

LCD Module

C-Berry

DATA SHEET

Product specification V 1.2

This product complies to EU directive 2002/95/EC (RoHS) of January 27th, 2003.

Revision record

Table 0.1: Revision record

Rev.	Date	Chapter	Description
1.0	2013-12-11	all	initial release
1.1	2014-02-19	12	changed assembly instruction
	2014-03-03	8.1	changed description added examples.c, examples.h to Table 8.1 added examples.c, examples.h to Figure 8.1
1.2	2014-05-16	8.1	expanded figure 8.1
		8.2	added chapter 'Additional software'

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1 General data

Table 1.1: General data of TFT

No.	Item	Content
1.	module size	76.9mm (W) * 63.9mm (H) * 7.0mm (D)
2.	visible area	72.88mm (W) * 55.36mm (H)
3.	active area	70.08mm (W) * 52.56mm (H)
4.	pixel size	0.219mm (W) * 0.219mm (H)
5.	number of dots	320 * 3 (RGB) (W) * 240 (H)
6.	LCD typ	TFT color 65k, 600cd/m ²
7.	backlight	LED white
8.	graphic controller	RA8870
9.	interface	parallel 8080
10.	weight	32g (approx.)

Table 1.2: General data of C-Berry TFT Adapter

No.	Item	Content
1.	adapter size	40mm (W) * 40mm (H) * 10.1mm (D)
2.	serial/parallel converter	74VHC595
3.	weight	10g (approx.)

2 Absolute maximum ratings

Within this specification all voltages are referred to ground (GND).

Absolute maximum ratings are defined ratings, which when being exceeded may cause permanent damage to the device. Moreover, this device is not guaranteed to operate properly at the maximum ratings. These are stress ratings only and functional operation of the device at these or any other condition beyond those indicated under '3 Electrical characteristics' is not implied.

2.1 Electrical absolute maximum ratings

Table 2.1: Electrical absolute maximum ratings

Item	Symbol	Min.	Max.	Unit	Comment
power supply	V_{CC}	-0.3	4.0	V	--
	V_{CC_5V}	-0.3	6.0	V	
input voltage	V_I	-0.3	$V_{CC}+0.3$	V	--
static electricity	--	--	--	--	see note

Note: LCM should be grounded during handling.

2.2 Environmental absolute maximum ratings

Table 2.2: Environmental absolute maximum ratings

Item	Symbol	Min.	Max.	Unit	Comment
operating temperature	T_{OP}	-20	70	°C	$T_a \leq 70^\circ\text{C}$: 75%RH max
storage temperature	T_{ST}	-30	80	°C	--

3 Electrical characteristics

3.1 Electrical characteristics of C-Berry TFT-Adapter

Table 3.1: Electrical characteristic of C-Berry TFT-Adapter

T_a=25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
power supply for logic	V _{CC}	--	3.0	3.3	3.6	V
input voltage	V _{IH}	H-level	0.8V _{CC}	--	V _{CC}	V
	V _{IL}	L-level	GND	--	0.2V _{CC}	
power supply current	I _{CC}	V _{CC} =3.3V	--	30	--	mA

3.2 Electrical characteristics of backlight

Table 3.2: Electrical characteristics of backlight

Item	Symbol	Min.	Typ.	Max.	Unit	Condition
applied forward voltage	V _{CC_5V}	4.5	5.0	5.5	V	
applied forward current	I _{CC_5V}	--	320	--	mA	V _{CC_5V} =5V at 100% PWM see note
LED life time	L _L	--	20,000	--	h	

Note: LED life time is defined as follows: The final brightness is at 50% of original brightness

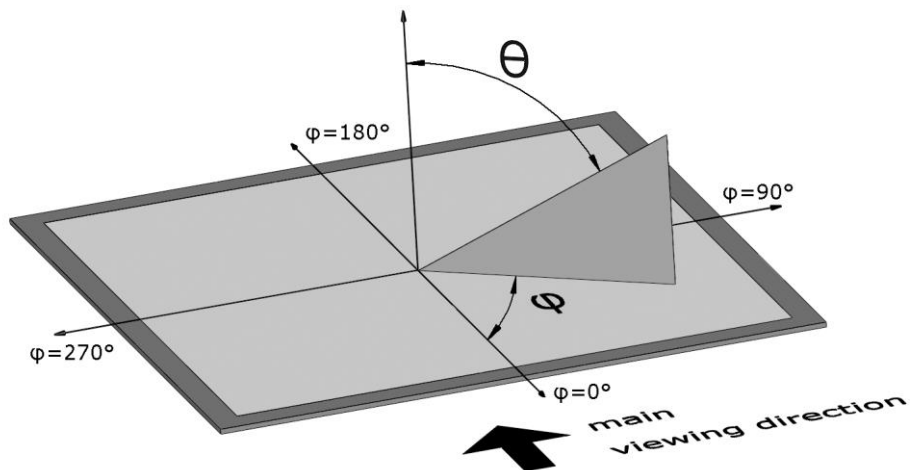
4 Optical characteristics of TFT

Table 4.1: Optical characteristics

Ta=25°C

Item	Symbol	Condition	Min.	Typ.	Max.	Unit
viewing angle Cr≥10	θ	$\theta(\varphi = 0^\circ)$	--	65	--	°
		$\theta(\varphi = 180^\circ)$	--	55	--	°
		$\theta(\varphi = 90^\circ)$	--	60	--	°
		$\theta(\varphi = 270^\circ)$	--	60	--	°
contrast ratio	Cr	--	200	250	--	°
surface luminance of LCM	L _I	at 100% PWM	--	600	--	cd/m ²

Note 1: Definition of viewing angle $\theta(\varphi)$



Note 2: Definition of contrast ratio (Cr)

The brightness is measured with a TOPCON BM-7 at the center point of the TFT. The contrast is defined by the following equation:

$$Cr = \frac{\text{Brightness when TFT is at "White" state}}{\text{Brightness when TFT is at "Black" state}}$$

6 Interface description

6.1 Interface of C-Berry TFT Adapter connector X2

Table 6.1: LCD interface description

Symbol	Pin no.	IO	Function
V _{CC}	1	PWR	power supply 3.3V
V _{CC_5V}	2	PWR	power supply 5V
GPIO2	3	I/O	raspberry pi GPIO port
V _{CC_5V}	4	PWR	power supply 5V
GPIO3	5	I/O	raspberry pi GPIO port
GND	6	PWR	ground
GPIO4	7	I/O	raspberry pi GPIO port
GPIO14	8	I/O	raspberry pi GPIO port
GND	9	PWR	ground
GPIO15	10	I/O	raspberry pi GPIO port
/OE	11	I	output enable of serial to parallel converter
RS	12	I	register select 'H' = control word 'L' = display data
/INT	13	O	interrupt output to indicate the status of TFT controller
GND	14	PWR	ground
/WAIT	15	O	wait output to indicate that TFT controller is busy
/RD	16	I	data read
V _{CC}	17	PWR	power supply 3.3V
/WR	18	I	data write
MOSI	19	I	serial data input
GND	20	PWR	ground
MISO	21	O	serial data output
/RST	22	I	reset
SCLK	23	I	serial clock
/CS	24	I	chip select of TFT controller
GND	25	PWR	ground
STCP	26	I	store signal of serial to parallel converter

Female connector: 2x13 pin, 2.54 mm pitch
connect it to Raspberry Pi[®] Model B port P1

6.2 Interface of C-Berry TFT Adapter connector X3

Symbol	Pin no.	IO	Function
V _{CC_5V}	1	PWR	power supply 5V
V _{CC}	2	PWR	power supply 3.3V
GND	3	PWR	ground
GND	4	PWR	
nc	5	--	not connected
GPIO2	6	I/O	raspberry pi GPIO port (pass through from X2)
GPIO3	7	I/O	
GPIO4	8	I/O	
GPIO14	9	I/O	
GPIO15	10	I/O	

Connector: 2x5 pin, 2.54 mm pitch

7 Hardware

7.1 Schematic of C-Berry TFT Adapter

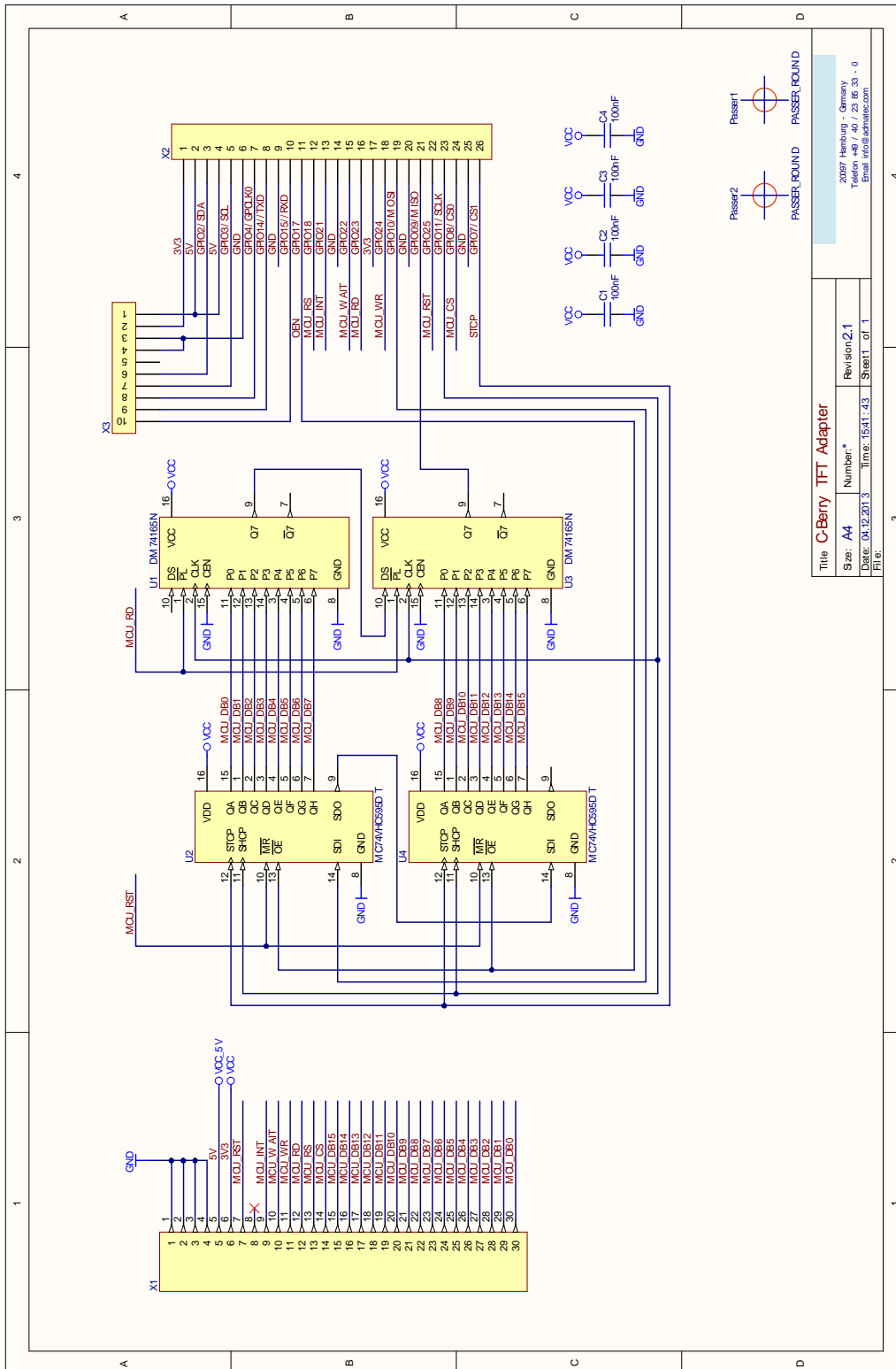


Figure 7.1 : Schematic for C-Berry TFT Adapter

7.2 PCB of C-Berry TFT Adapter

The layout of the C-Berry TFT Adapter is depicted by Figure 7.2. The connector X1 will be used to connect the TFT Adapter with the TFT Module via the FFC cable. Connector X2 is the interface to the Raspberry Pi Module. On the left hand side is an additional connector X3. It is connected with unused GPIOs, the supply voltages and GND. For detailed information about X2 and X3 see chapter "6 Interface description".

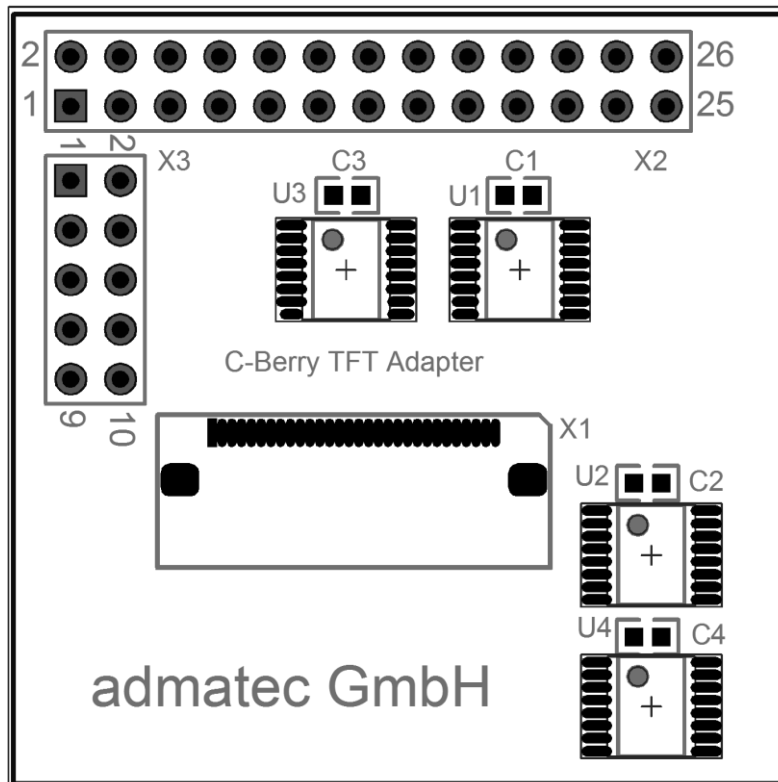


Figure 7.2 : PCB for C-Berry TFT Adapter

8 Software

8.1 C-Berry example

An example software for C-Berry is available for download. Please follow this > [link](#) < or use the following install guide:

- start LXTerminal
- download the package
`wget http://admatec.de/sites/default/files/downloads/C-Berry.tar.gz`
- unzip the package
`tar zxvf C-Berry.tar.gz`
- compile the test software
`cd C-Berry/SW/tft_test`
`make`
- start the programm
`sudo ./tft_test`

To use this example it is required that the BCM2835 library is successfully installed.

The package contains the folder structure like Figure 8.1.

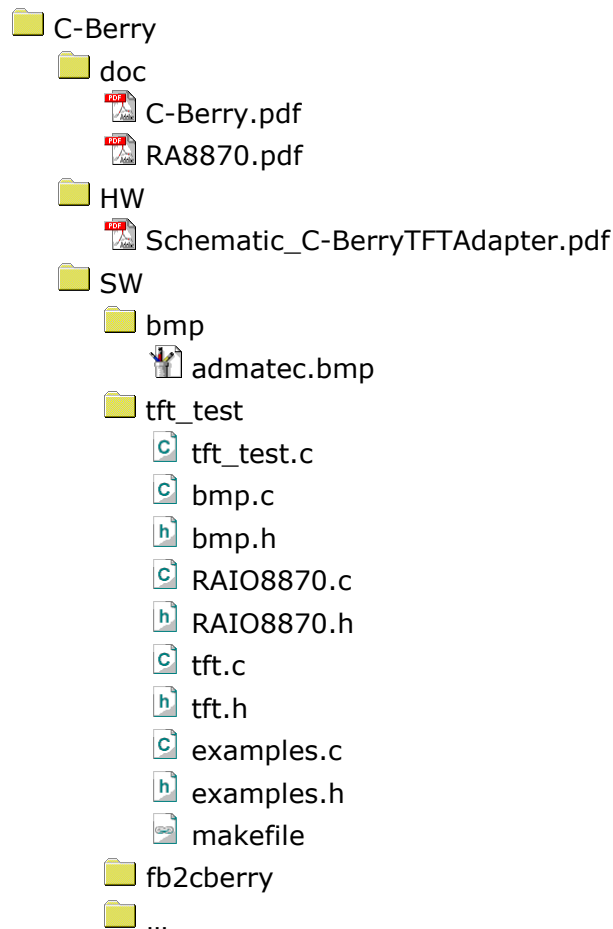


Figure 8.1: Folder structure

In the doc folder is the specification of the C-Berry and the graphic controller RA8870.

The HW folder contains the schematic of the C-Berry TFT Adapter.

The SW folder contains the source code. The source code consists of RA8870.c, tft.c, bmp.c, example.c and the corresponding header files, as well as tft_test.c and a makefile. A short description of each file is given in Table 8.1. The program allows drawing circles, rectangles and lines by using the RA8870, displaying BMP files and some more examples.

Table 8.1: Functions of the different source files

File	Function
bmp.h / bmp.c	Image processing for showing BMP file on the TFT. The BMP files must have a dimension of 320 x 240 pixel and a color depth of 24Bit.
RAIO8870.h / RAIO8870.c	Contains the definitions of the RA8870 register and several functions to control the graphic controller RA8870.
tft.h / tft.c	Responsible for the SPI communications and for the initialization of the GPIO Pins.
examples.h / examples.c	Contains functions to demonstrate some opportunities
tft_test.c	This file contains the main loop. The program shows one BMP file on the TFT and some basic drawings which were created by the RA8870 graphic controller.

8.2 Additional software

The package will be expanded with additional software examples on demand, like fb2cberry.

8.3 Timing characteristics

Please refer to the specification of IC RA8870 and IC 74VHC595.

9 Quality assurance

9.1 Setup definition

9.1.1 Scope

This chapter is to define the module quality evaluation.

9.1.2 Sampling plan and definition

The sample plan follows ISO-2859-1/MIL-STD-105E.

"Lot size" is defined as: Quantity per shipment as one lot

9.1.3 Panel Inspection Condition

- Environment: Room temperature, 25 ± 5 °C, Humidity $65\pm 5\%$ RH, Illumination: 300-700 Lux
- Inspection distance: 35 ± 5 cm
- Inspection angle: The vision of inspector should be perpendicular to the surface of the module.
- Inspection time: Perceptibility test time: 20s max.

9.2 Display quality

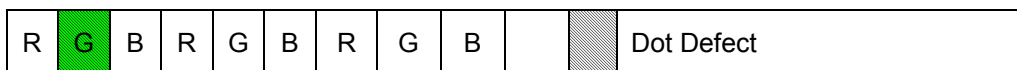
Sample type is normal inspection, sampling level is level 2. Acceptable Quality Level for major defects is $AQL=2.5$, for minor $AQL=4.0$.

9.2.1 Function related

The function defects of line defects, abnormal display, and no display are considered as MAJOR defects.

9.2.2 Pixel Definition and Pixel Error Definition

One *RGB triple* will be considered as ONE *pixel*. Any part of a pixel will be considered as *sub-pixel* or *dot*.



Note 1 If pixel or partial sub-pixel defects exceed 50% of the affected pixel or sub pixel area, it shall be considered as 1 defect.

Note 2 There should be no distinct non-uniformity visible through defined ND-Filter within 2 sec inspection time.

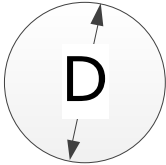
Defect type	Specification	Minor	Major
Bright dots	$N \leq 2$		✓
Dark dots	$N \leq 5$		✓

Note 1 Bright dot: Dots appear bright and unchanged in size in which LCD panel is displaying under black pattern. The bright dot must not be visible through 2% ND filter.

Note 2 Dark dot: Dots appear dark and unchanged in size in which LCD panel is displaying under pure red, green, blue pattern.

9.2.3 Mechanical defects

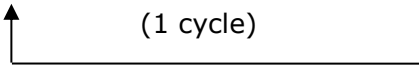
Mechanical defects in the display area for dot and line shapes, like particles, scratches and bubbles are handled the same way.

Defect type	Size	Count	Minor	Major
Dot shape 	$D \leq 0.25\text{mm}$	Ignored		✓
	$0.25\text{mm} < D \leq 0.5\text{mm}$	$N \leq 3$		✓
	$D > 0.5\text{mm}$	$N=0$		✓
Line shape 	$W \leq 0.01\text{mm}$	Ignored		✓
	$0.01\text{mm} < W \leq 0.05\text{mm}$ and $L \leq 3\text{mm}$	$N \leq 3$		✓
	$W > 0.05\text{mm}$ or $L > 3\text{mm}$	$N=0$		✓

10 Reliability data for TFT

10.1 Test condition

Table 10.1: Test condition

No.	Item	Condition		Standard	Note
1.	high temp. storage	80°C	240h	appearance w/o defect	--
2.	low. temp storage	-30°C	240h		--
3.	high temp. & high humid. storage	60°C 90%RH	240h		--
4.	high temp. operating	70°C	240h		--
5.	low temp. operating	-20°C	240h		--
6.	vibration	operating time: 1h for X,Y,Z dir. sweep frequency: 10~55~10 Hz amplitude: 1.5mm			--
7.	thermal shock	30min@-30°C → 30min@80°C 			20 cycles

Note 1: In the standard condition, there shall be no practical problem that may affect the display function. After the reliability test, the product only guarantees operation, but doesn't guarantee to fulfill all of the cosmetic specifications.

Note 2: Before cosmetic and function test, the product must have enough recovery time, at least 2 hours at room temperature.

11 Label definition

The final module is labeled with a label as depicted in Figure 11.1.

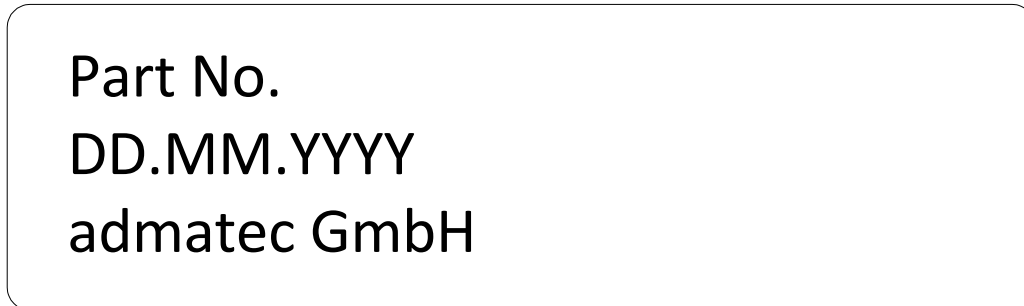


Figure 11.1 : Label definition (example)

Text definition:

Line 1: Name of module

Line 2: DD.MM.YYYY

DD: day of production

MM: month of production

YYYY: year of production

Line 3: Name of manufacturer

12 Assembly

Open both connector brackets. Connect the FFC with the TFT (see Figure 12.1) and the C-Berry TFT Adapter (see Figure 12.2). Make sure that the contacts are seen while plugging FFC to connector. Close both connector brackets. Switch off the power of the Raspberry Pi. Plug the C-Berry TFT Adapter with the Raspberry Pi such as shown in the Figure 12.3. The final assembled module is depicted in Figure 12.4.

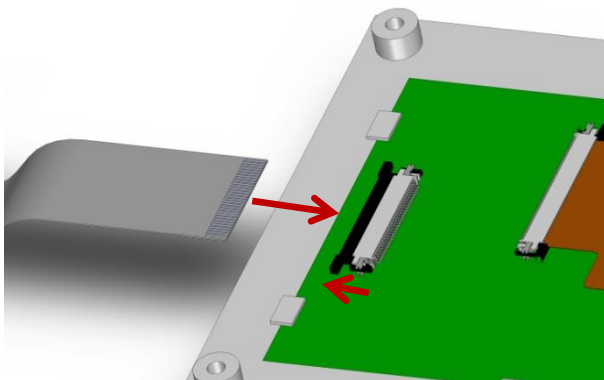


Figure 12.1: Connect FFC with TFT Module

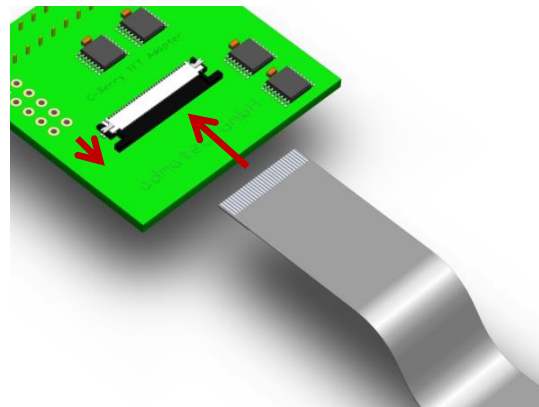


Figure 12.2: Connect FFC with C-Berry TFT Adapter

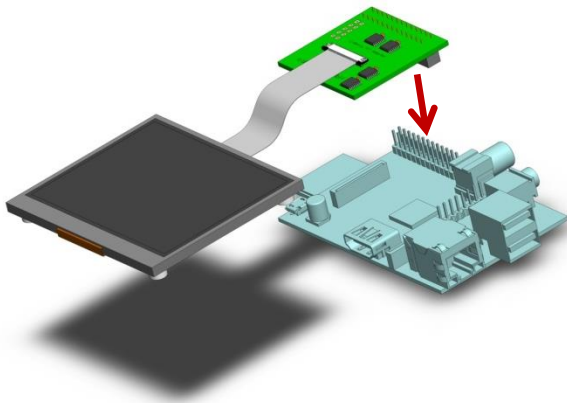


Figure 12.3: Plug C-Berry to Raspberry Pi

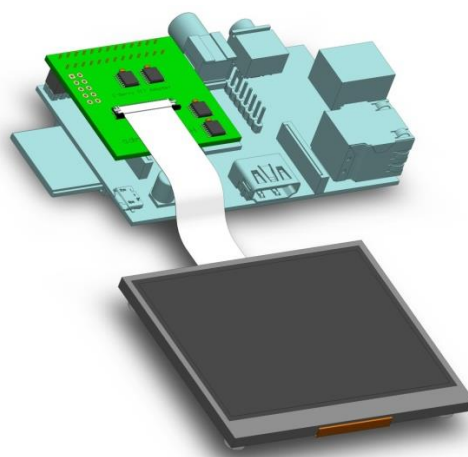


Figure 12.4: Final assembly

13.2 Drawing of C-Berry TFT Adapter

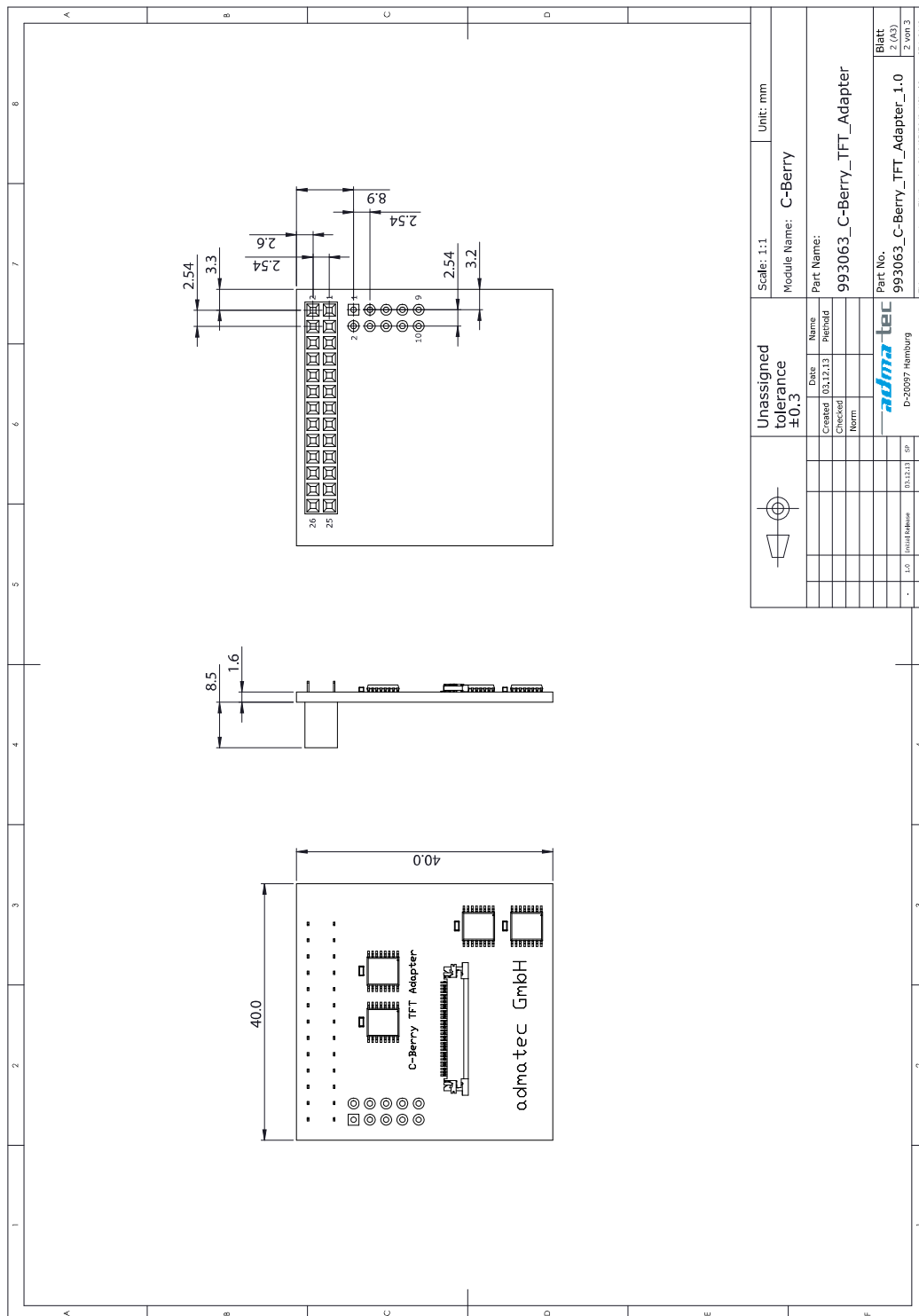


Fig 13.2: Drawing of C-Berry TFT Adapter

13.3 Drawing of the Flat Flex Cable (FFC)

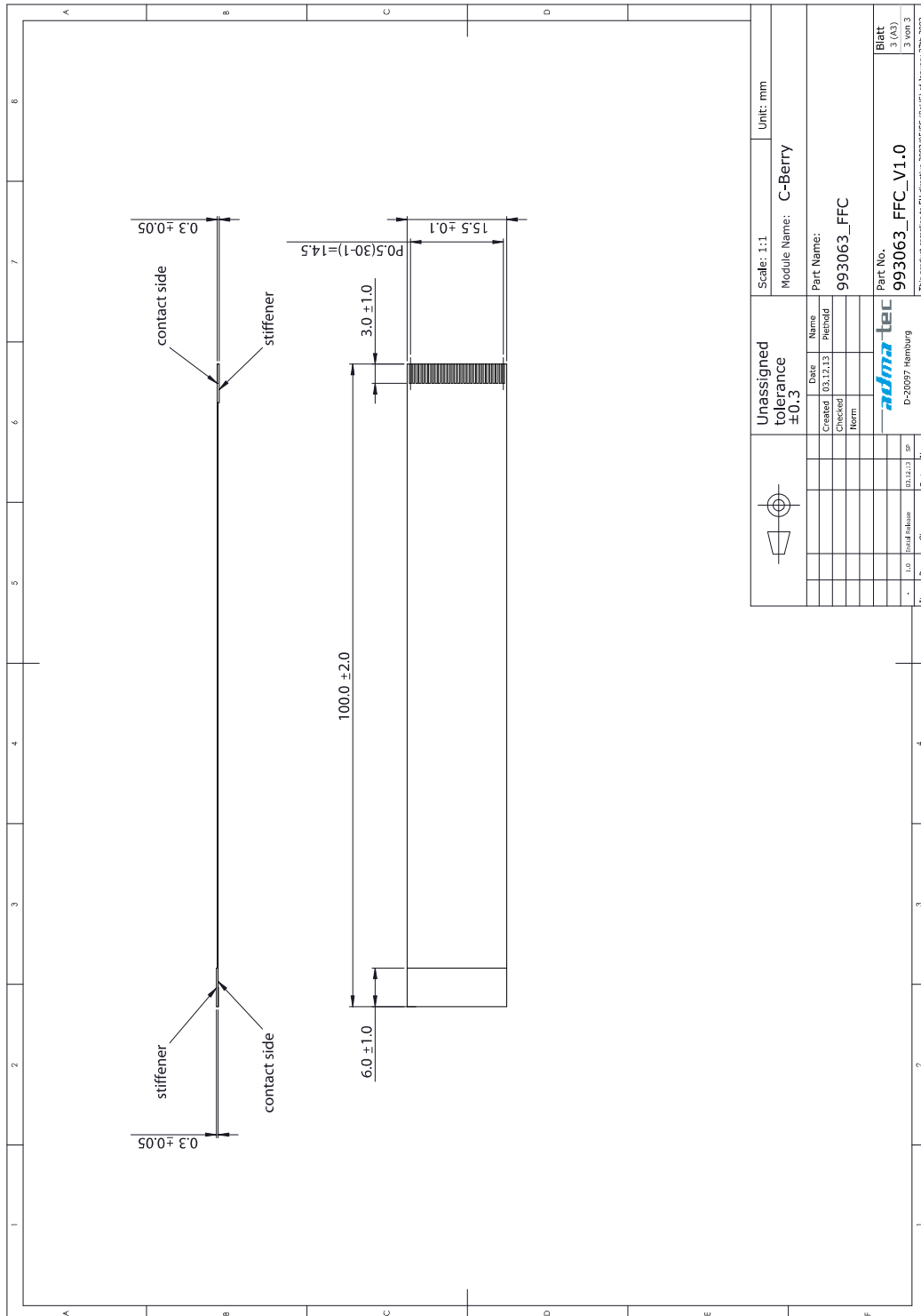


Fig 13.3: Drawing of FFC

14 LCM handling

LCMs and especially LC-glasses are very fragile and easy to damage. Please follow this > **link** < to find a guideline for recommended LCM handling. Its purpose is to help customers best in handling LCMs correctly to avoid any malfunction of LCMs due to incorrect handling.