DI460ELF-HDMI Product Specification

High Performance Simultaneous Data Acquisition

 Preliminary Product Document
Subject to change

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Revision History

Revision	Date	Author(s)	Description
1	04-08-2023	JMcL	Initial Version For Review

Glossary

- FMC: VITA57.1 FPGA Mezzanine Card.
- Xilinx ZYNQ Soc
- FPGA : Field Programmable Gate Array.
- LPC : FMC Low pin count wiring standard.
- DULPC: FMC Differential Ultra low pin count (D-TACQ).
- Extended ELF : FMC Extended size module (D-TACQ).

1 Product Definition

The key specification attributes of the **DI460ELF-HDMI** are as follows,

Key Specification Attributes

1. ELF Module with with 12 channels LVDS input on 6xHDMI connectors giving 6 AquadB inputs.
2. DULPC signal standard, for use in site 1..6 on ACQ2106(ACQ2206) or site 1 on ACQ1001.
3. HDMI connectors mount on underside of the ELF module; when the ELF module is fitted face down, the HDMI connectors are ABOVE the module.
4. Module is INPUT only
5. An output option (for stimulation / testing) can be built by build option.
6. The HDMI Connectors on the back of the board require a Double Height (DH) box option.

Additional connector detail

Carrier FPGA Logic and HDMI Pinout are compatible with the AquadB Position Pinout on the Qutools quDIS product as per their manual at quDIS Manual
This Product Specification refers to Version 2.1 of the above manual.

2 Product Description

1. DI460ELF-HDMI is a standard D-TACQ product, 12 channels LVDS Inputs buffered then connected direct to Carrier FPGA pins
2. Standard LVDS 100Ω termination
3. Compliant with D-TACQ ELF sites.

2.1 Product Variants

- DI460ELF-HDMI-STIM : Stimulator variant with driver capability for stimulating the standard product inputs

Note: the Stimulator Drives the AquadB outputs on HDMI connectors 1-3 and the Error Output on HDMI connectors 3-6. This allows all key LVDS inputs to be stimulated.

Note: the test Carrier FPGA logic produces a 50 MHz pulse train for the A input signals and a 25 MHz pulse train for the B inputs.

2.2 Overview

The ELF module standard is a D-TACQ standard and is compatible with only D-TACQ Carriers.

Compatible carriers include:

- D-TACQ ACQ1001-OEM : D-TACQ single slot FMC carrier, Z7020
- D-TACQ ACQ2106 : D-TACQ 6 slot FMC carrier, Z7030
- D-TACQ ACQ2206 : D-TACQ 6 slot FMC carrier, Z7030

Note: There is an issue receiving the B input to the HDMI connector 6 when the board is in site 3. This may be resolved at a later date.

3 Physical

- Single ELF Form Factor with connectors on the Rear requiring
- Three LVDS Channels Per HDMI Connector AquadB signals POS-A and POS-B and the Position Error Signal POS-ERR using Pinout as per Qutools quDIS pinout

3.1 Board Outline

The picture below shows the board outline and connector position for the HDMI connectors

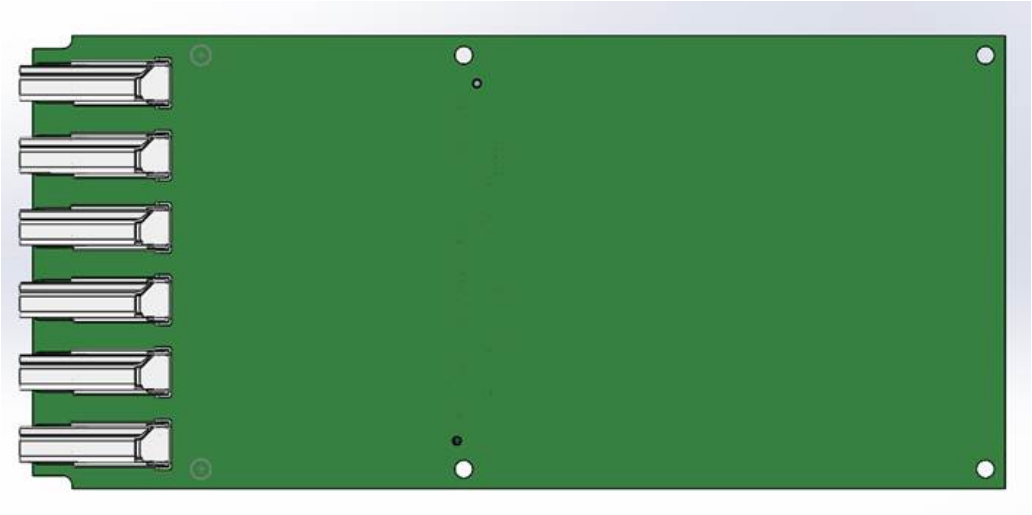


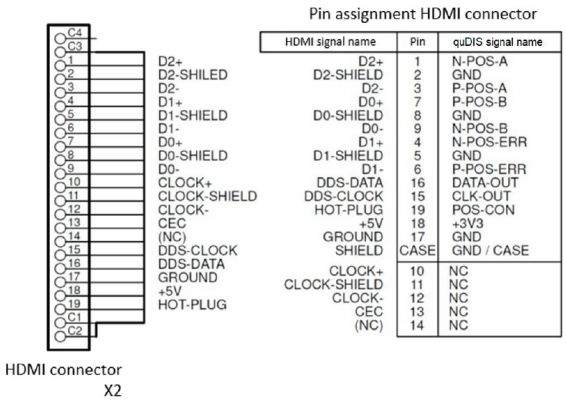
Figure 1: DI460ELF-HDMI Board Outline

As previously mentioned as the connectors are on the opposite side of the board from normal FMC connectors this means that the board will only fit in D-TACQ carriers with a custom panel. This is a sufficient for most of the sites in a ACQ2016/ACQ2206 however the position of the connectors rules out the possibility of using a ACQ1001S but may be possibly with a custom panel on site 1 of a ACQ1002.

In order to fit in the module pitch of 70mm the HDMI connector pitch will be a minimum of 11.5mm. This may require HDMI cables to be chosen to fit with this pitch

3.2 Front Panel Connectors

6 HDMI connectors to interface with the Qutools quDIS appliance, these HDMI connectors are defined on page 27 of the manual shown in the figure below



HDMI signal name	Pin	quDIS signal name
D2+	1	N-POS-A
D2-SHIELD	2	GND
D2-	3	P-POS-A
D0+	7	P-POS-B
D0-SHIELD	8	GND
D0-	9	N-POS-B
D1+	4	N-POS-ERR
D1-SHIELD	5	GND
D1-	6	P-POS-ERR
DDS-DATA	16	DATA-OUT
DDS-CLOCK	15	CLK-OUT
HOT-PLUG	19	POS-CON
+5V	18	+3V3
GROUND	17	GND
SHIELD	CASE	GND / CASE
CLOCK+	10	NC
CLOCK-SHIELD	11	NC
CLOCK-	12	NC
CEC	13	NC
(NC)	14	NC

Figure 2: HDMI Connector

The signal definitions are as per the table on page 28 of the manual as shown below

Name	Description	Levels
P-POS-A	Differential quadrature signal A	LVDS
N-POS-A	Complementary differential quadrature signal A	LVDS
P-POS-B	Differential quadrature signal B	LVDS
N-POS-B	Complementary differential quadrature signal B	LVDS
P-POS-ERR	Differential error signal, high active	LVDS
N-POS-ERR	Complementary differential error signal	LVDS
DATA-OUT	HSSL serial output: Data	LVTTL
CLK-OUT	HSSL serial output: Clock	LVTTL
+3V3	Power supply, max. 300mA	3.3V
GND	Ground	-
GND/CASE	Ground	-
POS-CON	Input, high active, signals a connected device	LVTTL
NC	Not connected	-

Table 1: PIN description

Figure 3: HDMI Pin Description

Each Qutools quDIS appliance has 3 output HDMI connectors meaning each DI460ELF-HDMI module can receive signals from 2 quDIS appliances.

The DI460ELF-HDMI board is required to support the POS-A and POS-B LVDS differential pairs for quadrature movement position detection.

In addition to this the POS-ERR Position Error Signal is also supported, this signal is translated to a LVCMOS signal before connection to the Carrier FPGA due to LVDS pin limitations

The other signals are a Not Applicable (N/A) and shall be left open circuit. The DI460ELF-HDMI board shall provide a Pull-up/Pull-down option between the 3.3V and the POS-CON signal as provision in case the quDIS appliance uses this signal to determine whether to switch on the output LVDS drivers

4 Specification

4.1 Electrical Specification to Qutools quDIS appliance

The HDMI connectors from the Qutools quDIS appliance generate LVDS signals to the specification below

Load	Typ. LVDS U_{low}	Typ. LVDS U_{high}
100 R	+1.15 V	1.35 V

Figure 4: quDIS Manual LVDS Levels

These signals are within the standard LVDS voltage range and will be correctly received by standard LVDS receivers

4.2 Signal Timing AquadB Signal Reception

The input signalling environment is LVDS however the frequencies of signals on the AquadB pairs is not directly specified. This is estimated from the quDIS Manual from page 25 where the quadrature signals are described as having defined minimum pulse width as shown below:

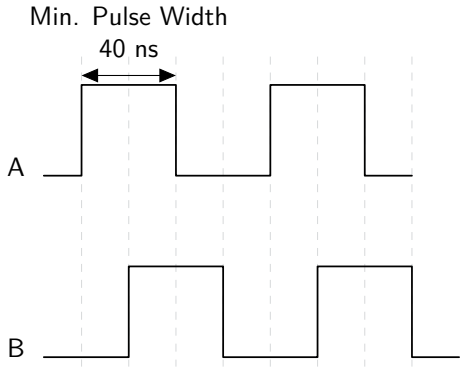


Figure 5: AquadB signals and minimum pulse width

This results in a maximum input frequency on each A or B signal of 12.5MHz, however due to the 90° phase difference between the signals a sample rate of > 50MHz is required to detect the quadrature progression.

The Stimulator Logic in the test Carrier FPGA logic demonstrates this frequency reception

4.3 LVDS Receiver

The core component of the DI460ELF-HDMI board is the LVDS Receiver/repeater. The device fitted is a TI SN65LVDS100D, this LVDS differential receiver requires termination but allows the potential for CML and LVPECL differential signals and LVTTL and LVCMOS single ended signals. Alternative input signalling levels are only available by population and not all supported. It can can operate at very high frequencies well above the target 50MHz, the DI460ELF-HDMI inputs were tested for pulse detection at <10nS widths. In addition to this phase skew of the AquadB signals will be very low for quadrature detection.

4.4 Other HDMI Signals

The DI460ELF-HDMI board provides POSS-ERR interface to the Carrier FPGA, this is received as a LVDS signal and translated to a LVCMOS signal for reception in the Carrier FPGA. using a SN65LVDS4 device.

The DI460ELF-HDMI board provides a Pull-up/Pull-down option between the 3.3V and the POS-CON signal as provision in case this is required for the quDIS appliance.

4.5 I²C Devices

The board is fitted with 3 I²C devices as follows

Address	Device	Description
0x20	TCA9534	Bus Expander Digital I/O
0x28	AD7417	Temperature Sensor and Analog Input
0x50	M24C64	Serial IPMI FRU PROM

Table 1: I²C devices

4.5.1 TCA9534 POS-CON Bus Expander

The sense of the Pull-up/Pull-down option between the 3.3V and the POS-CON signals on the HDMI connectors can be read by the TCA9534 with the signal definition as follows

Port	Description
P00	HDMI 1 POS-CON [1]
P01	HDMI 2 POS-CON
P02	HDMI 3 POS-CON
P03	HDMI 4 POS-CON
P04	HDMI 5 POS-CON
P05	HDMI 6 POS-CON

[1] 0 = HDMI Cable Not Connected
1 = HDMI Cable Connected

Table 2: POS-CON Bus Expander

4.5.2 AD7417 Temperature Sensor

See the data sheet at AD7417

4.5.3 Serial IPMI FRU PROM

This is a standard FMC FRU devices the contents of the PROM are as per the FMC standard and the *IPMI Platform Management FRU Information Storage Definition v1.0*

Below is an example of a DI460ELF-HDMI module with the serial number 10.

```
./fru-dump fru/E46020010.fru
header 0x18f0010 bia 0x18f0018
fru/E46020010.fru: manufacturer: D-TACQ Solutions
header 0x18f0010 bia 0x18f0018
fru/E46020010.fru: product-name: DI460ELF
header 0x18f0010 bia 0x18f0018
fru/E46020010.fru: serial-number: E46020010
header 0x18f0010 bia 0x18f0018
fru/E46020010.fru: part-number: DI460ELF N=16 M=72
```

4.6 FMC Connector Pin Out

FMC Pin	Signal Name	Description
p_FMC_CLK0_M2C_p		Not Used, Dedicated Clock to Carrier FPGA
p_FMC_CLK0_M2C_n		Not Used, Dedicated Clock to Carrier FPGA
p_FMC_CLK1_C2M_p		Not Used, Dedicated Clock from Carrier FPGA
p_FMC_CLK1_C2M_n		Not Used, Dedicated Clock from Carrier FPGA
p_FMC_LA00_CC_p	HDMI_1_POS_A_p	LVDS +ve HDMI 1 POS-A
p_FMC_LA00_CC_n	HDMI_1_POS_A_n	LVDS -ve HDMI 1 POS-A
p_FMC_LA01_CC_p	HDMI_1_POS_B_p	LVDS +ve HDMI 1 POS-B
p_FMC_LA01_CC_n	HDMI_1_POS_B_n	LVDS -ve HDMI 1 POS-B
p_FMC_LA02_p	HDMI_2_POS_A_p	LVDS +ve HDMI 2 POS-A
p_FMC_LA02_n	HDMI_2_POS_A_n	LVDS -ve HDMI 2 POS-A
p_FMC_LA03_p	HDMI_2_POS_B_p	LVDS +ve HDMI 2 POS-B
p_FMC_LA03_n	HDMI_2_POS_B_n	LVDS -ve HDMI 2 POS-B
p_FMC_LA04_p	HDMI_3_POS_A_p	LVDS +ve HDMI 3 POS-A
p_FMC_LA04_n	HDMI_3_POS_A_n	LVDS -ve HDMI 3 POS-A
p_FMC_LA05_p	HDMI_3_POS_B_p	LVDS +ve HDMI 3 POS-B
p_FMC_LA05_n	HDMI_3_POS_B_n	LVDS -ve HDMI 3 POS-B
p_FMC_LA06_p	HDMI_4_POS_A_p	LVDS +ve HDMI 4 POS-A
p_FMC_LA06_n	HDMI_4_POS_A_n	LVDS -ve HDMI 4 POS-A
p_FMC_LA07_p	HDMI_4_POS_B_p	LVDS +ve HDMI 4 POS-B
p_FMC_LA07_n	HDMI_4_POS_B_n	LVDS -ve HDMI 4 POS-B
p_FMC_LA08_p	HDMI_5_POS_A_p	LVDS +ve HDMI 5 POS-A
p_FMC_LA08_n	HDMI_5_POS_A_n	LVDS -ve HDMI 5 POS-A
p_FMC_LA09_p	HDMI_5_POS_B_p	LVDS +ve HDMI 5 POS-B
p_FMC_LA09_n	HDMI_5_POS_B_n	LVDS -ve HDMI 5 POS-B
p_FMC_LA10_p	HDMI_6_POS_A_p	LVDS +ve HDMI 6 POS-A
p_FMC_LA10_n	HDMI_6_POS_A_n	LVDS -ve HDMI 6 POS-A
p_FMC_LA11_p	HDMI_6_POS_B_p	LVDS +ve HDMI 6 POS-B
p_FMC_LA11_n	HDMI_6_POS_B_n	LVDS -ve HDMI 6 POS-B
p_FMC_LA12_p	HDMI_1_HSSL_DATA	LVCMOS HSSL Data Signal (Test only) from HDMI 1
p_FMC_LA13_p	HDMI_1_HSSL_CLOCK	LVCMOS HSSL Clock Signal (Test only) from HDMI 1
p_FMC_LA14_p	HDMI_2_HSSL_DATA	LVCMOS HSSL Data Signal (Test only) from HDMI 2
p_FMC_LA15_p	HDMI_2_HSSL_CLOCK	LVCMOS HSSL Clock Signal (Test only) from HDMI 2
p_FMC_LA16_p	CONFIG_0	LVCMOS Configuration Jumper
p_FMC_LA17_CC_p	CONFIG_1	LVCMOS Configuration Jumper
p_FMC_LA18_CC_p	HDMI_1_POS_ERR	LVCMOS Position Error Signal From HDMI 1
p_FMC_LA19_p	HDMI_2_POS_ERR	LVCMOS Position Error Signal From HDMI 2
p_FMC_LA20_p	HDMI_3_POS_ERR	LVCMOS Position Error Signal From HDMI 3
p_FMC_LA21_p	HDMI_4_POS_ERR	LVCMOS Position Error Signal From HDMI 4
p_FMC_LA22_p	HDMI_5_POS_ERR	LVCMOS Position Error Signal From HDMI 5
p_FMC_LA23_p	HDMI_6_POS_ERR	LVCMOS Position Error Signal From HDMI 6

Table 3: FMC Connector Pin Out

Config Pins allow the Carrier FPGA to detect for Receiver or Stimulator as follows

CONFIG_1	CONFIG_0	Board Configuration
0	0	Standard Receiver
0	1	Stimulator

4.7 Environmental Specification

#	Parameter	Value
1	Form Factor	ELF with HDMI connectors on top of board
2	Power source	DC 12V, 20mA DC 3.3V, 250 mA
3	Environmental	0°C - 50°C Operational -10°C - 85°C Non-Operational
4	ELF Socket	Custom ELF in Differential Ultra Low Pin Count DULPC
5	Digital Signal Input	Standard LVDS

Table 4: DI460ELF-HDMI Electrical Specification