Laser Beam Scanning Pico Projector module

Ver. 1.2.0   # CXN0102

Description

The CXN0102 is a laser beam scanning pico projector module. This pico projector module equipped with an independently-developed image processing system that uses laser beam scanning (LBS) to realize crisp, beautiful high-definition resolution and "focus-free" projection, regardless of the distance from the projection surface.

By combining this module with Wi-Fi components and a battery, it can realize a compact, pocket-sized projector which can be used to project images from products such as smartphones or tablets, focus-free and in even higher resolution, on any flat or curved surface such as a wall or desk.

Features

◆ HD resolution

   input: 1280x720P (60Hz)

   output: 1920x720 (60Hz, up-scaled aspect ratio 16:9)

◆ Wide color gamut

   Direct RGB Laser light source

◆ Focus free projection

◆ Low speckle

Module Size

Size   52.5mm(L) ×63mm(W)×7.2mm(T)
Weight   31g

Recommended Operating Conditions

Supply voltage	VBAT	3.7 (typ.)	V	one cell Li-ion battery
	VDD33	3.3 (typ.)	V	
	VDD18	1.8 (typ.)	V	
Operating temperature	Topr	0 to +40	˚C	environment
	Ths	0 to +60	˚C	temperature of the specified heat sink described as "Thermal Design".

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Block Diagram
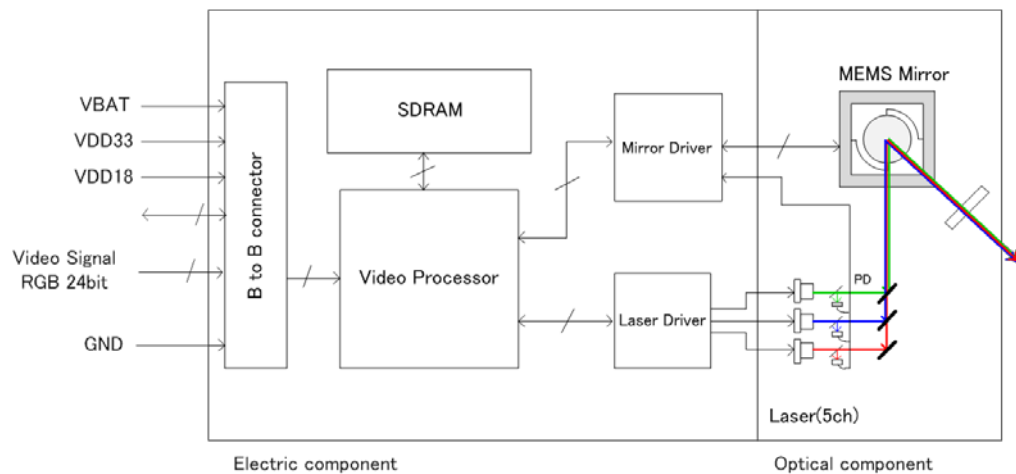
Module characteristics

1. Display Performance

item		condition	min	typ	max	unit	comment
Brightness		ANSI (9points)	27	32	37	lm	
Input resolution		-		1280×720 P		pix	
Output resolution		-		1920×720		pix	
Refresh Rate		-		60		Hz	
Color Depth		-		16.7M colors (R/G/B=8/8/8bit)		-	
Aspect ratio		-		16:9		-	
Horizontal FOV		-		42.1		deg	
Throw Ratio		-		1.3		-	
White Point		-		CCT=9300K, X=0.2831, Y=0.2971		-	
Sequential Contrast		full White / Black		80000:1		-	
Light Source	Red	-		639		nm	
	Green	-		522		nm	
	Blue	-		445		nm	
Color Gamut		reference NTSC			140	%	depend on color setting by Sony
Latency		-	1		2	frame	
Laser Safety Classification		-		Class-3R		-	IEC60825 Edition2

2. Electrical Characteristics

item	condition	min	typ	max	unit	comment
Video Interface	-		Digital RGB 24bit (8:8:8)		-	
Input video	-		720p (1280x720) 60Hz		-	
Control Interface	-		I2C (400kbit/s)		-	
Power consumption	30% white video		2.6		W	sum of VBAT(3.7V), VDD33(3.3V) and VDD18(1.8V), Ta=25 ˚C
				3.0	W	sum of VBAT(5.5V), VDD33(3.3V) and VDD18(1.98V), T_heat_sink=55 ˚C

Pin Description

Pin No	Symbol	Type	I/O	I/O standard	Description
1	V_HSYNC	DIGITAL	I		Video H-sync signal
2	V_VSYNC	DIGITAL	I		Video V-sync signal
3	V_DE	DIGITAL	I		Data Enable signal
4	V_VCLK	DIGITAL	I		Video Clock signal
7	V_RD_7	DIGITAL	I		
8	V_RD_3	DIGITAL	I		
9	V_RD_4	DIGITAL	I		
10	V_RD_2	DIGITAL	I		
11	V_RD_5	DIGITAL	I		
12	V_RD_1	DIGITAL	I		
13	V_RD_6	DIGITAL	I		
14	V_RD_0	DIGITAL	I		
17	V_GD_6	DIGITAL	I		
18	V_GD_5	DIGITAL	I	LVCMOS	
19	V_GD_7	DIGITAL	I	1.8V	
20	V_GD_4	DIGITAL	I		Input Video signal
21	V_GD_3	DIGITAL	I		RGB 24bit
22	V_GD_0	DIGITAL	I		
23	V_GD_2	DIGITAL	I		
24	V_GD_1	DIGITAL	I		
27	V_BD_6	DIGITAL	I		
28	V_BD_0	DIGITAL	I		
29	V_BD_7	DIGITAL	I		
30	V_BD_5	DIGITAL	I		
31	V_BD_4	DIGITAL	I		
32	V_BD_1	DIGITAL	I		
33	V_BD_3	DIGITAL	I		
34	V_BD_2	DIGITAL	I		
37	UART_TX	DIGITAL	O	LVCMOS	Debug Port
38	UART_RX	DIGITAL	I	3.3V	
39	SYSERR_X	DIGITAL	O	LVCMOS 1.8V	System Error Signal
40	NC	-	-	-	
41	I2C_SDA	DIGITAL	I/O		Module control I2C Data
42	I2C_SCL	DIGITAL	I	LVCMOS	Module control I2C Clock
43	EN	DIGITAL	I	1.8V	Module Enable signal
44	COM_REQ	DIGITAL	O		FW command request signal
45	VDD33	Supply	I	-	3.3V power supply
46	VDD18	Supply	I	-	1.8V power supply
47, 49, 51, 53, 55, 57, 59	VBAT	Supply	I	-	Battery power supply
5, 6, 15, 16, 25, 26, 35, 36, 48, 50, 52, 54, 56, 58, 60	GND	Supply	I	-	GND

## Interface Descriptions

Host Control Interface

I2C

Fast Mode (up to 400Hz)

The CXN0102 has I2C interface which works as slave, the slave address is 0x77 (7bit). It conforms to the Philips I2C bus standard. The SCL line may be held low by the slave after receiving a byte to force the master into a wait state until the slave is ready for the next byte transfer, therefore the master should be support clock stretching feature described in the I2C bus specification. Both of the SDA and SCL lines have internal pull-up resistors (4.7 kΩ), so additional pull-up resistors are not necessary.

Parameter	Symbol	Min	Max	Units
SCL clock frequency	f_{SCL}	0	400	kHz
LOW period of the SCL clock	t_{LOW}	1.3	-	µs
HIGH period of the SCL clock	t_{HIGH}	0.6	-	µs
hold time for a repeated START condition	$t_{HD:STA}$	600	-	ns
set-up time for a repeated START condition	$t_{SU:STA}$	600	-	ns
data hold time	$t_{HD:DAT}$	0	-	ns
data set-up time	$t_{SU:DAT}$	-	100	ns
rise time of both SDA and SCL signals	t_r	20+0.1*Cb [1]	300	ns
fall time of both SDA and SCL signals	t_f	20+0.1*Cb [1]	300	ns
set-up time for STOP condition	$t_{SU:STO}$	600	-	ns
bus free time between a STOP and START condition	t_{BUF}	1.3	-	µs

[1] Cb= total capacitance of one bus line in pF
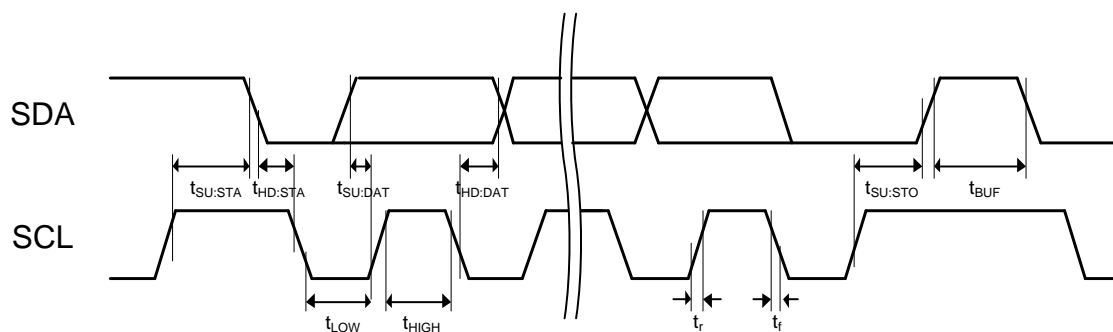
SYSERR_X

The SYSERR_X port is used to notify internal error to the host.

In normal operation it keeps high level (1.8V), and if some kind of error is detected it goes low level (0V).
In case of the error with SYSERR_X, it is required shut-down of power supplies and the system reboot.

SYSERR_X Timing Diagram
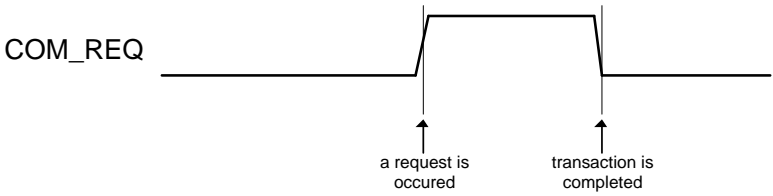
SYSERR_X

Normal operation | Error is detected
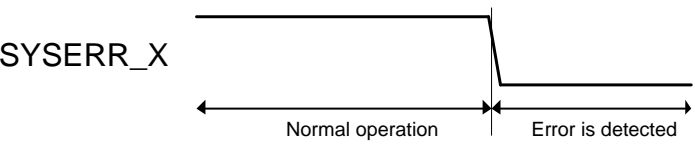
COM_REQ

The COM_REQ port is used for a command request signal from CXN0102 to the host.

When a request is sent to the host, it goes high level (1.8V) and keeps high level during transaction. It is de-asserted after completion of a transaction.

COM_REQ Timing Diagram

COM_REQ

a request is occured

transaction is completed

UART

The CXN0102 has a UART (Universal Asynchronous Receiver/Transmitter) interface. This is used for Sony maintenance and FW/Picture Data update. It is strongly recommended to place terminals on board to access from outside. In case of UART connected to controller devise, it is required to control UART_RX pin to GND level in shutdown state (all supply voltage at GND). In case of UART not connected to controller device, it is required to put pull-up resistor at high resistance value to UART_RX pin and the resistor is pulled up to 3.3V which is controlled to GND level in shutdown state (all supply voltage at GND).

The data format and baud rate are shown below:

Parameter	Value	Units
Data Bits	8	Bit
Stop Bits	1	Bit
Baud Rate	460800	bps
Parity Type	None	—
Flow Control	None	—

UART Data Format

Frame

D0 | D1 | D2 | D3 | D4 | D5 | D6 | D7

(LSB)   (MSB)

Start Bit | Data Bits (1byte) | Stop Bit
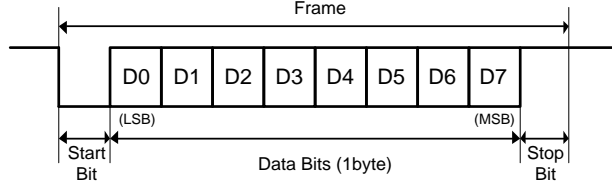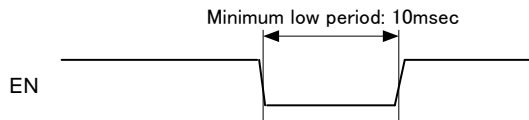
EN

Enable port is module enable signal, active high, asynchronous. Please refer to Power Supply Recommendation section.
The minimum low period is 10msec. It is required to shut down the CXN0102 using "Shut Down" command before disable (EN goes low).

Minimum low period: 10msec

EN

Video Interface

Video interface port receives video data from host system.

CEA-861-D

Video signals: 8bit RGB, SDR

V_RD_[7:0]   8-bit Video Data for Red Data

V_GD_[7:0]   8-bit Video Data for Green Data
V_BD_[7:0]   8-bit Video Data for Blue Data

Input video range: Limited (16-235)

Sync. Signals:
V-VSYNC
H-HSYNC

Data enable signal:
V_DE

Clock for video data:
V_VCLK   up to 148.5MHz

Pin Name	Parameter	Symbol	Min	Max	Unit	Note
Clock	Clock Cycle Width	tMCKW	6.734	—	ns	148.5MHz
	Clock duty factor	tMCKH	40	60	%	duty ratio in tMCKW
		tMCKL	40	60	%	duty ratio in tMCKW
	Clock Jitter	-	-4	4	%	Within ±4%
Data	Input Setup time to CLK	tMIS	2	—	ns	
	Input hold time from CLK	tMIH	2	—	ns	

Video Interface Timing Diagram

V_DE polarity: Positive

Synch signal polarity: Positive
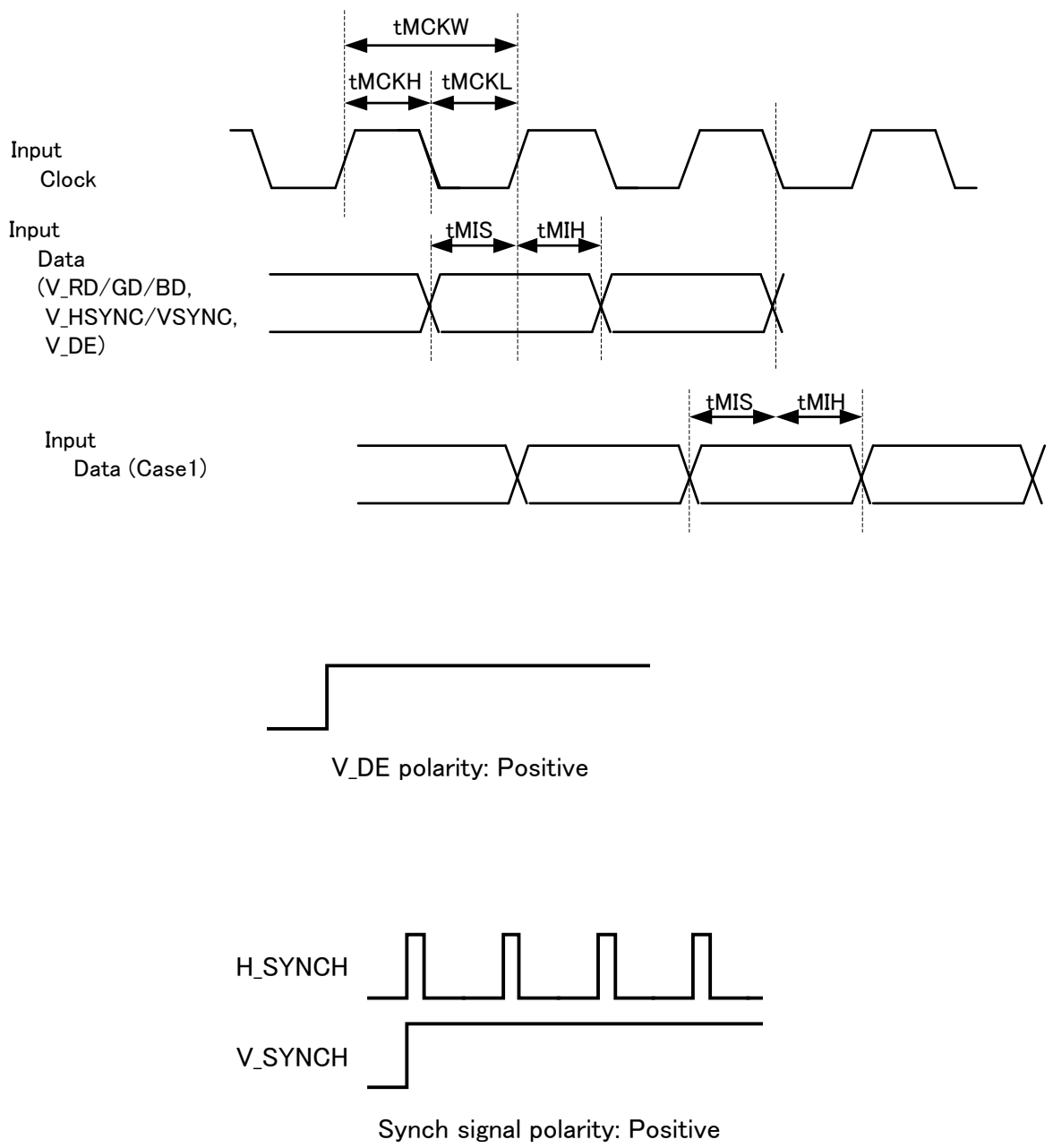
1280*720P 60Hz
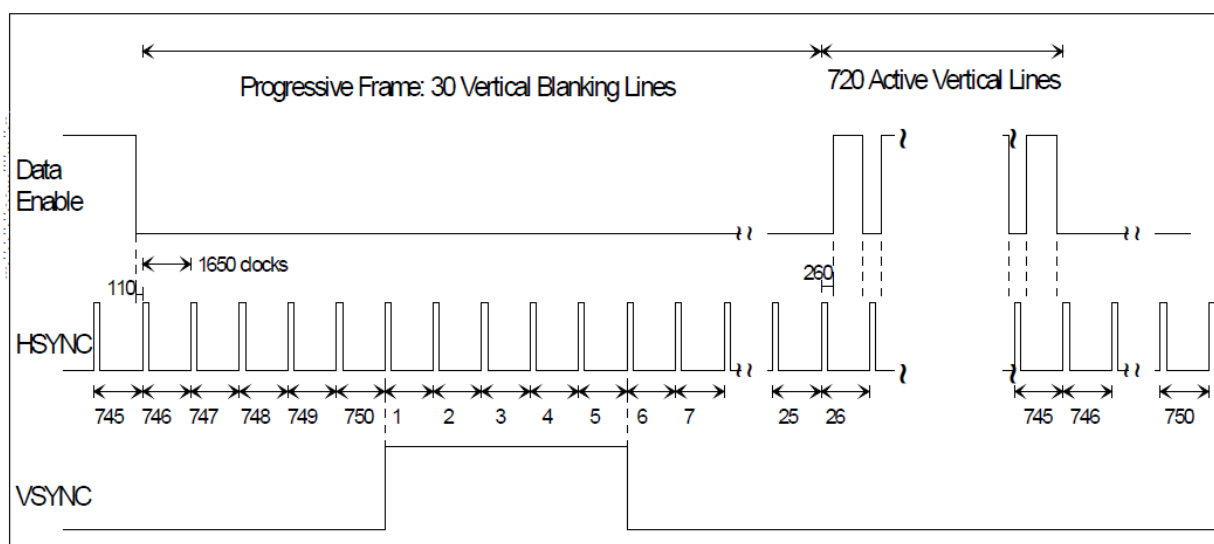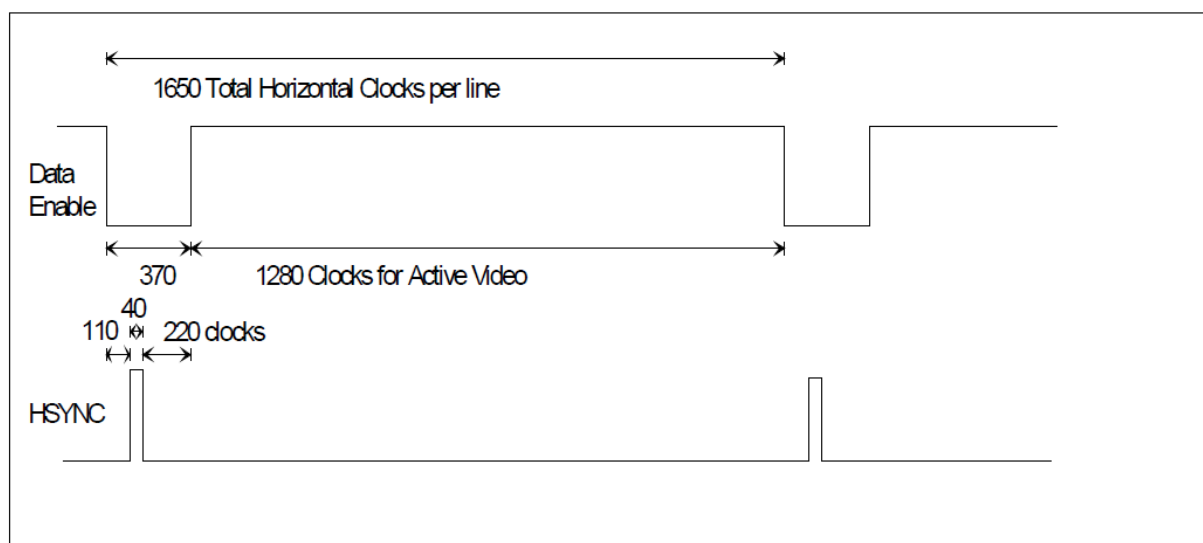
Total line count in one frame: 750

Active pixel count on horizontal line: 1280

Active line count: 720

Electrical Characteristics

Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit
Supply voltage	VBAT	-0.3	7	V
	VDD33	-	4.5	V
	VDD18	-	2.5	V
Input data and control pin voltage	V_*, I2C_SCL	-0.5	VDD18 + 0.5 ($\leq$2. 5)	V
	EN	-0.3	7	V
Input control pin voltage	UART_RX	-0.5	VDD33 + 0.5 ($\leq$4. 5)	V

DC Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Supply Voltage	VBAT	3	3.7	5.5	V	
	VDD33	3.25	3.3	3.35	V	
	VDD18	1.62	1.8	1.98	V	
Output high level voltage	VOH	VDD18 - 0.4	-	VDD18	V	IOH = -2mA
		VDD33 - 0.4	-	VDD33	V	IOH= -4mA
Output low level voltage	VOL	0	-	0.4	V	VDD18: IOL = 2mA VDD33: IOL= 4mA
Input high level voltage	VIH	VDD18 * 0.65	-	VDD18 + 0.3	V	V_*, I2C_SCL, EN
		2.0	-	VDD33 + 0.3	V	UART_RX
Input low level voltage	VIL	-0.3	-	VDD18 * 0.35	V	V_*, I2C_SCL
		0	-	0.4	V	EN
		-0.3	-	0.8	V	UART_RX
Internal Pull-down resistance *1	RPD	43	76	124	kΩ	COM_REQ
Internal Pull-down resistance *2			400		kΩ	EN
Pull-up resistance *3	RPU2	4.5	4.7	4.9	kΩ	I2C_DSA/SCL

*1: COM_REQ is functionally output port, but the port uses I/O cell with pull-down resistance internally. No outside resistor is required.

*2: EN is input port with pull-down resistance internally. No outside resistor is required.

*3: I2C_SDA/SCL ports have pull-up resistance internally. No outside resistor is required.

Recommended Pin State

When module is not activated, it is recommended to shut down power supplies to GND to minimize leakage power. It is required to keep video interface pins at GND level in shutdown state (all supply voltage at GND). In case of UART connected to controller devise, it is required to control UART_RX pin to GND level in shutdown state (all supply voltage at GND). In case of UART not connected to controller device, it is required to put pull-up resistor at high resistance value to UART_RX pin and the resistor is pulled up to 3.3V which is controlled to GND level in shutdown state (all supply voltage at GND). Voltage should not be applied to all pins in shutdown state to avoid unexpected leakage through to GND.
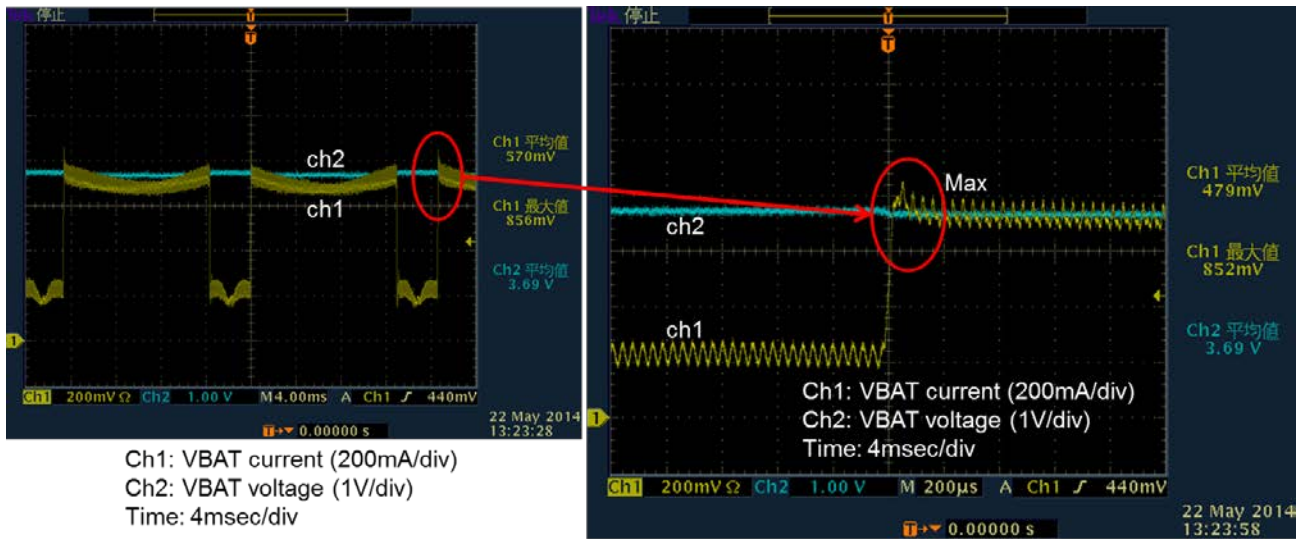
Power Supply Recommendation

Power-UP/Down Sequence
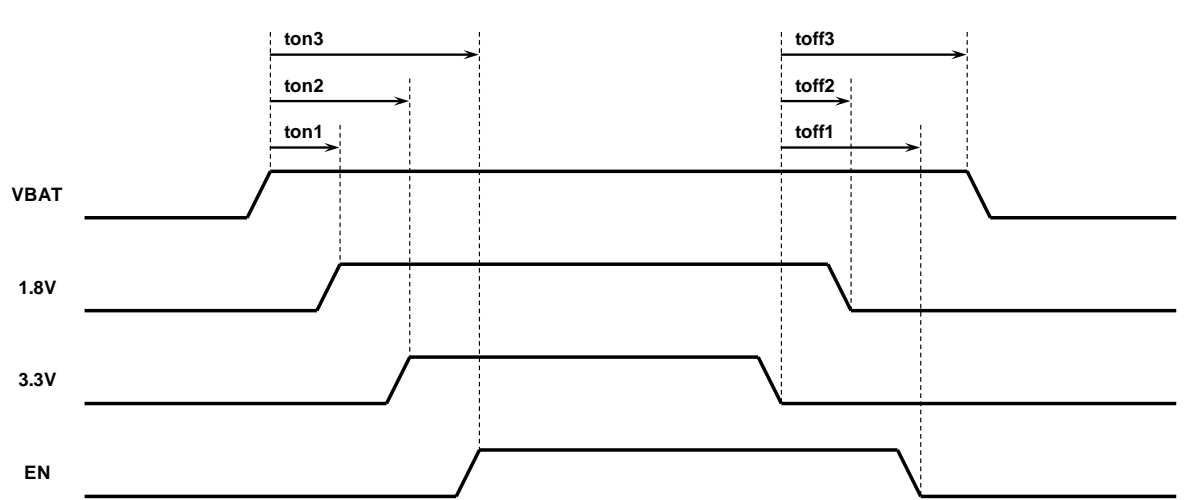
Symbol	Min	Typ	Max	Unit
ton1	0	-	ton2	mS
ton2	0	-	-	mS
ton3	ton2	-	-	mS
toff1	0	-	20	mS
toff2	0	-	toff1	mS
toff3	toff1	-	-	mS

Power Rating

Symbol	Min	Ave.	Max	Unit	Comment
VBAT	-	880	2550	mA	Ave: white 30% video, VBAT=3.0V, Ta=25 ˚C Max: white 100% video, VBAT=3.0V, T_heat_sink=55 ˚C
	-	700	1900	mA	Ave: white 30% video, VBAT=3.7V, Ta=25 ˚C Max: white 100% video, VBAT=3.7V, T_heat_sink=55 ˚C
	-	470	1250	mA	Ave: white 30% video, VBAT=5.5V, Ta=25 ˚C Max: white 100% video, VBAT=5.5V, T_heat_sink=55 ˚C
VDD33	-	70	80	mA	Ave: white 30% video, VDD33=3.3V, Ta=25 ˚C Max: white 100% video, VDD33=3.3V, T_heat_sink=55 ˚C
VDD18	-	40	50	mA	Ave: white 30% video, VDD18=1.8V, Ta=25 ˚C Max: white 100% video, VDD18=1.98V, T_heat_sink=55 ˚C

Ch1: VBAT current (200mA/div)
Ch2: VBAT voltage (1V/div)
Time: 4msec/div

Ch1: VBAT current (200mA/div)
Ch2: VBAT voltage (1V/div)
Time: 4msec/div

Function Overview

The CXN0102 is a laser beam scanning pico projector module which displays the image input from video interface (RGB 24bit) described in Video Interface section. The I2C commands are used for control and Firmware update. It is required to implement Beam Alignment and Beam Scan Phase Adjustment functions as user maintenance mode.
Firmware specification document describes more details.

Module Outline
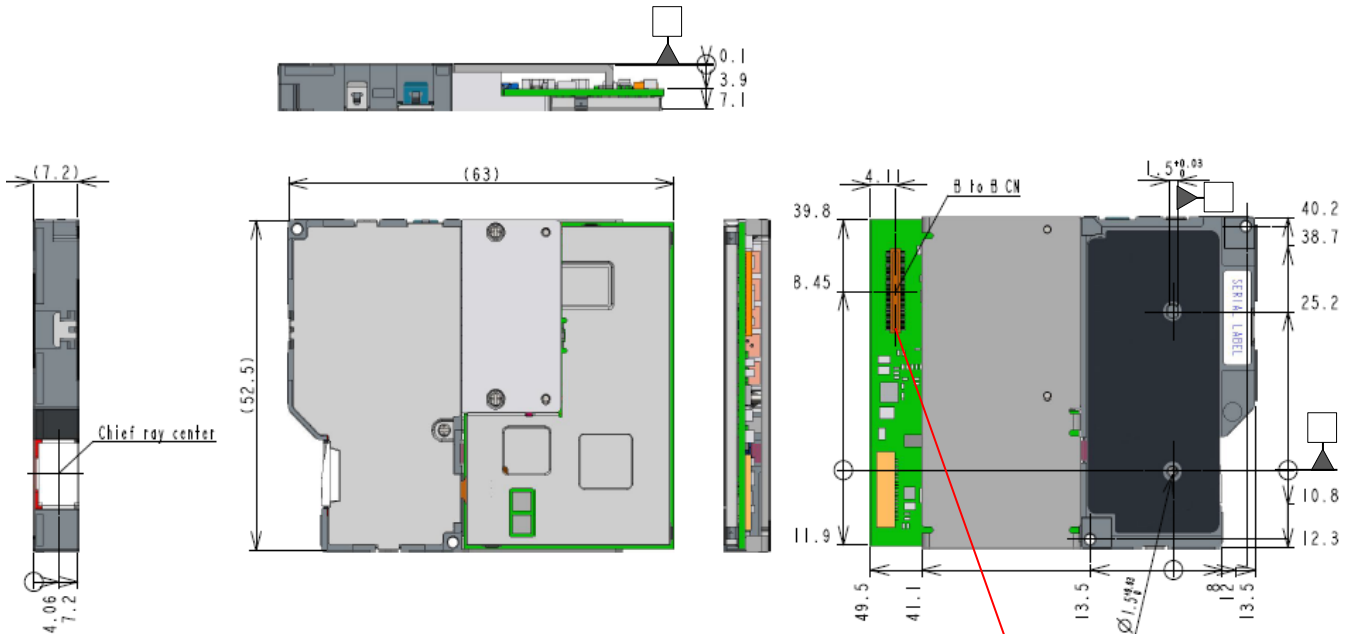
Top View

| Pin Name	Pin #	Pin #	Pin Name
V_VSYNC	2	1	V_HSYNC
V_VCLK	4	3	V_DE
GND	6	5	GND
V_RD_3	8	7	V_RD_7
V_RD_2	10	9	V_RD_4
V_RD_1	12	11	V_RD_5
V_RD_0	14	13	V_RD_6
GND	16	15	GND
V_GD_5	18	17	V_GD_6
V_GD_4	20	19	V_GD_7
V_GD_0	22	21	V_GD_3
V_GD_1	24	23	V_GD_2
GND	26	25	GND
V_BD_0	28	27	V_BD_6
V_BD_5	30	29	V_BD_7
V_BD_1	32	31	V_BD_4
V_BD_2	34	33	V_BD_3
GND	36	35	GND
UART_RX	38	37	UART_TX
NC	40	39	SYSERR_X
I2C_SCL	42	41	I2C_SDA
COM_REQ	44	43	EN
VDD18	46	45	VDD33
GND	48	47	VBAT
GND	50	49	VBAT
GND	52	51	VBAT
GND	54	53	VBAT
GND	56	55	VBAT
GND	58	57	VBAT
GND	60	59	VBAT
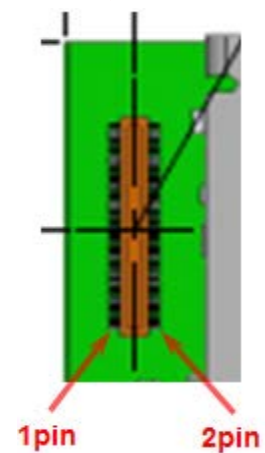
Module B to B connector

B to B connector: Hirose DF40C-60DP-0.4V

Stack height: 1.5mm, receptacle

Thermal Design
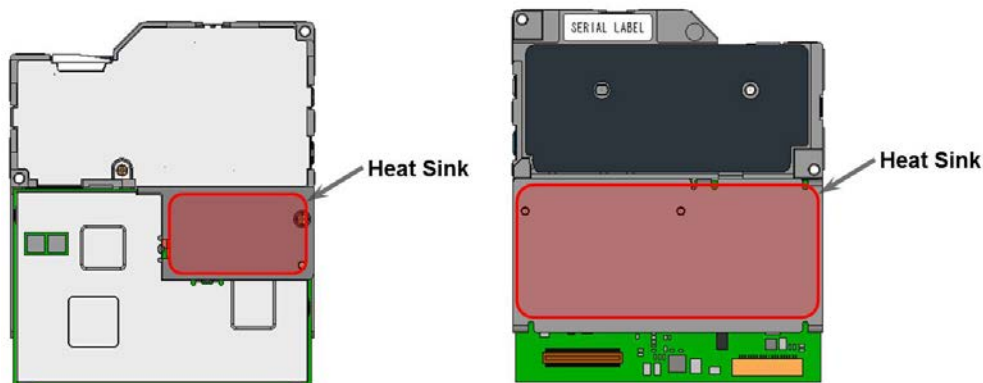
The thermal design is expected to make the temperatures of the specified heat sink never exceed 60 ˚C.

In the default setting, the CNX0102 is in Mute (black) mode at 60 ˚C internal temperature and system is stopped at 65 ˚C internal temperature. This monitored temperature differs from heat sink temperature. Thermal design must be based on the specified heat sink temperature.

Revision History

Version	Date	Description
1.0.0	21, Apr., 2014	1st release
1.0.1	22, May, 2014	Laser Safety Classification is updated. SYSERR_X description is updated. Power consumption of electrical characteristic and power rating are updated. Thermal design description is updated.
1.0.2	24, May, 2014	Laser Safety Classification is corrected.
1.0.3	8, Sep., 2014	Display Performance of Module characteristics is to be updated. Power consumption of electrical characteristic is updated. Power rating is updated. RST_X is updated to NC (not connected). UART description is updated. EN description is updated. Voltage specification of VDD33 is updated. Recommended Pin State description is updated.
1.1.0	15, Dec., 2014	Weight is updated. Another FOV description is deleted. Typ. Power and ave. current are updated. EN and UART descriptions are updated.

		Voltage range of VDD33 is updated.
1.1.1	17, Feb., 2015	Color depth description is corrected.
		Thermal design description is updated.
1.2.0	20, Oct., 2015	White point is updated.
		Power consumption of electrical characteristics is updated.
		VBAT of power rating are updated.

Note

Incorporates the PicoP® display technology developed by Microvision, Inc.

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Customer shall use the Products with the utmost concern for safety, and shall not use the Products for any purpose that may endanger life or physical wellbeing, or cause serious damage to property or the environment, either through normal use or malfunction.
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