

# **Microtronix HDMI 1.4 Receiver HSMC Daughter Card**

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USER MANUAL  
REVISION 1.0



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## Document Revision History

This user guide provides basic information about using the **Microtronix HDMI 1.4 Receiver HSMC Daughter Card, (PN: 6291-01-01)**. The following table shows the document revision history.

| Date      | Rev | Description  |
|-----------|-----|--------------|
| Feb. 2013 | 1.0 | Release      |
| Jan. 2013 | 0.9 | Beta release |
|           |     |              |

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Software updates to the **HDMI 1.4 Receiver HSMC Daughter Card** and supporting Microtronix IP Cores are listed on the download page of our website and made available via an email request form. Some product upgrades are only available to customers who have purchased the ViClaro III or ViClaro IV-GX Development kit.

The upload site is for sending files to Technical Support.

General Website: <http://www.microtronix.com>

Downloads Page: <http://www.microtronix.com/downloads/>

FTP Upload Site: <http://microtronix.leapfile.com>

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## Typographic Conventions

|                        |  |
|------------------------|--|
| Path/Filename          | A path/filename  |
| [SOPC Builder]\$ <cmd> | A command that should be run from within the Cygwin Environment.             |
| Code                   | Sample code.   |
| ↵                      | Indicates that there is no break between the current line and the next line. |

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## Introduction

The Microtronix **HDMI 1.4 Receiver HSMC Daughter Card** is targeted at the development of 12-bit Deep Color HD video systems. It is designed to interface an HDMI Receiver to an Altera FPGA Development Kit using the HSMC expansion connector.

The key features of the board include:

- Analog Devices ADV7612 – HDMI 1.4 Receiver Interface
  - HDMI v1.4 Receiver
  - 12-bit Deep Color
  - 3D video ready
  - Supports RGB, YCbCr and DDR video
- Quartus Reference Design
- Altera compatible HSMC expansion connector

## Kit Contents

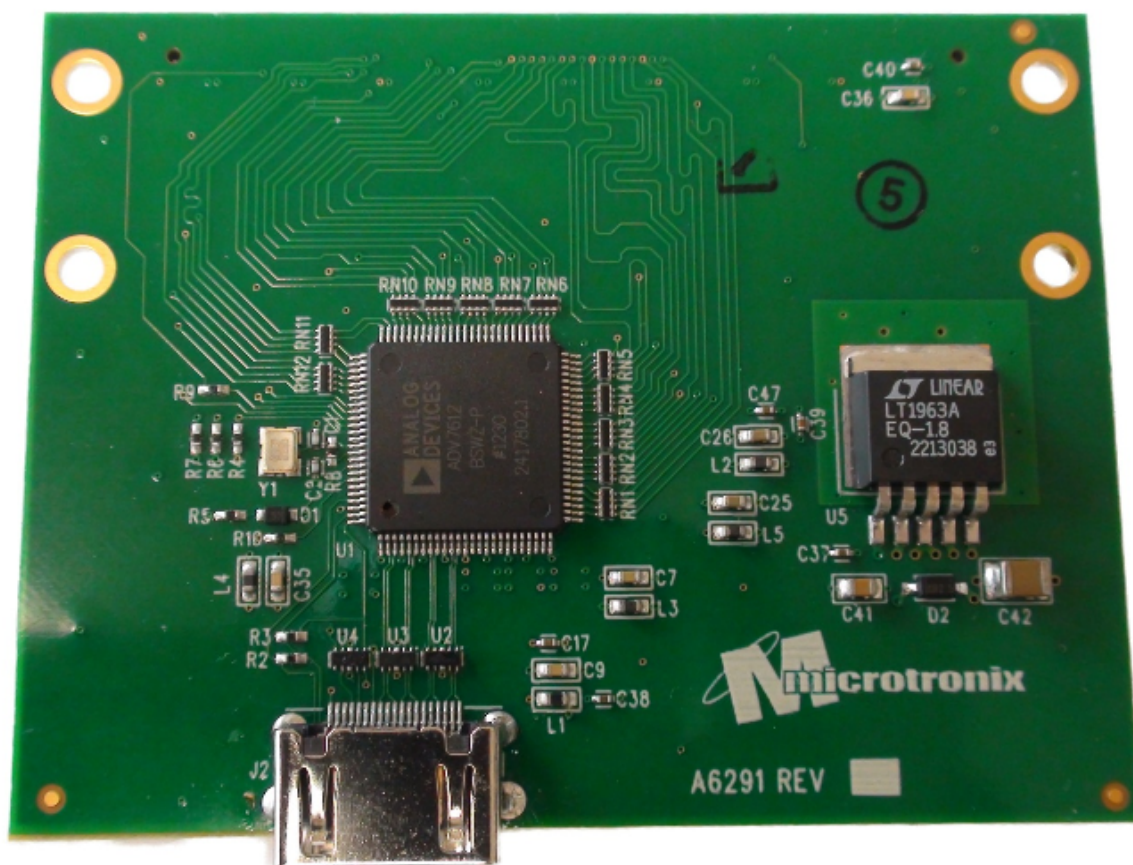
The Microtronix **HDMI 1.4 Receiver HSMC Daughter Card** includes the following hardware components:

- HDMI 1.4 Receiver HSMC Daughter Card (PN: 6290-01-01)
  - Card mounting hardware
- Installation CD

**NOTE:** The CD is not supplied when the HDMI card is purchased in conjunction with a Microtronix ViClaro III or ViClaro IV-GX Development Kit.

**Board Overview** The Microtronix **HDMI 1.4 Receiver HSMC Daughter Card** uses the Analog Device ADV7612BSWZ-P high-performance HDMI v1.4 Receiver to support HDTV formats up to 1080p at 60 Hz. using a 225 MHz, high-definition multimedia interface (HDMI 1.4) transmitter.

A picture of the card is shown below.



**Figure 1: HDMI 1.4 Receiver HSMC Daughter Card**

### **Power Supply**

The card operates from 3.3 VDC supplied from the HSMC connector.

### **Power Consumption**

The HDMI Transmitter board draws approximately 1A at 3.3 VDC. Power consumption varies according to the transmit video resolution.

## HDMI 1.4 Receiver Card Components

The Microtronix **HDMI 1.4 Receiver HSMC Daughter Card** incorporates the following components and devices:

- Analog Devices ADV7612 – HDMI v1.4 Receiver Interface
- Misc:
  - TSV voltage clamps

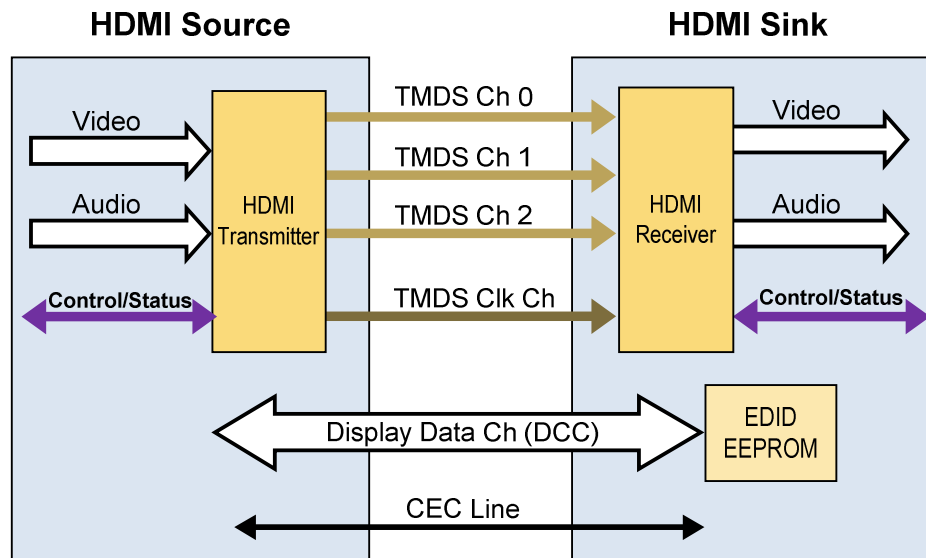
For more information on the IC components, contact the respective vendors.

## Introduction to HDMI Interfaces

The **High-Definition Multimedia Interface (HDMI)** is a compact connector interface for transmitting uncompressed digital video/audio streams. It is widely used across a broad range of consumer devices including: set-top TV boxes, Blu-ray Disk players, personal computers, televisions, and AV receivers.

The interface uses a Transition Minimized Differential Signaling (TMDS)-based protocol and electrical signaling

The HDMI cable and connectors carry four differential pairs that make up the TMDS data and clock channels. These channels are used to carry video, audio and auxiliary data. In addition, HDMI carries a VESA DDC channel. The DDC is used for configuration and status exchange between a single Source and a single Sink. The optional CEC protocol provides high-level control functions between all of the various audiovisual products. This feature is not supported by reference design.



**Figure 2: HDMI System Architecture**

### ***EDID Interface***

Extended display identification data (EDID) is a data structure provided by a display panel to describe its capabilities to a graphics card. EDID is defined by a standard published by the Video Electronics Standards Association (VESA). The EDID includes manufacturer name, product type, phosphor or filter type, timings supported by the display, display size, luminance data and (for digital displays only) pixel mapping data.

EDID functionality is supported on the HSMC HDMI card.

### ***HDMI Connector Pin Assignments***

The card incorporates a Type A connector which has 19 pins. The pin assignment is shown in the following table.

**Table 1: HDMI Type A Connector Pin Assignment**

| Pin | Signal Name       | Pin | Signal Name       |
|-----|-------------------|-----|-------------------|
| 1   | TMDS Data2+       | 2   | TMDS Data2 Shield |
| 3   | TMDS Data2+       | 4   | TMDS Data1+       |
| 5   | TMDS Data1 Shield | 6   | TMDS Data1+       |
| 7   | TMDS Data0+       | 8   | TMDS Data0 Shield |
| 9   | TMDS Data0+       | 10  | TMDS Clock+       |
| 11  | TMDS Clock Shield | 12  | TMDS Clock-       |
| 13  | CEC               | 14  | Reserved (N.C.)   |
| 15  | SCL               | 16  | SDA               |
| 17  | DDC/CEC Ground    | 18  | +5V Power         |
| 19  | Hot Plug Detect   |     |                   |

### I<sup>2</sup>C 2-Wire Serial Bus

The HDMI Transmitter card used an I<sup>2</sup>C Bus to configure the ADV7511 video transmitter. The I<sup>2</sup>C SDA and SCL bus signals are connected to the assigned pins (33 & 34) of the HSMC connector. The user can access I<sup>2</sup>C connected devices from a Host board using a Microtronix I<sup>2</sup>C Master IP Core programmed into the FPGA device.

**Table 2: I<sup>2</sup>C Addresses**

| Device  | I <sup>2</sup> C Address |
|---------|--------------------------|
| ADV7612 | 0x98                     |

### HDMI Receiver HSMC Connector, J1

The HDMI 1.4 Receiver HSMC Connector, J1 interfaces the **HDMI 1.4 Receiver HSMC Daughter Card** to the Host FPGA Development board.

The J1 pin assignments in Table 3 below show the Cyclone III FPGA pin mapping when the HDMI 1.4 Receiver board is installed on HSMC Header J4, (the LVDS header) of the ViClaro III Board.

**Table 3: ViClaro III FPGA – HDMI 1.4 Receiver board HSMC Connector Pin Assignment Mappings**

| Cyclone III Pin # | Signal Name | HSMC Pin # | HSMC Pin # | Signal Name | Cyclone III Pin # |
|-------------------|-------------|------------|------------|-------------|-------------------|
|                   | NC          | 1          | 2          | NC          |                   |
|                   | NC          | 3          | 4          | NC          |                   |
|                   | NC          | 5          | 6          | NC          |                   |



|     |           |    |    |           |      |
|-----|-----------|----|----|-----------|------|
|     | NC        | 7  | 8  | NC        |      |
| AE3 | NC        | 9  | 10 | NC        | AE2  |
| AF2 | NC        | 11 | 12 | NC        | AE1  |
| AC3 | NC        | 13 | 14 | NC        | AD2  |
| AD3 | NC        | 15 | 16 | NC        | AD1  |
| AC5 | NC        | 17 | 18 | NC        | AC2  |
| AC4 | NC        | 19 | 20 | NC        | AC1  |
| AB6 | NC        | 21 | 22 | NC        | AB2  |
| AB5 | NC        | 23 | 24 | NC        | AB1  |
| AA6 | NC        | 25 | 26 | NC        | AA4  |
| AA5 | NC        | 27 | 28 | NC        | AA3  |
| Y6  | NC        | 29 | 30 | NC        | Y4   |
| Y5  | NC        | 31 | 32 | NC        | Y3   |
| Y10 | I2C_SDA   | 33 | 34 | I2C_SCL   | AA10 |
|     | NC        | 35 | 36 | NC        |      |
|     | NC        | 37 | 38 | NC        |      |
|     | NC        | 39 | 40 | NC        |      |
| T8  | VIDEO_P35 | 41 | 42 | VIDEO_P34 | T7   |
| M5  | VIDEO_P33 | 43 | 44 | VIDEO_P32 | L5   |
|     | 3.3V      | 45 | 46 | 12V       |      |
| W8  | VIDEO_P31 | 47 | 48 | VIDEO_P30 | W2   |
| Y7  | VIDEO_P29 | 49 | 50 | VIDEO_P28 | W1   |
|     | 3.3V      | 51 | 52 | 12V       |      |
| V8  | VIDEO_P27 | 53 | 54 | VIDEO_P26 | W4   |
| V7  | VIDEO_P25 | 55 | 56 | VIDEO_P24 | W3   |
|     | 3.3V      | 57 | 58 | 12V       |      |
| V6  | VIDEO_LLO | 59 | 60 | VIDEO_P23 | V4   |
| V5  | VIDEO_P22 | 61 | 62 | VIDEO_P21 | V3   |
|     | 3.3V      | 63 | 64 | 12V       |      |
| U6  | VIDEO_P20 | 65 | 66 | VIDEO_P19 | V2   |
| U5  | VIDEO_P18 | 67 | 68 | VIDEO_P17 | V1   |
|     | 3.3V      | 69 | 70 | 12V       |      |
| R7  | VIDEO_P16 | 71 | 72 | VIDEO_P15 | U2   |
| R6  | VIDEO_P14 | 73 | 74 | VIDEO_P13 | U1   |
|     | 3.3V      | 75 | 76 | 12V       |      |

|    |           |     |     |                  |    |
|----|-----------|-----|-----|------------------|----|
| M8 | VIDEO_P12 | 77  | 78  | VIDEO_P11        | U3 |
| M7 | VIDEO_P10 | 79  | 80  | VIDEO_P9         | U4 |
|    | 3.3V      | 81  | 82  | 12V              |    |
| K8 | VIDEO_P8  | 83  | 84  | VIDEO_P7         | T4 |
| L8 | VIDEO_P6  | 85  | 86  | VIDEO_P5         | T3 |
|    | 3.3V      | 87  | 88  | 12V              |    |
| J7 | VIDEO_P4  | 89  | 90  | VIDEO_P3         | R2 |
| K7 | VIDEO_P2  | 91  | 92  | VIDEO_P1         | R1 |
|    | 3.3V      | 93  | 94  | 12V              |    |
| R3 | VIDEO_D0  | 95  | 96  | VIDEO_DE         | Y2 |
| R4 | VIDEO_HS  | 97  | 98  | VIDEO_VS_FIELD   | Y1 |
|    | 3.3V      | 99  | 100 | 12V              |    |
| M4 | AUDIO_AP0 | 101 | 102 | AUDIO_DSD1       | L4 |
| M3 | AUDIO_AP2 | 103 | 104 | AUDIO_DSD3       | L3 |
|    | 3.3V      | 105 | 106 | 12V              |    |
| P2 | AUDIO_AP4 | 107 | 108 | AUDIO_SCLK_INT2  | L2 |
| P1 | AUDIO_AP5 | 109 | 110 | AUDIO_MCLK_INT2F | L1 |
|    | 3.3V      | 111 | 112 | 12V              |    |
| N4 | INT1      | 113 | 114 | RESETn           | K4 |
| N3 |           | 115 | 116 | CSn              | K3 |
|    | 3.3V      | 117 | 118 | 12V              |    |
| L7 |           | 119 | 120 |                  | K2 |
| L6 |           | 121 | 122 |                  | K1 |
|    | 3.3V      | 123 | 124 | 12V              |    |
| J6 |           | 125 | 126 |                  | J4 |
| J5 |           | 127 | 128 |                  | J3 |
|    | 3.3V      | 129 | 130 | 12V              |    |
| M2 |           | 131 | 132 |                  | H4 |
| M1 |           | 133 | 134 |                  | H3 |
|    | 3.3V      | 135 | 136 | 12V              |    |
| G6 |           | 137 | 138 |                  | G2 |
| G5 |           | 139 | 140 |                  | G1 |
|    | 3.3V      | 141 | 142 | 12V              |    |
| G4 |           | 143 | 144 |                  | F2 |
| G3 |           | 145 | 146 |                  | F1 |

|    |      |     |     |              |    |
|----|------|-----|-----|--------------|----|
|    | 3.3V | 147 | 148 | 12V          |    |
| D2 |      | 149 | 150 |              | E3 |
| D1 |      | 151 | 152 |              | F3 |
|    | 3.3V | 153 | 154 | 12V          |    |
| D3 |      | 155 | 156 |              | J2 |
| C2 |      | 157 | 158 |              | J1 |
|    | 3.3V | 159 | 160 | Presence LED |    |

The pin assignments of Table 4 below apply when the HDMI 1.4 Receiver board is installed on the ViClaro IV-GX Host board using HSMC Header J1.

**Table 4: ViClaro IV-GX FPGA – HDMI 1.4 Receiver board HSMC Connector Pin Assignment Mappings**

| Cyclone IV Pin # | Signal Name | HSMC Pin # | HSMC Pin # | Signal Name | Cyclone IV Pin # |
|------------------|-------------|------------|------------|-------------|------------------|
|                  | NC          | 1          | 2          | NC          |                  |
|                  | NC          | 3          | 4          | NC          |                  |
|                  | NC          | 5          | 6          | NC          |                  |
|                  | NC          | 7          | 8          | NC          |                  |
|                  | NC          | 9          | 10         | NC          |                  |
|                  | NC          | 11         | 12         | NC          |                  |
|                  | NC          | 13         | 14         | NC          |                  |
|                  | NC          | 15         | 16         | NC          |                  |
| AB4              | NC          | 17         | 18         | NC          | AC2              |
| AB3              | NC          | 19         | 20         | NC          | AC1              |
| Y4               | NC          | 21         | 22         | NC          | AA2              |
| Y3               | NC          | 23         | 24         | NC          | AA1              |
| V4               | NC          | 25         | 26         | NC          | W2               |
| V3               | NC          | 27         | 28         | NC          | W1               |
| T4               | NC          | 29         | 30         | NC          | U2               |
| T3               | NC          | 31         | 32         | NC          | U1               |
| J9               | I2C_SDA     | 33         | 34         | I2C_SCL     | H9               |
|                  | NC          | 35         | 36         | NC          |                  |

|     |           |     |     |                |     |
|-----|-----------|-----|-----|----------------|-----|
|     | NC        | 37  | 38  | NC             |     |
| G6  | NC        | 39  | 40  | NC             | L11 |
| F17 | VIDEO_P35 | 41  | 42  | VIDEO_P34      | G14 |
| F16 | VIDEO_P33 | 43  | 44  | VIDEO_P32      | G15 |
|     | 3.3V      | 45  | 46  | 12V            |     |
| E15 | VIDEO_P31 | 47  | 48  | VIDEO_P30      | G12 |
| D14 | VIDEO_P29 | 49  | 50  | VIDEO_P28      | G13 |
|     | 3.3V      | 51  | 52  | 12V            |     |
| D13 | VIDEO_P27 | 53  | 54  | VIDEO_P26      | G10 |
| D12 | VIDEO_P25 | 55  | 56  | VIDEO_P24      | F11 |
|     | 3.3V      | 57  | 58  | 12V            |     |
| D11 | VIDEO_LLO | 59  | 60  | VIDEO_P23      | F8  |
| E10 | VIDEO_P22 | 61  | 62  | VIDEO_P21      | F9  |
|     | 3.3V      | 63  | 64  | 12V            |     |
| E9  | VIDEO_P20 | 65  | 66  | VIDEO_P19      | F6  |
| D8  | VIDEO_P18 | 67  | 68  | VIDEO_P17      | G7  |
|     | 3.3V      | 69  | 70  | 12V            |     |
| E7  | VIDEO_P16 | 71  | 72  | VIDEO_P15      | F4  |
| E6  | VIDEO_P14 | 73  | 74  | VIDEO_P13      | F5  |
|     | 3.3V      | 75  | 76  | 12V            |     |
| D5  | VIDEO_P12 | 77  | 78  | VIDEO_P11      | F10 |
| E4  | VIDEO_P10 | 79  | 80  | VIDEO_P9       | F7  |
|     | 3.3V      | 81  | 82  | 12V            |     |
| E3  | VIDEO_P8  | 83  | 84  | VIDEO_P7       | C2  |
| D3  | VIDEO_P6  | 85  | 86  | VIDEO_P5       | D4  |
|     | 3.3V      | 87  | 88  | 12V            |     |
| D1  | VIDEO_P4  | 89  | 90  | VIDEO_P3       | C4  |
| E16 | VIDEO_P2  | 91  | 92  | VIDEO_P1       | C3  |
|     | 3.3V      | 93  | 94  | 12V            |     |
| D16 | VIDEO_D0  | 95  | 96  | VIDEO_DE       | D6  |
| C16 | VIDEO_HS  | 97  | 98  | VIDEO_VS_FIELD | C5  |
|     | 3.3V      | 99  | 100 | 12V            |     |
| A4  | AUDIO_AP0 | 101 | 102 | AUDIO_DSD1     | C7  |
| A5  | AUDIO_AP2 | 103 | 104 | AUDIO_DSD3     | D7  |
|     | 3.3V      | 105 | 106 | 12V            |     |

|     |           |     |     |                  |     |
|-----|-----------|-----|-----|------------------|-----|
| A6  | AUDIO_AP4 | 107 | 108 | AUDIO_SCLK_INT2  | D10 |
| A7  | AUDIO_AP5 | 109 | 110 | AUDIO_MCLK_INT2F | D9  |
|     | 3.3V      | 111 | 112 | 12V              |     |
| A8  | INT1      | 113 | 114 | RESETn           | C12 |
| A9  |           | 115 | 116 | CSn              | C11 |
|     | 3.3V      | 117 | 118 | 12V              |     |
| A10 |           | 119 | 120 |                  | C14 |
| A11 |           | 121 | 122 |                  | F14 |
|     | 3.3V      | 123 | 124 | 12V              |     |
| A12 |           | 125 | 126 |                  | C15 |
| A13 |           | 127 | 128 |                  | D15 |
|     | 3.3V      | 129 | 130 | 12V              |     |
| A14 |           | 131 | 132 |                  | F13 |
| B16 |           | 133 | 134 |                  | F15 |
|     | 3.3V      | 135 | 136 | 12V              |     |
| A16 |           | 137 | 138 |                  | E12 |
| D17 |           | 139 | 140 |                  | F12 |
|     | 3.3V      | 141 | 142 | 12V              |     |
| A17 |           | 143 | 144 |                  | E13 |
| C17 |           | 145 | 146 |                  | C6  |
|     | 3.3V      | 147 | 148 | 12V              |     |
| C9  |           | 149 | 150 |                  | B6  |
| B9  |           | 151 | 152 |                  | B7  |
|     | 3.3V      | 153 | 154 | 12V              |     |
| B10 |           | 155 | 156 |                  | C13 |
| C10 | HSMC1_D78 | 157 | 158 | HSMC1_D79        | B12 |
|     | 3.3V      | 159 | 160 | Presence LED*    |     |

\* Note: Connect to GND to turn LED on.

## Software Installation

**NOTE:** This section only applies if the **HDMI 1.4 Receiver HSMC Daughter Card** was purchased as a stand-alone board. When the card is purchased in conjunction with the Microtronix ViClaro III or ViClaro IV-GX HD Video IP Development Kit, the HDMI reference designs are supplied as part of the ViClaro III or ViClaro IV-GX Software Installation CD.

The HDMI 1.4 Receiver Card software may also be supplied by Microtronix on a CD or via FTP as a zipped file. If you received the latter, unzip the file to a temporary file directory and run the setup.exe file. The software should self-install from the CD or it can be manually installed by running the setup.exe file.

**WARNING:** Remove older installations of the HDMI 1.4 Receiver Card software from the PC prior to installing the new version of software.

## Overview of HDMI 1.4 Receiver Reference Designs

The HDMI 1.4 Receiver board is supplied with a basic reference design for; the Microtronix ViClaro III (Cyclone III), the ViClaro IV-GX (Cyclone IV-GX) and for the Terrasic DE4 (Stratix IV) Development Kits. It includes a pre-compiled SOF file and the Quartus II 12.1 project files.

The receiver design requires the use of the Microtronix HDMI 1.4 Transmitter board to loop or pass video between the HDMI video input directly to the HDMI output. A Nios II and the Microtronix Avalon I2C Controller is used to configure the HDMI devices. The Receiver board is preprogrammed with a EDID supporting standard video resolutions. A supplied design also enables the user to reprogram the EDID on the receiver as required to match the desired video resolution of their display monitor.

The Reference Designs are listed in Table 5 below. Additional information is supplied in the Quartus project and on the Installation CD.

**Table 5: Quartus Reference Designs**

| Name / Description         | Directory & Filename                     |
|----------------------------|--|
| HDMI pass-through          | example/hsmc_hdmi/: mtx_hdmi.sof         |
| EDID Programming for 60 Hz | example/hsmc_hdmi/: mtx_hdmi_EDID_60.sof |
| EDID Programming for 50 Hz | example/hsmc_hdmi/: mtx_hdmi_EDID_50.sof |

## Nios II Source Code

Source code for the Nios II software can be found in example/hsmc\_hdmi/software. The two software projects, mtx\_hdmi\_bsp and mtx\_hdmi can be imported into the Nios II IDE with the following procedure.

1. Selecting "Import..." from the "File" menu.
2. Choose "Altera Nios II" and "Existing Nios II IDE project into workspace" as the import source then click "Next".
3. Browse to the mtx\_hdmi\_bsp project and click "OK"

4. Enter the same project name.
5. Click “Finish” to import the project.
6. Repeat process for the mt\_x\_hdmi project.

### **Microtronix I<sup>2</sup>C IP Core**

The reference design(s) incorporate the **Microtronix I<sup>2</sup>C Master / Slave / PIO Controller IP Core**. This core is used in conjunction with an Nios II soft-core processor to initialize and configure the Analog Devices Receiver and Transmitter components and to program EDID EEPROM in the Receiver.

A 90-day OpenCores Plus license is available for testing your custom design in-circuit limited time period before timing out. (Refer to the Altera website for more information.)

To receive your IP core license contact sales, [sales@microtronix.com](mailto:sales@microtronix.com) and provide them with the serial number of your board and either your NIC or GUARD ID. This license is required for you to recompile and test in-circuit new IP core designs.