LAMPIRAN

Koding

```python
import cv2
import numpy as np
from tkinter import *
from PIL import ImageTk,Image
from threading import Thread
import os
import time
import RPi.GPIO as GPIO


judul = "Judul"
GPIO_TRIGGER = 20
GPIO_ECHO = 26

GPIO.setmode(GPIO.BCM)

GPIO.setup(GPIO_TRIGGER, GPIO.OUT)
GPIO.setup(GPIO_ECHO, GPIO.IN)

GPIO.output(GPIO_TRIGGER,False)

class ThreadTimer(Thread):
    def __init__(self, group=None, target=None, name=None, args=(),
kwargs=None, verbose=None):
        super(ThreadTimer, self).__init__(group=group, target=target,
name=name)

        self.gui = args[0]
        self.runningState = False
        self.statusSuaraPeringatan = False

    def run(self):
        self.runningState = True

        timeoutBeep = time.time()
        while self.runningState:
            GPIO.output(GPIO_TRIGGER, True)

            time.sleep(0.00001)
            GPIO.output(GPIO_TRIGGER, False)

            StartTime = time.time()
            StopTime = time.time()

            while GPIO.input(GPIO_ECHO) == 0:
                StartTime = time.time()

            while GPIO.input(GPIO_ECHO) == 1:
                StopTime = time.time()

            TimeElapsed = StopTime - StartTime

            jarak = (TimeElapsed * 17150)
            jarak = round(jarak, 2)

            if self.runningState:
                self.gui.updateJarak(jarak)
```

```python
                    if timeoutBeep < time.time():
                        if jarak < 50:
                            # os.system('omxplayer -o local beep.mp3')
                            # os.system('mpg321 beep.mp3 &')
                            timeoutBeep = time.time() + 1
                        elif jarak < 100:
                            # os.system('omxplayer -o local beep.mp3')
                            #   os.system('mpg321 beep.mp3 &')
                            timeoutBeep = time.time() + 1

    def stop(self):
        self.runningState = False


class ThreadKamera(Thread):
    def __init__(self, group=None, target=None, name=None, args=(),
kwargs=None, verbose=None):
        super(ThreadKamera, self).__init__(group=group, target=target,
name=name)

        self.gui = args[0]
        self.runningState = False

    def run(self):
        self.runningState = True
        self.camera = cv2.VideoCapture(0)
        self.camera.open(0)

        if not (self.camera.isOpened()):
            print("Could not open video device")
        else:
            timeSuaraPeringatan = time.time()
            while self.runningState :
                ret, frame = self.camera.read()
                if ret:
                    cv2image = cv2.cvtColor(frame, cv2.COLOR_BGR2RGBA)


                    if self.runningState:
                        resized = cv2.resize(cv2image, (320, 240),
interpolation=cv2.INTER_AREA)
                        img = Image.fromarray(resized)
                        self.gui.updateImage(img)

        self.camera.release()


    def stop(self):
        self.runningState = False


class guiClass(Frame):
    def __init__(self, mainWindow=None):
        Frame.__init__(self, mainWindow)
        self.pack(fill=BOTH, expand=1)

        self.mainWindow = mainWindow
        self.counter = StringVar()
        self.create_widgets()


    def updateImage(self, img):
        # print("frame")
```

```python
        render = ImageTk.PhotoImage(image=img)
        self.frame.imgtk = render
        self.frame.configure(image=render)

    def updateJarak(self, jarak):
        self.counter.set("Jarak : {:10.2f}".format(jarak))

    def create_widgets(self):
        self.frame = Label(self.mainWindow, height=280, width=350)
        self.frame.place(relx=0.5, y = 200, anchor=CENTER)

        self.countingLabel =
Label(self.mainWindow,textvariable=self.counter, font=("Courier", 20))
        self.countingLabel.place(relx=0.5, y = 100, anchor=CENTER)

mainWindow = Tk()
mainWindow.title(judul)
mainWindow.attributes('-zoomed', True)
# mainWindow.state('withdrawn')
# mainWindow.geometry("%dx%d+0+0" % (mainWindow.winfo_screenwidth(),
mainWindow.winfo_screenheight()))
gui = guiClass(mainWindow=mainWindow)

kamera = ThreadKamera(args=(gui,))
kamera.start()


timer = ThreadTimer(args=(gui,))
timer.start()

mainWindow.mainloop()

kamera.stop()
kamera.camera.release()
timer.stop()
```

DATASHEET

Ultrasonic Ranging Module HC - SR04

Product features:

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

(1) Using IO trigger for at least 10us high level signal,

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

(3) IF the signal back, through high level , time of high output IO duration is the time from sending ultrasonic to returning.

Test distance = (high level time×velocity of sound (340M/S) / 2,

Wire connecting direct as following:

- 5V Supply
- Trigger Pulse Input
- Echo Pulse Output
- 0V Ground

Electric Parameter

Working Voltage	DC 5 V
Working Current	15mA
Working Frequency	40Hz
Max Range	4m
Min Range	2cm
MeasuringAngle	15 degree
Trigger Input Signal	10uS TTL pulse
Echo Output Signal	Input TTL lever signal and the range in proportion
Dimension	45*20*15mm

Vcc Trig Echo GND

Timing diagram

The Timing diagram is shown below. You only need to supply a short 10uS pulse to the trigger input to start the ranging, and then the module will send out an 8 cycle burst of ultrasound at 40 kHz and raise its echo. The Echo is a distance object that is pulse width and the range in proportion .You can calculate the range through the time interval between sending trigger signal and receiving echo signal. Formula: uS / 58 = centimeters or uS / 148 =inch; or: the range = high level time * velocity (340M/S) / 2; we suggest to use over 60ms measurement cycle, in order to prevent trigger signal to the echo signal.
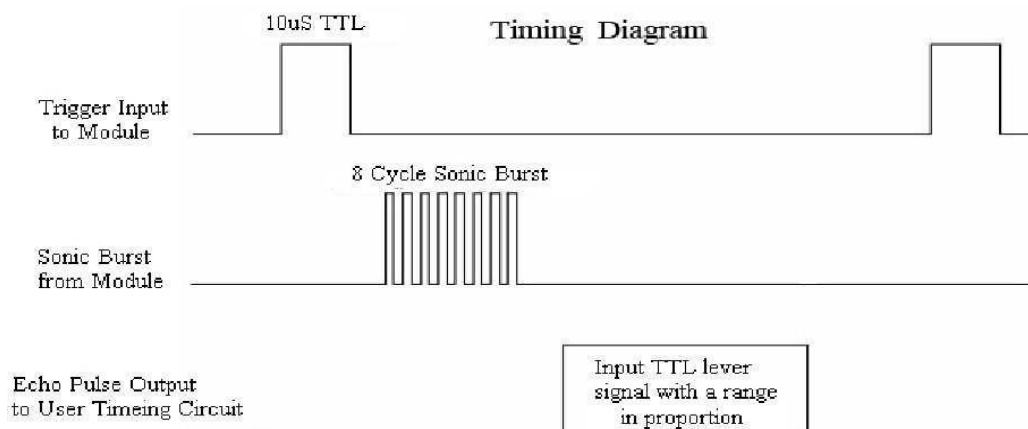
Attention:

- The module is not suggested to connect directly to electric, if connected electric, the GND terminal should be connected the module first, otherwise,
it will affect the normal work of the module.
- When tested objects, the range of area is not less than 0.5 square meters and the plane requests as smooth as possible, otherwise ,it will affect the results of measuring.

Yealink UVC30 4K USB Camera

UVC30 USB camera is a Ultra HD camera released by Yealink. It includes two editions to satisfy different usage scenarios, one is the UVC30-Room edition for small and huddle meeting rooms, the other is the UVC30-Desktop edition for your daily use with your PC. Based on standard UVC protocol, UVC30 camera can work with most UC platform, including Microsoft Teams and Skype for

Business. Zoom. etc.

Products at a Glance

Yealink UVC30-Room 4K USB Camera
Smart Framing 4K USB Camera for Meeting Rooms

Yealink UVC30 Room is a premium USB camera designed for small and huddle meeting room. Offering sharp image and accurate color reproduction, it rewards you with a vivid face-to-face video meeting experience in ultra HD 4K resolution and high frame rates. A wide FOV ensures everyone sitting around the table visible during a meeting that perfectly suits the focus and small meeting room. Based on the facial detection, it supports auto framing feature to accomplish a much more intelligent meeting experience. What's more, a flexible clip gives you multiple chooses to mount UVC30 Room.

Key Features:

4K UHD

Superb Image Quality

UVC30 Room not only delivers the best-class image quality with natural color reproduction, but also the smooth video and details, endeavoring to optimize the meeting experience for users. UVC30 Room also supports multiple resolutions, including 4K/30FPS, 1080P/60FPS and 720P/60FPS to adapt to different displays and applications.

Auto

Smooth and Precise Auto-Framing, API for Data Analysis

Based on face detection, UVC30 Room is capable of performing auto-framing to frame people in the room smoothly and precisely, bringing a more intelligent meeting experience for users. With API developed, statistic data of people in meeting room is accessible for further analyzing.

Ultra Expansive Field of View

With large 120° field of view, everyone sitting in the room can be seen without any positon adjustment, perfectly suit for focus and small meeting room.

Easier and Smooth PTZ Control

Certified by Microsoft & Zoom, UVC30 Room can achieve an easier and smooth PTZ control on touch console via Yealink RoomConnect and Zoom Rooms Camera Control. It can entirely work with all Microsoft Teams Rooms systems and Zoom Rooms systems as a USB camera.

Multiple Mounting Options

With a retractable clip, you can mount UVC30 wherever it works best, whether on the top of monitor, under the monitor or on the wall.

Yealink UVC30-Desktop 4K Webcam
Ultra HD 4K Webcam for PC

Yealink UVC30 Desktop is a new USB Camera with 4K UHD and 3x digital zoom for vivid and excellent experience. Equipped with built-in infrared sensor and face recognition, UVC30 Desktop supports Windows Hello feature to enhance your login security. Thanks to the sharp image and accurate color reproduction, it provides a vivid face-to-face video meeting experience in ultra HD 4K resolution and high frame rates. A wide FOV ensures everyone sitting before the monitor or laptop visible to far end. Moreover, the feature of facial detection allows UVC30 Desktop always to frame people smoothly and precisely to accomplish a much more intelligent experience.

Key Features:

Superb Image Quality

UVC30 Desktop not only delivers a the best-class image quality with natural color reproduction, but also the smooth video and details, endeavoring to optimize the meeting experience for users. UVC30 Desktop also supports multiple resolutions, including 4K/30FPS, 1080P/60FPS and 720P/60FPS to adapt to different displays and applications.

Ultra Expansive Field of View

With large 120° field of view, people sitting before the monitor or laptop can be seen without any positon adjustment.

Windows Hello Feature

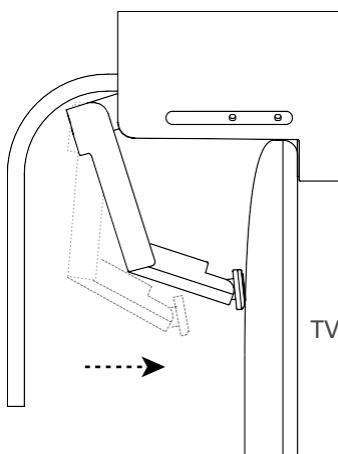Certified by Microsoft, UVC30 Desktop is capable of Windows Hello feature to enhance your PC login security.
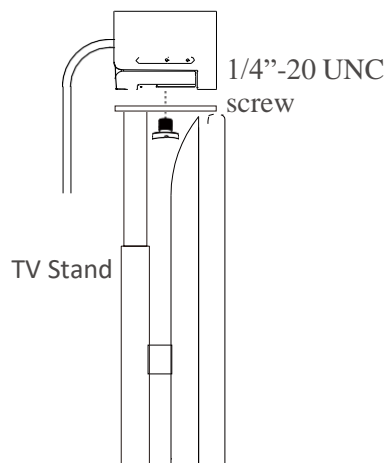
HD Voice Quality

The embedded microphone helps UVC30 Desktop to achieve a voice pickup range of up to 150°/ 6.6 feet and deliver a clear and optimal sound.
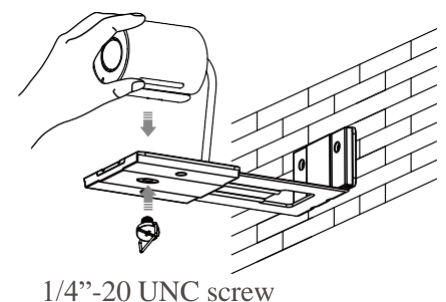
UVC30 Installation

Mount on top of a TV

TV

TV Stand

1/4"-20 UNC screw

Mount onto a TV Stand or a Tripod

1/4"-20 UNC screw

Mount on a Wall

UVC30 Room & Desktop Specification

Model		
PositioningCamera		
UVC Protocol USB Cable Infrared Camera		
Built-in Microphone Depth of View (meter) Field of View (Diagonal)		
Auto Framing		
PTZ		
Zoom		
Video Output Maximum ResolutionMaximum FPS		
Wide Dynamic RangeExposure		
White Balance (WB)Shutter Speed		
Signal Noise Ratio(SNR)LED Indicator		
Effective Focus Length		
Aperture (F#) Min, Illumination		
Dimensions		
System RequirementCertification		

UVC30 Room

Small and huddle rooms

1/2.5"

CMOS

,8.5

UVC30 Desktop

Personal computer 1/2.5" CMOS,

8.51M pixel

UVC 1.5/UVC 1.1

1 x 1.6m USB 3.0

√

√

0.5m~3m

120°

√

EPTZ

3x digital

4K30, 1080p60/30, 720p60/30

4K

60FPS

√

Auto

ATW/Auto/Manual

1/60～1/10000 seconds

63dB

√

f=2.22mm

F/2.4

0.5 lux (in daylight),

0.1 lux (at night) 59 mm x

φ45 mm

Windows7, Windows10, Mac OS 10.10 or higherWindows Hello

Certification (ongoing)

About Yealink

Yealink is a global leading provider of enterprise communication and collaboration solutions, offering video conferencing service to worldwide enterprises. Focusing on research and development, Yealink also insists on innovation and creation. With the outstanding technical patents of cloud computing, audio, video and image processing technology, Yealink has built up a panoramic collaboration solution of audio and video conferencing by merging its cloud services with a series of endpoints products. As one of the best providers in more than 140 countries and regions including the US, the UK and Australia, Yealink ranks No.1 in the global market share of SIP phone shipments.

Copyright

Technical Support

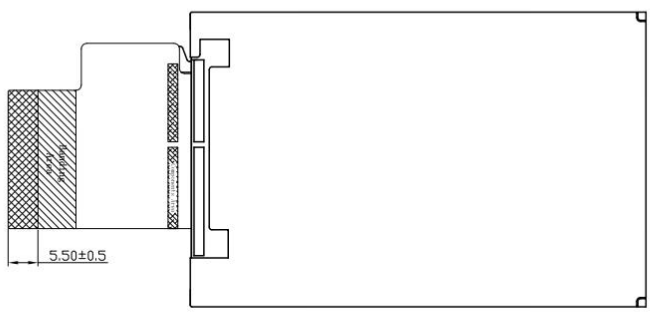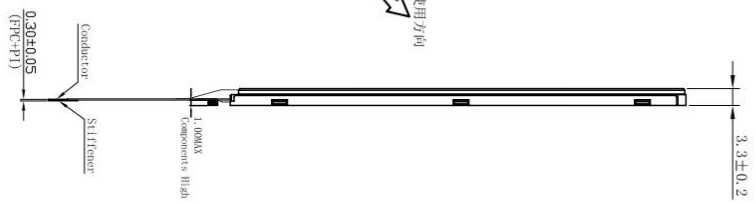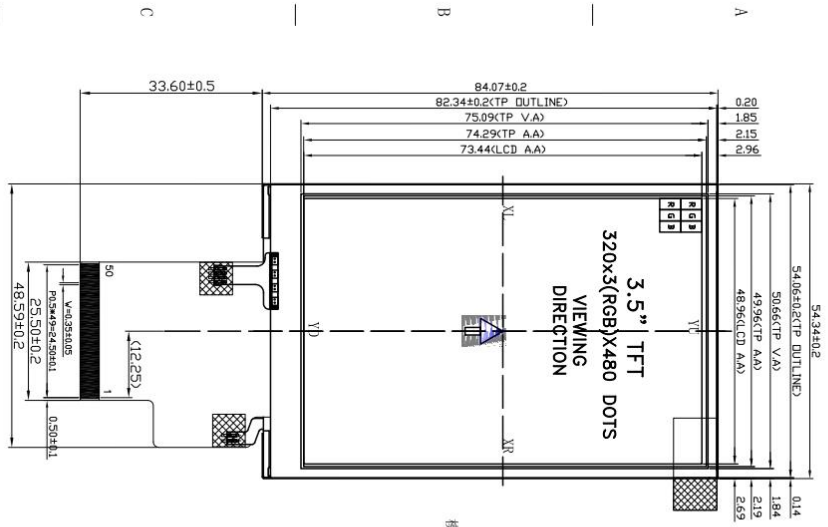Visit Yealink WIKI (http://support.yealink.com/) for firmware downloads, product documents, FAQ, and more. For better service, we sincerely recommend you to use Yealink Ticketing system (https://ticket.yealink.com) to submit all your technical issues.

Addr: No.1 Ling-Xia
      North Road, High
      Tech Park,Huli
      District, Xiamen,
      Fujian, P.R. China

LCD

NOTES:
1. DISPLAY TYPE: 3.5" TFT
2. VIEWING DIRECTION: 6 o'clock
3. VIEWING DIRECTION: 6 o'clock
4. POLARIZER MODE: TRANSMISSIVE/POSITIVE
5. RECOMMEND CONNECTOR:
6. OPERATING TEMP: -20°C~+70°C
7. STORAGE TEMP: -30°C~+80°C
8. UNMARKER TOLERANCE: ±0.20
9. REQUIREMENTS ON ENVIRONMENTAL PROTECTION: RoHS

3.5" TFT
320x3(RGB)X480 DOTS
VIEWING DIRECTION

模块推荐使用方向
A视

84.07±0.2
82.34±0.2(TP OUTLINE)
75.09(TP V.A)
74.29(TP A.A)
73.44(LCD A.A)

33.60±0.5

0.20
1.85
2.15
2.96

54.34±0.2
54.06±0.2(TP OUTLINE)
50.66(TP V.A)
49.96(TP A.A)
48.96(LCD A.A)

0.14
1.84
2.19
2.69

48.59±0.2
25.50±0.2
P0.5×49=24.50±0.1
W=0.35±0.05
0.50±0.1

3.3±0.2

0.30±0.05
(FPC-P1)

Conductor
Stiffener
1.0MAX
Components High

5.50±0.5

FPC弯折示意图

(12.40)
(12.25)

32.0±0.5
1.0MAX

BL CIRCUIT DIAGRAM
VF=19.2V, IF=20mA
A────K

REV.	CONTENT	DATA	APPROVE	DATE		
A	NEW	2014.03.21	CHECK	DATE		
			DRAWING	LGZ	DATE	2014.03.21
			TOLERANCE	.X ±0.3, .XX ±0.2	PAGE	1 of 1
					SCALE	
					UNIT	mm
					SIZE	A4

PIN	SYMBOL		PIN	SYMBOL
1	LEDK		26	DB5
2	LEDA		27	DB4
3	LEDA		28	DB3
4	LEDK		29	DB2
5	LEDA		30	DB1
6	IM0		31	DB0
7	IM1		32	SDO
8	IM2		33	SDI
9	NC		34	/RD
10	/RESET		35	/VR_SCL
11	VSYNC		36	RS
12	HSYNC		37	/CS
13	DOTCLK		38	TE
14	DE		39	IDVCC
15	DB17		40	IDVCC
16	DB16		41	VC1
17	DB15		42	XR
18	DB14		43	GND
19	DB13		44	YD
20	DB12		45	YU
21	DB11		46	XL
22	DB10		47	GND
23	DB9		48	GND
24	DB8		49	GND
25	DB6		50	GND

Raspberry Pi Compute Module 3+

Raspberry Pi Compute Module 3+ Lite

Release 1, January 2019

Table 1: Release History

Release	Date	Description
1	28/01/2019	First release

The latest release of this document can be found at `https://www.raspberrypi.org`

Contents

List of Figures

List of Tables

1   Introduction

The Raspberry Pi Compute Module 3+ (CM3+) is a range of DDR2-SODIMM-mechanically-compatible System on Modules (SoMs) containing processor, memory, eMMC Flash (on non-Lite variants) and supporting power circuitry. These modules allow a designer to leverage the Raspberry Pi hardware and software stack in their own custom systems and form factors. In addition these modules have extra IO interfaces over and above what is available on the Raspberry Pi model A/B boards, opening up more options for the designer.

The CM3+ contains a BCM2837B0 processor (as used on the Raspberry Pi 3B+), 1Gbyte LPDDR2 RAM and eMMC Flash. The CM3+ is currently available in 4 variants, CM3+/8GB, CM3+/16GB, CM3+/32GB and CM3+ Lite, which have 8, 16 and 32 Gigabytes of eMMC Flash, or no eMMC Flash, respectively.

The CM3+ Lite product is the same as CM3+ except the eMMC Flash is not fitted, and the SD/eMMC interface pins are available for the user to connect their own SD/eMMC device.

Note that the CM3+ is electrically identical and, with the exception of higher CPU z-height, physically identical to the legacy CM3 products.

CM3+ modules require a software/firmware image dated November 2018 or newer to function correctly.

2 Features

2.1 Hardware

- Low cost
- Low power
- High availability
- High reliability
    - Tested over millions of Raspberry Pis Produced to date
    - Module IO pins have 15 micro-inch hard gold plating over 2.5 micron Nickel

2.2 Peripherals

- 48x GPIO
- 2x I2C
- 2x SPI
- 2x UART
- 2x SD/SDIO
- 1x HDMI 1.3a
- 1x USB2 HOST/OTG
- 1x DPI (Parallel RGB Display)
- 1x NAND interface (SMI)
- 1x 4-lane CSI Camera Interface (up to 1Gbps per lane)
- 1x 2-lane CSI Camera Interface (up to 1Gbps per lane)
- 1x 4-lane DSI Display Interface (up to 1Gbps per lane)
- 1x 2-lane DSI Display Interface (up to 1Gbps per lane)

2.3 Software

- ARMv8 Instruction Set
- Mature and stable Linux software stack
    - Latest Linux Kernel support
    - Many drivers upstreamed
    - Stable and well supported userland
    - Full availability of GPU functions using standard APIs

3 Block Diagram
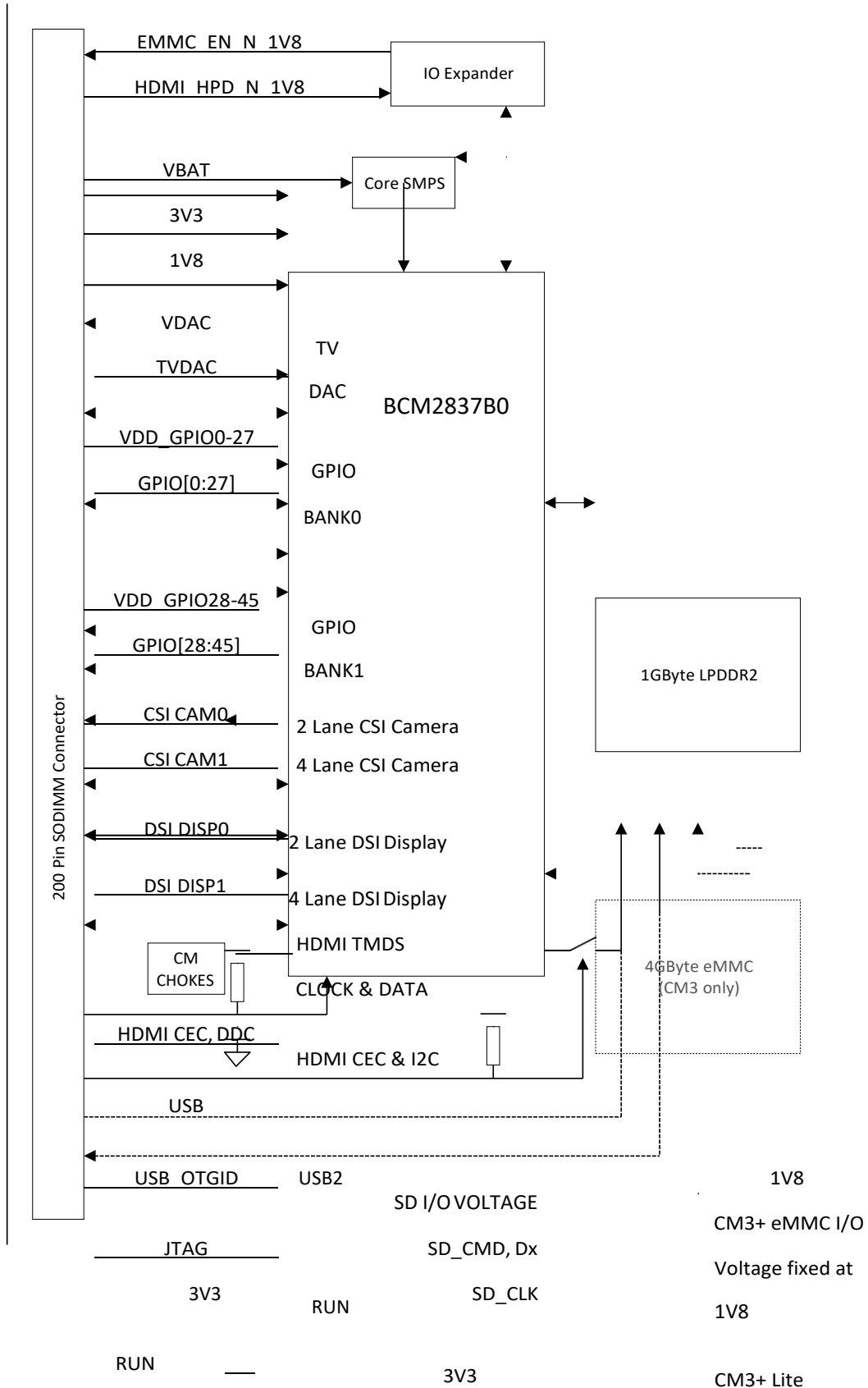
SD I/O Voltage

EMMC_DISABLE_N

supplied from
SDX_VDD

SDX_CLK (CM3+ Lite only)

SDX_CMD, Dx (CM3+ Lite only)

SDX_VDD (CM3+ Lite only)

Figure 1: CM3+ Block Diagram

SDX_CLK (CM3+ Lite only)

SDX_CMD, Dx (CM3+ Lite only)

SDX_VDD (CM3+ Lite only)

4   Mechanical Specification

The CM3+ modules conform to JEDEC MO-224 mechanical specification for 200 pin DDR2 (1.8V) SODIMM modules and therefore should work with the many DDR2 SODIMM sockets available on the market. **(Please note that the pinout of the Compute Module is not the same as a DDR2 SODIMM module; they are not electrically compatible.)**

The SODIMM form factor was chosen as a way to provide the 200 pin connections using a standard, readily available and low cost connector compatible with low cost PCB manufacture.

The maximum component height on the underside of the Compute Module is 1.2mm.

The maximum component height on the top side of the Compute Module is 2.5mm.

The Compute Module PCB thickness is 1.0mm +/- 0.1mm.

Note that the location and arrangement of components on the Compute Module may change slightly over time due to revisions for cost and manufacturing considerations; however, maximum component heights and PCB thickness will be kept as specified.

Figure 2 gives the CM3+ mechanical dimensions.

Figure 2: CM3+ Mechanical Dimensions

5 Pin Assignments

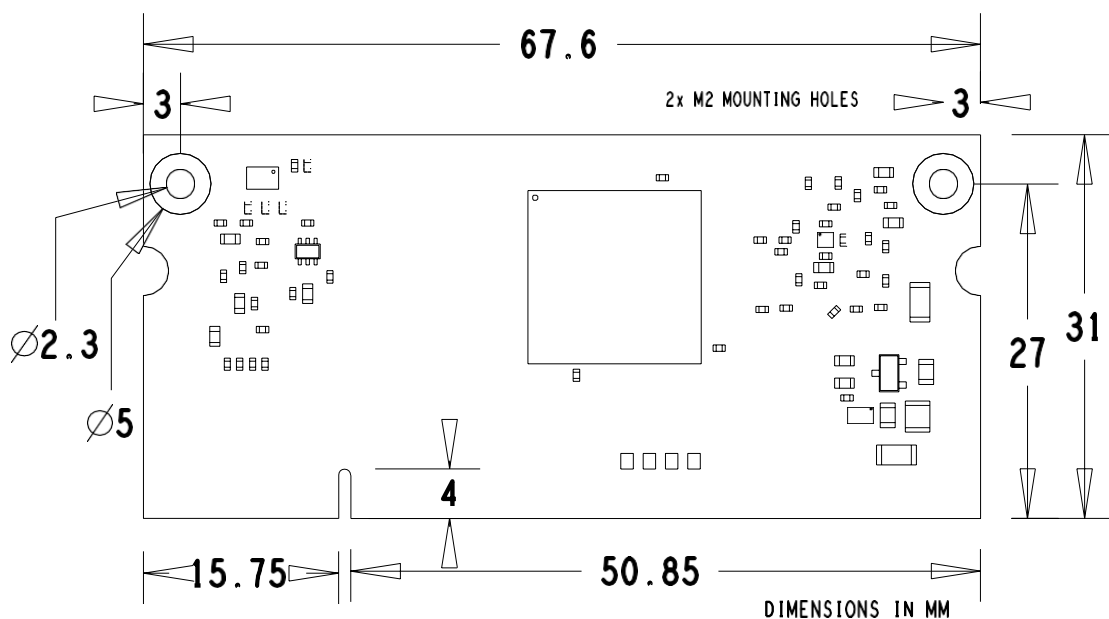| CM3+	CM3+ Lite	PIN		PIN	CM3+	CM3+ Lite
GND		1		2	EMMC_DISABLE_N	
GPIO0		3		4	NC	SDX_VDD
GPIO1		5		6	NC	SDX_VDD
GND		7		8	GND	
GPIO2		9		10	NC	SDX_CLK
GPIO3		11		12	NC	SDX_CMD
GND		13		14	GND	
GPIO4		15		16	NC	SDX_D0
GPIO5		17		18	NC	SDX_D1
GND		19		20	GND	
GPIO6		21		22	NC	SDX_D2
GPIO7		23		24	NC	SDX_D3
GND		25		26	GND	
GPIO8		27		28	GPIO28	
GPIO9		29		30	GPIO29	
GND		31		32	GND	
GPIO10		33		34	GPIO30	
GPIO11		35		36	GPIO31	
GND		37		38	GND	
GPIO0-27_VDD		39		40	GPIO0-27_VDD	
			KEY			
GPIO28-45_VDD		41		42	GPIO28-45_VDD	
GND		43		44	GND	
GPIO12		45		46	GPIO32	
GPIO13		47		48	GPIO33	
GND		49		50	GND	
GPIO14		51		52	GPIO34	
GPIO15		53		54	GPIO35	
GND		55		56	GND	
GPIO16		57		58	GPIO36	
GPIO17		59		60	GPIO37	
GND		61		62	GND	
GPIO18		63		64	GPIO38	
GPIO19		65		66	GPIO39	
GND		67		68	GND	
GPIO20		69		70	GPIO40	
GPIO21		71		72	GPIO41	
GND		73		74	GND	
GPIO22		75		76	GPIO42	
GPIO23		77		78	GPIO43	
GND		79		80	GND	
GPIO24		81		82	GPIO44	
GPIO25		83		84	GPIO45	
GND		85		86	GND	
GPIO26		87		88	HDMI_HPD_N_1V8	
GPIO27		89		90	EMMC_EN_N_1V8	
GND		91		92	GND	
DSI0_DN1		93		94	DSI1_DP0	
DSI0_DP1		95		96	DSI1_DN0	
GND		97		98	GND	
DSI0_DN0		99		100	DSI1_CP	
DSI0_DP0		101		102	DSI1_CN	
GND		103		104	GND	
DSI0_CN		105		106	DSI1_DP3	
DSI0_CP		107		108	DSI1_DN3	
GND		109		110	GND	
HDMI_CLK_N		111		112	DSI1_DP2	
HDMI_CLK_P		113		114	DSI1_DN2	
GND		115		116	GND	
HDMI_D0_N		117		118	DSI1_DP1	
HDMI_D0_P		119		120	DSI1_DN1	
GND		121		122	GND	
HDMI_D1_N		123		124	NC	
HDMI_D1_P		125		126	NC	
GND		127		128	NC	
HDMI_D2_N		129		130	NC	
HDMI_D2_P		131		132	NC	
GND		133		134	GND	
CAM1_DP3		135		136	CAM0_DP0	
CAM1_DN3		137		138	CAM0_DN0	
GND		139		140	GND	
CAM1_DP2		141		142	CAM0_CP	
CAM1_DN2		143		144	CAM0_CN	
GND		145		146	GND	
CAM1_CP		147		148	CAM0_DP1	
CAM1_CN		149		150	CAM0_DN1	
GND		151		152	GND	
CAM1_DP1		153		154	NC	
CAM1_DN1		155		156	NC	
GND		157		158	NC	
CAM1_DP0		159		160	NC	
CAM1_DN0		161		162	NC	
GND		163		164	GND	
USB_DP		165		166	TVDAC	
USB_DM		167		168	USB_OTGID	
GND		169		170	GND	
HDMI_CEC		171		172	VC_TRST_N	
HDMI_SDA		173		174	VC_TDI	
HDMI_SCL		175		176	VC_TMS	
RUN		177		178	VC_TDO	
DD_CORE (DO NOT CONNECT)		179		180	VC_TCK	
GND		181		182	GND	
1V8		183		184	1V8	
1V8		185		186	1V8	
GND		187		188	GND	
VDAC		189		190	VDAC	
3V3		191		192	3V3	
3V3		193		194	3V3	
GND		195		196	GND	
VBAT		197		198	VBAT	
VBAT		199		200	VBAT	

Table 2: Compute Module 3+ SODIMM Connector Pinout

Table 2 gives the Compute Module 3+ pinout and Table 3 gives the pin functions.

Pin Name	DIR	Voltage Ref	PDN[a] State	If Unused	Description/Notes
RUN and Boot Control (see text for usage guide)					
RUN	I	3V3[b]	Pull High	Leave open	Has internal 10k pull up EMMC
DISABLE N	I	3V3[b]	Pull High	Leave open	Has internal 10k pull up EMMC EN N 1V8 O 1V8
			Pull High	Leave open	Has internal 2k2 pull up
GPIO					
GPIO[27:0]	I/O	GPIO0-27 VDD	Pull or Hi-Z[c]	Leave open	GPIO Bank 0
GPIO[45:28]	I/O	GPIO28-45 VDD	Pull or Hi-Z[c]	Leave open	GPIO Bank 1
Primary SD Interface[d,e]					
SDX CLK	O	SDX VDD	Pull High	Leave open	Primary SD interface CLK SDX
CMD	I/O	SDX VDD	Pull High	Leave open	Primary SD interface CMD SDX Dx
	I/O	SDX VDD	Pull High	Leave open	Primary SD interface DATA
USB Interface					
USB Dx	I/O	-	Z	Leave open	Serial interface
USB OTGID	I	3V3		Tie to GND	OTG pin detect
HDMI Interface					
HDMI SCL	I/O	3V3[b]	Z[f]	Leave open	DDC Clock (5.5V tolerant)
HDMI SDA	I/O	3V3[b]	Z[f]	Leave open	DDC Data (5.5V tolerant)
HDMI CEC	I/O	3V3	Z	Leave open	CEC (has internal 27k pull up)
HDMI CLKx	O	-	Z	Leave open	HDMI serial clock
HDMI Dx	O	-	Z	Leave open	HDMI serial data
HDMI HPD N 1V8	I	1V8	Pull High	Leave open	HDMI hotplug detect
CAM0 (CSI0) 2-lane Interface					
CAM0 Cx	I	-	Z	Leave open	Serial clock
CAM0 Dx	I	-	Z	Leave open	Serial data
CAM1 (CSI1) 4-lane Interface					
CAM1 Cx	I	-	Z	Leave open	Serial clock
CAM1 Dx	I	-	Z	Leave open	Serial data
DSI0 (Display 0) 2-lane Interface					
DSI0 Cx	O	-	Z	Leave open	Serial clock
DSI0 Dx	O	-	Z	Leave open	Serial data
DSI1 (Display 1) 4-lane Interface					
DSI1 Cx	O	-	Z	Leave open	Serial clock
DSI1 Dx	O	-	Z	Leave open	Serial data
TV Out					
TVDAC	O	-	Z	Leave open	Composite video DAC output
JTAG Interface					
TMS	I	3V3	Z	Leave open	Has internal 50k pull up
TRST N	I	3V3	Z	Leave open	Has internal 50k pull up
TCK	I	3V3	Z	Leave open	Has internal 50k pull up
TDI	I	3V3	Z	Leave open	Has internal 50k pull up
TDO	O	3V3	O	Leave open	Has internal 50k pull up

[a] The PDN column indicates power-down state (when RUN pin LOW)

[b] Must be driven by an open-collector driver

^c GPIO have software enabled pulls which keep state over power-down

^d Only available on Lite variants

^e The CM will always try to boot from this interface first

^f Requires external pull-up resistor to 5V as per HDMI spec

Table 3: Pin Functions

6 Electrical Specification

Caution! Stresses above those listed in Table 4 may cause permanent damage to the device. This is a stress rating only; functional operation of the device under these or any other conditions above those listed in the operational sections of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Symbol	Parameter	Minimum	Maximum	Unit
VBAT	Core SMPS Supply	-0.5	6.0	V
3V3	3V3 Supply Voltage	-0.5	4.10	V
1V8	1V8 Supply Voltage	-0.5	2.10	V
VDAC	TV DAC Supply	-0.5	4.10	V
GPIO0-27_VDD	GPIO0-27 I/O Supply Voltage	-0.5	4.10	V
GPIO28-45_VDD	GPIO28-45 I/O Supply Voltage	-0.5	4.10	V
SDX_VDD	Primary SD/eMMC Supply Voltage	-0.5	4.10	V

Table 4: Absolute Maximum Ratings

DC Characteristics are defined in Table 5

Symbol	Parameter	Conditions	Minimum	Typical	Maximum	Unit
V_{IL}	Input low voltage[a]	VDD_IO = 1.8V	-	-	0.6	V
		VDD_IO = 2.7V	-	-	0.8	V
		VDD_IO = 3.3V	-	-	0.9	V
V_{IH}	Input high voltage[a]	VDD_IO = 1.8V	1.0	-	-	V
		VDD_IO = 2.7V	1.3	-	-	V
		VDD_IO = 3.3V	1.6	-	-	V
I_{IL}	Input leakage current	TA = +85°C	-	-	5	μA
C_{IN}	Input capacitance	-	-	5	-	pF
V_{OL}	Output low voltage[b]	VDD_IO = 1.8V, IOL = -2mA	-	-	0.2	V
		VDD_IO = 2.7V, IOL = -2mA	-	-	0.15	V
		VDD_IO = 3.3V, IOL = -2mA	-	-	0.14	V
V_{OH}	Output high voltage[b]	VDD_IO = 1.8V, IOH = 2mA	1.6	-	-	V
		VDD_IO = 2.7V, IOH = 2mA	2.5	-	-	V
		VDD_IO = 3.3V, IOH = 2mA	3.0	-	-	V
I_{OL}	Output low current[c]	VDD_IO = 1.8V, VO = 0.4V	12	-	-	mA
		VDD_IO = 2.7V, VO = 0.4V	17	-	-	mA
		VDD_IO = 3.3V, VO = 0.4V	18	-	-	mA
I_{OH}	Output high current[c]	VDD_IO = 1.8V, VO = 1.4V	10	-	-	mA
		VDD_IO = 2.7V, VO = 2.3V	16	-	-	mA
		VDD_IO = 3.3V, VO = 2.3V	17	-	-	mA
R_{PU}	Pullup resistor	-	50	-	65	kΩ
R_{PD}	Pulldown resistor	-	50	-	65	kΩ

[a] Hysteresis enabled

[b] Default drive strength (8mA)

[c] Maximum drive strength (16mA)

Table 5: DC Characteristics

AC Characteristics are defined in Table 6 and Fig. 3.

Pin Name	Symbol	Parameter	Minimum	Typical	Maximum	Unit
Digital outputs	t_{rise}	10-90% rise time[a]	-	1.6	-	ns
Digital outputs	t_{fall}	90-10% fall time[a]	-	1.7	-	ns
GPCLK	t_{JOSC}	Oscillator-derived GPCLK cycle-cycle jitter (RMS)	-	-	20	ps
GPCLK	t_{JPLL}	PLL-derived GPCLK cycle-cycle jitter (RMS)	-	-	48	ps

^{a} Default drive strength, CL = 5pF, VDD IOx = 3.3V

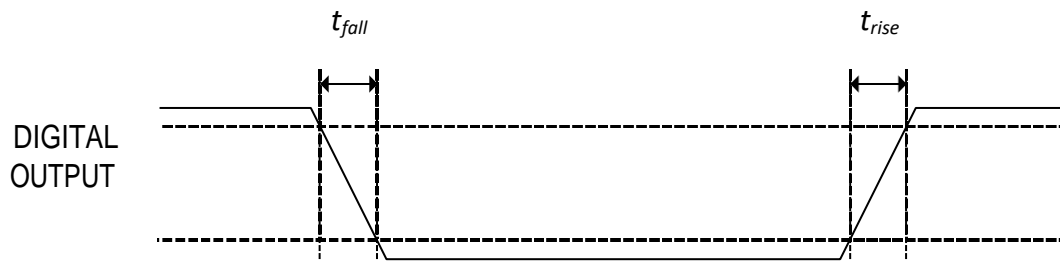Table 6: Digital I/O Pin AC Characteristics

Figure 3: Digital IO Characteristics

7 Power Supplies

The Compute Module 3+ has six separate supplies that must be present and powered at all times; you cannot leave any of them unpowered, even if a specific interface or GPIO bank is unused. The six supplies are as follows:

1. VBAT is used to power the BCM2837 processor core. It feeds the SMPS that generates the chip core voltage.

2. 3V3 powers various BCM2837 PHYs, IO and the eMMC Flash.

3. 1V8 powers various BCM2837 PHYs, IO and SDRAM.

4. VDAC powers the composite (TV-out) DAC.

5. GPIO0-27_VREF powers the GPIO 0-27 IO bank.

6. GPIO28-45_VREF powers the GPIO 28-45 IO bank.

Supply	Descripion	Minimum	Typical	Maximum	Unit
VBAT	Core SMPS Supply	2.5	-	5.0 + 5%	V
3V3	3V3 Supply Voltage	3.3 - 5%	3.3	3.3 + 5%	V
1V8	1V8 Supply Voltage	1.8 - 5%	1.8	1.8 + 5%	V
VDAC	TV DAC Supply[a]	2.5 - 5%	2.8	3.3 + 5%	V
GPIO0-27_VDD	GPIO0-27 I/O Supply Voltage	1.8 - 5%	-	3.3 + 5%	V
GPIO28-45_VDD	GPIO28-45 I/O Supply Voltage	1.8 - 5%	-	3.3 + 5%	V
SDX_VDD	Primary SD/eMMC Supply Voltage	1.8 - 5%	-	3.3 + 5%	V

[a] Requires a clean 2.5-2.8V supply if TV DAC is used, else connect to 3V3

Table 7: Power Supply Operating Ranges

7.1 Supply Sequencing

Supplies should be staggered so that the highest voltage comes up first, then the remaining voltages in descending order. This is to avoid forward biasing internal (on-chip) diodes between supplies, and causing latch-up. Alternatively supplies can be synchronised to come up at exactly the same time as long as at no point a lower voltage supply rail voltage exceeds a higher voltage supply rail voltage.

7.2 Power Requirements

Exact power requirements will be heavily dependent upon the individual use case. If an on-chip subsystem is unused, it is usually in a low power state or completely turned off. For instance, if your application does not use 3D graphics then a large part of the core digital logic will never turn on and need power. This is also the case for camera and display interfaces, HDMI, USB interfaces, video encoders and decoders, and so on.

Powerchain design is critical for stable and reliable operation of the Compute Module 3+. We strongly recommend that designers spend time measuring and verifying power requirements for their particular use case and application, as well as paying careful attention to power supply sequencing and maximum supply voltage tolerance.

Table 8 specifies the recommended minimum power supply outputs required to power the Compute Module 3+.

Supply	Minimum Requirement	Unit
VBAT (CM1)	2000[a]	mW
VBAT (CM3,3L)	3500[a]	mW
3V3	250	mA
1V8	250	mA
VDAC	25	mA
GPIO0-27_VDD	50[b]	mA
GPIO28-45_VDD	50[b]	mA
SDX_VDD	50[b]	mA

[a] Recommended minimum. Actual power drawn is very dependent on use-case
[b] Each GPIO can supply up to 16mA, aggregate current per bank must not exceed 50mA

Table 8: Mimimum Power Supply Requirements

8 Booting

The eMMC Flash device on CM3+ is directly connected to the primary BCM2837 SD/eMMC interface. These connections are not accessible on the module pins. On CM3+ Lite this SD interface is available on the SDX_pins.

When initially powered on, or after the RUN pin has been held low and then released, the BCM2837 will try to access the primary SD/eMMC interface. It will then look for a file called bootcode.bin on the primary partition (which must be FAT) to start booting the system. If it cannot access the SD/eMMC device or the boot code cannot be found, it will fall back to waiting for boot code to be written to it over USB; in other words, its USB port is in slave mode waiting to accept boot code from a suitable host.

A USB boot tool is available on Github which allows a host PC running Linux to write the BCM2837 boot code over USB to the module. That boot code then runs and provides access to the SD/eMMC as a USB mass storage device, which can then be read and written using the host PC. Note that a Raspberry Pi can be used as the host machine. For those using Windows a precompiled and packeged tool is available. For more information see here.

The Compute Module has a pin called EMMC_DISABLE_N which when shorted to GND will disable the SD/eMMC interface (by physically disconnecting the SD_CMD pin), forcing BCM2837 to boot from USB. Note that when the eMMC is disabled in this way, it takes a couple of seconds from powering up for the processor to stop attempting to talk to the SD/eMMC device and fall back to booting from USB.

Note that once booted over USB, BCM2837 needs to re-enable the SD/eMMC device (by releasing EMMC_DISABLE_N) to allow access to it as mass storage. It expects to be able to do this by driving the EMMC_EN_N_1V8 pin LOW, which at boot is initially an input with a pull up to 1V8. If an end user wishes to add the ability to access the SD/eMMC over USB in their product, similar circuitry to that used on the Compute Module IO Board to enable/disable the USB boot and SD/eMMC must be used; that is, EMMC_DISABLE_N pulled low via MOSFET(s) and released again by MOSFET, with the gate controlled by EMMC_EN_N_1V8. **Ensure you use MOSFETs suitable for switching at 1.8V (i.e. use a device with gate threshold voltage, Vt, suitable for 1.8V switching).**

9   Peripherals

9.1   GPIO

BCM2837 has in total 54 GPIO lines in 3 separate voltage banks. All GPIO pins have at least two alternative functions within the SoC. When not used for the alternate peripheral function, each GPIO pin may be set as an input (optionally as an interrupt) or an output. The alternate functions are usually peripheral I/Os, and most peripherals appear twice to allow flexibility on the choice of I/O voltage.

GPIO bank2 is used on the module to connect to the eMMC device and for an on-board I2C bus (to talk to the core SMPS and control the special function pins). On CM3+ Lite most of bank2 is exposed to allow a user to connect their choice of SD card or eMMC device (if required).

Bank0 and 1 GPIOs are available for general use. GPIO0 to GPIO27 are bank0 and GPIO28-45 make up bank1. GPIO0-27_VDD is the power supply for bank0 and GPIO28-45_VDD is the power supply for bank1. SDX_VDD is the supply for bank2 on CM3+ Lite. These supplies can be in the range 1.8V-3.3V (see Table 7) and are not optional; each bank must be powered, even when none of the GPIOs for that bank are used.

Note that the HDMI_HPD_N_1V8 and EMMC_EN_N_1V8 pins are 1.8V IO and are used for special functions (HDMI hot plug detect and boot control respectively). Please do not use these pins for any other purpose, as the software for the module will always expect these pins to have these special functions. If they are unused please leave them unconnected.

All GPIOs except GPIO28, 29, 44 and 45 have weak in-pad pull-ups or pull-downs enabled when the device is powered on. It is recommended to add off-chip pulls to GPIO28, 29, 44 and 45 to make sure they never float during power on and initial boot.

9.1.1 GPIO Alternate Functions

GPIO	Default Pull	ALT0	ALT1	ALT2	ALT3	ALT4	ALT5
0	High	SDA0	SA5	PCLK	-	-	-
1	High	SCL0	SA4	DE	-	-	-
2	High	SDA1	SA3	LCD_VSYNC	-	-	-
3	High	SCL1	SA2	LCD_HSYNC	-	-	-
4	High	GPCLK0	SA1	DPI_D0	-	-	ARM_TDI
5	High	GPCLK1	SA0	DPI_D1	-	-	ARM_TDO
6	High	GPCLK2	SOE_N	DPI_D2	-	-	ARM_RTCK
7	High	SPI0_CE1_N	SWE_N	DPI_D3	-	-	-
8	High	SPI0_CE0_N	SD0	DPI_D4	-	-	-
9	Low	SPI0_MISO	SD1	DPI_D5	-	-	-
10	Low	SPI0_MOSI	SD2	DPI_D6	-	-	-
11	Low	SPI0_SCLK	SD3	DPI_D7	-	-	-
12	Low	PWM0	SD4	DPI_D8	-	-	ARM_TMS
13	Low	PWM1	SD5	DPI_D9	-	-	ARM_TCK
14	Low	TXD0	SD6	DPI_D10	-	-	TXD1
15	Low	RXD0	SD7	DPI_D11	-	-	RXD1
16	Low	FL0	SD8	DPI_D12	CTS0	SPI1_CE2_N	CTS1
17	Low	FL1	SD9	DPI_D13	RTS0	SPI1_CE1_N	RTS1
18	Low	PCM_CLK	SD10	DPI_D14	-	SPI1_CE0_N	PWM0
19	Low	PCM_FS	SD11	DPI_D15	-	SPI1_MISO	PWM1
20	Low	PCM_DIN	SD12	DPI_D16	-	SPI1_MOSI	GPCLK0
21	Low	PCM_DOUT	SD13	DPI_D17	-	SPI1_SCLK	GPCLK1
22	Low	SD0_CLK	SD14	DPI_D18	SD1_CLK	ARM_TRST	-
23	Low	SD0_CMD	SD15	DPI_D19	SD1_CMD	ARM_RTCK	-
24	Low	SD0_DAT0	SD16	DPI_D20	SD1_DAT0	ARM_TDO	-
25	Low	SD0_DAT1	SD17	DPI_D21	SD1_DAT1	ARM_TCK	-
26	Low	SD0_DAT2	TE0	DPI_D22	SD1_DAT2	ARM_TDI	-
27	Low	SD0_DAT3	TE1	DPI_D23	SD1_DAT3	ARM_TMS	-

Table 9: GPIO Bank0 Alternate Functions

GPIO	Default Pull	ALT0	ALT1	ALT2	ALT3	ALT4	ALT5
28	None	SDA0	SA5	PCM_CLK	FL0	-	-
29	None	SCL0	SA4	PCM_FS	FL1	-	-
30	Low	TE0	SA3	PCM_DIN	CTS0	-	CTS1
31	Low	FL0	SA2	PCM_DOUT	RTS0	-	RTS1
32	Low	GPCLK0	SA1	RING_OCLK	TXD0	-	TXD1
33	Low	FL1	SA0	TE1	RXD0	-	RXD1
34	High	GPCLK0	SOE_N	TE2	SD1_CLK	-	-
35	High	SPI0_CE1_N	SWE_N	-	SD1_CMD	-	-
36	High	SPI0_CE0_N	SD0	TXD0	SD1_DAT0	-	-
37	Low	SPI0_MISO	SD1	RXD0	SD1_DAT1	-	-
38	Low	SPI0_MOSI	SD2	RTS0	SD1_DAT2	-	-
39	Low	SPI0_SCLK	SD3	CTS0	SD1_DAT3	-	-
40	Low	PWM0	SD4	-	SD1_DAT4	SPI2_MISO	TXD1
41	Low	PWM1	SD5	TE0	SD1_DAT5	SPI2_MOSI	RXD1
42	Low	GPCLK1	SD6	TE1	SD1_DAT6	SPI2_SCLK	RTS1
43	Low	GPCLK2	SD7	TE2	SD1_DAT7	SPI2_CE0_N	CTS1
44	None	GPCLK1	SDA0	SDA1	TE0	SPI2_CE1_N	-
45	None	PWM1	SCL0	SCL1	TE1	SPI2_CE2_N	-

Table 10: GPIO Bank1 Alternate Functions

Table 9 and Table 10 detail the default pin pull state and available alternate GPIO functions. Most of these alternate peripheral functions are described in detail in the Broadcom Peripherals Specification document and have Linux drivers available.

9.1.2 Secondary Memory Interface (SMI)

The SMI peripheral is an asynchronous NAND type bus supporting Intel mode80 type transfers at 8 or 16 bit widths and available in the ALT1 positions on GPIO banks 0 and 1 (see Table 9 and Table 10). It is not publicly documented in the Broadcom Peripherals Specification but a Linux driver is available in the Raspberry Pi Github Linux repository (bcm2835_smi.c in linux/drivers/misc).

9.1.3 Display Parallel Interface (DPI)

A standard parallel RGB (DPI) interface is available on bank 0 GPIOs. This up-to-24-bit parallel interface can support a secondary display. Again this interface is not documented in the Broadcom Peripherals Specification but documentation can be found here.

9.1.4 SD/SDIO Interface

The BCM283x supports two SD card interfaces, SD0 and SD1.

The first (SD0) is a proprietary Broadcom controller that does not support SDIO and is the primary interface used to boot and talk to the eMMC or SDX_x signals.

The second interface (SD1) is standards compliant and can interface to SD, SDIO and eMMC devices; for example on a Raspberry Pi 3 B+ it is used to talk to the on-board CYW43455 WiFi device in SDIO mode.

Both interfaces can support speeds up to 50MHz single ended (SD High Speed Mode).

9.2 CSI (MIPI Serial Camera)

Currently the CSI interface is not openly documented and only CSI camera sensors supported by the official Raspberry Pi firmware will work with this interface. Supported sensors are the OmniVision OV5647 and Sony IMX219.

It is recommended to attach other cameras via USB.

9.3 DSI (MIPI Serial Display)

Currently the DSI interface is not openly documented and only DSI displays supported by the official Raspberry Pi firmware will work with this interface.

Displays can also be added via the parallel DPI interface which is available as a GPIO alternate function - see Table 9 and Section 9.1.3

9.4 USB

The BCM2837 USB port is On-The-Go (OTG) capable. If using either as a fixed slave or fixed master, please tie the USB_OTGID pin to ground.

The USB port (Pins USB_DP and USB_DM) must be routed as 90 ohm differential PCB traces.

Note that the port is capable of being used as a true OTG port however there is no official documentation. Some users have had success making this work.

9.5 HDMI

BCM283x supports HDMI V1.3a.

It is recommended that users follow a similar arrangement to the Compute Module IO Board circuitry for HDMI output.

The HDMI CK P/N (clock) and D0-D2 P/N (data) pins must each be routed as matched length 100 ohm differential PCB traces. It is also important to make sure that each differential pair is closely phase matched. Finally, keep HDMI traces well away from other noise sources and as short as possible.

Failure to observe these design rules is likely to result in EMC failure.

9.6 Composite (TV Out)

The TVDAC pin can be used to output composite video (PAL or NTSC). Please route this signal away from noise sources and use a 75 ohm PCB trace.

Note that the TV DAC is powered from the VDAC supply which must be a clean supply of 2.5-2.8V. It is recommended users generate this supply from 3V3 using a low noise LDO.

If the TVDAC output is not used VDAC can be connected to 3V3, but it must be powered even if the TV-out functionality is unused.

10 Thermals

The BCM2837 SoC employs DVFS (Dynamic Voltage and Frequency Scaling) on the core voltage. When the processor is idle (low CPU utilisation), it will reduce the core frequency and voltage to reduce current draw and heat output. When the core utilisation exceeds a certain threshold the core votlage is increased and the core frequency is boosted to the maximum working frerquency of 1.2GHz. The voltage and frequency are throttled back when the CPU load reduces back to an 'idle' level OR when the silicon temperature as mesured by the on-chip temperature sensor exceeds 80C (thermal throttling).

A designer must pay careful attention to the thermal design of products using the CM3+ so that performance is not artificially curtailed due to the processor thermal throttling, as the Quad ARM complex in the BCM2837 can generate significant heat output under load.

10.1 Temperature Range

The operating temperature range of the module is set by the lowest maximum and highest minimum of any of the components used.

The eMMC and LPDDR2 have the narrowest range, these are rated for -25 to +80 degrees Celsius. Therefore the nominal range for the CM3+ and CM3+ Lite is -25C to +80C.

However, this range is the maximum for the silicon die; therefore, users would have to take into account the heat generated when in use and make sure this does not cause the temperature to exceed 80 degrees Celsius.

11 Availability

Raspberry Pi guarantee availability of CM3+ and CM3+ Lite until at least January 2026.

12 Support

For support please see the hardware documentation section of the Raspberry Pi website and post questions to the Raspberry Pi forum.