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**LCDK185CTL1ART01 & LCDK185NTL1NCT01**  
**LCD185 with Adapter for TI AM62x SOC**

Approvals	
Model Number	LCDK185CTL1ART01 LCDK185NTL1NCT01
Datasheet Revision	1.3
Drawing Revision	B

Customer Approval	
Approved by: _____	Date: _____

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## Revision History

### Document Revision

Date	Version #	Description	Created By	Checked By	Approved By
9/28/2022	R1.0	Initial release	DA	KB	JH
9/30/2022	R1.1	Updated schematics, R303 is now 100K	ZA	JH	JH
2/17/2023	R1.2	Updated mechanical drawing, updated ordering information table, removed PCB schematics, updated PCB pictorials, PCB-L0136R1.2 was PCB-L0136R1.1	LH	DA	JH
03/27/2023	R1.3	Updated USB-C Charger to USB-A, and updated the part number to a 5V 2A part	ZH	DA	JH

### Hardware Revision

Date	Version #	Description
09/27/2022	R1.0	Initial Release
2/17/2023	R1.1	Added PCB stacking hardware
3/27/2023	R1.2	Charger part number AQ10A-050BP-H was VEL05US050-US-BB

## Product Overview

This LCD kit supports connecting LTS LCD185 to both the Beagle BeaglePlay and Phytex PhyCore platforms, both of which are based on the new TI AM62x Sitara MPUs. These 2 platforms may also be referred to as AM62x platforms. This kit predominantly consists of LCD185 and PCB-L0136.

LCD185 is a high-brightness, high-resolution (WUXGA) 10.1" LCD that requires the following 3 connections.

- LVDS (45-pin flex)
- Touch Screen (8-pin flex)
- Backlight (cabled 2-pin connectors)

PCB-L0136 converts the 2 flex connections to the single 40-pin flex used on the Beagle and Phytex platforms. PCB-L0136 also provides the LCD185 backlight driver which the Beagle and Phytex platforms control over the same 40-pin flex. Finally, PCB-L0136 supports a USB Type C connector to be powered from commodity USB chargers. Since these chargers can support various maximum currents, PCB-L0136 has a rotary switch to adjust the maximum backlight power.

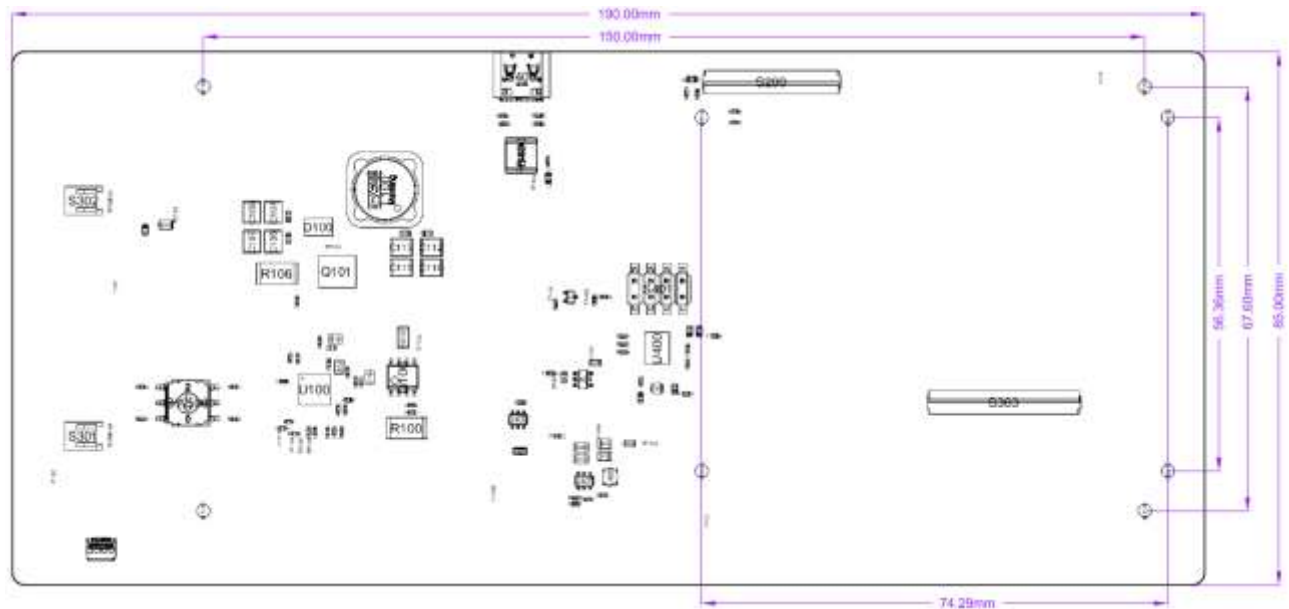
## Ordering Information

This document refers to parts listed below either by part number or name indicated in the following table. Part revisions are only specifically indicated in this table and may be excluded in other sections of this document.

LTS Part #	Parts in Kit	Description
LCDK185CTL1ART01R1.2	PCB-L0136R1.2	AM62x_SOC to LCD185 Adapter Board
	LCD185-101CTL1ARNTR1.0	10.1" HBWG Cap Touch
	0151661165	LCD Flex (2" 0.5mm pitch 45 POS FFC cable)
	0151660431	AM62x Flex (4" 0.5mm pitch 40 POS FFC cable)
	AQ10A-050BP-H	USB-A Charger
	DH-20M50052	USB-A to USB-C cable
	A14040700UX0339	M3 X 9 mm + 4 mm Hex Standoff
	93640A125	M3 x 6 mm Nylon Socket Head Screw
LCDK185NTL1NCT01R1.2	PCB-L0136R1.2	AM62x_SOC to LCD185 Adapter Board
	LCD185-101NTL1NCNTR1.0	10.1" HBWG No Touch with CG
	0151661165	LCD Flex (2" 0.5mm pitch 45 POS FFC cable)
	0151660431	AM62x Flex (4" 0.5mm pitch 40 POS FFC cable)
	AQ10A-050BP-H	USB-A Charger
	DH-20M50052	USB-A to USB-C cable
	A14040700UX0339	M3 X 9 mm + 4 mm Hex Standoff
	93640A125	M3 x 6 mm Nylon Socket Head Screw

## Pictorial

The following shows a 3D rendering as well as a dimensioned mechanical drawing.





## Required Connections

PCB-L0136 requires the following 3 “types” of connections.

**NOTE:** Full details on the connectors is provided in [Connector Summary](#) and [Connector Pinouts](#).

### LCD

PCB-L0136 should be positioned so that the Touch I2C and LCD185 connectors are aligned with the corresponding flex and connector on LCD185.

- The Touch I2C connector supports the Touch flex on LCD185.
- The LCD185 connector supports the flex connector on LCD185 using the LCD Flex.
- The Backlight connectors support the cabled backlight connectors on LCD185.

### Power

The VBUS connector supports a standard USB-C cable from a USB charger or power bank.

### AM62x SOC

The AM62x SOC connector supports the flex connector on the AM62x (BeaglePlay and PhyCore) platforms. This connector has both top and bottom contacts to maximize flex orientation support. An AM62x flex cable sample and part number are provided, but the required flex will be defined by the final orientation of the Beagle and Phytex platforms relative to PCB-L0136. At a minimum it must support 40 pins and 0.5mm pitch.

## Specifications

### Optical and Mechanical (LCD185 + PCB-L0136)

Item	Specification	Unit
Outline Dimensions (typ) <sup>1</sup>	228 x 154 (LCD185) Thickness: 20 (with PCB stacking hardware)	mm
LCD Size (diagonal)	10.1	inches
Active Area	216.8x135.5	mm
Resolution	1920x1200	pixels
Backlight Type	Edge lit	-



(1) The outline dimensions do not include any AM62x platform or associated cabling

### Environmental

Item	Symbol	Value	Unit
Operating Temperature	T <sub>OPR</sub>	0 ~ 70	°C
Storage Temperature	T <sub>STG</sub>	-20 ~ 70	°C

## Connector Summary

Connector Type	MPN	Description
AM62x SOC (S200) 	FH34SRJ-40S-0.5SH(50)	40 positions 0.5mm pitch Connector to AM62x SOC
Touch I2C (S300) 	5034800600	6 positions 0.5mm pitch Connector to Touch I2C
Backlight (S301, S302) 	S2B-ZR(LF)(SN)	Connector to LCD backlight 2 positions 1.5mm pitch
LCD185 (S303) 	FH34SRJ-45S-0.5SH(50)	45 positions 0.5mm pitch Connector to LCD185

<p>USB-C (S400)</p> 	<p>TYPE-C-31-M-12</p>	<p>16 positions</p> <p>5V Power</p>
<p>EEPROM (S401)</p> 	<p>TSM-104-01-L-DV</p>	<p>8 positions</p> <p>2.54mm pitch</p> <p>Optional connector for EEPROM programming.</p>

## Connector Pinouts

### AM62xSOC (S200)

Number	Pin Name	I/O	Description
1	GND	P	Ground
2	VSYS	I	Beagle and Phytex power-up indicator
3	GND	P	Ground
4	TP_SCL_1V8	I	Touch Panel and EEPROM I2C Clock
5	TP_SDA_1V8	I/O	Touch Panel and EEPROM I2C Data
6	TP_INT_1V8	O	Touch Panel Interrupt
7	MSTR_RST_3V3	I	Reset
8	BL_PWM_3V3	I	Pulse Width Modulation Back light brightness control

9	BL_EN_3V3	I	Backlight Enable
10	GND	P	Ground
11	OLDI0_CLK1N	I	LVDS clock pin
12	OLDI0_CLK1P	I	LVDS clock pin
13	GND	P	Ground
14	OLDI0_CLK0N	I	LVDS clock pin
15	OLDI0_CLK0P	I	LVDS clock pin
16	GND	P	Ground
17	OLDI0_A7N	I	LVDS data pin
18	OLDI0_A7P	I	LVDS data pin
19	GND	P	Ground
20	OLDI0_A6N	I	LVDS data pin
21	OLDI0_A6P	I	LVDS data pin
22	GND	P	Ground
23	OLDI0_A5N	I	LVDS data pin
24	OLDI0_A5P	I	LVDS data pin
25	GND	P	Ground
26	OLDI0_A4N	I	LVDS data pin
27	OLDI0_A4P	I	LVDS data pin
28	GND	P	Ground
29	OLDI0_A3N	I	LVDS data pin
30	OLDI0_A3P	I	LVDS data pin
31	GND	P	Ground
32	OLDI0_A2N	I	LVDS data pin

33	OLDIO_A2P	I	LVDS data pin
34	GND	P	Ground
35	OLDIO_A1N	I	LVDS data pin
36	OLDIO_A1P	I	LVDS data pin
37	GND	P	Ground
38	OLDIO_A0N	I	LVDS data pin
39	OLDIO_A0P	I	LVDS data pin
40	GND	P	Ground

#### Touch I2C (S300)

Number	Pin Name	I/O	Description
1	GND	P	Ground
2	TP_SDA_1V8	I/O	Touch Panel I2C Data
3	TP_SCL_1V8	O	Touch Panel I2C Clock
4	TP_INT_1V8	O	Touch Panel Interrupt
5	TP_RST_1V8	I	Touch Panel Reset
6	VDD	P	Touch Panel Power

#### Backlight (S301, S302)

Number	Pin Name	I/O	Description
1	V <sub>BL_A</sub>	P	Backlight Anode
2	V <sub>BL_C</sub>	P	Backlight Cathode

## LCD185 (S303)

Number	Pin Name	I/O	Description
1	VDD	P	LCD185 Power
2	VDD	P	LCD185 Power
3	VDD	P	LCD185 Power
4	VDD	P	LCD185 Power
5	VDD	P	LCD185 Power
6	NC	-	No Connection
7	NC	-	No Connection
8	NC	-	No Connection
9	NC	-	No Connection
10	GND	P	Ground
11	O_LVDS_0_N	O	LVDS Odd Channel, Pair 0
12	O_LVDS_0_P	O	LVDS Odd Channel, Pair 0
13	GND	P	Ground
14	O_LVDS_1_N	O	LVDS Odd Channel, Pair 1
15	O_LVDS_1_P	O	LVDS Odd Channel, Pair 1
16	GND	P	Ground
17	O_LVDS_CLK_N	O	LVDS Odd Channel, Clock
18	O_LVDS_CLK_P	O	LVDS Odd Channel, Clock
19	GND	P	Ground
20	O_LVDS_2_N	O	LVDS Odd Channel, Pair 2
21	O_LVDS_2_P	O	LVDS Odd Channel, Pair 2
22	GND	P	Ground

23	O_LVDS_3_N	O	LVDS Odd Channel, Pair 3
24	O_LVDS_3_P	O	LVDS Odd Channel, Pair 3
25	GND	P	Ground
26	E_LVDS_0_N	O	LVDS Even Channel, Pair 0
27	E_LVDS_0_P	O	LVDS Even Channel, Pair 0
28	GND	P	Ground
29	E_LVDS_1_N	O	LVDS Even Channel, Pair 1
30	E_LVDS_1_P	O	LVDS Even Channel, Pair 1
31	GND	P	Ground
32	E_LVDS_CLK_N	O	LVDS Even Channel, Clock
33	E_LVDS_CLK_P	O	LVDS Even Channel, Clock
34	GND	P	Ground
35	E_LVDS_2_N	O	LVDS Even Channel, Pair 2
36	E_LVDS_2_P	O	LVDS Even Channel, Pair 2
37	GND	P	Ground
38	E_LVDS_3_N	O	LVDS Even Channel, Pair 3
39	E_LVDS_3_P	O	LVDS Even Channel, Pair 3
40	GND	P	Ground
41	NC	-	No Connection
42	NC	-	No Connection
43	NC	-	No Connection
44	NC	-	No Connection
45	NC	-	No Connection



## USB-C Power (S400)

Pin	Name	I/O	Description
A1 / B12	GND	P	Ground
A2 / B11	NC	-	No Connection
A3 / B10	NC	-	No Connection
A4 / B9	VBUS	P	Input from USB Charger or Power Bank
A5 / B8	NC	-	No Connection
A6 / B7	NC	-	No Connection
A7 / B6	NC	-	No Connection
A8 / B5	NC	-	No Connection
A9 / B4	VBUS	P	5V VBUS
A10 / B3	NC	-	No Connection
A11 / B2	NC	-	No Connection
A12 / B1	GND	P	Ground

## EEPROM (S401)

This connector is provided to program an on-board EEPROM. This can be used for Linux to identify PCB-L0136, if required by the end customer.

Pin	Name	I/O	Description
1	EE_WP	I	EEPROM Write Protect
2	VSYS	O	Beagle and Phytex Power-Up Indicator
3	EE_VIO	O	EEPROM I/O Voltage Reference (1.8V)
4	EE_SCL	I	EEPROM I2C Clock
5	GND	P	Ground

6	EE_SDA	I/O	EEPROM I2C Data
7	GND	P	Ground
8	GND	P	Ground

### Electrical – Absolute Maximum

Item	Symbol	Value		Unit
		Min.	Max.	
Touch Panel and LCD185	VDD	-0.3	3.47	V
PCB-L0136 Voltage	VBUS	-0.3	6.0	V
Beagle Power-Up Indicator	VSYS	-0.3	6.0	V
Backlight Voltage – Anode	V <sub>BL,A</sub>	-0.3	50	V
Backlight Voltage – Cathode	V <sub>BL,C</sub>	-0.3	50	V
Signal names ending in 3V3	V <sub>IO3V3</sub>	-0.3	VDD+0.3	V
Signal names ending in 1V8	V <sub>IO1V8</sub>	-0.3	2.0	V
All other signals (LVDS)	V <sub>IOLVDS</sub>	-0.3	VDD+0.3	V

### Electrical – Typical

**NOTE:** Positive currents are *into* PCB-L0136.

**NOTE:** LVDS Differential Mode voltages are measured relative to the negative signal within each LVDS pair. All other voltages are measured relative to GND.

Item	Symbol	Min.	Typ.	Max.	Unit
Touch Panel and LCD185 Voltage	VDD	3.0		3.4	V
Touch Panel and LCD185 Current	I <sub>VDD</sub>	-0.36		n/a	A
PCB-L0136 Voltage	VBUS	4.5		5.5	V

PCB-L0136 Current	$I_{V_{BUS}}$	n/a		3.0	A
Beagle/Phytec Power-Up Indicator Voltage	$V_{SYS}$	3.23		5.5	V
Beagle/Phytec Power-Up Indicator Current	$I_{V_{SYS}}$	0		0.02	A
Backlight Voltage – Anode (100% PWM)	$V_{BL\_A}$	25		30	V
Backlight Voltage – Cathode (100% PWM)	$V_{BL\_C}$	0.7		5.4	V
Backlight PWM Frequency	$f_{BL\_PWM\_3V3}$	0.1		20	kHz
Backlight PWM ON Time	$t_{ON(BL\_PWM\_3V3)}$	0.22		n/a	us
Backlight Current (each connector)	$I_{V_{BL\_C}}$	0.04		0.2	A
Signal names ending in 3V3	$V_{IL\_3V3}$	-0.3		0.4	V
	$V_{IH\_3V3}$	2.0		VDD+0.3	V
Signal names ending in 1V8	$V_{IL\_1V8}$	-0.3		0.5	V
	$V_{IH\_1V8}$	1.5		2.0	V
	$V_{OL\_1V8}$	0.0		0.25	V
	$V_{OH\_1V8}$	1.4		1.9	V
All other signals (LVDS Common Mode)	$V_{CM\_LVDS}$	1.0		1.4	V
All other signals (LVDS Differential Mode)	$V_{IL\_LVDS}$	-0.3		-0.1	V
	$V_{IH\_LVDS}$	0.1		0.3	V

## Power-Up

In preparation for power-up, the following electromechanical connections are required.

1. Ideally PCB-L0136 is attached to the back of LCD185, allowing the following three connections to be consistently maintained with good mechanical stability. **NOTE:** The Backlight connectors are through-hole. To prevent any possible shorting of these connectors to the LCD185 metal housing, it is recommended that the through-hole pins be covered by tape that offers notable insulation. Additionally, it is recommended to use a double-sided tape (at least 1.0mm thick) to adhere PCB-L0136 to LCD185.
2. Touch I2C connector on PCB-L0136 is connected to LCD185 flex.

3. LCD185 connector on PCB-L0136 is connected to LCD185 using a flex.
4. Backlight connectors on PCB-L0136 are connected to LCD185 cabled connectors.
5. Beagle connector on PCB-L0136 is connected to the Beagle board using a flex.

Also, it is required that the Beagle boot code ensures that **neither** MSTR\_RST\_3V3 or TP\_INT\_1V8 to PCB-L0136 is configured as Output-High during and immediately after boot. Configuring them as Input is preferred.

With those connections and boot code configuration, the following power-up sequence is recommended.

1. Apply VBUS to PCB-L0136. Adjust SW500 if needed based on VBUS supply current rating.
2. Apply VSYS to PCB-L0136 by applying power to the Beagle board and initiating the boot process.
3. After 10~50ms, Beagle board changes MSTR\_RST\_3V3 to Output-High and starts the LVDS interface.
4. After 200ms, Beagle board changes BL\_EN\_3V3 to Output-High.
5. Beagle board controls BL\_PWM\_3V3 as needed. Options are either static high (for full brightness) or PWM with required frequency and minimum on time (for dimming).

## Interfaces

LCD185 requires the following two industry standard interfaces. Specific requirements are summarized in this section.

### I2C

This interface is required to read touch panel data and read/write to a EEPROM. It supports the Fast-mode implementation of the I2C standard.

- I2C 8-bit slave address of the Touch Panel is 0xBA/0xBB.
- I2C 8-bit slave address of the EEPROM is 0xAE/0xAF.

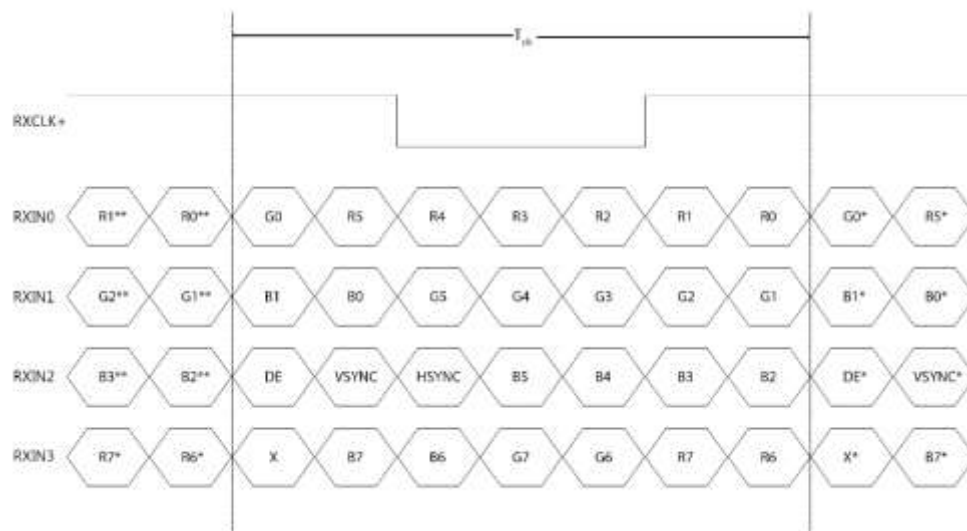
## LVDS

This interface is required to send video data. The required timing parameters are summarized in the following table.

Item	Symbol	Min	Typ	Max	Unit
CLK Frequency	$f_{\text{CLK}}$	74.5	77.56	85	MHz
CLK Period	$t_{\text{CLK}}$	11.76	12.89	13.42	ns
Horizontal Display Area <sup>1</sup>	$t_{\text{HD}}$	960			$t_{\text{CLK}}$
HSYNC Period	$t_{\text{H}}$	989	1040	1248	$t_{\text{CLK}}$
Horizontal Blank	$t_{\text{HB}}$	29	80	288	$t_{\text{CLK}}$
HSYNC Pulse Width	$t_{\text{HP}}$	2	10	255	$t_{\text{CLK}}$
HSYNC Back Porch	$t_{\text{HBP}}$	3	6	255	$t_{\text{CLK}}$
HSYNC Front Porch	$t_{\text{HFP}}$	24	64	260	$t_{\text{CLK}}$
Vertical Display Area	$t_{\text{VD}}$	1200			$t_{\text{H}}$
VSYNC Period	$t_{\text{V}}$	1243	1243	1560	$t_{\text{H}}$
Vertical Blank	$t_{\text{VB}}$	43	43	360	$t_{\text{H}}$
VSYNC Pulse Width	$t_{\text{VP}}$	4	4	20	$t_{\text{H}}$
VSYNC Back Porch	$t_{\text{VBP}}$	20	20	255	$t_{\text{H}}$
VSYNC Front Porch	$t_{\text{VFP}}$	19	19	260	$t_{\text{H}}$
Refresh Frequency	$f_{\text{REFRESH}}$		60		Hz

**(1) Two pixels are sent in parallel each  $t_{\text{CLK}}$  period. The number of active horizontal pixels is still 1920 as specified in [section 3.1](#), and all other Horizontal specs are double their listed values when counted as pixels.**

Additionally, the LVDS interface uses the VESA (Format 2) RGB bit mapping, which is summarized in the following figure. This shows a single lane but LCD185 requires two lanes, which are identified as Odd (OLDI0\_A0~3) and Even (OLDI0\_A4~7).



## Bring-Up Support

To assist with any bring-up concerns, PCB-L0136 supports the following.

- LVDS signals are accessible using test points placed near the LCD185 connector.
- Input voltages (VBUS, VSYS) and generated voltages (VDD=3V3, 1V8) are accessible using test points. Nearby GND test points are also provided.
- Backlight boost signals (VBOOST\_IN, VBOOST\_OUT, Switch Node, etc.) are accessible using various test points.

## Appendix 1: Mechanical Drawing