4D SYSTEMS
TURNING TECHNOLOGY INTO ART

gen4-LCD-CAPE Range

DATASHEET

DOCUMENT DATE: **14th March 2019**
DOCUMENT REVISION: **1.1**

gen4-4DCAPE-43 (4.3” Non-Touch)
gen4-4DCAPE-43T (4.3” Resistive Touch)
gen4-4DCAPE-43CT-CLB (4.3” Capacitive Touch)
gen4-4DCAPE-50 (5.0” Non-Touch)
gen4-4DCAPE-50T (5.0” Resistive Touch)
gen4-4DCAPE-50CT-CLB (5.0” Capacitive Touch)
gen4-4DCAPE-70 (7.0” Non-Touch)
gen4-4DCAPE-70T (7.0” Resistive Touch)
gen4-4DCAPE-70CT-CLB (7.0” Capacitive Touch)
gen4-4DCAPE-xxx-SB (Super Bright, All sizes/Touch)

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Please refer to the 4D Systems website for the latest
Revision of this document

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gen4-4DCAPE - BBB

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1. Description

The gen4-LCD-CAPE range is specifically designed for the Beagle Bone Black* (BBB), and provides a 4.3", 5.0" or 7.0" primary display for the BBB for direct user interaction and information display.

Available in both Resistive Touch (GEN4-4DCAPE-xxT), Capacitive Touch (GEN4-4DCAPE-xxCT-CLB) and non-touch (GEN4-4DCAPE-xx) via special request – the non-touch version may be subject to MOQ.
(xx refers to 43, 50 and 70 accordingly)

The gen4-4DCAPE is not compatible with the previous Beagle Bone (Beagle Bone White), and can only be used with the Beagle Bone Black.

The gen4-4DCAPE features an on-board Microchip AR1021 resistive touch controller (Resistive Touch version only), which talks to the BBB over I2C. This enables a robust and reliable resistive touch platform, compared to previous gen4-4DCAPE models which used the BBB's analog inputs, which were prone to external noise and open source software. The Capacitive Touch version utilises a Focaltech capacitive touch controller, which also communicates over I2C.

The Beagle Bone Black connects directly on to an adaptor CAPE, which then connects to the display module using a 30 way FFC ribbon cable, enabling multiple mounting options. Everything the LCD CAPE requires such as power and display signals are provided from the BBB directly, via the Adaptor and FFC ribbon cable.

The gen4 LCD CAPE features an optional push buttons connector, providing capability for an external button board. Please contact Sales regarding this item, it is a special-order item only.

Mounting of the 4DCAPE is achieved with the 4x 4mm mounting holes present on the Display Module (Resistive and Non-Touch), enabling standard screws to fasten the GEN4 4DCAPE as required, or via the adhesive supplies on the Cover Lens Bezel which is part of the Capacitive Touch version.

Note (*): The Beaglebone, Beaglebone Black and Beagleboard remains the property of beaglebone.org. All references to the words Beaglebone, Beaglebone Black, Beagleboard are licensed under a Creative Commons Attribution-Share Alike 3.0 license.

2. Features

- 4.3", 5.0" and 7.0" TFT LCD CAPE options for the Beagle Bone Black
- Available in 3 models, Resistive Touch (GEN4-4DCAPE-xxT), Capacitive Touch (GEN4-4DCAPE-xxCT) and Non-Touch (GEN4-4DCAPE-xx) where xx is 43, 50 and 70.
- 480x272 Resolution 4.3" TFT LCD Display, or 800x480 Resolution 5.0" and 7.0" TFT LCD Display
- 7 optional push buttons via external button board is available on request, enabling LEFT, RIGHT, UP, DOWN, ENTER, RESET and POWER functionality. This push button board is only available on request and is made to order.
- EEPROM CAPE ID selection via DIP switch
- 4x 4.0mm Mounting holes on Non-Touch and Resistive Touch modules, or via adhesive for Capacitive Touch model.
- RoHS and CE Compliant.

GEN4-4DCAPE Adaptor

GEN4-4DCAPE 4.3" Resistive Touch Display

3. Getting Started

3.1. Requirements

The gen4-LCD-CAPE's are designed to work with the Debian Operating System supplied for the Beagle Bone Black. It could however be adapted to work on other distributions by the User.

The Requirements for use are:

- GEN4 LCD Cape + Adaptor + FFC Cable
- Beagle Bone Black (BBB) with suitable distribution loaded
- 5V DC Supply suitable for the Beagle Bone Black (using DC Jack), recommended 2A @ 5V.
- A Stylus is recommended for accurate touch, however is not required.

3.2. How to use the GEN4 LCD CAPE

The following steps should be all that is required to use the gen4-4DCAPE:

1. Connect the gen4-4DCAPE Adaptor to the Beagle Bone Black while the Beagle Bone Black is not powered.
2. Connect the 30 way FFC cable to the gen4-4DCAPE Adaptor, and to the gen4-4DCAPE Display. The 30 way FFC connectors are 'Upper Contact' meaning the blue stiffener on the FFC cable should be against the PCB, with the metal pads on the cable facing upward.
3. If using with other capes on your BBB, ensure the gen4-4DCAPE is not conflicting pin wise to any other cape installed.
4. Ensure the EEPROM ID switch on the gen4-4DCAPE is set to a different EEPROM ID to any other capes.
5. Ensure your Beagle Bone Black is loaded with a suitable Linux distribution which is compatible with 4D Systems gen4-4DCAPE's. Debian is the distribution shipping with current BBB boards now, and can be installed onto older BBB's. If the distribution you wish to use is not supporting 4D Systems gen4-4DCAPE's by default, the supplied source files can be used, please refer to our Product Page.
6. Connect a 5V Supply to the DC Jack of the Beagle Bone Black. It is recommended to use a 2A supply to ensure sufficient supply. By default, the gen4-4DCAPE requires power via the DC Jack, as the on-board power management of the BBB may be overloaded depending on other systems installed. So, the USB jack will not supply power to the gen4-4DCAPE unless the Solder Bridge jumper on the top of the gen4-4DCAPE Adaptor board, is cut and resoldered. (Discussed further in a later section)
7. Once power is connected, something should be displayed on the gen4-4DCAPE a few moments after it has started to boot. Each distribution will behave differently and require different input from the User. It is recommended to have a keyboard attached while setting the system up, as login details etc may be required. Some distributions may prompt for LCD calibration, while others may prompt for Username/Password.

   If there is no output, check the bootloader version of the BBB by running the following in the command terminal:

   ```
   $ sudo /opt/scripts/tools/version.sh | grep bootloader
   ```

   The version of the bootloader in the microSD and eMMC should be later than 2018.13 and the microSD's bootloader must be older than what is loaded in the eMMC in order for the CAPE to work properly.

   A quick fix is to always remove the version of u-boot from the eMMC, for example this clears out the first 10Mb of the drive:

   ```
   $sudo dd if=/dev/zero of=/dev/mmcblk1 bs=1M count=10
   ```

For support of the BBB and various distributions, please seek support from the respective websites associated with the BBB itself or the distributions – See Section 5.

A good place to start for information and support regarding the BBB and various distributions available, is www.beagleboard.org

This website details the latest firmware images for the BBB: http://beagleboard.org/latest-images

This website details how to get started with the BBB: http://beagleboard.org/getting-started

For support regarding the 4DCAPE hardware itself, please go to the 4D Systems website and either contact Support directly via a Ticket, or use the 4D Systems Forum. http://forum.4dsystems.com.au

3.3. Changing the brightness (Debian)

It is possible to change the backlight brightness as the backlight is PWM controlled.

Please note, these instructions may become obsolete as new versions of Debian are released, or if different distributions are used.

One method is to SSH into the Beaglebone Black from your PC, and set the backlight value that way. Note this does not persist over restarts, so this would need to be entered into a startup script if the setting is required to be set each startup.

At the command prompt, type the following:

```
# sudo su
# cd /sys/class/backlight/backlight
# echo 50 > brightness
```

Where 50 represents 50%, this can be changed to any number from 0 to 100 as required.

The exact path may vary with distributions, so check the /sys/class/backlight path to see what backlight file exists.

3.4. Calibrating resistive touch (Debian)

When a distribution is used for the first time with a gen4-4DCAPE, often a LCD calibration application will start automatically. However, depending on the distribution in use, this may or may not happen. Some distributions may not even come with a calibration application loaded.

For ones that do have the calibration program loaded by default, and if the calibration is input incorrectly and it is required to be set again, it can be generally be started from the 'Start' menu.

Note, this may change as newer distributions become available, or if different distributions are used, so these instructions may become obsolete or inaccurate.

4. EEPROM Details

On the gen4-4DCAPE Display Module there is an EEPROM which the BBB reads and uses to determine which drivers/modules to load based on overlay files which exist on that specific distribution.

There is a DIP Switch on the top left corner of the 4DCAPE Display Module, which allow the EEPROM ID to be set to 4 different values, so 4 different CAPES can be added to a single BBB if required. Only 1 LCD CAPE can be installed at once however.

The EEPROM ID will change from 0x57 when both switches are OFF, 0x56 when the left-hand side (A0) is ON, 0x55 when the right-hand side (A1) is ON, and 0x54 when both are ON.

5. Hardware Drivers

The gen4-4DCAPE features the AR1021 resistive touch IC, made by Microchip, and a driver is supplied for this by 4D Systems for use with Linux systems such as Debian. Communications to the AR1021 are via I2C, specifically utilising the I2C #1 channel on the BBB. Please refer to the Schematic Diagram for more information about its connections.

The gen4-4DCAPE also features the TI TPS61165 backlight drive IC, which implements a 1-wire communications protocol between the BBB and the Driver IC, enabling software commands to be sent from the BBB rather than PWM signals, to vary the backlight brightness. This results in lower noise and a more stable backlight system. A Driver for this is supplied by 4D Systems for use with Linux system such as Debian.

The Capacitive Touch version of the gen4-4DCAPE features a Focaltech Capacitive Touch controller built into the display. This communicates to the BBB using the I2C #1 channel. A Driver for this is supplied by 4D Systems for use with Linux system such as Debian.

6. Display Precautions

• Avoid having to display the same image/object on the screen for lengthy periods of time. This will cause a burn-in which is a common problem with all types of display technologies. Blank the screen after a while or dim it very low by adjusting the contrast. Better still; implement a screen saver feature.

• Moisture and water can damage the display. Moisture on the surface of a powered display will cause the electrodes to corrode. Wipe off any moisture gently or let the display dry before usage.

• Dirt from fingerprint oil and fat can easily stain the surface of the display. Gently wipe off any stains with a soft lint-free cloth.

• The performance of the display will degrade under high temperature and humidity. Avoid such conditions when storing.

• Do not tamper with the display flex cable that is connected to the control board. This may affect the connection between the display and the driving circuitry and cause failure. Under no circumstances should the display flex be disconnected from the PCB and power applied to the PCB, as this could result in instant failure of the CAPE.

• Displays are susceptible to mechanical shock and any force exerted on the module may result in deformed zebra stripes, a cracked display cell and broken backlight

• Always use the mounting holes (where applicable) on the module to mount the display.

7. Optional Button Board

The gen4-4DCAPE has the option to use an external button board, for actions such as up, down, left, right, enter/return, power and reset, or as required by the User.

Alternatively, any momentary push buttons can be attached, as they are simply a connection between a GPIO and GND to form the button press connection. 4D Systems provides a button board which can be used if required, and supplied/sold on request. It is not offered as part of the module as standard.

The gen4-4DCAPE button board is a small PCB with a row of 7 momentary push buttons on the front, and a 10 way FFC connector designed for a 10-way ribbon cable to attach to, and then connect to the gen4-4DCAPE Adaptor board.

The 10 way FFC connectors for the gen4-gen4-4DCAPE Button Board are Bottom Contact, meaning the terminals need to be towards the PCB, and the stiffener needs to be facing upwards (opposite to the main 30 way FFC cable to the display).

8. Power Source

The gen4-gen4-4DCAPE power source comes from the BBB, via the gen4-4D CAPE Adaptor board which plugs on top of the BBB itself.

The Adaptor board taps into the VDD_5V bus power on the BBB, which is connected to the DC Barrel Jack on the BBB. **It will not receive power when the BBB is powered from USB**, as the USB power goes via the BBB power management IC, which then is supplied on the SYS_5V bus.

It has been designed this way by default as the SYS_5V system has finite capabilities, and depending what else the BBB is doing and what other gen4-CAPES/Devices are connected, there may not be sufficient power left to supply the gen4-4DCAPE. Also, if a SB (Super Bright) version of the gen4-4DCAPE is used, it is very likely the USB power management system would not supply enough power even if nothing else was connected. It however is possible to modify the gen4-4DCAPE Adaptor board to use the SYS_5V bus, if required.

On the top of the gen4-4DCAPE Adaptor is a Solder Jumper, which has 3 pads. By default, there is a track connecting the centre pad to the side marked VDD_5V. If SYS_5V is required instead, then this VDD_5V track must be cut between these 2 pads, and a solder blob be added instead between the centre pad and the pad marked SYS_5V. DO NOT have both sides connected to the centre pad at once, else your BBB may be damaged.

A sharp craft knife, a soldering iron and solder are required ideally for this modification.

Take care when doing this modification, as warranty claims will not apply due to damage of the product while undertaking this modification.

9. Display Module Part Numbers

The following is a breakdown on the part numbers and what they mean.

Example:
gen4-4DCAPE-70CT-SB

gen4 - gen4 Display Range
4DCAPE - Display Family
70 - Display size (7.0”)
T - Resistive Touch.
CT - Capacitive Touch (with CLB)
SB - Super Bright Display

- For part numbers which do not include T or CT, these are non-touch variants.
- Cover Lens Bezels (CLB) are glass fronts for the display module with overhanging edges, which allow the display module to be mounted directly into a panel using special adhesive on the overhanging glass. These are available for Capacitive Touch only.

10. Cover Lens Bezel – Tape Spec

The perimeter of the CLB display modules features double-sided adhesive tape, designed to stick directly onto a panel, enclosure, box etc without the need for any mounting screws or hardware.

The tape used is 3M 9495LE tape, which uses the well-known and strong 3M 300LSE adhesive.

The double-sided adhesive has a thickness of 0.17mm once the backing has been removed.

More information on this adhesive can be found on the 3M website.
http://multimedia.3m.com/mws/media/771683O/3mtm-double-coated-tapes-9474le-9495le.pdf

11. Standard FFC Specifications

Between the gen4-4DCAPE-Adaptor and the gen4-CAPE Display Module, the following FFC cable is supplied:

30 Pin Flexible Flat Cable, 150mm Long, 0.5mm (0.02") pitch
Cable Type: AWM 20624 80C 60V VW-1
Heat Resistance 80 Degrees Celsius
Connections on the opposite side at each end (Type B)

Between the gen4-4DCAPE-Adaptor and the gen4-4DCAPE Button Board (when purchased via Sales Dept), the following FFC cable is supplied:

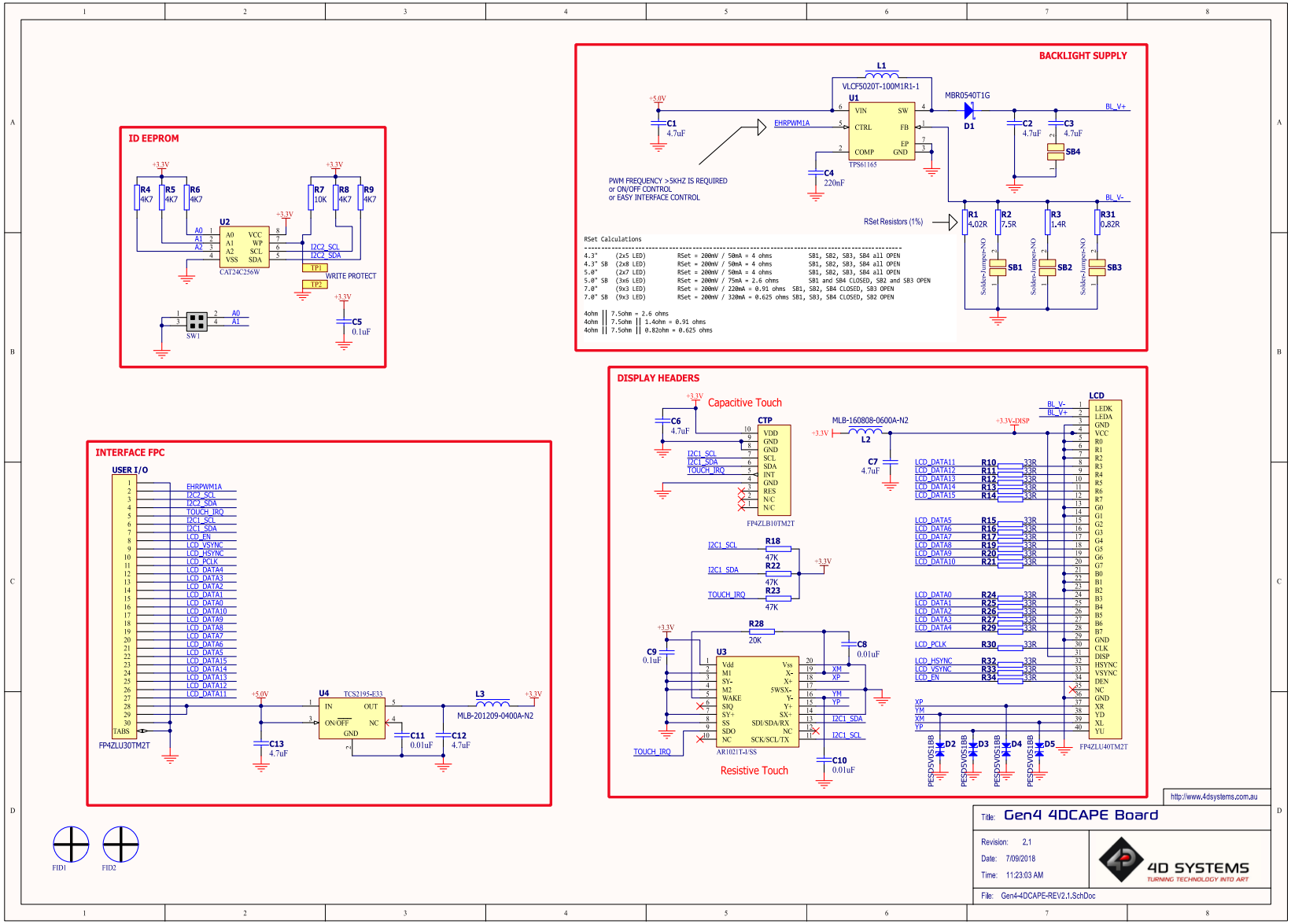
10 Pin Flexible Flat Cable, 150mm Long, 0.5mm (0.02") pitch
Cable Type: AWM 20624 80C 60V VW-1
Heat Resistance 80 Degrees Celsius
Connections on the opposite side at each end (Type B)

12. Software / Driver Disclaimer

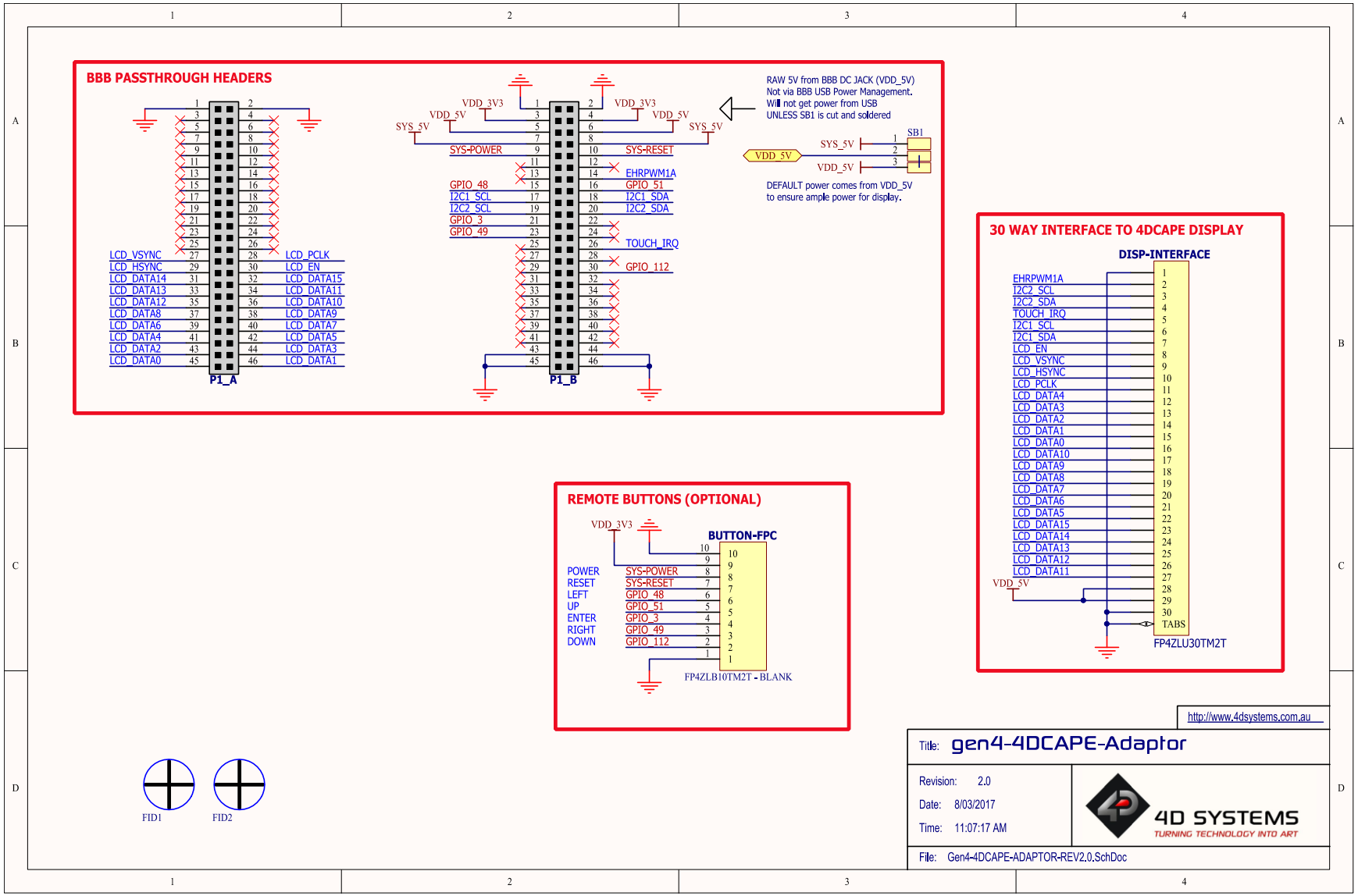
4D Systems has developed this gen4-4DCAPE for the Beaglebone Black. 4D Systems does NOT support any software associated with the BBB itself, as 4D Systems is not involved with the development or support of the BBB Operating Systems. It is up to the user to determine which distributions are used on the BBB, and therefore which are compatible with this CAPE. 4D Systems will supply the source code for the gen4-4DCAPE, which is installed on the Debian Distribution for the BBB by default, however the source can be used if Users wish to use another operating system. It will however be up to the User to get this operational. Assistance can be provided on our Forum. http://forum.4dsystems.com.au

4D Systems is not responsible for issues regarding software or drivers associated with the BBB and the compatibility with this product. Community software support is available via resources at www.beaglebone.org/discuss

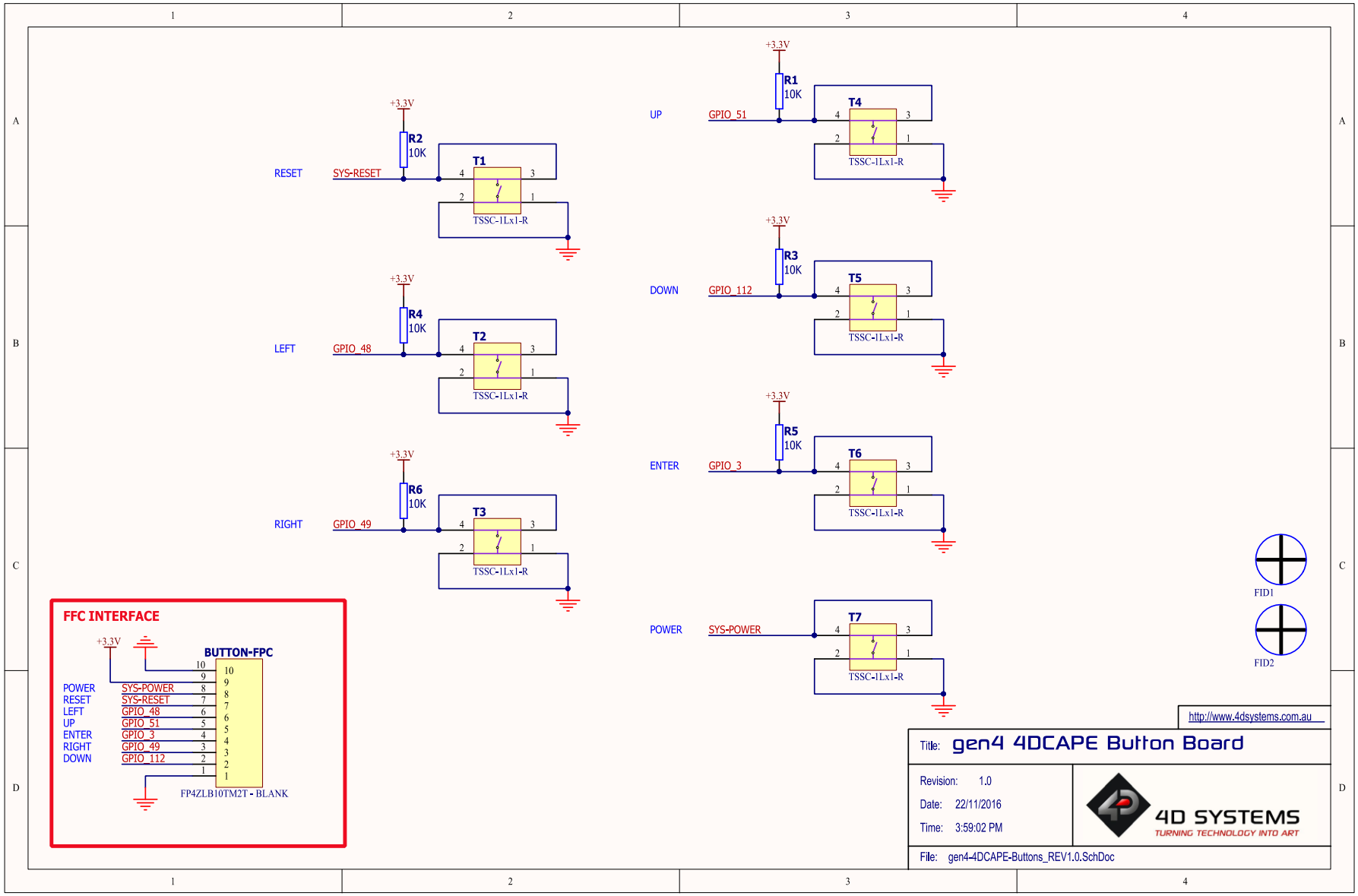
13. Schematic Diagram (4D CAPE)



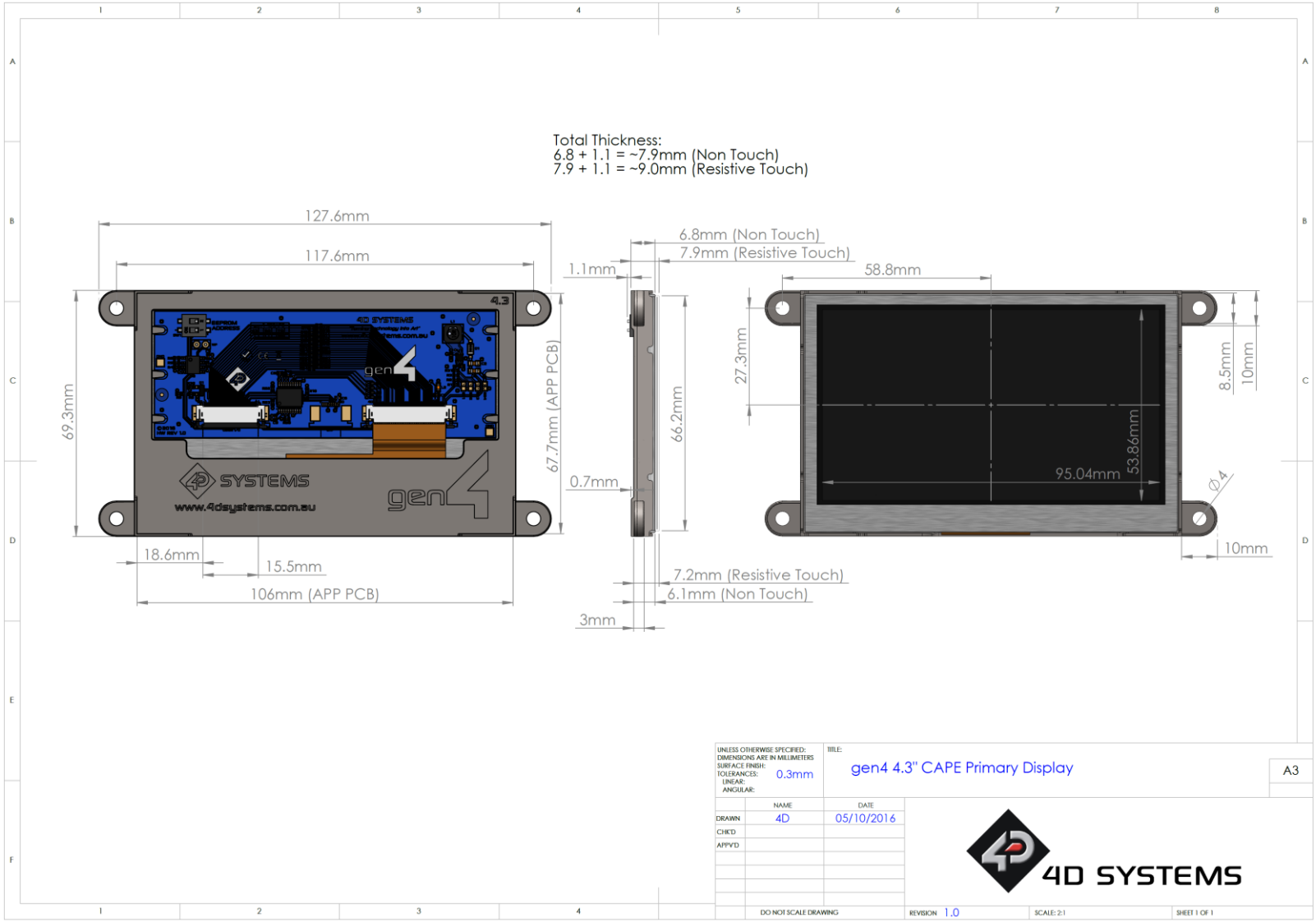
14. Schematic Diagram (gen4-4DCAPE Adaptor)



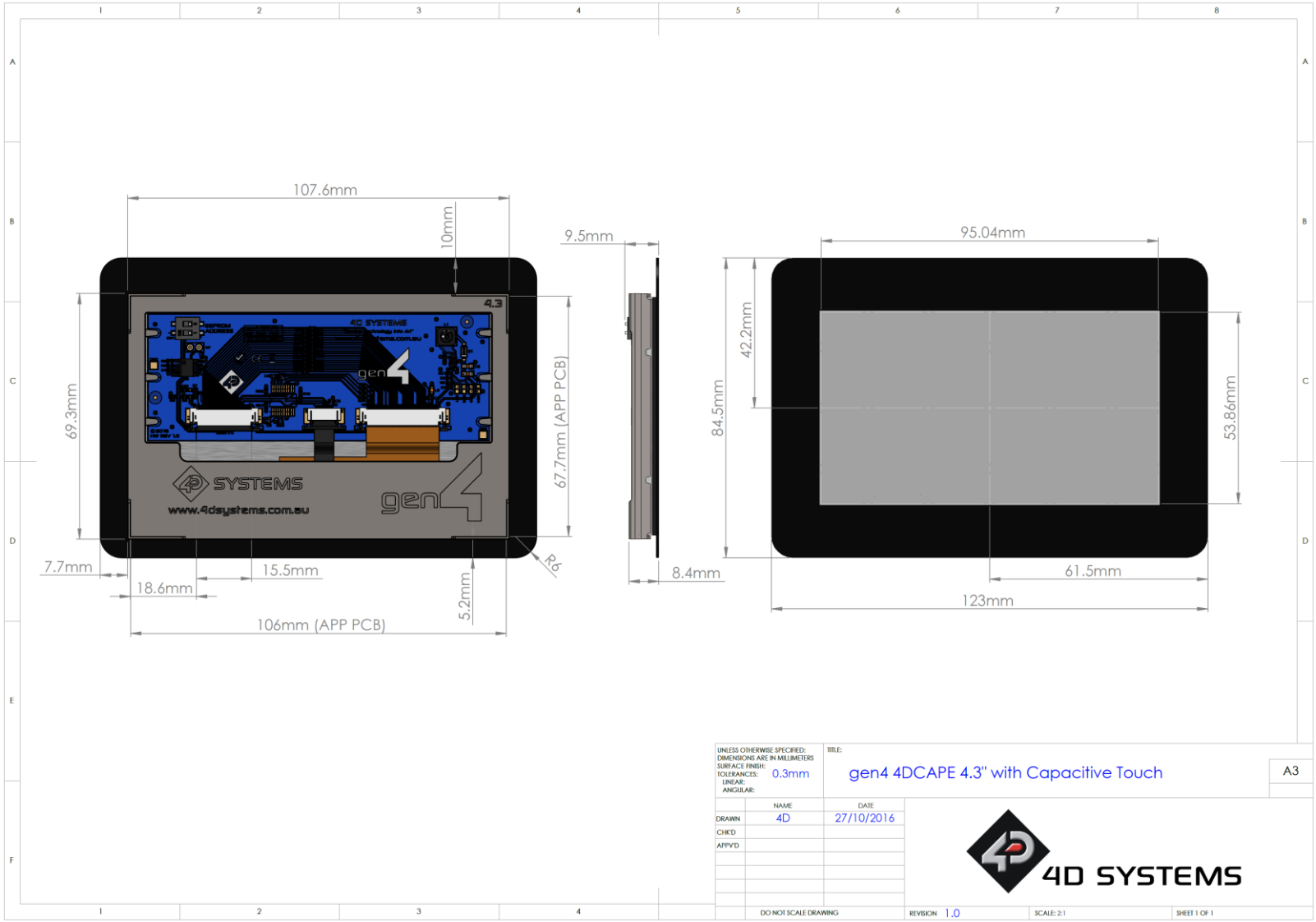
15. Schematic Diagram (gen4-4DCAPE Button Board – OPTIONAL)



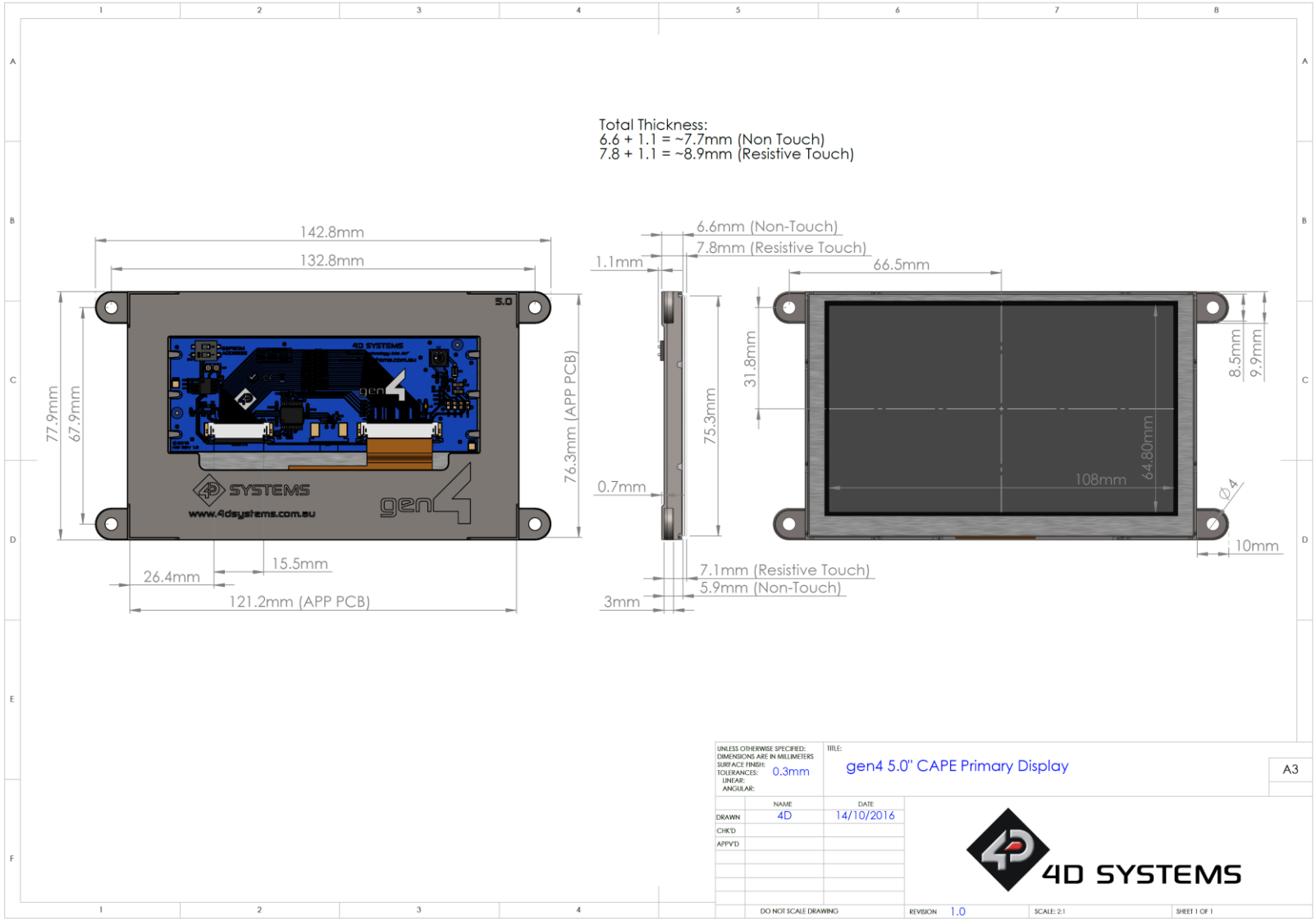
16. Mechanical Details – 4.3” (Non-Touch & Resistive Touch)



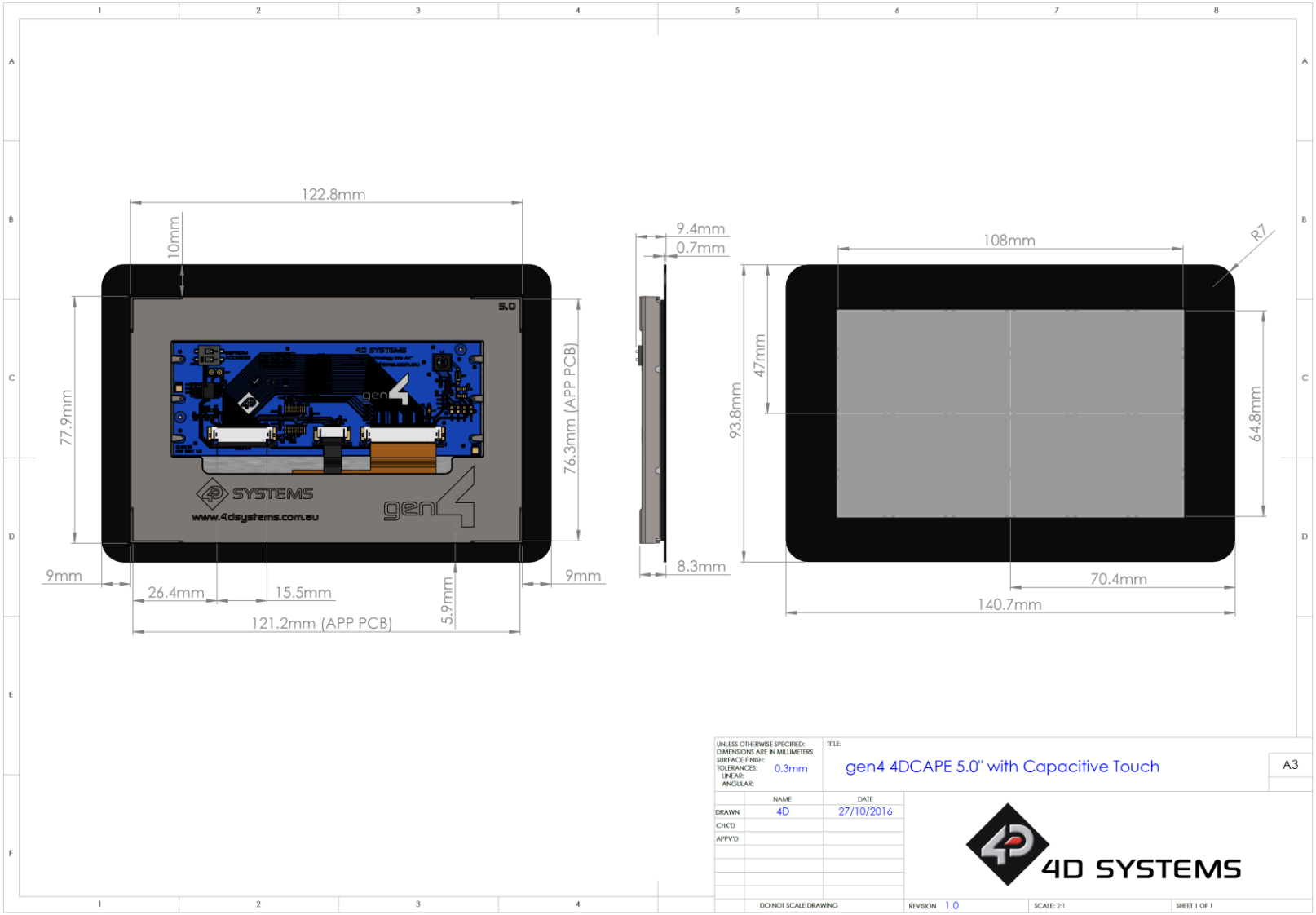
17. Mechanical Details – 4.3” (Capacitive Touch)



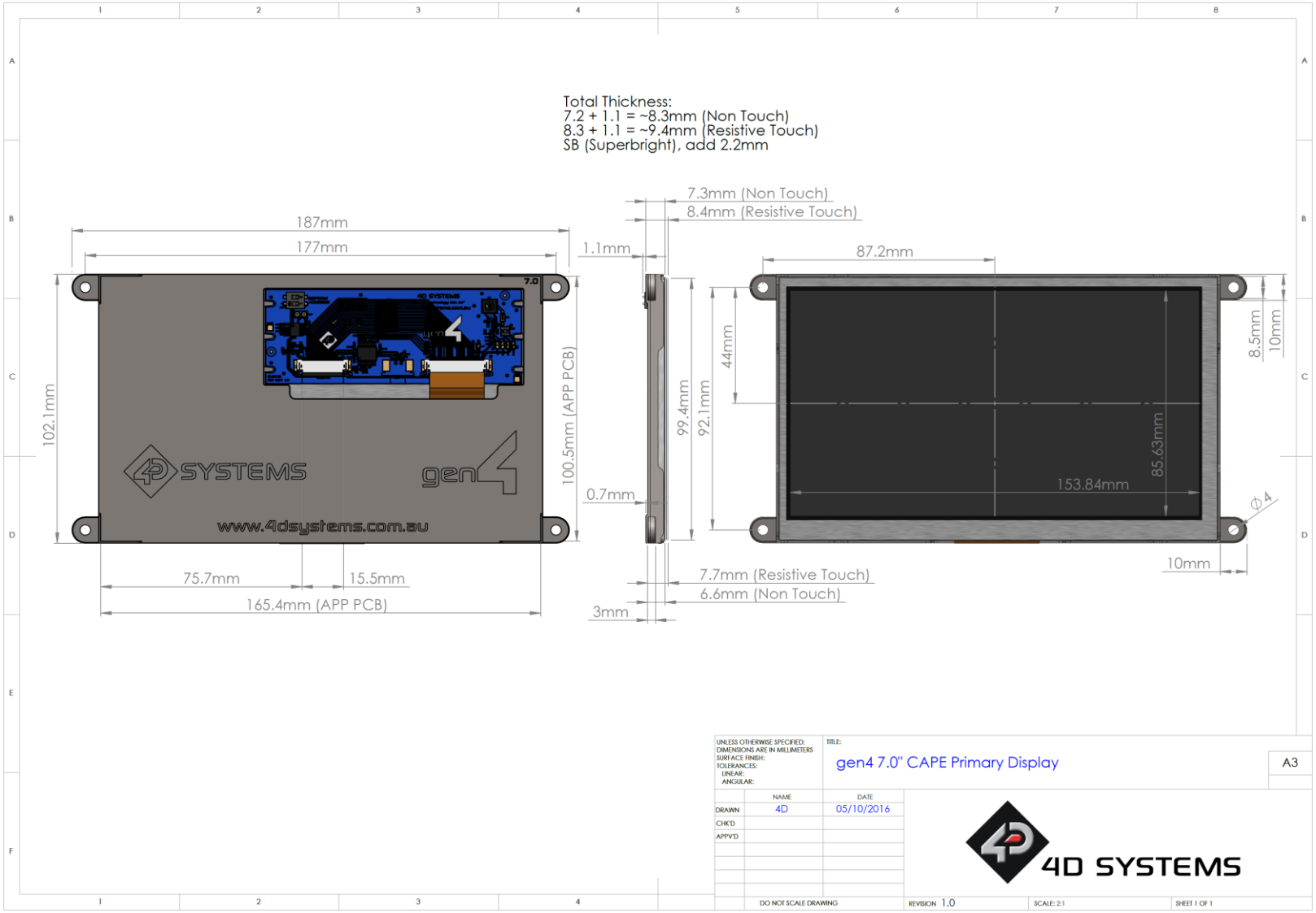
18. Mechanical Details – 5.0" (Non-Touch & Resistive Touch)



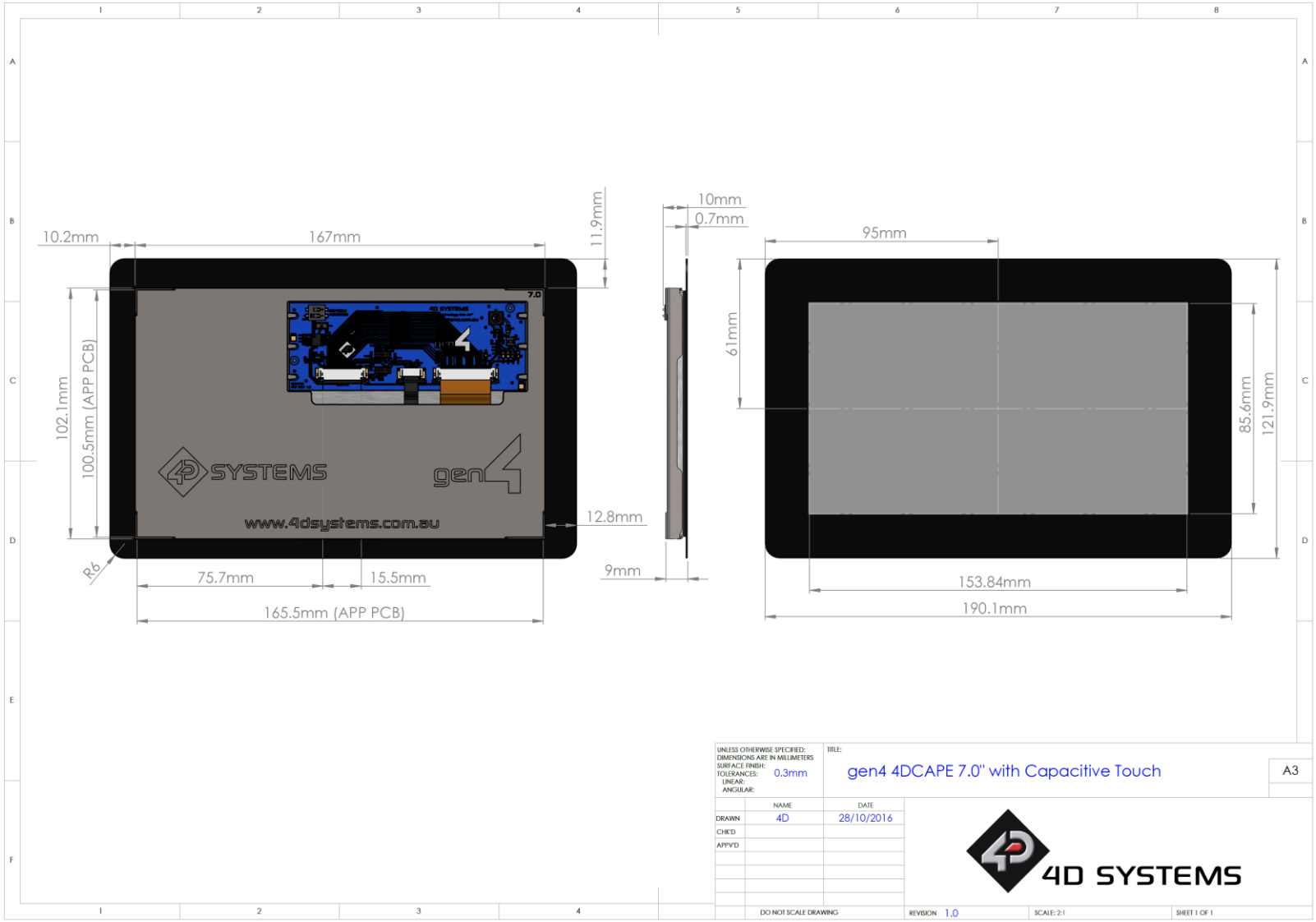
19. Mechanical Details – 5.0” (Capacitive Touch)



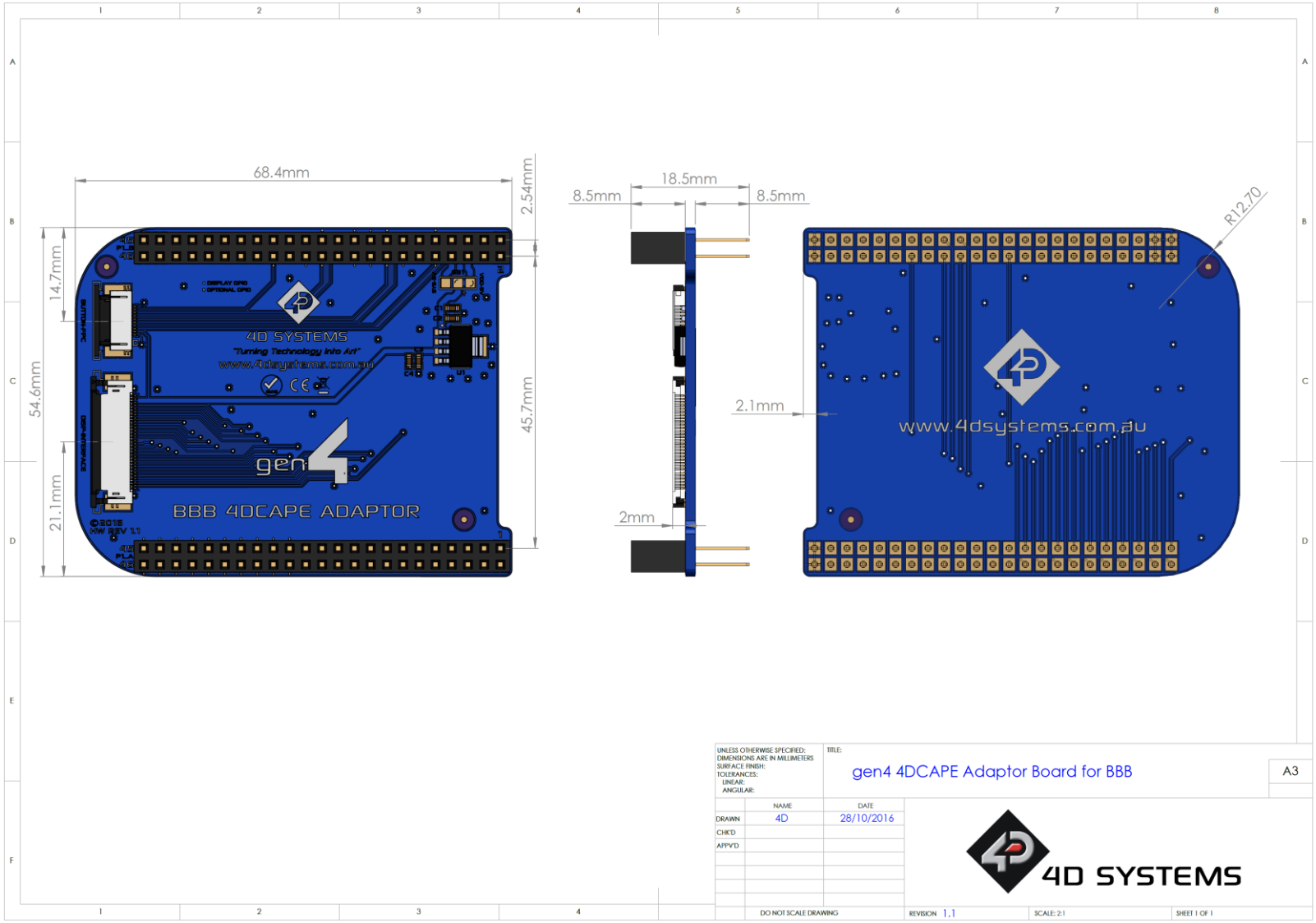
20. Mechanical Details – 7.0" (Non-Touch & Resistive Touch)



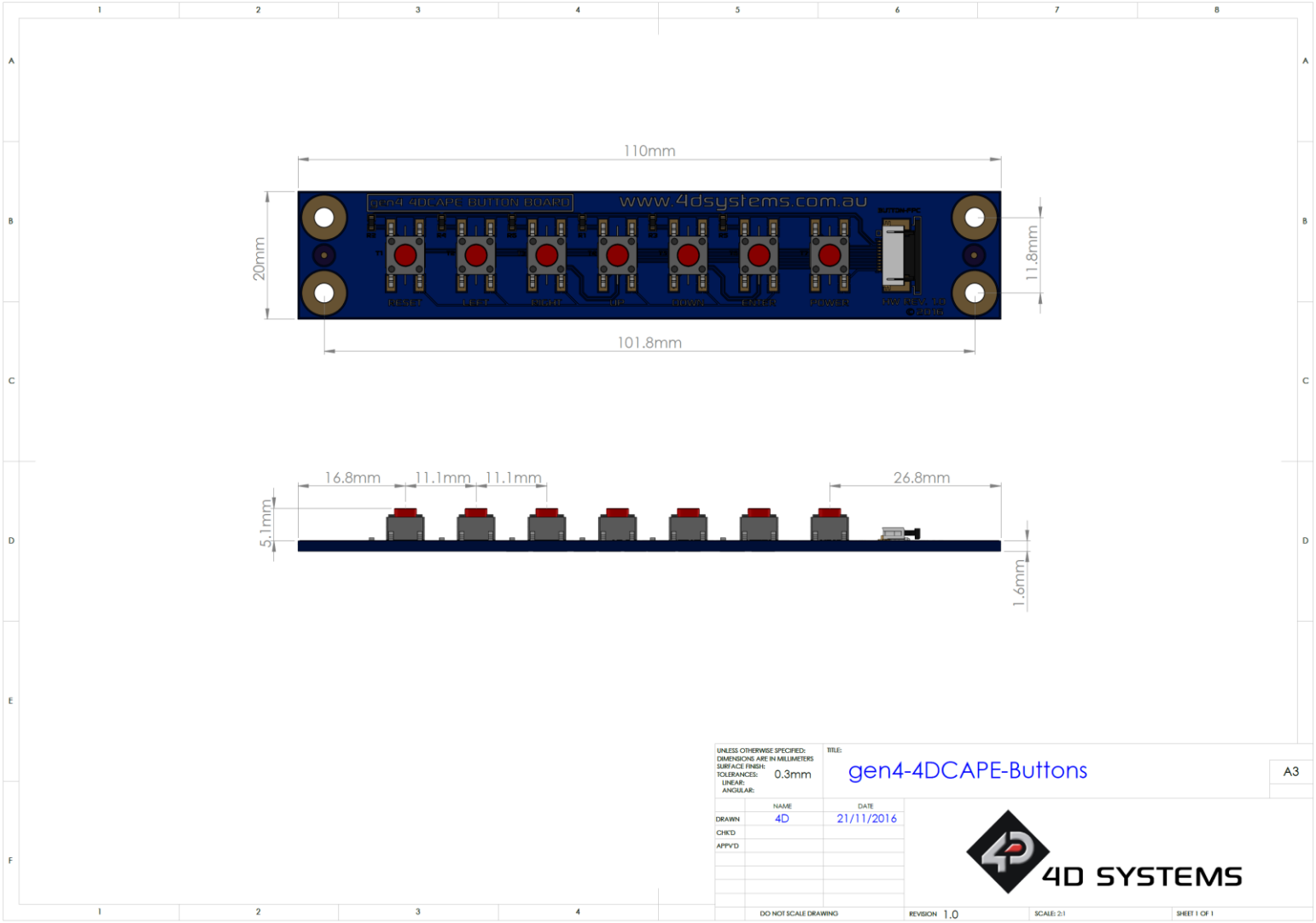
21. Mechanical Details – 7.0" (Capacitive Touch)



22. Mechanical Details (gen4-4DCAPE Adaptor)



23. Mechanical Details (gen4-4DCAPE Button Board – OPTIONAL – BUILT ON REQUEST ONLY)



24. Specifications

ABSOLUTE MAXIMUM RATINGS	
Operating ambient temperature	-20°C to +70°C
Storage temperature	-30°C +80°C

NOTE: Stresses above those listed here may cause permanent damage to the device. This is a stress rating only and functional operation of the device at those or any other conditions above those indicated in the recommended operation listings of this specification is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

GLOBAL CHARACTERISTICS BASED ON OPERATING CONDITIONS					
Parameter	Conditions	Min	Typ	Max	Units
Supply Current (5V bus of BBB) (**INCLUDES POWER BBB USES ALSO** – NOTE)	gen4-4DCAPE-43 (Max Brightness)	--	590	--	mA
	gen4-4DCAPE-43T (Max Brightness)	--	600	--	mA
	gen4-4DCAPE-43CT (Max Brightness)	--	620	--	mA
	gen4-4DCAPE-43-SB (Max Brightness)	--	690	--	mA
	gen4-4DCAPE-43T-SB (Max Brightness)	--	700	--	mA
	gen4-4DCAPE-43CT-SB (Max Brightness)	--	720	--	mA
	gen4-4DCAPE-50 (Max Brightness)	--	700	--	mA
	gen4-4DCAPE-50T (Max Brightness)	--	710	--	mA
	gen4-4DCAPE-50CT (Max Brightness)	--	720	--	mA
	gen4-4DCAPE-50-SB (Max Brightness)	--	830	--	mA
	gen4-4DCAPE-50T-SB (Max Brightness)	--	840	--	mA
	gen4-4DCAPE-50CT-SB (Max Brightness)	--	850	--	mA
	gen4-4DCAPE-70 (Max Brightness)	--	980	--	mA
	gen4-4DCAPE-70T (Max Brightness)	--	990	--	mA
	gen4-4DCAPE-70CT (Max Brightness)	--	1100	--	mA
	gen4-4DCAPE-70-SB (Max Brightness)	--	1190	--	mA
	gen4-4DCAPE-70T-SB (Max Brightness)	--	1200	--	mA
	gen4-4DCAPE-70CT-SB (Max Brightness)	--	1220	--	mA
Display Endurance	Hours of operation, measured to when display is 50% original brightness	30000	--	--	H
Touch Screen Endurance (Resistive Touch)	Number of touches/hits with a 12.5mm tip at a rate of 2x per second with 250gf force	--	1M	--	Touches
	Slide stylus on screen, 100gf force, 60mm/s speed with a 0.8mm polyacetal tip stylus pen	--	100K	--	Slides
Touch Screen Transparency	Resistive Touch	82	--	--	%
	Capacitive Touch	90	--	--	%
Touch Screen Operational Force (Resistive Touch)	Only use Finger or Stylus, do not use anything sharp or metal	20	--	100	Gf
CLB Hardness (Capacitive Touch)	Cover Lens Bezel Glass Hardness	--	6	--	H

LCD INFORMATION		
Parameter	**Conditions**	**Specification**
Display Type		TFT Transmissive LCD
Display Sizes		4.3”, 5.0” or 7.0” Diagonal
Display Resolution		480 x 272 (Landscape Viewing) – 4.3” 800 x 480 (Landscape Viewing) – 5” & 7”
Display Brightness	gen4-4DCAPE-43 (Max Brightness)	500 cd/m2
	gen4-4DCAPE-43T (Max Brightness)	400 cd/m2
	gen4-4DCAPE-43CT (Max Brightness)	475 cd/m2
	gen4-4DCAPE-43-SB (Max Brightness)	1020 cd/m2
	gen4-4DCAPE-43T-SB (Max Brightness)	825 cd/m2
	gen4-4DCAPE-43CT-SB (Max Brightness)	880 cd/m2
	gen4-4DCAPE-50 (Max Brightness)	500 cd/m2
	gen4-4DCAPE-50T (Max Brightness)	400 cd/m2
	gen4-4DCAPE-50CT (Max Brightness)	475 cd/m2
	gen4-4DCAPE-50-SB (Max Brightness)	820 cd/m2
	gen4-4DCAPE-50T-SB (Max Brightness)	650 cd/m2
	gen4-4DCAPE-50CT-SB (Max Brightness)	705 cd/m2
	gen4-4DCAPE-70 (Max Brightness)	500 cd/m2
	gen4-4DCAPE-70T (Max Brightness)	400 cd/m2
	gen4-4DCAPE-70CT (Max Brightness)	475 cd/m2
	gen4-4DCAPE-70-SB (Max Brightness)	844 cd/m2
	gen4-4DCAPE-70T-SB (Max Brightness)	679 cd/m2
	gen4-4DCAPE-70CT-SB (Max Brightness)	758 cd/m2
Display Contrast Ratio	Typical	500:1
Display Viewing Angles	Above Centre	70 Degrees
	Below Centre	60 Degrees
	Left of Centre	70 Degrees
	Right of Centre	70 Degrees
Display Viewing Direction		12 o’clock Display (Optimal viewing is from above when in Landscape/Wide mode)
Display Backlighting	gen4-4DCAPE-43xx Models	2x5 Parallel LED’s
	gen4-4DCAPE-43xx-SB Models	2x8 Parallel LED’s
	gen4-4DCAPE-50xx Models	2x6 Parallel LED’s
	gen4-4DCAPE-50xx-SB Models	3x6 Parallel LED’s
	gen4-4DCAPE-70xx Models	9x3 Parallel LED’s
	gen4-4DCAPE-70xx-SB Models	9x3 Parallel LED’s
Pixel Pitch	4.3”	0.198 x 0.198mm (Square pixels)
	5.0”	0.135 x 0.135mm (Square pixels)
	7.0”	0.1925 x 0.179mm (non-Square pixels)
Pixel Density	4.3”	128 DPI/PPI
	5.0”	183 DPI/PPI
	7.0”	132 DPI/PPI (Horizontal) 142 DPI/PPI (Vertical)

25. Hardware Revision History (4D CAPE)

Revision Number	Date	Description
1.0	28/10/2016	Initial Public Release Version – ONLY FOR 4.3” MODEL
2.1	23/11/2016	Updated Version – For All Models, including SB Fixed bottleneck with power supply, apparent on 5.0” and higher Added local 3.3V regulator Removed FET Polarity Protection

26. Hardware Revision History (4D CAPE Adaptor)

Revision Number	Date	Description
1.0	28/10/2016	Initial Public Release Version – ONLY FOR 4.3” MODEL
1.1	23/11/2016	Updated Version – For All Models, including SB Fixed bottleneck with power supply, apparent on 5.0” and higher Removed 3.3V Regulator, changed FFC to use 5V rather than 3.3V

27. Datasheet Revision History

Revision Number	Date	Description
1.0	08/03/2017	Initial Public Release
1.1	14/03/2019	Cosmetic Changes to gen4 Datasheet range

28. Ordering Information

ORDERING INFORMATION
Order Code:
GEN4-4DCAPE-43 (Non-Touch) GEN4-4DCAPE-43T (Resistive Touch) GEN4-4DCAPE-43CT (Capacitive Touch) GEN4-4DCAPE-50 (Non-Touch) GEN4-4DCAPE-50T (Resistive Touch) GEN4-4DCAPE-50CT (Capacitive Touch) GEN4-4DCAPE-70 (Non-Touch) GEN4-4DCAPE-70T (Resistive Touch) GEN4-4DCAPE-70CT (Capacitive Touch) **Packaging:** Module sealed in antistatic foam padded 4D Systems Box

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