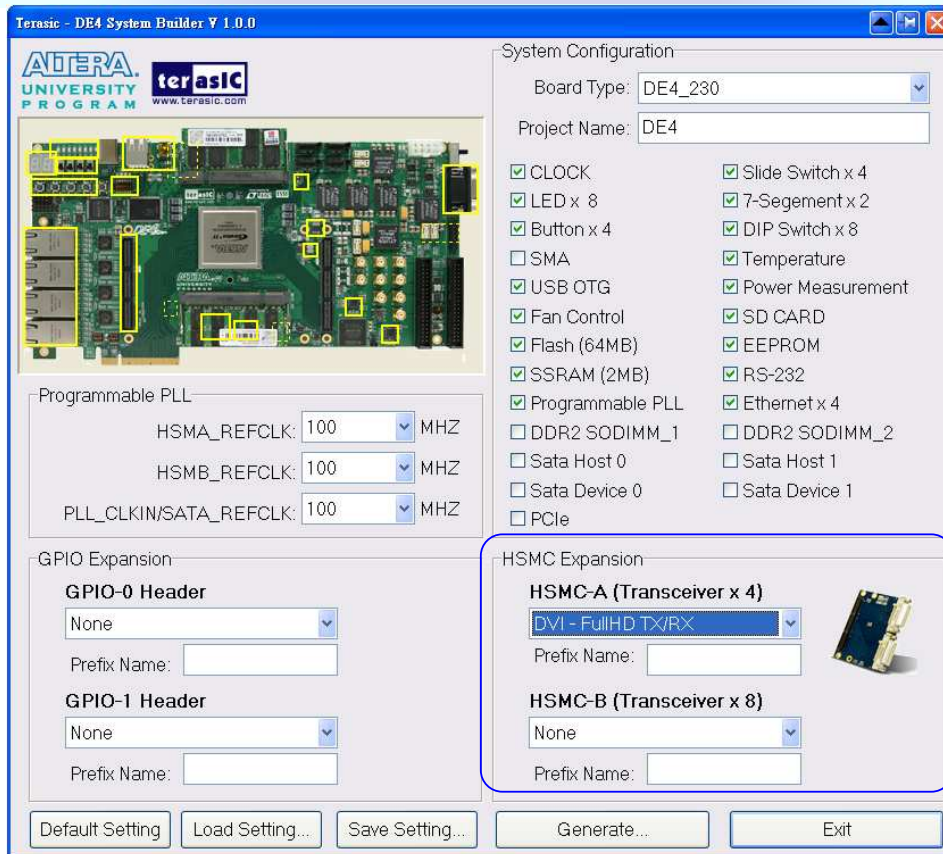
Default Setting Load Setting... Save Setting... Generate... Exit

- 3) Select the components on the DE4 to be enabled in your design.



- 4) Under HSMC Expansion, select DVI under HSMC-A or HSMC-B or both to which the daughter card is connected to. The 'Prefix Name;' is an optional feature that denotes the pin name of the daughter card assigned in your design. Users may leave this field empty. However, if 2 DVI daughter cards are connected to both HSMC-A and HSMC-B, a prefix name is required to avoid duplication in the pin name.

Board Components



For the DE2-115 development board:

- 1) Launch the DE2-115 System Builder.

