SEACOMP

Display Interface Board
Product Datasheet

SEA0010, SEA0010-HB

HDMI Interface Board for LVDS Displays

Revision	Description	Date
A1	PRW: Initial Release	03/13/2019
A2	PRW: Part number correction, Section 5	8/19/2019
A3	PRW: Added high-bright option, Updated assembly drawings and display part numbers	5/18/2020

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Table of Contents

1 Features **2**

2 Applications **2**

3 Acronyms **2**

4 Product Description **3**

5 External Interfaces **3**

5.1 MCU Interface, CN3 3

5.1.1 Pass-Through Signals 4

5.2 HDMI Interface, CN1 5

5.3 LVDS Display Interface, CN4 5

5.4 I²C Interface, CN5 6

5.5 EDID Interface, CN6 7

6 Display Backlight Power **7**

7 Jumper Options **8**

7.1 Display On/Off Control (STBYB) 8

7.2 Pixel Clock Polarity 8

7.3 6/8-Bit Data Mode Select 8

7.4 Gate Up/Down Scan Control 8

7.5 Right/Left Control Sequence 9

7.6 LCD Power 9

8 Absolute Maximum Ratings **9**

9 Recommended Operating Conditions **10**

10 Electrical Characteristics **10**

11 Example Software **10**

12 Mechanical Drawings **11**

12.1 SEA0010 Top View 13

12.2 SEA0010 Bottom View 13

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1 Features

- HDMI receiver
  - Supports pixel rates up to 165 Mhz
  - Supports display resolutions up to 1080p
- On-board re-programmable EDID EEPROM, I²C compatible
- I²C Capacitive touch interface
- 40-pin LVDS interface
- Optional display backlight PWM control

2 Applications

Provides LVDS display data for Raspberry Pi, Beagle Bone, other embedded applications that supply HDMI video input.

3 Acronyms

DVI - Digital Visual Interface
EDID - Extended Display Identification Data
EEPROM - Electrically Erasable Programmable Read-Only Memory
FPC - Flexible Printed Circuit
HDMI - High-Definition Multimedia Interface
IC - Integrated Circuit
I²C - Inter-Integrated Circuit
LCD - Liquid Crystal Display
LED - Light Emitting Diode
LVDS - Low Voltage Differential Signaling
MCU - Microcontroller Unit
PCAP - Projected Capacitive Touch
PWM - Pulse Width Modulation
RGB - Red, Green, Blue
RPi - Raspberry Pi
SBC - Single Board Computer
TFT - Thin-Film Transistor

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4 Product Description

The SEA0010 is a display format converter board designed for use with an LVDS TFT display, such as the Displaytech DT070DTFT-IPS-PTS. It translates HDMI input to LVDS and has an I²C interface for capacitive touch capability. The board allows for operation with an HDMI input, provided by a video source such as an SBC, Raspberry Pi, Personal Computer. There is a programmable on-board EEPROM that provides the video source with an EDID through the HDMI interface, supplying the video source with the display resolution configuration.

5 External Interfaces

The SEA0010 supports driving the DT070DTFT-IPS's EK79001 TFT source driver via an LVDS interface. Video input is received via a Type-A HDMI receptacle and the resulting LVDS data is relayed to the LCD's flex connector through an LVDS 40-pin interface.
Capacitive touch I²C interface signals are passed through from the display's capacitive touch controller directly to an MCU interface (CN3), with internal pull-ups at each signal.
The display's on/off control signal (STBYB) is also passed through to this interface for optional MCU control. The interface also provides access to the board's power connections, and pads for installation of a second (vertical) header are available depending on the user's mechanical needs. The board also provides pads for optional installation of a 4-pin header (CN6) which provides access to the on-board EDID EEPROM.

5.1 MCU Interface, CN3

A 0.1" 10-pin right angle header provides an interface between the SEA0010 and the MCU device. The SEA0010 does not contain a video scaler, so display resolution must be properly scaled on the MCU. In addition, a driver with the appropriate device address is needed for I²C communication between the MCU master and the display's capacitive touch controller (slave).

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Pin Descriptions, MCU Interface, CN3				
Pin	Signal Name	Type	Description	Comments
1	+5V	PWR	+5V power supply	If using RPi, supplied from I/O header.
2	RESET	I	Display reset, active LOW	
3	P-RST	I	Touch reset, active LOW	Pass-through from capacitive touch on display (CN5) to MCU.
4	P-INT	I/O	Touch interrupt/wakeup, active LOW	Pass through from capacitive touch on display (CN5) to MCU.
5	P-SDA	I/O	I2C touch data input/output	Pass through from capacitive touch on display (CN5) to MCU.
6	P-SCL	I	I2C clock input	Pass through from capacitive touch on display (CN5) to MCU.
7	BKLT-PWM	I	PWM input to backlight driver	Optional
8	STBYB	I	Display On/Off (HIGH = On, LOW = Standby)	This pin is not used in normal operation. See Section 5.1 for jumper options and usage details.
9	GND	PWR	Ground	
10	NC			

* NOTE: Active High/Low assumes use of Displaytech DT070DTFT-IPS-PTS display.
* NOTE: The user has the option to install a vertical 10-pin 0.1” header at CN2. The connections to CN2 are identical to those to CN3. See Section 12 for recommended connector.

5.1.1 Pass-Through Signals

SEA0010 Pass-Through Signals			
Signal Name	CN3 Pin	CN4 Pin	CN5 Pin
RESET	2	5	
P-SCL	3		1
P-SDA	4		2
P-INT	5		5
P-WAKE	6		4
BKLT-PWM	7		
STBYB	8		
3.3V		2, 3	3

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5.2 HDMI Interface, CN1

The HDMI video signal is supplied by the SBC (Raspberry Pi or equivalent) via a 19-pin Type-A HDMI connector. The SEA0010 was designed with the 1024x600 DT070DTFT-IPS-PTS display in mind but can convert any resolution up to 165MHz, including 1080p, and is DVI compliant.

5.3 LVDS Display Interface, CN4

LVDS display data is delivered to the display via a 40-pin FPC connector.
See Section 12 for connector details.

Pin Descriptions, LVDS Display Interface, CN4			
Pin	Signal Name	Type	Description
1	VCOM	PWR	Common voltage
2	3.3V	PWR	3.3V Supply
3	3.3V	PWR	3.3V Supply
4	NC		
5	RESET	DO	Global reset, normally High
6	STBYB	DO	Sync detect. Monitors state of DISPEN to determine activity. High = Active, Low = Inactive See Section 5.1 for jumper options.
7	GND	PWR	Ground
8	RXOUT0_N	O	Negative LVDS differential output
9	RXOUT0_P	O	Positive LVDS differential output
10	GND	PWR	Ground
11	RXOUT1_N	O	Negative LVDS differential output
12	RXOUT1_P	O	Positive LVDS differential output
13	GND	PWR	Ground
14	RXOUT2_N	O	Negative LVDS differential output
15	RXOUT2_P	O	Positive LVDS differential output
16	GND	PWR	Ground
17	RXCLKOUT_N	O	Negative LVDS differential clock output
18	RXCLKOUT_P	O	Positive LVDS differential clock output
19	GND	PWR	Ground
20	RXOUT3_N	O	Negative LVDS differential output
21	RXOUT3_P	O	Positive LVDS differential output
22	GND	PWR	Ground
23-24	NC		
25	GND	PWR	Ground

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26-27	NC		
28	SELB	DO	6/8 bit RGB data mode select. Normally low. See Section 12 for jumper options.
29	AVDD	PWR	Analog power supply.
30	GND	PWR	Ground
31-32	LED-K	PWR	Backlight voltage supply, cathode
33	SHLR	DO	Right/left sequence control. Normally High. See Section 7 for jumper options.
34	UPDN	DO	Up/down scan control. Normally Low. See Section 7 for jumper options.
35	VGL	PWR	LCD Power, gate drive output Low
36-37	NC		
38	VGH	PWR	LCD Power, gate drive output High
39-40	LED-A	PWR	Backlight voltage supply, anode

5.4 I²C Interface, CN5

I²C capacitive touch signals from the display's capacitive touch controller are passed through to the MCU interface via a 6-pin FPC connector (CN5). Pull-up resistors are installed at each PCAP connection (see table below for resistor values).

Pin Descriptions, I²C Interface, CN5			
Pin	Signal Name	Type	Description
1	P-SCL	O	I²C Clock Output
2	P-SDA	I/O	Capacitive touch data from I²C slave device
3	3.3V	PWR	3.3V capacitive touch controller power supply
4	P-WAKE	O	Capacitive touch external Reset/Wake
5	P-INT	I/O	Interrupt request from I²C slave device
6	GND	PWR	Ground

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The I²C interface includes internal pull-up resistors on each of the capacitive touch signals.The following table lists the resistor values:

PCAP Signal	Pull-up Resistor Value (Ω)
P-SCL	4.7K
P-SDA	4.7K
P-INT	100K
P-WAKE	10K

5.5 EDID Interface, CN6

The user has the option to program the on-board EDID EEPROM by installing a 0.1” 4-pin header at CN6 and using an off-the-shelf serial EEPROM programmer.
The 2Kb EEPROM is organized as a block of 256x8 bit memory with a 2-wire serial interface. This device must be controlled by a master which generates the serial clock, controls bus access, and generates start and stop conditions while the EEPROM acts as slave. The master and slave can both act as transmitter or receiver, but the master must determine which mode is activated.

Please refer to the EEPROM manufacturer datasheet, part number 24LC024B.

EDID EEPROM Interface, Pin Descriptions, CN6			
Pin	Signal Name	Type	Description
1	HDMI-5V	PWR	EEPROM +5V power supply
2	GND	PWR	EEPROM Ground
3	SCL	I	EEPROM serial clock
4	SDA	I/O	EEPROM serial data in/out

* See Section 12 for recommended connector.

6 Display Backlight Power

An on-board LED driver provides power to the display backlight, with jumper options for multiple current requirements.
By default resistor R12 is installed, providing 140mA backlight current. A 4.99Ω resistor may be installed at R13 in order to provide 200mA for use with Displaytech’s DT070DTFT-IPS-HB “High-Bright” display. If a different current is required, the R13 resistor value can be changed according to the following:

$$I_{BKLT} = 300/R13 + 140 \ \ (mA)$$

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The following table provides examples of R13 resistor values needed for various current requirements.

R13 Resistance (Ω)	I_{BKLT} (mA)
30	150
15	160
10	170
7.5	180

Backlight LED dimming can optionally be controlled by application of a PWM signal at CN3, Pin 7 (BKLT-PWM).

7 Jumper Options

The SEA0009 provides the following custom jumper options:

7.1 Display On/Off Control (STBYB)

By default the display's on/off control (STBYB) is handled by the SEA0010 and requires no input from the user. If the user wishes to independently control the STBYB signal's behavior (CN3-8) they can do so by removing the R24 jumper. Alternatively, a 10K ohm resistor can be installed at R25 to keep the display permanently in the on state.

7.2 Pixel Clock Polarity

By default, output data to the display is latched on the rising edge of the SEA0009's pixel clock. By removing the R3 resistor and installing a jumper at R18, this can be reversed so that data is latched on the falling edge of the clock.

7.3 6/8-Bit Data Mode Select

The SEA0010 is configured for 8-bit input data by default. To configure for 6-bit data, remove the resistor at R45 and install a 10K ohm resistor at R42.

7.4 Gate Up/Down Scan Control

The SEA0010 is configured for shift down control of the display's gate driver. To change to shift up control, remove the resistor and R4 and install a 10K ohm resistor at R44.

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7.5 Right/Left Control Sequence

The SEA0010 is configured for right sequence control of the display's gate driver. For left sequence control, remove the resistor at R40 and install a 10K ohm resistor at R43.

7.6 LCD Power

LCD power is provided by an on-board LCD supply IC that acts as a voltage doubler. Default electrical characteristics are as follows:

LCD Power Electrical Characteristics					
Parameter	Symbol	Min.	Typ.	Max	Unit
LCD Analog Supply Voltage	A_{VDD}	9.4	9.6	9.8	V
LCD Gate On Voltage	V_{GH}	17.0	18.0	19.0	V
LCD Gate Off Voltage	V_{GL}	-6.6	-6.0	-5.4	V
LCD Common Voltage	V_{COM}	2.85		3.45	V

The SEA0010 provides for a voltage tripler option, configured by removing R35 and installing a .22uF capacitor at C43.

8 Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Power Supply Voltage	V_{IN}	-.3	6	V
Operating Temperature	T_{OP}	0	70	°C
Storage Temperature	T_{ST}	-55	150	°C
EDID Supply Voltage	V_E		6.5	V
EDID Clock Frequency	f_{CLE}		400	kHz
EDID I/O Voltage	V_{EIO}	-0.3	V_E+1	V
Backlight Forward Voltage	V_{BKLT}	-.3	40	V
Backlight PWM Voltage	V_{PWM}	-.3	7	V

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9 Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit
Power Supply Voltage	V_{IN}		5		V
EDID Supply Voltage	V_E		5		V
Backlight PWM Frequency	f_{PWM}	100		2000	Hz

10 Electrical Characteristics

Parameter	Symbol	Min.	Typ	Max.	Unit
Power Supply Voltage	V_{IN}	2.7		5.5	V
EDID Supply Voltage	V_E	2.5		5.5	V
Backlight PWM Voltage, High threshold Low threshold	V_{PWM}	 .4	 .8 .7	1.5	V
Backlight Forward Voltage	V_{BKLT}		9.6		V
Backlight Supply Current	I_{BKLT}		140		mA

11 Example Software

Sample software is available from Displaytech upon request. Please contact Displaytech at sales@displaytech-us.com

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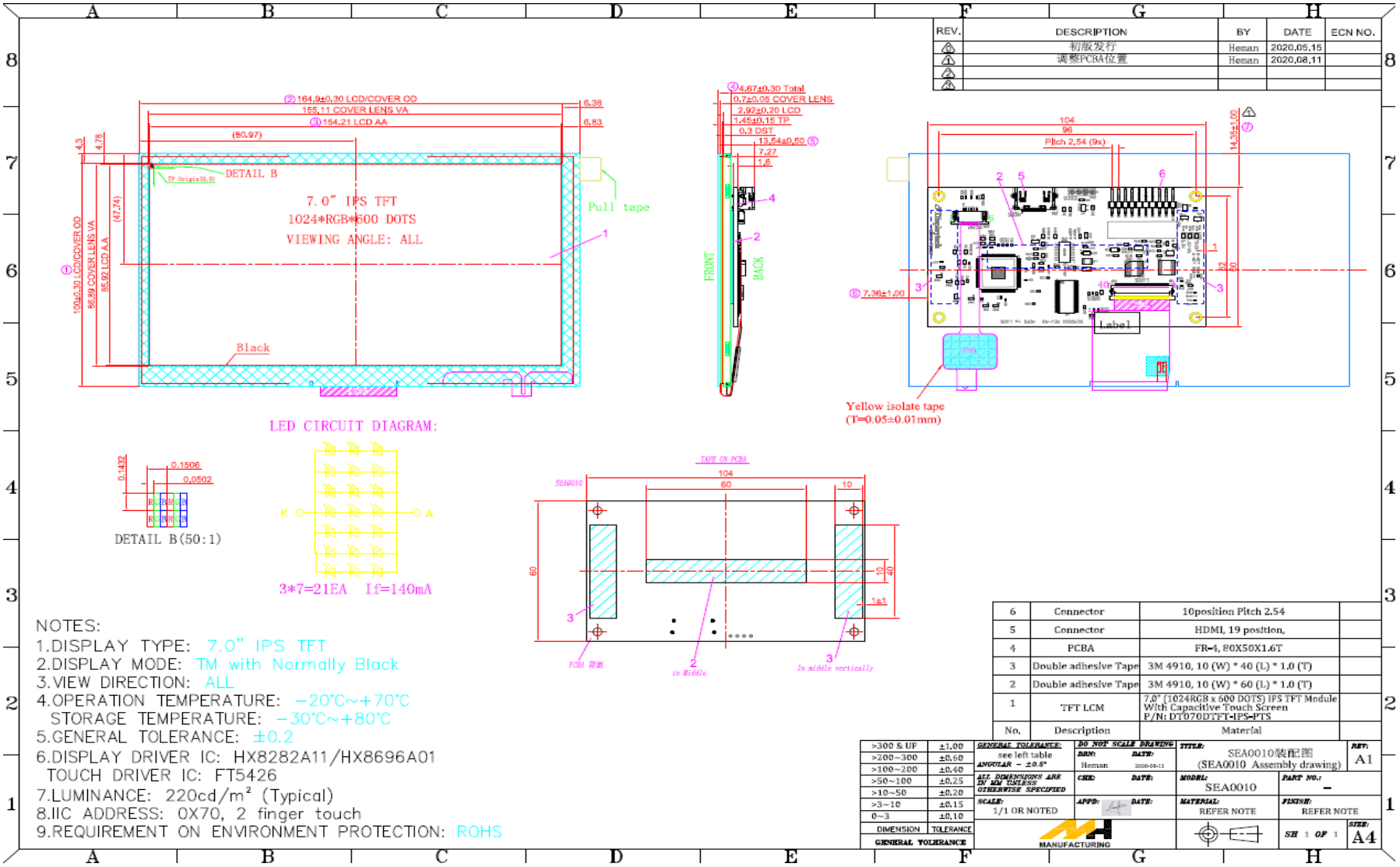
12 Mechanical Drawings



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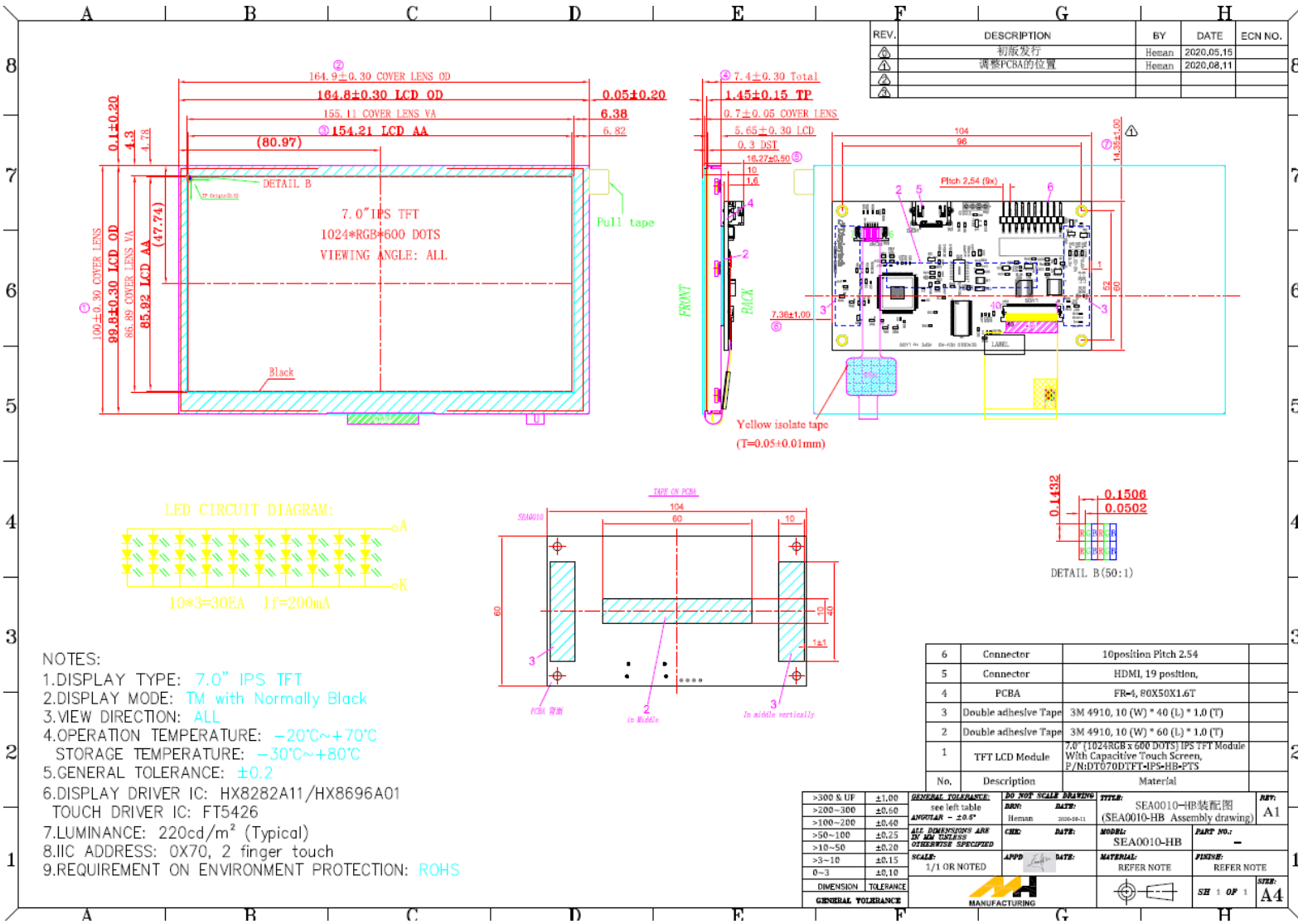

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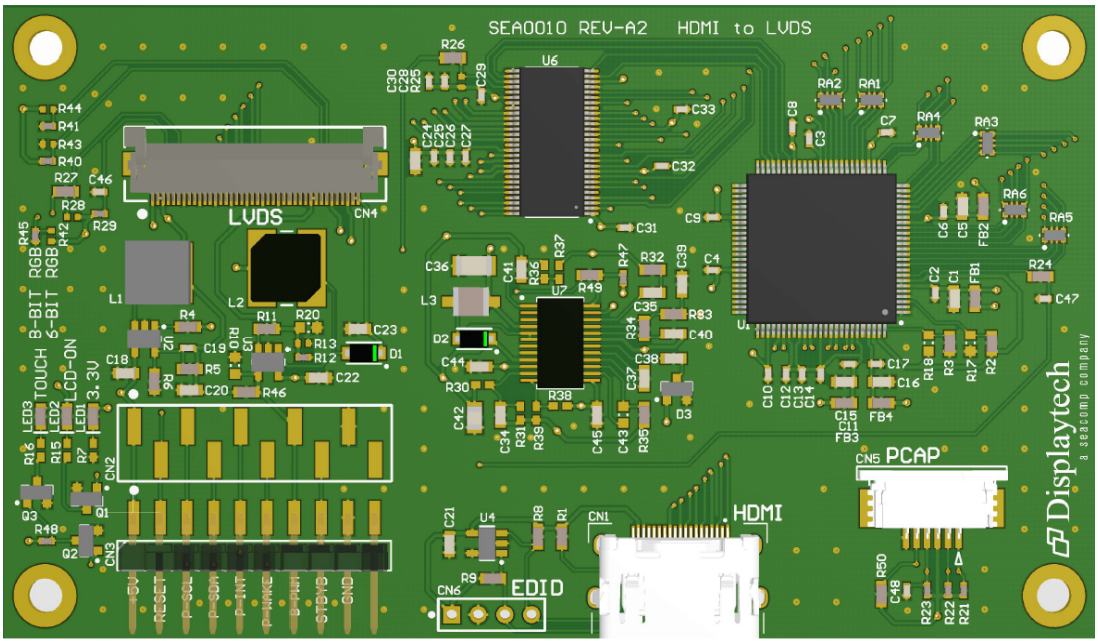
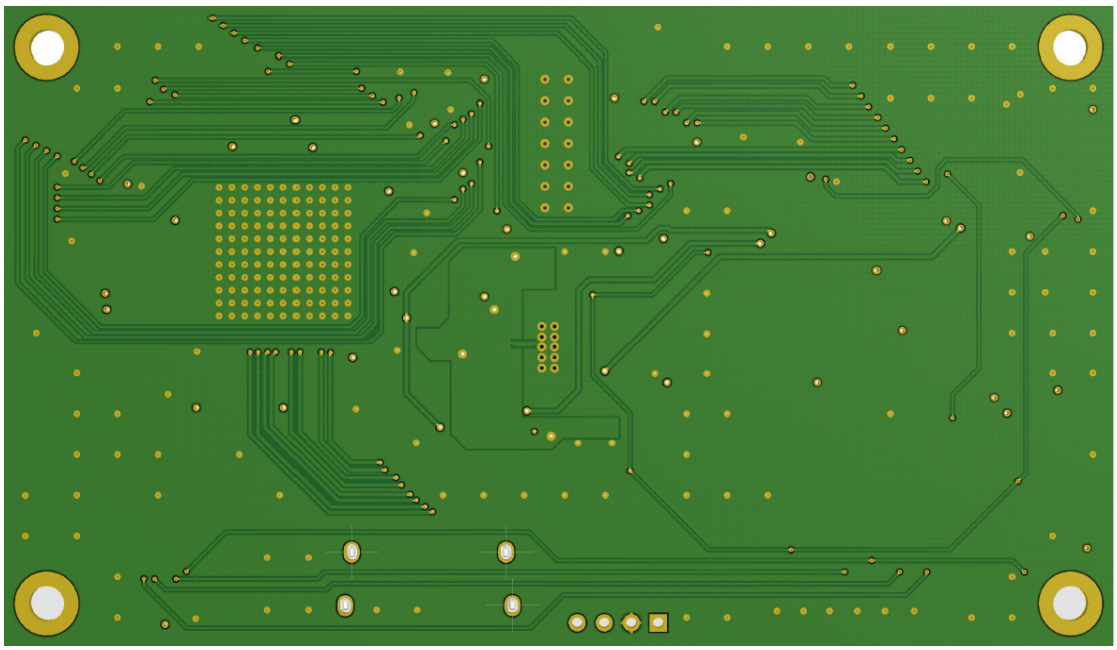
12.1 SEA0010 Top View



12.2 SEA0010 Bottom View