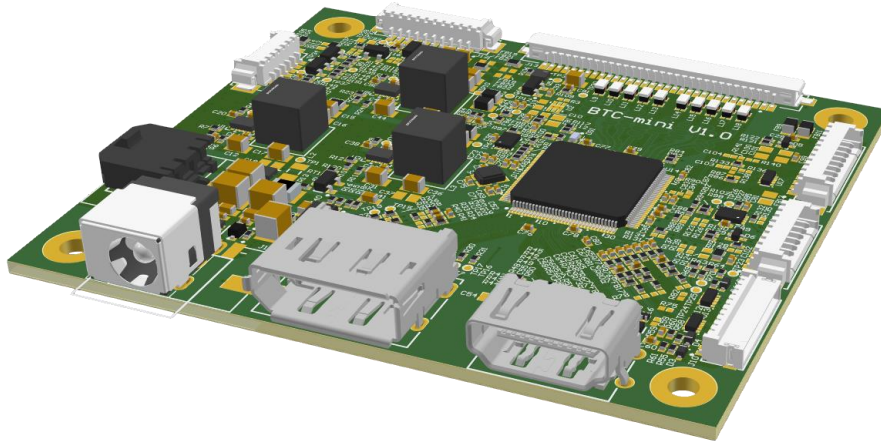


# BTC-mini

(DisplayPort, HDMI and RGB TFT-LCD Controller)

## Product Specification



### Product Specification Status

- Preliminary
- Final

This specification is subject to legal disclaimers.

## 1. Product Overview

This DisplayPort, HDMI and analog RGB to LVDS converter board accepts common video signals. DisplayPort 1.2 HDMI 1.4a and all backward compatible signals are supported as well as analog RGB. It generates all necessary control signals and panel data to drive TFT-LCDs with VDD levels 3.3V, 5V or 12V. This TFT-controller board supports resolutions up to 1920x1200 (WUXGA) at a vertical refresh rate up to 60Hz. The user interface includes backlight, brightness, contrast, etc. adjustment by on-screen programming. For automatic backlight adjustment an ambient light sensor is supported. Several OSD functions can be managed via embedded I<sup>2</sup>C-interface or DDC/CI.

This board is available in different assembly configurations.

## 2. Features

### General

- Support up to 1920x1200 (WUXGA) resolution @ 60Hz
- DDC/CI support by embedded DDC I<sup>2</sup>C-bus interface
- I<sup>2</sup>C-slave interface for display control
- Panel usage timer
- On-board status LED

### Power Management

- Input voltage from 12V to 32V
- Reverse voltage protection
- TFT panel power supply of 3.3V, 5V or 12V
- Backlight power supply 5V, 12V or 24V

### DisplayPort 1.2 Digital Input Interface

- High-Bandwidth Digital Content Protection (HDCP v1.4) support
- Supports 6-bit, 8-bit, 10-bit, and 12-bit color depth transport

### HDMI 1.4a Compliant Digital Input Interface

- Single link on-chip TMDS receiver up to 225MHz
- High-Bandwidth Digital Content Protection (HDCP v1.4) support
- Supports DVI 1.0

### Analog RGB Input Interface

- Supports Sync-On-Green (SOG) and various kinds of composite sync modes
- YPbPr support up to 1080p

### Auto Detection / Calibration

- Input format detection
- Compatibility with standard VESA Mode
- Smart engine for phase / image position / color calibration

### Scaling

- Fully programmable zoom ratios
- Independent horizontal/vertical scaling
- Advanced zoom algorithm provides high image quality
- Sharpness/Smooth filter enhancement
- Support non-linear scaling from 4:3 to 16:9 or 16:9 to 4:3

### Color Processor

- True 10-bit color processing engine
- sRGB compliance

### Output Interface

- Dual-LVDS 24-bit output interface
- Spread-Spectrum DPLL to reduce EMI

- Support VESA and JEIDA mapping

#### On Screen Display menu

- Backlight dimming
- Color adjustments
- Several other settings

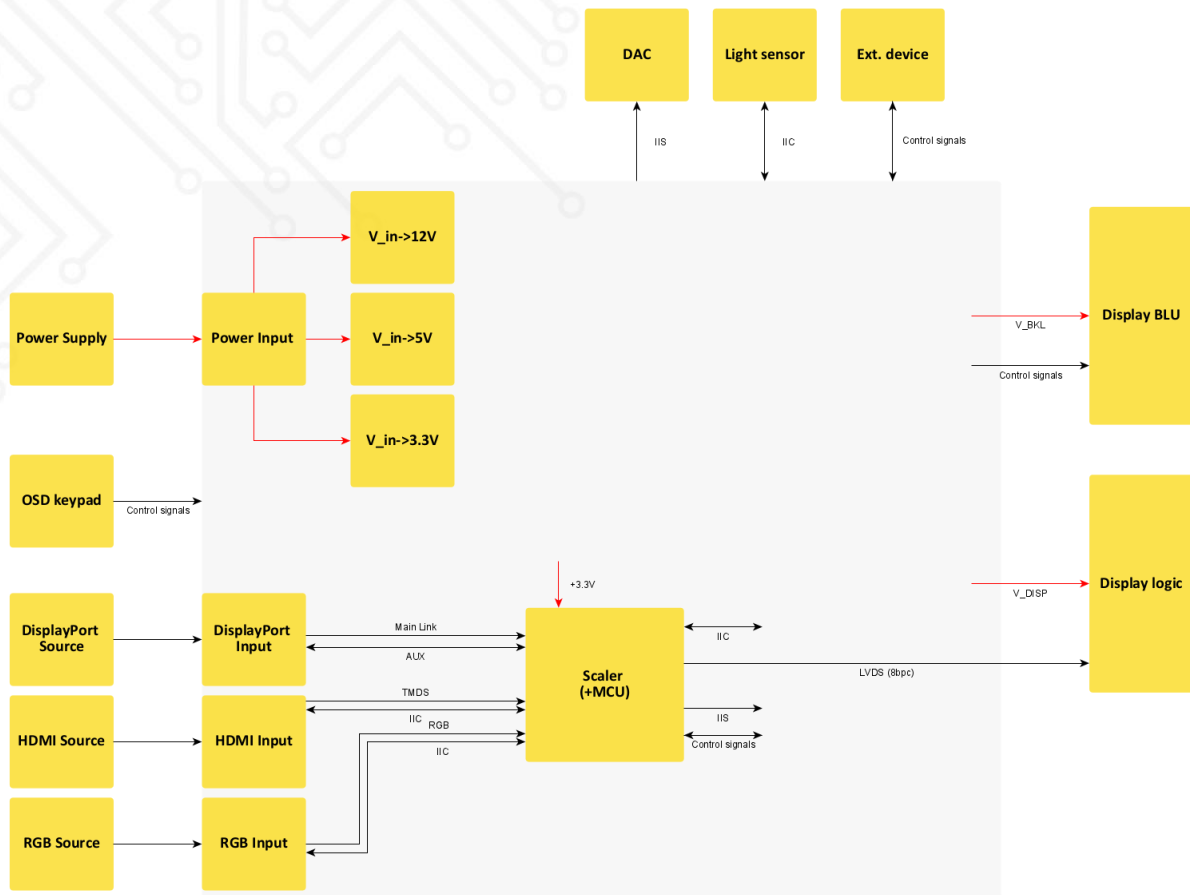
#### Audio

- I<sup>2</sup>S 8-channel support
- Embedded Audio DAC

#### Environmental

- ✓RoHS
- ✓REACH

### 3. Functional Diagram



**Fig 1. System Diagram**

## 4. Typical Application

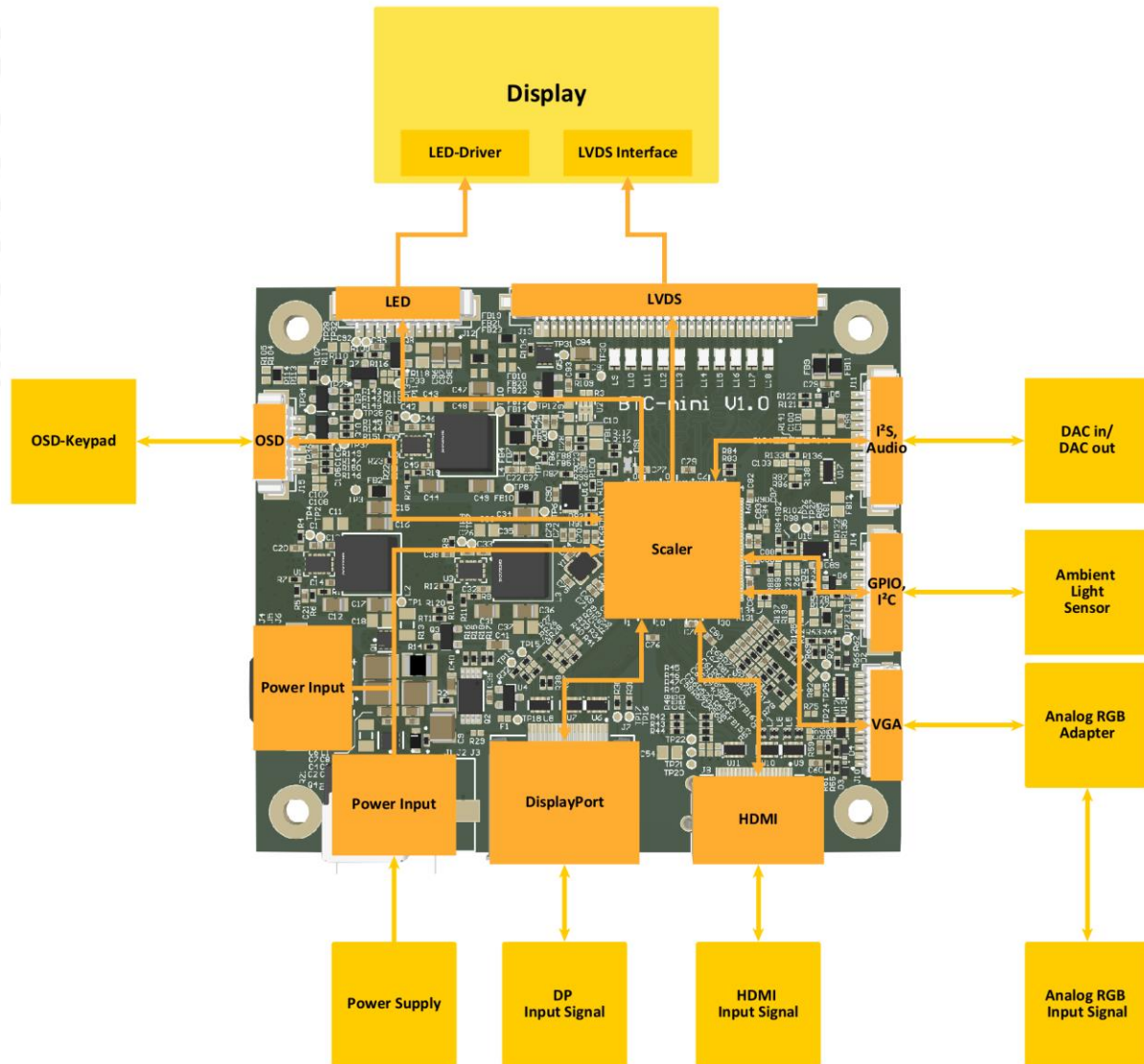


Fig 2. Application of BTC-mini

## 5. Electrical Characteristics

All ratings @  $V_{DD} = 12.0V$ ,  $\theta = 25^{\circ}C$ , Var. STD, and voltages referenced to GND, unless otherwise noted.

### a. Input

**Table 1. Electrical Input Characteristics**

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
$V_{DD}$	Operating Supply Voltage <sup>1</sup>	Var. STD	10.8	12.0/ 13.5V- 32.0V	32.0	V DC
		Var. Lite-12V	10.8	12.0	13.2	V DC
		Var. Lite-24V	15.0	24.0	32.0	V DC
$V_{DDmax}$	Absolute Max. Rating <sup>2</sup>	Var. STD	-36	-	36	V DC
		Var. Lite-12V	-0.3	-	38	V DC
		Var. Lite-24V	-0.3	-	38	V DC
$I_{DD}$	Current Consumption <sup>3</sup>	Board Only (active mode)	47	60	104	mA
		Board Only (sleep mode)	6	7	8	mA
		With WVGA Display <sup>4</sup>	0.17	0.26	0.39	A
		With XGA Display <sup>5</sup>	0.25	0.55	0.88	A
		With FHD Display <sup>6</sup>	0.32	0.6	0.83	A
$P_{DD}$	Power Consumption	Active mode	0.56	0.72	1.25	W

### b. Output

#### DC Characteristics

**Table 2. Electrical Output Characteristics**

Symbol	Parameter	Test conditions	Min	Typ	Max	Unit
$V_{Panel}$	Display Supply Voltage	3.3V configuration	3.0	3.3	3.6	V DC
		5V configuration	4.5	5	5.5	V DC

<sup>1</sup> In Var. STD: Avoid permanent voltages which are others than "Typ"-values.

<sup>2</sup> Consider ratings of connected parts

<sup>3</sup> Current consumption depends on the board's variant & firmware

<sup>4</sup> Test was performed with InnoLux G070Y2-L01 Rev. C6 (WVGA, 500cd/m<sup>2</sup>). Backlight PWM duty ratio min: 10%

<sup>5</sup> Test was performed with InnoLux G150XNE-L01 (XGA, 500cd/m<sup>2</sup>). Backlight PWM duty ratio min: 5%

<sup>6</sup> Test was performed with AUO G215HVN01.0 (FHD, 300cd/m<sup>2</sup>). Backlight PWM duty ratio min: 10%

		12V configuration	10.8	12	13.2	V DC
$I_{Panel}$	Display Supply Current	-	-	-	2.5	A
$V_{BKL}$	Backlight Supply Voltage	5V configuration	4.5	5	5.5	V DC
		12V configuration	10.8	12	13.2	V DC
		$V_{DD}$ configuration	-	$V_{DD}$	-	V DC
$I_{BKL}$	Backlight Supply Current	$V_{DD}$ configuration	-	-	3	A
$V_{BKL\_EN}$	Backlight Enable Voltage	3.3V configuration	3.0	3.3	3.6	V DC
		5V configuration	4.5	5	5.5	V DC
$V_{BKL\_ADJ}$	Backlight Adjust Voltage	3.3V configuration	3.0	3.3	3.6	V DC
		5V configuration	4.5	5	5.5	V DC
$f_{BKL\_ADJ}^7$	Backlight Adjust Frequency	PWM configuration	160	200	20k	Hz
$D_{BKL\_ADJ}$	Backlight Adjust Duty Cycle	PWM configuration	0	-	100	%

### Panel Power Sequencing

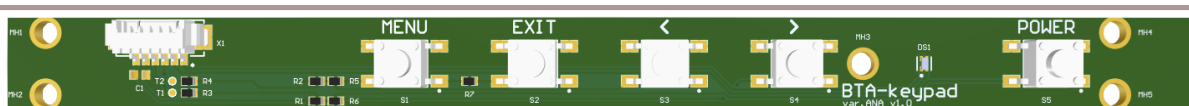
BTC-mini follows a special sequence to power up display- and backlight-VCC. This timing is set in the F/W.

## 6. OSD (On-Screen Display)

The user-friendly, intuitive controllable integrated OSD menu provides certain functions to change settings, adjust the image and others. It can be controlled by an OSD-keyboard. The status of the LCD controller can be checked by a LED which is integrated on the keyboard.

### a. OSD-Keyboard

A 5-button OSD-keyboard with one LED on it to show the board's status is connectable.



**Fig 3. OSD-keyboard**

#### Buttons

The function of each OSD key is shown in the following table.

**Table 3. OSD keyboard functions**

No.	Button	Switch Function	Hot-Key Function
1	Menu	1. Open OSD sub menu 2. Save changes and exit	Open OSD main menu

<sup>7</sup> Analog inverse output by hardware configuration.

2	Exit	Discard changes and exit	-
3	Left	1. Move left in menu list 2. Decrease the value of selected item	Show signal info
4	Right	1. Move right in menu list 2. Increase the value of selected item	Input select
5	Power	Turn power on / off	-

## LED

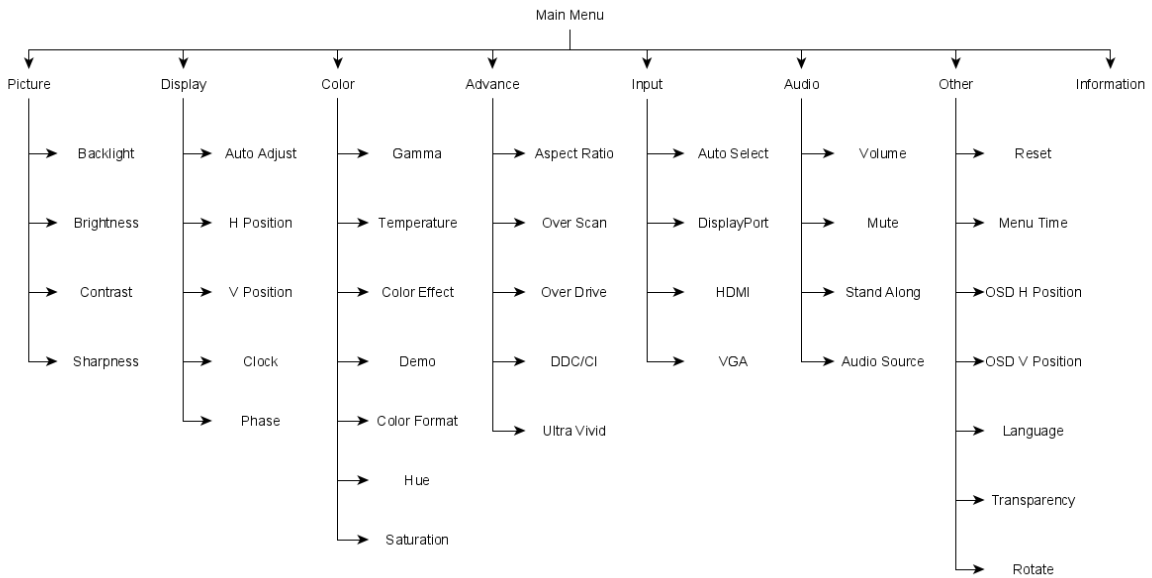
LED colors and their meanings are described in the table below.

**Table 4. OSD-keyboard LED status lights**

LED Color	Status	Represents
Green	Constant	Normal state
Amber	Constant	Searching signal
Red	Constant	Power saving

## b. OSD-menu

### Menu Structure



**Fig 4. OSD-menu structure**



## Menu Items

**Table 5. OSD: Menu Items**

Title	Function
Picture	Adjust image settings
Display	Adjust image position
Color	Adjust color settings
Advance	Advanced settings
Input	Input source selection
Audio	Audio settings
Other	Adjust the On-Screen-Display settings
Information	Information about current timing

### Main-Menu: Picture

**Table 6. OSD: Main-Menu Picture**

Title	Function
Backlight	Adjust the backlight-intensity
Brightness	Adjust the brightness of the image
Contrast	Adjust the contrast of the image
Sharpness	Adjust the sharpness of the image

### Main-Menu: Display<sup>8</sup>

**Table 7. OSD: Main-Menu Display**

Title	Function
Auto Adjust	Input format detection, phase/image position adjustment
H Position	Adjust horizontal position of the image
V Position	Adjust vertical position of the image
Clock	Adjust clock
Phase	Adjust phase

### Main-Menu: Color

**Table 8. OSD: Main-Menu Color**

Title	Function
Gamma	Adjust gamma level of the image
Temperature	Adjust the color temperature
Color Effect	Select a color effect
Demo	Select a mode to check hue and saturation settings
Color Format	Select the color model
Hue	Adjust the color balance
Saturation	Adjust the color intensity

### Sub-Menu: Temperature - User

**Table 9. OSD: Sub-Menu: Temperature - User**

Title	Function
R	Adjust red video gain
G	Adjust green video gain
B	Adjust blue video gain

<sup>8</sup> Available for analog RGB

Sub-Menu: Color Effect - User

**Table 10. OSD: Sub-Menu: Color Effect - User**

Title	Function
Hue	Adjust hue of respective 6-axis color
Saturation	Adjust saturation of respective 6-axis color

Main-Menu: Advance

**Table 11. OSD: Main-Menu Advance**

Title	Function
Aspect Ratio	Select aspect ratio or scaling factor of the image
Over Scan	Enable / Disable overscan function
Over Drive	Enable / Disable overdrive function
DDC/CI	Enable / Disable DDC/CI function
Ultra Vivid	Select grades of Ultra Vivid color mode

Main-Menu: Input

**Table 12. OSD: Main-Menu Input**

Title	Function
Auto Select	Select first available input signal
DisplayPort	DisplayPort fixed
HDMI	HDMI fixed
RGB	RGB fixed

Main-Menu: Audio<sup>9</sup>

**Table 13. OSD: Main-Menu Audio**

Title	Function
Volume	Adjust audio volume

Mute	Mute audio output
Stand Along	Enable / Disable standby audio
Audio Source	Select audio source

Main-Menu: Other

**Table 14. OSD: Main-Menu Other**

Title	Function
Reset	Reset all OSD settings
Menu Time	Set the OSD duration [s]
OSD Position H	Set the horizontal position of OSD menu
OSD Position V	Set the vertical position of OSD menu
Language	Select OSD menu language
Transparency	Adjust the transparency of the OSD menu
Rotate	Rotate OSD by 0°, 90° or 270°

Main-Menu: Information

**Table 15. OSD: Main-Menu Information**

Title	Function
Signal source	Show current signal source
Current resolution	Show resolution of input signal
H- & V-frequency	Show horizontal and vertical frequency
Pixel clock frequency	Show pixel clock frequency
Board model	Board model
Firmware name	Firmware name
Firmware version	Firmware version

<sup>9</sup> Only for analog audio output.

## 7. Interfaces

### a. LVDS Interface

At the LVDS-Interface, single- and dual-channel LVDS is supported in either 6- or 8-bit configuration. As the board is delivered pre-configured, no changes have to be made to the settings. Pixel clocks up to 93MHz in single-channel LVDS and 186MHz in dual-channel LVDS configuration, and therefore resolutions up to WUXGA (1920x1200) @ 60Hz are supported.

#### Settings

In order to achieve reliable communication when using longer cables, pre-emphasis may be applied to the LVDS signal lines. On the other hand, the spread spectrum function can enhance the behavior in an EMI sensitive environment.

#### Mapping

6-bit and 8-bit per color (18-bit or 24-bit color depth) VESA- and JEIDA-mappings are supported at the LVDS-interface. The bit numbering of pixels is big endian, where the most significant bit has the largest bit number.

**Table 16. LVDS Bit Number Mappings**

VESA		JEIDA	
6-bit	8-bit	6-bit	8-bit
5	7	5	5
4	6	4	4
3	5	3	3
2	4	2	2
1	3	1	1
0	2	0	0
	1		7
	0		6

The following tables are identical for odd and even lines.

**Table 17. VESA Data Packing**

LVDS Data Line	Bit position						
	6	5	4	3	2	1	0
D 0	G0	R5	R4	R3	R2	R1	R0
D 1	B1	B0	G5	G4	G3	G2	G1
D 2	DE	VS	HS	B5	B4	B3	B2
D 3 (for 8-bit)	-	B7	B6	G7	G6	R7	R6

**Table 18. JEIDA Data Packing**

LVDS Data Line	Bit position						
	6	5	4	3	2	1	0
D 0	G2	R7	R6	R5	R4	R3	R2
D 1	B3	B2	G7	G6	G5	G4	G3
D 2	DE	VS	HS	B7	B6	B5	B4
D 3 (for 8-bit)	-	B1	B0	G1	G0	R1	R0

## b. I<sup>2</sup>C Interface

BTC-mini can control various slave devices via a general purpose I<sup>2</sup>C-bus interface. Also BTC-mini can act as slave device and receive display configuration settings. For further information about I<sup>2</sup>C usage, please contact your local sales partner.

### Ambient Light Sensor

BTC-mini can control an ambient light sensor via an I<sup>2</sup>C-bus or SMBus interface. Various light sensors are supported which are Plug & Play ready (e.g. TI OPT3001) and therefore do not require additional modifications.

### Audio Amplifier

BTC-mini can control an external audio amplifier with I<sup>2</sup>C-bus or SMBus interface connected to the Audio Connector (J11).

## Electrical Characteristics

### DC Characteristics

**Table 19. I<sup>2</sup>C Interface DC Characteristics**

Symbol	Characteristic	Test conditions	Min	Typ	Max	Unit
V <sub>CC</sub>	I <sup>2</sup> C-bus operating voltage (internal pull-up)	3.3V configuration	3.0	3.3	3.6	V
V <sub>IH</sub>	High-level input voltage	-	0.7 V <sub>CC</sub>	-	-	V
V <sub>IL</sub>	Low-Level input voltage	-	-	-	0.3V <sub>CC</sub>	V

### AC Characteristics

**Table 20. I<sup>2</sup>C Interface AC Characteristics**

Symbol	Characteristic	Min	Typ	Max	Unit
f <sub>CLK</sub>	Clock Frequency	-	100	400	kHz
t <sub>HIGH</sub>	Clock high time	600	-	-	ns
t <sub>LOW</sub>	Clock low time	1300	-	-	ns

## Operations

In general, the I<sup>2</sup>C-bus operations must follow the I<sup>2</sup>C-bus standard.

### Write

A write operation looks the following way:

Start	Device Address	Write	Ack	Word Address	Ack	Data	Ack	Stop
-------	----------------	-------	-----	--------------	-----	------	-----	------

### Read

A random read operation looks the following way:

Start	Device Address	Write	Ack	Word Address(n)	Ack	Start	Device Address	Read	Ack	Data(n)	No Ack	Stop
-------	----------------	-------	-----	-----------------	-----	-------	----------------	------	-----	---------	--------	------

### c. I<sup>2</sup>S Interface

BTC-mini has an I<sup>2</sup>S interface to handle and forward audio data. This 3-line serial bus consisting of a line for two time-multiplexed data channels (SD), a word select line (WS) and a clock line (SCK), follows the I<sup>2</sup>S-bus specification.

This controller can only act as master and generates the bit clock, word-select signal, and data.

Sampling frequencies of 32kHz to 192kHz are supported.

### d. DDC

This LCD controller provides a serial communications link between the video adapter and the controller, the DDC (Display Data Channel). Properties such as maximum resolution, color depth and supported video timing modes can be transmitted using DDC.

#### EDID

The BTC-mini controller board supports the Extended Display Identification Data (EDID 1.4) standard.

EDID contains basic information about a monitor and its capabilities, including vendor information, maximum image size, color characteristics, factory pre-set timings, frequency range limits, a character's string for the monitor name and serial number. The video adapter uses this information for configuration purposes, so that the monitor and system can work together.

#### DDC/CI

The display controller complies with the MCCS 2.2a standard. It supports a standard set of MCCS VCP codes to adjust the displayed image or control the display. Read and write commands are available for the following categories:

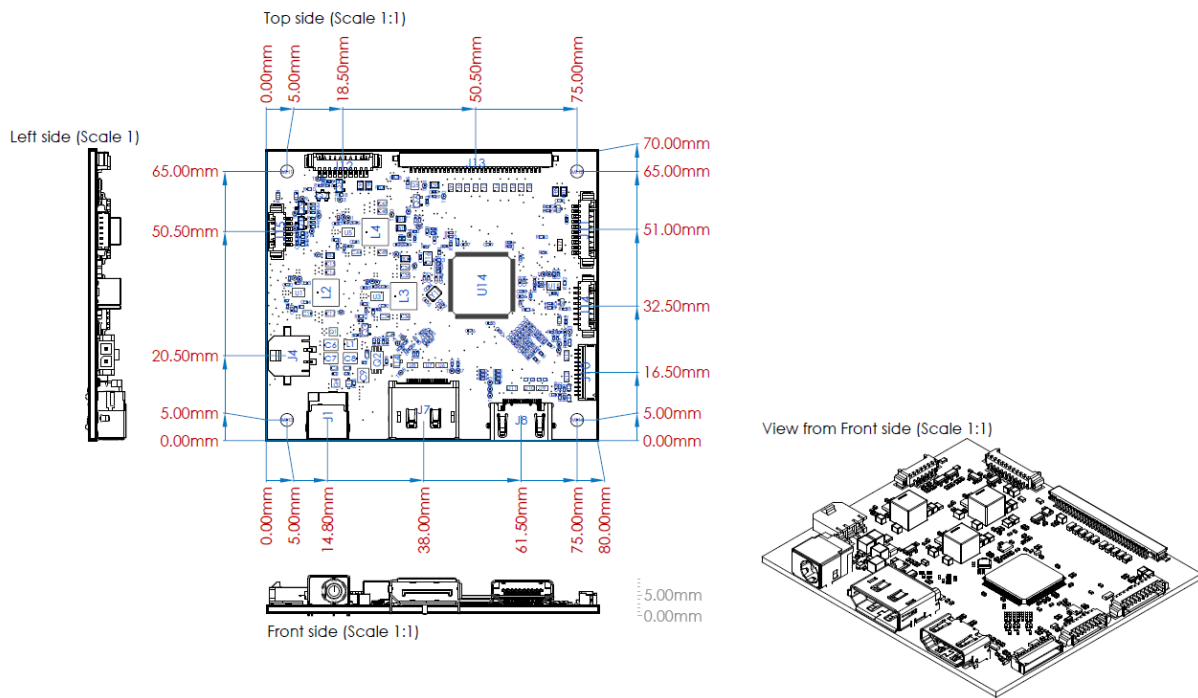
- Image Adjustments
- Color Adjustments
- Image Geometry Adjustments
- Audio Adjustments
- Window Operations
- DPVL Support

## 8. Mechanical Characteristics

2D- (e.g. DXF) & 3D- (e.g. STEP) files for easy product design-in available.

**Table 21. Mechanical Characteristics**

Parameter	Value
Dimensions (H x V)	80.0mm x 70.0mm
Total height (Var. STD)	9.8mm (Top: 7.3mm, PCB: 1.6mm, Bot: 0.9mm)
Contour	Rectangular
Production technology	SMT / THT
Mounting holes	3.2mm (Use M3 screws)
Weight	35g



**Fig 5. Outline**

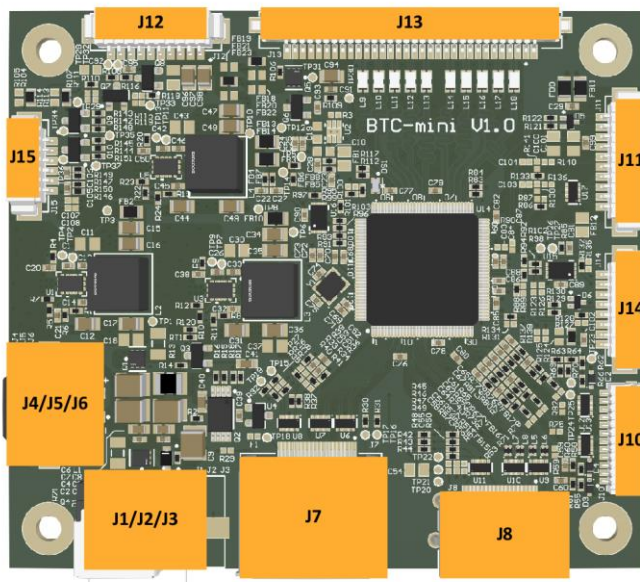
## 9. Connectors

Abbreviations used within this chapter are listed in the table below.

**Table 22. Signal Assignment Abbreviations**

Abbreviation	Description
GND	Ground
PWR	Power
I	Input
O	Output
I/O	Bi-directional
n.c.	Not connected (do not connect)

### a. Connector Overview



**Fig 6. Connector Overview**

## b. Input Connectors

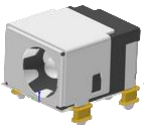
### Power Connectors

The board offers different connector configurations to be supplied with power. In standard configuration, Power Connector (J1) and Power Connector (J4) are assembled. The other types and combinations are available on request.

#### Power Connector (J1)

The Power Connector (J1) supplies the board with power. The connection is mandatory.

**Table 23. Power Connector (J1)**

	Parameter	Value
	Manufacturer: Connector model no.	CUI Devices: PJ-079BH <sup>10</sup>
	Pin amount	2 pins
	Mating housing part	DC Jack 2.5mm x 5.5mm

Note: 5A max

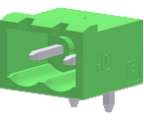
**Table 24. Power Connector (J1) Pin Assignment**

Pin	Signal	Description	Type
Inner	VIN	Power input	PWR
Outer	GND	Ground	GND

#### Power Connector (J2)

The Power Connector (J2) supplies the board with power. The connection is mandatory.

**Table 25. Power Connector (J2)**

	Parameter	Value
	Manufacturer: Connector model no.	Phoenix Contact: 1923759
	Pin amount	2 pins (use Pin 1 as marked on connector)
	Mating housing part	Phoenix Contact: 1911855

Note: 16A max

**Table 26. Power Connector (J2) Pin Assignment**

Pin	Signal	Description	Type
1	GND	Ground	GND
2	VIN	Power input	PWR

#### Power Connector (J3)


The Power Connector (J3) supplies the board with power. The connection is mandatory.

**Table 27. Power Connector (J3)**

Parameter	Value

<sup>10</sup> Mechanically highest part in var. STD



	Manufacturer: Connector model no.	Molex: 43650-0212
	Pin amount	2 pins (use Pin 1 as marked on connector)
	Mating housing part	Molex: 43645-0200

Note: 8.5A max


**Table 28. Power Connector (J3) Pin Assignment**

Pin	Signal	Description	Type
1	GND	Ground	GND
2	VIN	Power input	PWR

Power Connector (J4)

The Power Connector (J4) supplies the board with power. The connection is mandatory.

**Table 29. Power Connector (J4)**

	<b>Parameter</b>	<b>Value</b>
	Manufacturer: Connector model no.	Molex: 43650-0212
	Pin amount	2 pins (use Pin 1 as marked on connector)
	Mating housing part	Molex: 43645-0200

Note: 8.5A max


**Table 30. Power Connector (J4) Pin Assignment**

Pin	Signal	Description	Type
1	GND	Ground	GND
2	VIN	Power input	PWR

Power Connector (J5)

The Power Connector (J5) supplies the board with power. The connection is mandatory.

**Table 31. Power Connector (J5)**

	<b>Parameter</b>	<b>Value</b>
	Manufacturer: Connector model no.	Molex: 43650-0225
	Pin amount	2 pins (use Pin 1 as marked on connector)
	Mating housing part	Molex: 43645-0200

Note: 8.5A max


**Table 32. Power Connector (J5) Pin Assignment**

Pin	Signal	Description	Type
1	GND	Ground	GND
2	VIN	Power input	PWR

Power Connector (J6)

The Power Connector (J6) supplies the board with power. The connection is mandatory.

**Table 33. Power Connector (J6)**

	Parameter	Value
	Manufacturer: Connector model no.	Phoenix contact: 1727010-02
	Pin amount	2 pins (use Pin 1 as marked on PCB)
	Mating housing part	Conductor 1.5mm <sup>2</sup> / AWG26

Note: 13.5A max

**Table 34. Power Connector (J6) Pin Assignment**

Pin	Signal	Description	Type
1	VIN	Power input	PWR
2	GND	Ground	GND


### Video Input

The board has different connectors to connect a source, which provides the video signal. In standard configuration all video connectors are assembled.

#### DisplayPort Connector (J7)

The DisplayPort Connector (J7) can be used to provide a digital video signal to the board. The connection is mandatory.

**Table 35. DisplayPort Connector (J7)**

	Parameter	Value
	Manufacturer: Connector model no.	Standard DisplayPort receptacle
	Pin amount	20 pins
	Mating housing part	Standard DisplayPort plug

**Table 36. DisplayPort Connector (J7) Pin Assignment**


Pin	Signal	Description	Type
1	ML_Lane 3 (n)	Main-Link lane 3-	I
2	GND	Ground	GND
3	ML_Lane 3 (p)	Main-Link lane 3+	I
4	ML_Lane 2 (n)	Main-Link lane 2-	I
5	GND	Ground	GND
6	ML_Lane 2 (p)	Main-Link lane 2+	I
7	ML_Lane 1 (n)	Main-Link lane 1-	I
8	GND	Ground	GND
9	ML_Lane 1 (p)	Main-Link lane 1+	I
10	ML_Lane 0 (n)	Main-Link lane 0-	I
11	GND	Ground	GND
12	ML_Lane 0 (p)	Main-Link lane 0+	I
13	Config 1	-	-
14	Config 2	-	-
15	AUX CH (p)	AUX-CH+	I/O
16	GND	Ground	GND

17	AUX CH (n)	AUX-CH-	I/O
18	HPD	Hot-plug detect	0
19	PWR Return (GND)	Ground	GND
20	PWR (3.3V)	Power	PWR

HDMI connector (J8)

The HDMI connector (J8) can be used to provide a digital video signal to the board. The connection is mandatory.

**Table 37. HDMI connector (J8)**

	Parameter	Value
	Manufacturer: Connector model no.	Standard HDMI Type A (Single Link) receptacle
	Pin amount	19 pins
	Mating housing part	Standard HDMI Type A (Single Link) plug

Note: HDMI receptacle with flange available.

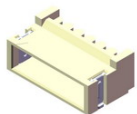
**Table 38. HDMI connector (J8) Pin Assignment**

Pin	Signal	Description	Type
1	D2+	T.M.D.S. Data2+	I
2	GND	T.M.D.S. Data2 shield	GND
3	D2-	T.M.D.S. Data2-	I
4	D1+	T.M.D.S. Data1+	I
5	GND	T.M.D.S. Data1 shield	GND
6	D1-	T.M.D.S. Data1-	I
7	D0+	T.M.D.S. Data0+	I
8	GND	T.M.D.S. Data0 shield	GND
9	D0-	T.M.D.S. Data0-	I
10	RXC+	T.M.D.S. Clock+	I
11	GND	T.M.D.S. Clock shield	GND
12	RXC-	T.M.D.S. Clock-	I
13	n.c.	-	n.c.
14	n.c.	-	n.c.
15	SCL	DDC Clock	I/O
16	SDA	DDC Data	I/O
17	GND	DDC/CEC Ground	GND
18	VCC	+5V Power	PWR
19	HPD	Hot-plug detect	0

RGB connector (J10)

The RGB connector (J10) can be used to provide an analog RGB signal to the board. The connection is mandatory.

**Table 39. RGB connector (J10)**

	Parameter	Value
	Manufacturer: Connector model no.	CviLux: C11412M1HRL-NH
	Pin amount	12 pins (use Pin 1 as marked on connector)
	Mating housing part	CviLux: C11412SL000-NH


**Table 40. RGB connector (J10) Pin Assignment**

Pin	Signal	Description	Type
1	AVS	Vertical sync	I
2	AHS	Horizontal sync	I
3	GND	Ground	GND
4	B- / Pb-	Blue ground / Pb-	I
5	B+ / Pb+	Blue signal / Pb+	I
6	G- / Y-	Green ground / Y-	I
7	G+ / Y+	Green signal / Y+	I
8	R- / Pr-	Red ground / Pr-	I
9	R+ / Pr+	Red signal / Pr+	I
10	GND	Ground	GND
11	SCL	DDC clock	I/O
12	SDA	DDC data	I/O

### OSD Interface Connector (J15)

The OSD Interface Connector (J15) can be used for different purposes. An OSD-keyboard can be connected by this interface. The connection is optional.

**Table 41. OSD Interface Connector (J15)**

	Parameter	Value
	Manufacturer: Connector model no.	Molex: 53261-0671
	Pin amount	6 pins (use Pin 1 as marked on connector)
	Mating housing part	Molex: 51021-0600

Note: Max 1A per contact

**Table 42. OSD Interface Connector (J15) Pin Assignment**


Pin	Signal	Description	Type
1	LED_GN	LED Green	O
2	LED_RD	LED Red	O
3	KEY1	Keypad Input 1	I
4	KEY2	Keypad Input 2	I
5	GND	Ground	GND
6	3.3V	Power	O

### c. Output Connectors

#### LVDS Interface (J13)

The LVDS Interface (J13) is the video output interface. The connection is mandatory.

**Table 43. LVDS Interface (J13)**

	Parameter	Value
	Manufacturer: Connector model no.	JAE: FI-X30SSLA-HF
	Pin amount	30 pins (use Pin 1 as marked on connector)
	Mating housing part	JAE: FI-X30HL

Note: Max 1A per contact


**Table 44. LVDS Interface (J13) Pin Assignment**

Pin	Signal	Description	Type
1	GND	Ground	GND
2	TXE3+	Positive LVDS differential data output – Line 3 (even)	0
3	TXE3-	Negative LVDS differential data output – Line 3 (even)	0
4	TXECLK+	Positive LVDS differential data output (even)	0
5	TXECLK-	Negative LVDS differential data output (even)	0
6	TXE2+	Positive LVDS differential data output – Line 2 (even)	0
7	TXE2-	Negative LVDS differential data output – Line 2 (even)	0
8	TXE1+	Positive LVDS differential data output – Line 1 (even)	0
9	TXE1-	Negative LVDS differential data output – Line 1 (even)	0
10	TXE0+	Positive LVDS differential data output – Line 0 (even)	0
11	TXE0-	Negative LVDS differential data output – Line 0 (even)	0
12	GND	Ground	GND
13	TXO3+	Positive LVDS differential data output – Line 3 (odd)	0
14	TXO3-	Negative LVDS differential data output – Line 3 (odd)	0
15	TXOCLK+	Positive LVDS differential clock output (odd)	0
16	TXOCLK-	Negative LVDS differential clock output (odd)	0
17	TXO2+	Positive LVDS differential data output – Line 2 (odd)	0
18	TXO2-	Negative LVDS differential data output – Line 2 (odd)	0
19	TXO1+	Positive LVDS differential data output – Line 1 (odd)	0
20	TXO1-	Negative LVDS differential data output – Line 1 (odd)	0
21	TXO0+	Positive LVDS differential data output – Line 0 (odd)	0
22	TXO0-	Negative LVDS differential data output – Line 0 (odd)	0
23	GND	Ground	GND
24	GND	Ground	GND
25	GND	Ground	GND
26	V_PNL	Panel Power	0
27	V_PNL	Panel Power	0
28	V_PNL	Panel Power	0
29	V_PNL	Panel Power	0
30	V_PNL	Panel Power	0

#### Backlight Connector (J12)

The Backlight Connector (J12) is used to power backlight units. The connection is mandatory.

**Table 45. Backlight Connector (J12)**

	Parameter	Value
	Manufacturer: Connector model no.	Molex: 53261-1071
	Pin amount	10 pins (use Pin 1 as marked on connector)
	Mating housing part	Molex: 51021-1000

Note: Max 1A per contact


**Table 46. Backlight Connector (J12) Pin Assignment**

Pin	Signal	Description	Type
1	V_BKL	Backlight Power	0
2	V_BKL	Backlight Power	0
3	V_BKL	Backlight Power	0
4	V_BKL	Backlight Power	0
5	GND	Ground	GND
6	GND	Ground	GND
7	GND	Ground	GND
8	GND	Ground	GND
9	BKL_EN	Backlight Enable	0
10	BKL_ADJ	Backlight Adjust	0

### GPIO Connector (J14)

The GPIO Connector (J14) is used to attach external peripherals. The connection is optional.

**Table 47. GPIO Connector (J14)**

	Parameter	Value
	Manufacturer: Connector model no.	Molex: 53261-0871
	Pin amount	8 pins (use Pin 1 as marked on connector)
	Mating housing part	Molex: 51021-0800

Note: Max 1A per contact


**Table 48. GPIO Connector (J14) Pin Assignment**

Pin	Signal	Description	Type
1	V_OUT	Output Voltage (Typ. 3.3V)	0
2	GND	Ground	GND
3	ADC1 / GPIO	Analog to digital converter	I/O
4	ADC2 / GPIO	Analog to digital converter	I/O
5	SCL / RX / GPIO	I2C Clock / UART Receive / GPIO	I/O
6	SDA / TX / GPIO	I2C Data / UART Transmit / GPIO	I/O
7	PWM1 / GPIO	Pulse Width Modulation Output / GPIO	I/O
8	PWM2 / GPIO	Pulse Width Modulation Output / GPIO	I/O

### Audio Connector (J11)

The Audio Connector (J11) can be used to attach external audio periphery. A DAC might be connected by I<sup>2</sup>S. The connection is optional.

**Table 49. Audio Connector (J11)**

	Parameter	Value
	Manufacturer: Connector model no.	Molex: 53261-1071
	Pin amount	10 pins (use Pin 1 as marked on connector)
	Mating housing part	Molex: 51021-1000

Note: Max 1A per contact

**Table 50. Audio Connector (J11) Pin Assignment**

Pin	Signal	Description	Type
1	MCK	Master Clock	O
2	SCK	Serial Clock	O
3	WS	Word Select	O
4	SD0 / SPDIF0 / SOUT_L	Serial Data / SPDIFOUT	O
5	GND	Ground	GND
6	SOUT_R	Speaker out right	O
7	GND	Ground	GND
8	V_OUT	Output Voltage (Typ. 3.3V)	O
9	SCL	I2C Clock	I/O
10	SDA	I2C Data	I/O

## 10. Environmental Ratings

**Table 51. Environmental ratings**

Symbol	Test item	Min	Max	Unit
$\vartheta_{ST}$	Storage temperature	-20	70	°C
$\vartheta_{OP}$	Operating temperature <sup>11</sup>	0	60	°C

## 11. Absolute Maximum Ratings

**Table 52. Absolute maximum ratings**

Symbol	Test item	Min	Max	Unit
$\vartheta_{ST}$	Storage temperature	-35	70	°C
$\vartheta_{OP}$	Operating temperature	-10	65	°C

## 12. Application Information

### a. Operating Precautions

- Be sure to ground yourself before handling the controller board.
- Turn off power supply before inserting or disconnecting any connector.
- Spike noise causes maloperation of circuits. It should be lower than following voltage:  $\pm 200\text{mV}$  (over and under shoot voltage).
- This module has high frequency circuits. Sufficient suppression to the electromagnetic interference shall be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.

### b. General Cautions

- The responsibility for the applicability of customer specific products and use in a particular customer design is always within the authority of the customer.
- An important factor for each system integration is the thermal design. System designers might need to implement a passive or active cooling system in their specific design to keep the temperatures of all parts within the specification.
- Be careful of condensation at sudden temperature change. Condensation damages electrical contacted parts.
- When preparing a cable for a specific display, always refer to appropriate cable pin-out and display specification. Always check the signals before connecting the cable. Any incorrect pin connection may

<sup>11</sup> Phase- or clock-shift can appear between -10°C and 0°C



damage the display and the controller permanently.

- Take care of all the sensitive electronic components.
- Do not modify the module assembly.
- You must mount a module using its respective mounting holes and avoid any bend force during mounting.
- Be sure to check the board's status LED and do a reset in OSD if any problem occurs during operation.
- Should you need any technical help, please contact Beck GmbH & Co. Elektronik Bauelemente KG.

### c. Status LED

BTC-mini has an on-board LED which can be used to check the board's status without a display attached. More detailed information will be printed as on-screen-message on the display (if attached). LED colors and their meanings are described in the table below.

**Table 53. On-board LED status table**

LED Color	Represents	User Actions
Off	Incorrect power supply	Check power supply
Green	Normal state	n/a
Red	Input signal/cable error	Check cable and input signal

## 13. Ordering Information

This board is available in different configurations which can be selected as best suitable for your application. The predefined hardware configurations of are available. If another assembly configuration or special FW settings (e.g. default values, boot logo, etc.) suits your needs better, please contact Beck GmbH & Co. Elektronik Bauelemente KG for a customized configuration.

**Table 54. Variant selection table**

#	Var.	V <sub>IN</sub>	DisplayPort	HDMI	Analog RGB	Reverse voltage protection	GPIOs	Audio
1	STD	12V-32V	✓	✓	✓	✓	✓	✓
2	Lite, 24V	15-32V	✓	✓	×	×	×	×
3	Lite, 12V	12V	✓	✓	×	×	×	×

## 14. Packaging / Labels

### a. Part

#### Serial number

Serial number looks in general the following way:

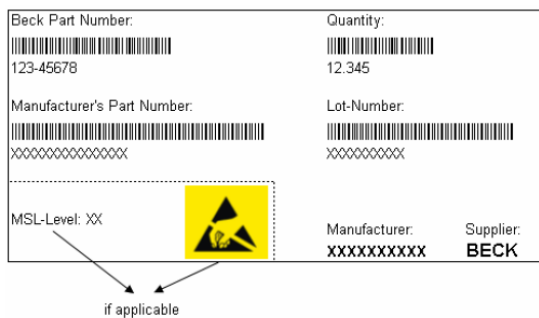
ABCN.NN-YYMMDDXXXX

**Table 55. S/N Encoding**

Code	Meaning
ABC	Acronym for the SMT producer
N.NN	Firmware version VN.NN
YYMMDD	Manufacturing date (YY/MM/DD)
XXXX	Manufacturing sequence of product

#### Label

Part label will look similar to the figure below.



**Fig 7. Part label**

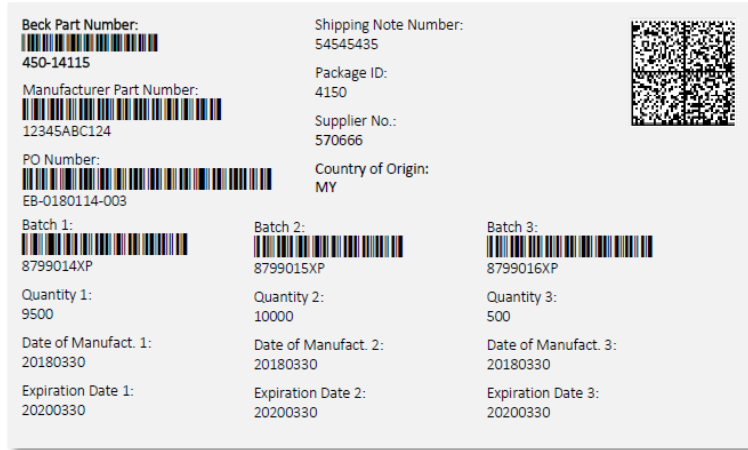
#### ESD bag

Each board will be packed in a conductive ESD bag.

### b. Packaging

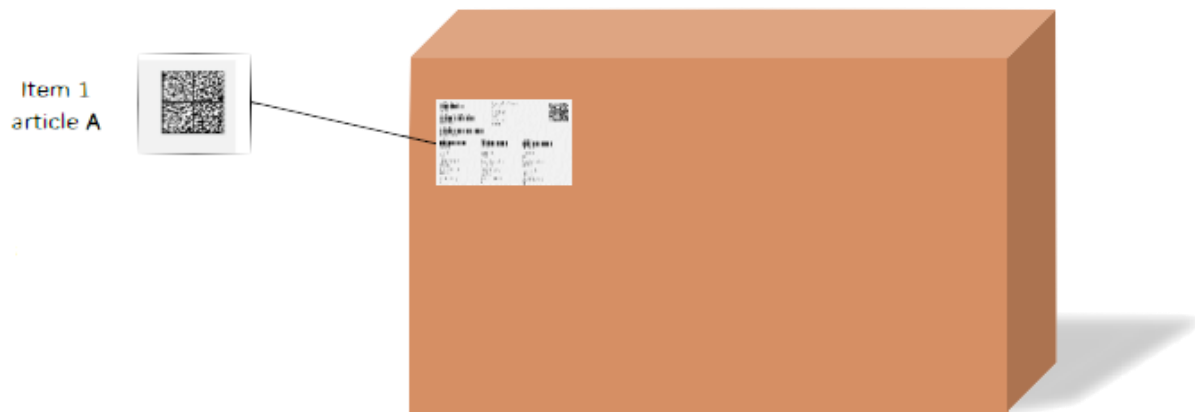
#### Label

The outer label will be similar to the figure below.



**Fig 8. Box label**

Box



**Fig 9. Carton**

**Table 56. Packaging details**

Name	Value
<b>Max capacity</b>	360 pcs per carton
<b>Max. weight</b>	14.0 kg per carton
<b>Outline dimension of carton</b>	530 mm x 350 mm x 300 mm

## 15. Abbreviations

**Table 57. Abbreviations**

<b>Abbr.</b>	<b>Description</b>
<b>ALS</b>	Ambient Light Sensor
<b>BLU</b>	Backlight Unit
<b>BPC</b>	Bits Per Color
<b>BPP</b>	Bits Per Pixel
<b>DAC</b>	Digital-to-analog Converter
<b>DDC</b>	Display Data Channel
<b>DDC/CI</b>	Display Data Channel Command Interface
<b>DDWG</b>	Digital Display Working Group
<b>DPLL</b>	Digital Phase-Locked Loop
<b>DPMS</b>	Display Power Management Service
<b>EDID</b>	Extended Display Identification Data
<b>EEPROM</b>	Electrically Erasable Programmable Read-Only Memory
<b>EMI</b>	Electromagnetic Interference
<b>ESD</b>	Electrostatic Discharge
<b>GND</b>	Ground
<b>HDCP</b>	High Digital Content Protection
<b>HDMI</b>	High Definition Multimedia Interface
<b>I<sup>2</sup>C</b>	Inter Integrated Circuit
<b>I<sup>2</sup>S</b>	Inter-IC Sound
<b>ISP</b>	In System Programming
<b>JEIDA</b>	Japan Electronic Industry Development Association
<b>LCD</b>	Liquid Crystal Display
<b>LED</b>	Light Emitting Diode
<b>LVDS</b>	Low Voltage Different Signaling
<b>MCCS</b>	Monitor Command Control Set
<b>OSD</b>	On Screen Display
<b>PCB</b>	Printed Circuit Board
<b>PCLK</b>	Pixel Clock

<b>PWM</b>	Pulse Width Modulation
<b>REACH</b>	Registration, Evaluation, Authorization and Restriction of Chemicals
<b>RGB</b>	Red, Green, Blue
<b>RoHS</b>	Restriction of Hazardous Substances
<b>SMBus</b>	System Management Bus
<b>SMT</b>	Surface Mounted Technology
<b>SOG</b>	Sync-On-Green
<b>sRGB</b>	Standard-RGB
<b>TMDS</b>	Transition-Minimized Different Signaling
<b>TFT</b>	Thin-Film Transistor
<b>VCP</b>	Virtual Control Panel
<b>VESA</b>	Video Electronics Standards Association

## 16. Revision History

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**Table 58. Revision History**

Rev.	Date	Section	Specification Status	Description
-	Mar 28 <sup>th</sup> , 2022	All	Final	Initial release

## 17. Legal Information

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### a. Disclaimers

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#### Limiting values

Stress above one or more limiting values (as defined in section Absolute maximum ratings) may cause permanent damage and irreversibly affect the quality and reliability of the device.

### b. Trademarks

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