

HDMI Add-on Board

For Sparrowhawk FX dev. board

USER MANUAL

UM0013

Rev. 1.0

29.6.2016.

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Revision History

Revision	Date	Author	Modification
1.0	29.6.2016.	NDZ	Initial

Related Documents

ID	Code	Description
1	UM0011	Sparrowhawk FX User's Manual

1 Introduction

Sparrowhawk FX Video Processing Board includes an expansion connection to support applications which uses High-Definition Multimedia Interface (HDMI) inputs and outputs.

The HDMI Add-on board is a Sparrowhawk FX (SHFX) video processing board daughter card designed to provide additional HDMI inputs and outputs for creating high-bandwidth interface between any audio/video source (video player, game console or A/V receiver) and receiving devices (digital television, various monitors) over a single cable. Additional inputs (4) and outputs (2) are available with following specifications:

- *DDC/EDID supported on all in/out connectors*
- *EDID controlled by IC parts on respective inputs*
- *2160p30 supported on all inputs*

HDMI In

- *2x HDMI input via SERDES, Equalized*
- *1x HDMI input via ADV7611 24-bit parallel LVCMOS33 interface*
- *1x HDMI input via ADV7619 48-bit parallel LVCMOS33 interface*

HDMI Out

- *2x HDMI output via SERDES*

2 Board features

Table 1: HDMI Add-on board features

Category	Features
HDMI	<ul style="list-style-type: none">• 4x HDMI input (2x via SERDES, 1x via ADV7611, 1x via ADV7619)• 2x HDMI output (via SERDES)
Communication Interfaces	<ul style="list-style-type: none">• I²C bus• SMBus
Board to board interface ports	<ul style="list-style-type: none">• Samtec QTH-060 Header Connector• Samtec QTH-030 Header Connector
Power supply	<ul style="list-style-type: none">• Interface header connector dedicated power pins (5 V and 3.3 V)• Onboard linear voltage regulator 1.8 V
Manufacturing	<ul style="list-style-type: none">• RoHS compliant

2.1 Block schematic

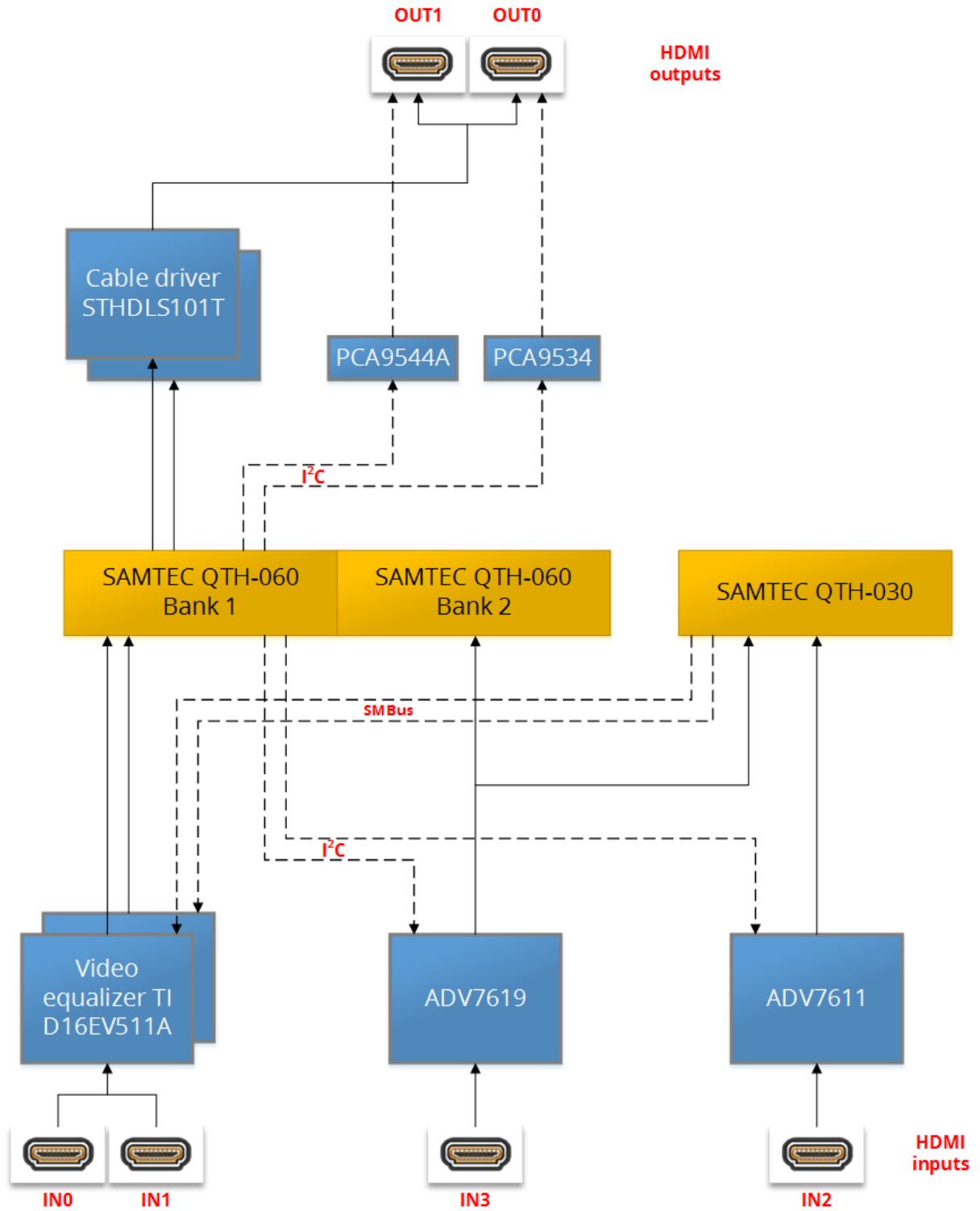


Figure 1: HDMI Add-on board block diagram

2.2 Board layout

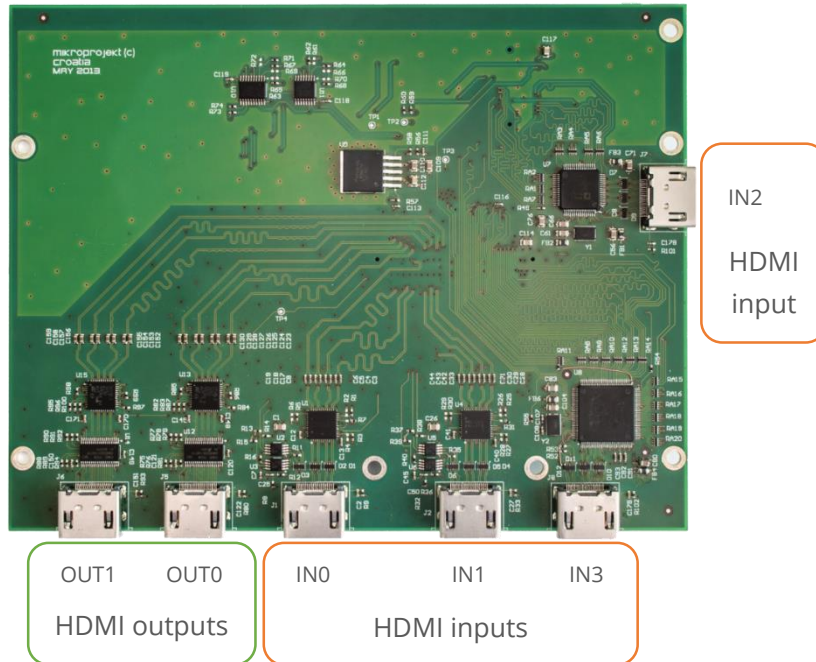


Figure 2: HDMI Add-on board layout - top

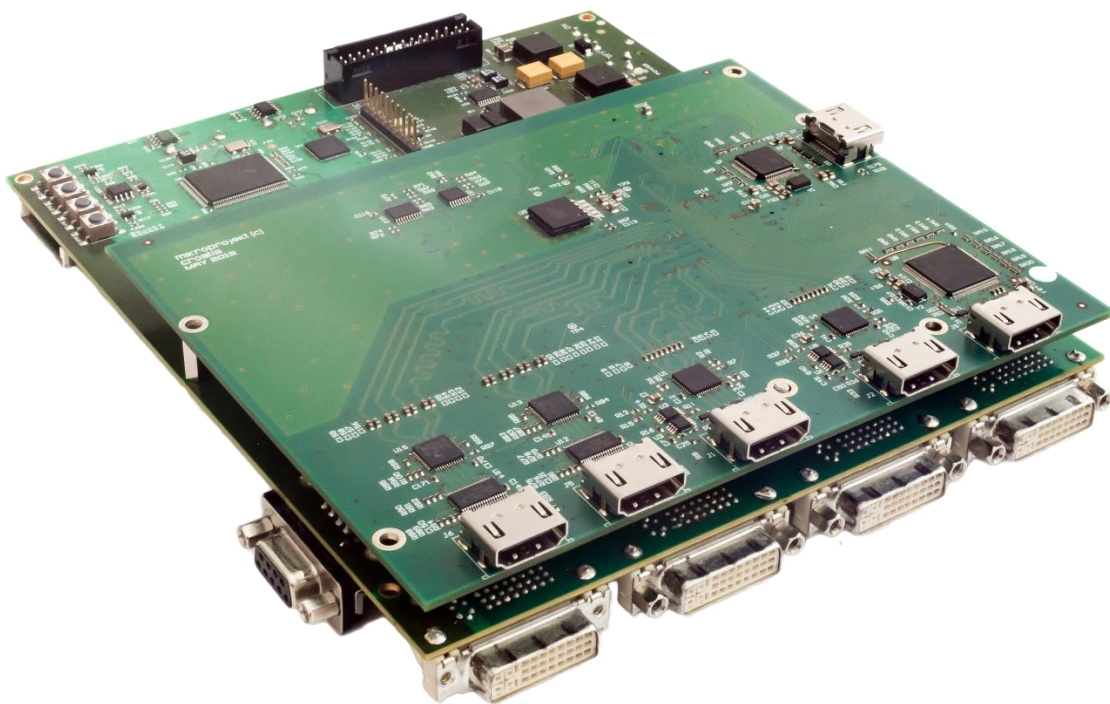


Figure 3: HDMI Add-on assembled on the Sparrowhawk FX

3 Powering up the board

CAUTION!

The HDMI Add-on PCB is protected against ESD (Electro Static Discharge), but improper handling can still damage the board. Try to avoid touching non-insulated parts of the board, especially DDR3 and the expansion connectors. If possible, use a functioning ground strap whenever handling the board.

To power up the HDMI Add-on board, it is necessary to plug it into the Sparrowhawk FX board (see Figure 3). The HDMI Add-on board is powered through the interface header connectors dedicated power pins, providing 3.3 V and 5 V to the board.

4 PCB details

The HDMI Add-on board uses HDMI connectors for all inputs and outputs. The HDMI channels are connected to the FPGA through the Samtec QTH-060 and QTH-030 header connectors (Expansion Connectors #0 and #1 on the Sparrowhawk FX).

4.1 HDMI input

HDMI input is available via 4 HDMI connectors according to table below.

Table 2: HDMI inputs

HDMI input	Connector
IN0	J1
IN1	J2
IN2	J7
IN3	J8

Inputs IN0 and IN1 are bridged between HDMI connectors and Lattice ECP3 150 FPGA on Sparrowhawk FX board through the TI D16EV511A video equalizers. Those video equalizers can be configured using the System Management Bus. The

connection to the FPGA is achieved by using fast differential pairs on the header connector J3 on the add-on board (expansion connector J12 on the SHFX board). These inputs are mapped to Lattice ECP3 SERDES quads A (IN0) and C (IN1) according to the table 3.

The IN2 HDMI input is provided over an ADV7611 HDMI receiver. The connection to the FPGA is achieved using the J3 connector on the add-on board and the J13 connector on the SHFX board. The input is mapped to the ECP3 bank 2.

The IN3 HDMI input is provided over an ADV7619 HDMI receiver. The connection to the FPGA is achieved using connectors J3 and J4 on the add-on board and connectors J12 and J13 on the SHFX board. The input is mapped to ECP3 banks 2 and 3.

Table 3: HDMI input mapping

HDMI input	ECP3
IN0	PCSA SERDES quad
IN1	PCSC SERDES quad
IN2	Bank 2
IN3	Bank 2, bank 3

4.2 HDMI output

HDMI output is available via 2 HDMI connectors, J5 and J6, which correspond to labels OUT0 and OUT1 (Table 4). The output connectors are connected to Lattice ECP3 SERDES through STHDLS101T HDMI cable driver and fast differential pairs on the header connector J3. The HDMI output interfaces are mapped to Lattice ECP3 SERDES quads A (OUT0) and C (OUT1). The table below describes mapping between SERDES and HDMI connectors.

Table 4: HDMI output SERDES mapping

HDMI output	Connector	ECP3 SERDES quad
OUT0	J5	PCSA
OUT1	J6	PCSC

4.3 I²C and SMBus

The I²C bus is used by Analog Devices' HDMI receivers (U7 and U8), NXP's multiplexer PCA9544A (U10) and Texas Instruments' I/O expander PCA9534 (U11), while the System Management Bus (SMBus) is used by Texas Instruments' video equalizers D16EV511A (U1 and U4).

Table 5: I²C and SMBus addresses

Component	Label	HDMI port	8-bit address	R/W
D16EV511A (CS0)*	U1	IN0	0xAC	W
			0xAB	R
D16EV511A (CS1)	U4	IN1	0xAC	W
			0xAB	R
ADV7611	U7	IN3	0x9A	W
			0x9B	R
ADV7619	U8	IN2	0x98	W
			0x99	R
PCA9544A	U10	OUT1	0xEE	W
			0xEF	R
PCA9534	U11	OUT0	0x46	W
			0x47	R

***Note:** components U1 and U4 are both addressed with the same address but selection is enabled and required with the Chip Select signal (CS0 and CS1).

4.4 Interface connectors

Header connector marked J3 is the Samtec QTH-060 high-speed mezzanine connector. It mates with the QSH-060-01-L-D-A connector (expansion connector #0 on SHFX board, marked J12). This board to board interface connector is divided into 2 banks, one dedicated to the high-speed differential pairs, the other to the HDMI pins. Each bank also has power supply pins, one 3.3 V and one 5 V. Two pins are dedicated to the system I²C bus.

The connector pinout and the corresponding PCB signal mapping is shown below.

Table 6: J3 interface connector Bank 1 pinout

EXP pin	Function	FPGA pin	EXP pin	Function	FPGA pin
1	VCC_3V3		2	VCC_3V3	
3	VCC_3V3		4	VCC_3V3	
5	VCC_3V3		6	VCC_3V3	
7	SYS_SDA	AN32	8	SYS_SCL	AN31
9	HDMI_IN3_D25	W34	10	HDMI_IN3_D39	AF32
11	HDMI_IN3_D24	W33	12	HDMI_IN3_D38	AF34
13	HDMI_IN3_D23	Y34	14	HDMI_IN3_D37	AG34
15	HDMI_IN3_D22	Y33	16	HDMI_IN3_D36	AH33
17	HDMI_IN3_D21	AB34	18	HDMI_IN3_D35	AJ31
19	HDMI_IN3_D20	AB33	20	HDMI_IN3_D34	AJ33
21	HDMI_IN3_D19	AC34	22	GND	
23	HDMI_IN3_D18	AC33	24	HDMI_IN3_CLK	AJ34
25	HDMI_IN3_D17	AD34	26	N/A	
27	HDMI_IN3_D16	AD33	28	GND	
29	HDMI_IN3_D15	AE34	30	HDMI_IN3_D33	AL32
31	HDMI_IN3_D14	AE33	32	HDMI_IN3_D32	AL34
33	HDMI_IN3_D13	W31	34	HDMI_IN3_D27	AL33
35	HDMI_IN3_D12	W32	36	HDMI_IN3_D26	AF31
37	HDMI_IN3_D11	Y31	38	HDMI_IN3_D31	AK31
39	HDMI_IN3_D10	Y32	40	HDMI_IN3_D30	AK32
41	HDMI_IN3_D9	AA30	42	HDMI_IN3_D29	AL31
43	HDMI_IN3_D28	AA31	44	HDMI_IN3_D40	AM32
45	HDMI_IN3_D8	AB31	46	N/A	
47	HDMI_IN3_D7	AB32	48	HDMI_IN3_D41	AM30
49	HDMI_IN3_D6	AB30	50	HDMI_IN3_D42	AN34
51	HDMI_IN3_D5	AC30	52	HDMI_IN3_D43	AN33
53	HDMI_IN3_D4	AD30	54	HDMI_IN3_D44	AP33
55	HDMI_IN3_D3	AD31	56	HDMI_IN3_D45	AP32
57	HDMI_IN3_D2	AE31	58	HDMI_IN3_D46	AP31
59	HDMI_IN3_D1	AE32	60	HDMI_IN3_D47	AP30

Table 7: J3 interface connector Bank 2 pinout

EXP pin	Function	FPGA pin	EXP pin	Function	FPGA pin
61	OUT1_CLK_N	PCSC_HDOUTN0	62	IN1_CLK_N	PCSC_REFCLKN
63	OUT1_CLK_P	PCSC_HDOUTP0	64	IN1_CLK_P	PCSC_REFCLKP
65	GND		66	GND	
67	OUT1_D0_N	PCSC_HDOUTN1	68	IN1_D2_P	PCSC_HDINN0
69	OUT1_D0_P	PCSC_HDOUTP1	70	IN1_D2_N	PCSC_HDINP0
71	GND		72	GND	
73	OUT1_D1_N	PCSC_HDOUTN2	74	IN1_D1_P	PCSC_HDINN1
75	OUT1_D1_P	PCSC_HDOUTP2	76	IN1_D1_N	PCSC_HDINP1
77	GND		78	GND	
79	OUT1_D2_N	PCSC_HDOUTN3	80	IN1_D0_P	PCSC_HDINN2
81	OUT1_D2_P	PCSC_HDOUTP3	82	IN1_D0_N	PCSC_HDINP2
83	GND		84	GND	
85	IN0_CLK_N	PCSA_REFCLKN	86	N/A	
87	IN0_CLK_P	PCSA_REFCLKP	88	N/A	
89	GND		90	GND	
91	OUT0_D2_P	PCSA_HDOUTN0	92	IN0_D2_P	PCSA_HDINN0
93	OUT0_D2_N	PCSA_HDOUTP0	94	IN0_D2_N	PCSA_HDINP0
95	GND		96	GND	
97	OUT0_D1_P	PCSA_HDOUTN1	98	IN0_D1_P	PCSA_HDINN1
99	OUT0_D1_N	PCSA_HDOUTP1	100	IN0_D1_N	PCSA_HDINP1
101	GND		102	GND	
103	OUT0_D0_P	PCSA_HDOUTN2	104	IN0_D0_P	PCSA_HDINN2
105	OUT0_D0_N	PCSA_HDOUTP2	106	IN0_D0_N	PCSA_HDINP2
107	GND		108	GND	
109	OUT0_CLK_P	PCSA_HDOUTN3	110	N/A	
111	OUT0_CLK_N	PCSA_HDOUTP3	112	N/A	
113	GND		114	GND	
115	VCC_5V		116	VCC_5V	
117	VCC_5V		118	VCC_5V	
119	VCC_5V		120	VCC_5V	

Header connector marked J4 is the Samtec QTH-030 high-speed mezzanine connector. It mates with the QSH-030-01-L-D-A connector (expansion connector #1 on SHFX board, marked J13). The connector is used for HDMI lines along with system bus management pins.

The connector pinout and the corresponding PCB signal mapping is shown below.

Table 8: J4 interface connector pinout

EXP pin	Function	FPGA pin	EXP pin	Function	FPGA pin
1	N/A		2	VCC_3V3	
3	N/A		4	VCC_3V3	
5	N/A		6	VCC_3V3	
7	N/A		8	N/A	
9	SMB_CS0	K33	10	N/A	
11	SMB_CS1	K34	12	VIN_RSTn	K29
13	N/A		14	IN_EN	L30
15	IN0_HPD_3V3	K31	16	HDMI_IN2_D15	L28
17	IN0_SDA_3V3	L33	18	HDMI_IN2_D14	L26
19	IN0_SCL_3V3	L34	20	HDMI_IN2_D13	M29
21	SMCLK	L32	22	HDMI_IN2_D12	M28
23	SMBDAT	L31	24	HDMI_IN2_D11	M27
25	IN1_HPD_3V3	M33	26	HDMI_IN2_D10	M26
27	IN1_SDA_3V3	M34	28	HDMI_IN2_D9	N30
29	IN1_SCL_3V3	M31	30	HDMI_IN2_D8	N29
31	HDMI_IN2_D4	M30	32	HDMI_IN2_D7	N28
33	HDMI_IN2_D3	N33	34	HDMI_IN2_D6	N27
35	HDMI_IN2_D2	N34	36	HDMI_IN2_D5	R31
37	HDMI_IN2_D1	N32	38	HDMI_IN2_D23	R30
39	HDMI_IN2_VS	N31	40	HDMI_IN2_D22	R28
41	GND		42	GND	
43	HDMI_IN2_CLK	U26	44	HDMI_IN2_D21	V34
45	N/A		46	N/A	
47	GND		48	GND	
49	HDMI_IN2_HS	P33	50	HDMI_IN2_D20	R27
51	HDMI_IN2_D0	P34	52	HDMI_IN2_D19	T32
53	HDMI_IN3_VS	R33	54	HDMI_IN2_D18	T31
55	HDMI_IN3_HS	R34	56	HDMI_IN2_D17	T30
57	HDMI_IN3_DE	T33	58	HDMI_IN2_D16	T29
59	HDMI_IN3_D0	T34	60	HDMI_IN2_DE	U32

4.5 Test points

The board includes following power voltage and GND test points.

Table 9: HDMI Add-on board test points

Test point	Description	Signal
TP1	Ground	GND
TP2	3.3 V power voltage	VCC_3V3
TP3	1.8 V power voltage	VCC_1V8
TP4	5 V power voltage	VCC_5V

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