

Bridgetek Pte Ltd

Datasheet

CleO50 Module



1 Introduction

CleO50 is a smart TFT display shield for Arduino and MikroBUS. It includes a 5.0 inch 800x480 pixel TFT LCD panel with resistive touch, PWM audio output with in-built speaker amplifier for better audio quality. For the convenience of user, speaker cable with 1X4 socket to 2 pin wire ended and 1X2 socket is provided. Users can use their own speaker.

These smart TFT display shields can be easily programmed by almost anyone to give professional looking HMI / GUI's with no prior knowledge of complex graphics programming or mathematics.

1.1 Features

CleO50 utilises the Bridgetek FT900 low power MCU to bridge between the Arduino and fast interface accessories such as MikroBUS, camera and SD Card input. For a full list of the FT900's features refer to the [FT90X datasheet](#). In addition, *CleO50* has the following features:

- Support landscape and portrait modes
- In built Bridgetek FT812 embedded video engine (EVE) graphic controller
- Anti-aliased graphics throughout for much finer image quality with no "jaggies"
- Ready to use LCD module with resistive touch in panel mountable bezel
- USB DFU port for firmware updates
- In built 8M Byte Eflash memory
- PWM audio supported and in built speaker amplifier
- Support MikroBUS interface
- Support Micro SD card
- Support camera interface
- Support I2S interface
- Support CAN bus
- Support RTC function
- Designed as Arduino and *NerO* shield
- Compatible with Bridgetek *CleO*-RIO, *CleO*-Camera and *CleO*-Speaker
- CE and FCC certified

Note: MikroBus interface is created by MikroElektronika is an open standard anyone can implement in their design. Please visit [MikroE](#) for more detail

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2 Ordering Information

| Part No. | Description |
|------------------|---|
| <i>CleO50A</i> | <i>CleO50</i> module, with FPC/FFC 40 LCD connector, 5.0 inch TFT LCD display panel preinstalled with resistive touch. Black bezel. |
| <i>CleO-RIO1</i> | Arduino Shield for users to stack Arduino board on bottom of <i>CleO50</i> . |
| <i>CleO-CAM1</i> | A camera plug-in module for <i>CleO50</i> . |
| <i>CleO-SPK1</i> | A speaker enclosure with connecting wires to <i>CleO50</i> . |

3 Program Support

Demo applications are provided for *CleO50* modules by Bridgetek. Visit Bridgetek's website <http://brtchip.com/m-cleo50/> for more information.

Table of Contents

| | | |
|----------|---|-----------|
| 1 | Introduction | 1 |
| 1.1 | Features..... | 1 |
| 2 | Ordering Information | 2 |
| 3 | Program Support..... | 2 |
| 4 | Module Hardware Feature | 5 |
| 4.1 | Power Supply | 6 |
| 4.2 | Micro-controller | 6 |
| 4.3 | Micro SD Interface | 6 |
| 4.4 | LCD Interface..... | 7 |
| 4.5 | Camera Interface | 9 |
| 4.6 | Audio Output..... | 11 |
| 4.7 | SPI Slave Interface | 12 |
| 4.8 | MikroBUS Interface..... | 13 |
| 4.9 | I²S Interface and CAN Bus | 15 |
| 4.10 | Power and Program Interface..... | 15 |
| 4.11 | MCU Interrupt Interface | 16 |
| 4.12 | External Real Time Clock (RTC) | 16 |
| 5 | Devices Characteristics and Ratings..... | 17 |
| 5.1 | Electrical Specification | 17 |
| 5.2 | Display Specification | 17 |
| 5.3 | Optical Specification | 18 |
| 6 | Board Schematics..... | 20 |
| 7 | Block Diagram | 23 |
| 8 | Mechanical Dimensions | 24 |
| 8.1 | CleO50 Module Dimensions | 24 |
| 8.2 | Bezel Drawing..... | 25 |
| 8.3 | Speaker Cable Drawing | 26 |
| 9 | Contact Information | 27 |
| | Appendix A – References | 28 |

| | |
|--|-----------|
| Document References | 28 |
| Acronyms and Abbreviations | 28 |
| Appendix B - List of Figures and Tables | 29 |
| List of Tables | 29 |
| List of Figures | 29 |
| Appendix C – Revision History | 30 |

4 Module Hardware Feature

The dimensions of *CleO50* module are 142 mm x 99 mm X17.8mm. See Figure 1 for all the hardware features.

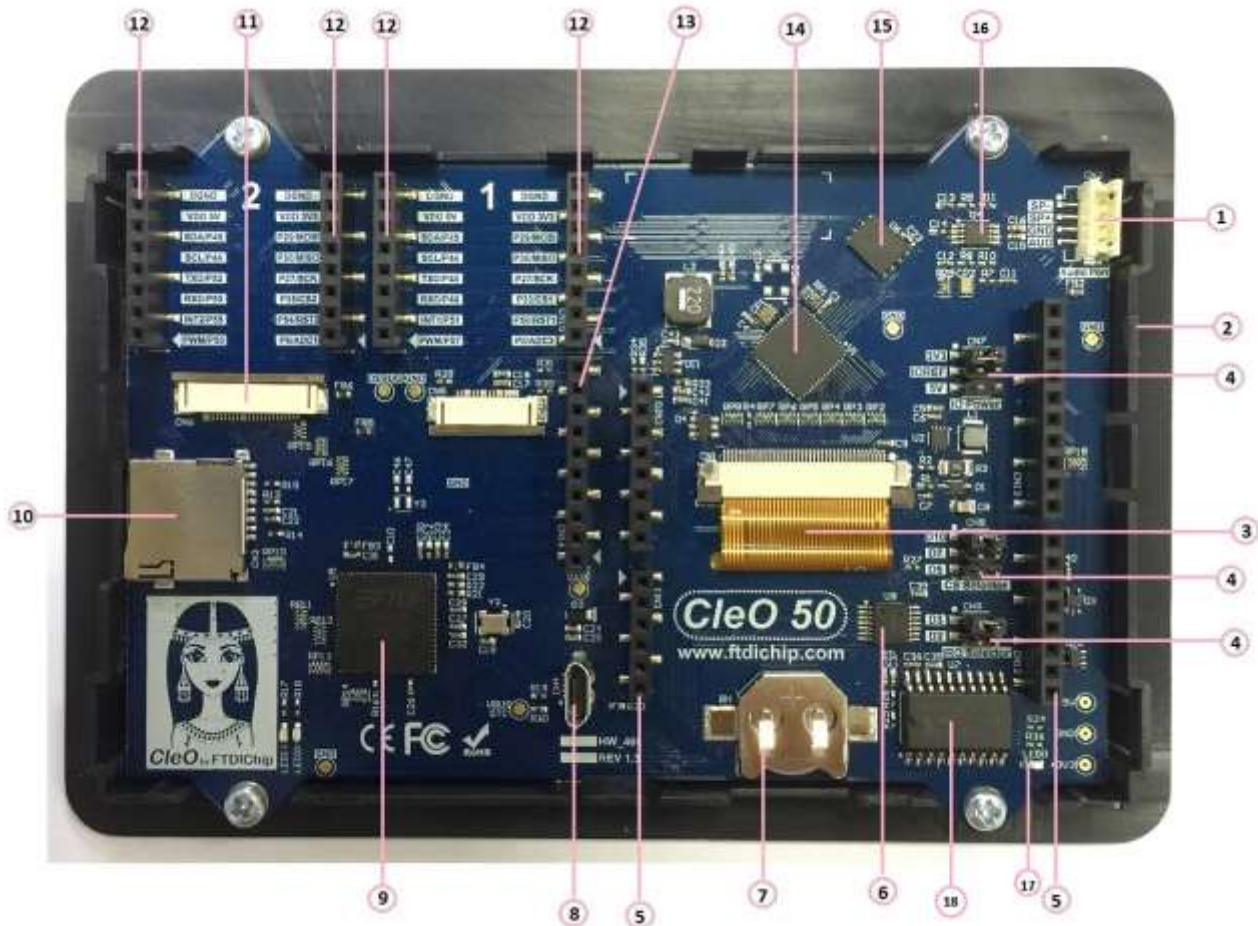


Figure 1 - CleO50 Bottom View

Key Features:

- | | |
|---|---------------------------------|
| 1 Speaker out / Line in | 2 Plastic Bezel |
| 3 5.0 in HVGA TFT I/F + Resistive Touch | 4 Arduino Configuration Jumpers |
| 5 Arduino I/F | 6 Level Shifter |
| 7 Battery Holder | 8 USB DFU Connector |
| 9 FT900 MCU | 10 MicroSD Card Socket |
| 11 Camera Interface | 12 MikroBus Interface |
| 13 I2S & Can Bus Interface | 14 FT812 GPU |
| 15 8M Byte E-Flash | 16 Audio Amplifier |
| 17 Power indicator LED | 18 RTC Circuitry |

4.1 Power Supply

CleO50 module receives power externally. Users can combine the module with the FCC/CE certified *NerO* or Arduino UNO and draw power from those board supplies. For details of the *NerO* module, refer to [Bridgetek-NerO](#).

Alternatively, the on board USB connector, **CN4** which is primarily for debug purpose and DFU firmware upgrade may also supply power.

Once the 5V supply is applied, a Red LED power indicator will be turned on. A step down regulator **U11** will step down the 5V to 3.3V. The 3.3V supply will serve all peripherals of the FT900 microcontroller.

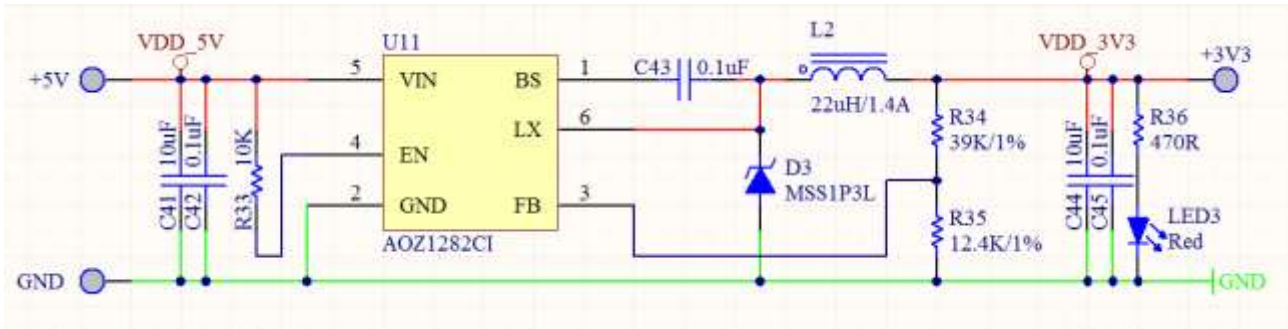


Figure 2 - Power Supply

4.2 Micro-controller

The FT900Q 100-pin QFN microcontroller which is provided on the board belongs to 32-bit FT90X Super Bridging Microcontroller family from Bridgetek. For details of the FT900Q Microcontroller, refer to [FT90X datasheet](#).

4.3 Micro SD Interface

A Micro SD card slot is provided on *CleO50* supporting two standard capacity card types:

- Secure Digital (SD) standard – Up to 2GB SD memory card
- Secure Digital High Capacity (SDHC) standard – Over 4GB-32GB SDHC memory card

The SD host controller is compatible with the standard specification V3.0. It supports up to 25MHz SD clock speed. *CleO50* physical interface supports 4-bit SD bus mode and card detection.

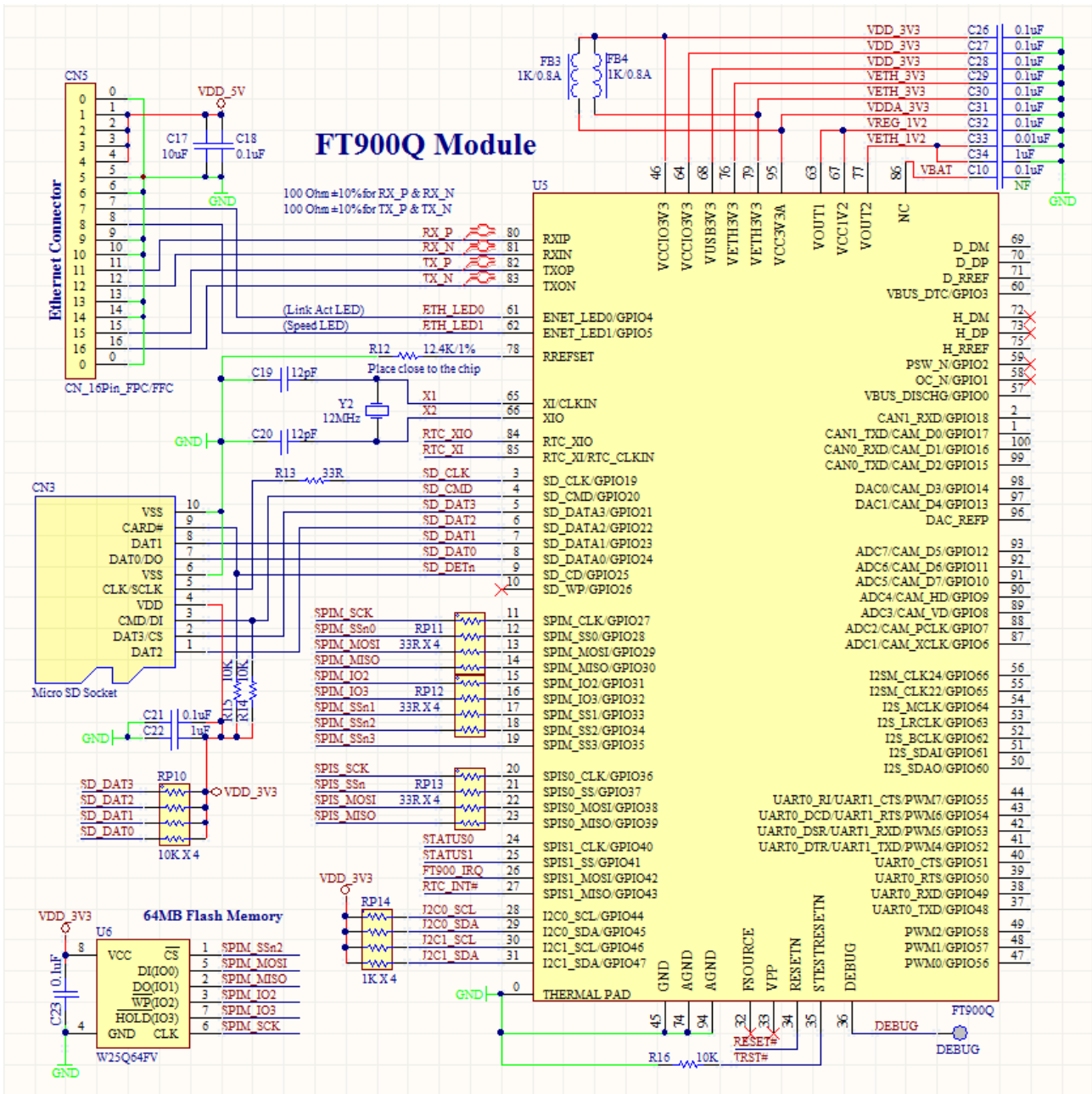


Figure 3 – MicroSD Interface

4.4 LCD Interface

CleO50 module supports a 5.0 inch TFT LCD with resistive touch. The FT812Q 56pin VQFN graphics controller IC with integrated touch and audio belongs to Bridgetek’s EVE series. For further details of the FT812Q EVE graphics controller, refer to the [FT81X datasheet](#).

The 5.0 inch LCD is connected through the 40 pin FPC/FPC connector **CN1**. See Table 1 for the LCD connector pinout.

| Pin No. | Name | Description |
|---------|---------|---------------------------|
| 1 | LEDK | Backlight LED Cathode |
| 2 | LEDA | Backlight LED Anode |
| 3 | GND | Ground |
| 4 | VDD_3V3 | LCD VCC Supply |
| 5 | R0 | Bit 0 of Red RGB Signal |
| 6 | R1 | Bit 1 of Red RGB Signal |
| 7 | R2 | Bit 2 of Red RGB Signal |
| 8 | R3 | Bit 3 of Red RGB Signal |
| 9 | R4 | Bit 4 of Red RGB Signal |
| 10 | R5 | Bit 5 of Red RGB Signal |
| 11 | R6 | Bit 6 of Red RGB Signal |
| 12 | R7 | Bit 7 of Red RGB Signal |
| 13 | G0 | Bit 0 of Green RGB Signal |
| 14 | G1 | Bit 1 of Green RGB Signal |
| 15 | G2 | Bit 2 of Green RGB Signal |
| 16 | G3 | Bit 3 of Green RGB Signal |
| 17 | G4 | Bit 4 of Green RGB Signal |
| 18 | G5 | Bit 5 of Green RGB Signal |
| 19 | G6 | Bit 6 of Green RGB Signal |
| 20 | G7 | Bit 7 of Green RGB Signal |
| 21 | B0 | Bit 0 of Blue RGB Signal |
| 22 | B1 | Bit 1 of Blue RGB Signal |
| 23 | B2 | Bit 2 of Blue RGB Signal |
| 24 | B3 | Bit 3 of Blue RGB Signal |
| 25 | B4 | Bit 4 of Blue RGB Signal |
| 26 | B5 | Bit 5 of Blue RGB Signal |
| 27 | B6 | Bit 6 of Blue RGB Signal |
| 28 | B7 | Bit 7 of Blue RGB Signal |
| 29 | GND | Ground |
| 30 | PCLK | Pixel Clock |
| 31 | DISP | LCD Display Enable |
| 32 | HSYNC | LCD Horizontal Sync |
| 33 | VSYSN | LCD Vertical Sync |
| 34 | DE | LCD Data Enable |
| 35 | NC | No Connection |
| 36 | GND | Ground |

| | | |
|----|----|---|
| 37 | XP | X Right Electrode of 4-Wire Resistive Touch-Screen Panel |
| 38 | YM | Y Bottom Electrode of 4-Wire Resistive Touch-Screen Panel |
| 39 | XM | X Left Electrode of 4-Wire Resistive Touch-Screen Panel |
| 40 | YP | Y Top Electrode of 4-Wire Resistive Touch-Screen Panel |

Table 1 – LCD Connector Pin Out

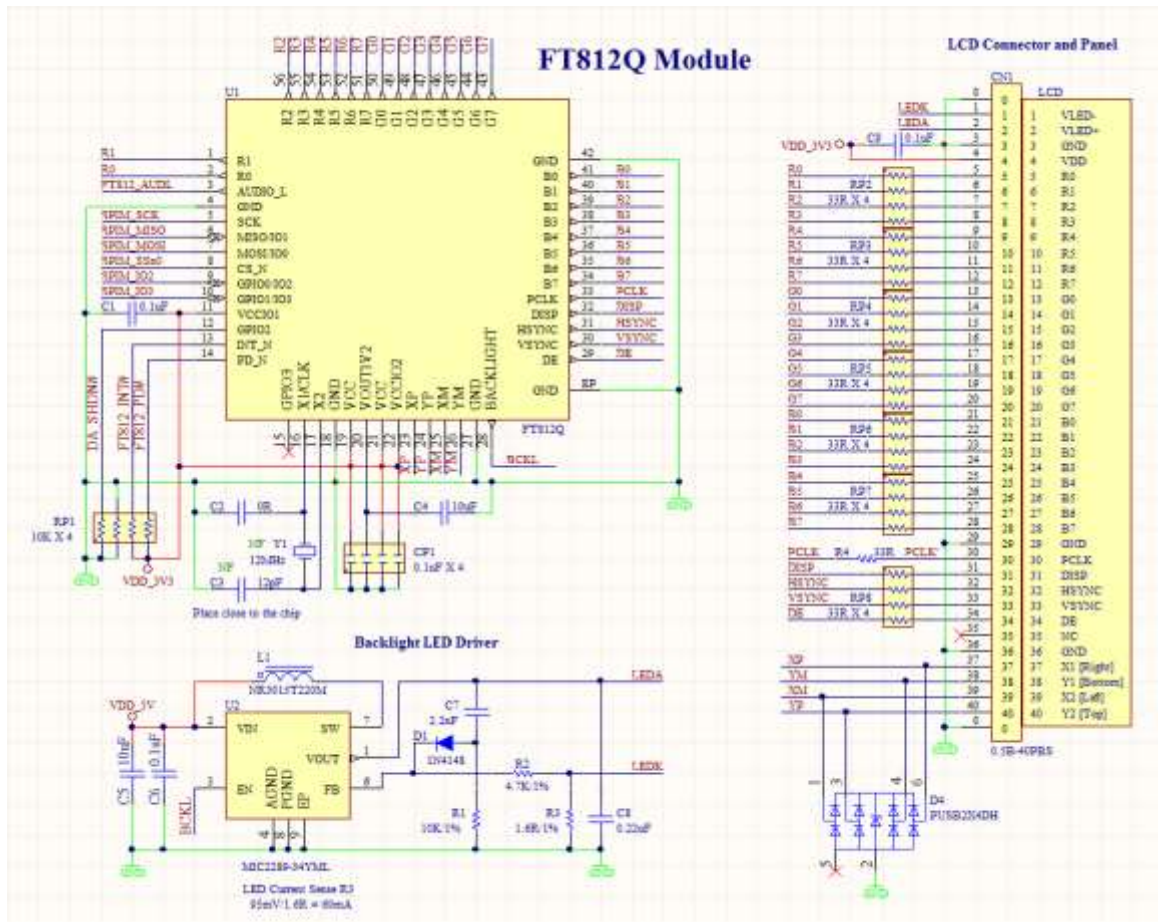


Figure 4 – LCD Interface

4.5 Camera Interface

CleO50 has a camera module interface, via a 24-pin 0.5mm pitch FFC/FPC, bottom contact connector, **CN6**. In this design, support is provided for an OmniVision OV5640 camera module. A readymade camera module (CleO-CAM1) can be purchased from Bridgetek. Support for further camera modules may be added in the future. Please visit [Bridgetek](http://www.bridgetek.com) website for more information.

See table 2 for the Camera interface pinout.

| Pin No. | Name | Description |
|---------|----------|--|
| 1 | GND | Ground |
| 2 | GND | Ground |
| 3 | I2C1_SDA | I2C Serial Bus, Data Line |
| 4 | CAM_5V | 5V Power Supply |
| 5 | I2C1_SCL | I2C Serial Bus, Clock Line |
| 6 | RESET# | Hardware Reset, Active Low |
| 7 | CAM_VD | Camera Vertical Sync Input |
| 8 | CAM_PWDN | Camera Module Power Down Signal, Active High |
| 9 | CAM_HD | Camera Horizontal Reference Input |
| 10 | CAM_3V3 | 3.3V Power Supply |
| 11 | CAM_3V3 | 3.3V Power Supply |
| 12 | CAM_D7 | Camera Data Line, Bit 7 |
| 13 | CAM_XCLK | Camera External Clock Output |
| 14 | CAM_D6 | Camera Data Line, Bit 6 |
| 15 | GND | Ground |
| 16 | CAM_D5 | Camera Data Line, Bit 5 |
| 17 | CAM_PCLK | Camera Pixel Clock Input |
| 18 | CAM_D4 | Camera Data Line, Bit 4 |
| 19 | CAM_D0 | Camera Data Line, Bit 0 |
| 20 | CAM_D3 | Camera Data Line, Bit 3 |
| 21 | CAM_D1 | Camera Data Line, Bit 1 |
| 22 | CAM_D2 | Camera Data Line, Bit 2 |
| 23 | CAM_5V | 5V Power Supply |
| 24 | PWM0 | Pulse Width Modulation 0 |

Table 2 – Camera Connector Pin Out

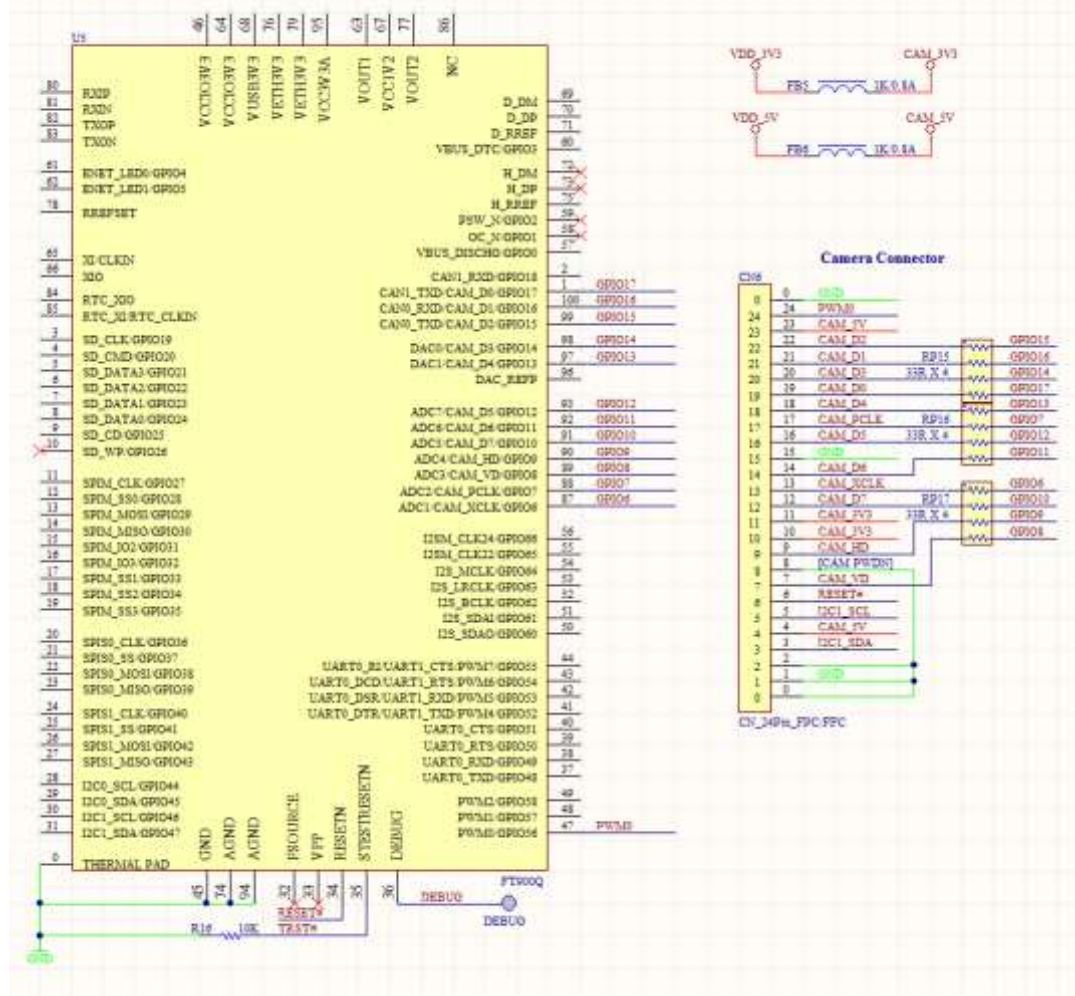


Figure 5 – Camera Interface

4.6 Audio Output

CleO50 supports a mono speaker output through **CN2**. Maximum output power, can drive up to 8 OHM, 1 Watt speaker driver. A readymade speaker module (CleO-SPK1) is also available. Visit [Bridgetek](http://Bridgetek.com) website for more information.

An alternative, mono line-in audio input is also provided on **CN2**. Users can drive in their own audio source to the on board power amplifier. See the Table 3 for the pin list for **CN2**.

| Pin No. | Pin Name | Description |
|---------|----------|----------------------|
| 1 | SP- | Speaker Out Negative |
| 2 | SP+ | Speaker Out Positive |
| 3 | GND | Ground |
| 4 | EXT_AUD | Ext Audio Line In |

Table 3 – Audio Connector Pin Out

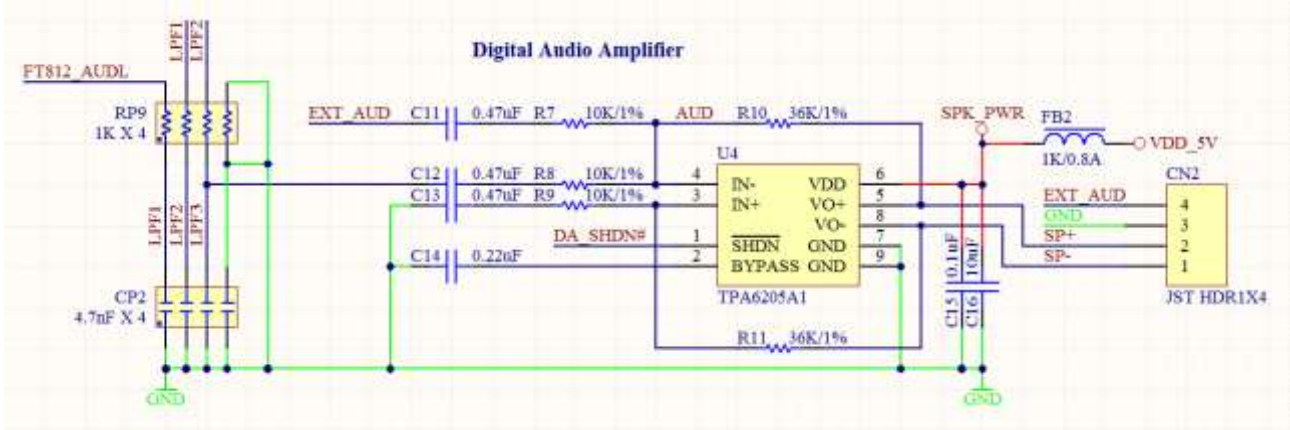


Figure 6 – Speaker Amplifier Circuitry

4.7 SPI Slave Interface

CleO50 has a SPI slave interface that supports single and dual (2 data lines) SPI data transfer modes. This interface supports both 5V, 3.3V as well as user defined output levels. The user defined interface levels must be between 3V (min) to 5.5V (max). The power selection jumper is through **CN7**.

| Pin No. | Description |
|---------|--|
| 1-2 | 3.3V SPI interface |
| 3-4 | SPI interface voltage level follows user setting (IOREF) |
| 5-6 | 5V SPI interface |

Table 4 – CN7 Jumper Selection

There are chip select (CS) jumper selections on **CN8**. The user has 3 options to choose for their connection.

| Pin No. | Description |
|---------|-------------------------------------|
| 1-2 | SPI chip select from D10 (option 1) |
| 3-4 | SPI chip select from D7 (option 2) |
| 5-6 | SPI chip select from D5 (option 3) |

Table 5 – CN8 Jumper Selection

For the SPI Slave interface, there are two connectors for the user to interface with the master side.

- The **CN13** – 1X10 position 2.54mm pitch female header
- The **CN12** – 1X8 position 2.54mm pitch female header

| Pin No. | Name | Description |
|---------|------|---------------------------|
| 1 | - | No Connection |
| 2 | - | No Connection |
| 3 | D10 | SPI Chip Select Option 1 |
| 4 | MOSI | SPI Data from Master Side |

| | | |
|----|------|-------------------------|
| 5 | MISO | SPI Data to Master Side |
| 6 | SCK | SPI Clock |
| 7 | GND | Ground |
| 8 | - | No Connection |
| 9 | - | No Connection |
| 10 | - | No Connection |

Table 6 – CN13 Pin Out

| Pin No. | Name | Description |
|---------|------|--------------------------------------|
| 1 | - | No Connection |
| 2 | - | No Connection |
| 3 | D2 | FT900 Interrupt Request Out Option 1 |
| 4 | D3 | FT900 Interrupt Request Out Option 2 |
| 5 | - | No Connection |
| 6 | D5 | SPI Chip Select Option 3 |
| 7 | - | No Connection |
| 8 | D7 | SPI Chip Select Option 2 |

Table 7 – CN12 Pin Out

4.8 MikroBUS Interface

CleO50 module has dual MikroBUS interfaces through **CN14** & **CN15** for MikroBUS 1 and **CN17** & **CN18** for MikroBUS 2.

See Table 8 for MikroBUS 1 interface pinout.

See Table 9 for MikroBUS 2 interface pinout.

| Pin No. of CN14 | Name | Description |
|-----------------|-----------|--------------------------------|
| 1 | PWM1 | Pulse Width Modulation 1 |
| 2 | UART0_CTS | Clear to Send Input for UART0 |
| 3 | UART0_RXD | Receiver Input for UART0 |
| 4 | UART0_TXD | Transmitter Output for UART0 |
| 5 | I2C0_SCL | I2C0 Serial Clock Input/Output |
| 6 | I2C0_SDA | I2C0 Data Line Input/Output |
| 7 | VDD_5V | 5V Power Supply |
| 8 | GND | Ground |
| Pin No. of CN15 | Name | Description |
| 1 | GPIO8 | 10-Bit A/D Converter 3, Input |

| | | |
|---|------------------------|--------------------------------------|
| 2 | UART0_RTS | Request to Send Output for UART0 |
| 3 | SPIM_SS _n 1 | Slave Select 1 Output for SPI Master |
| 4 | SPIM_SCK | Serial Clock Output for SPI Master |
| 5 | SPIM_MISO | Master In Slave Out for SPI Master |
| 6 | SPIM_MOSI | Master Out Slave In for SPI Master |
| 7 | VDD_3V3 | 3.3V Power Supply |
| 8 | GND | Ground |

Table 8 - MikroBUS 1 Interface Pin Out

| Pin No. of CN17 | Name | Description |
|-----------------|------------------------|--------------------------------------|
| 1 | PWM2 | Pulse Width Modulation 2 |
| 2 | UART1_CTS | Clear to Send Input for UART1 |
| 3 | UART1_RXD | Receiver Input for UART1 |
| 4 | UART1_TXD | Transmitter Output for UART1 |
| 5 | I2C0_SCL | I2C0 Serial Clock Input/Output |
| 6 | I2C0_SDA | I2C0 Data Line Input/Output |
| 7 | VDD_5V | 5V Power Supply |
| 8 | GND | Ground |
| Pin No. of CN18 | Name | Description |
| 1 | GPIO6 | 10-Bit A/D Converter 1, Input |
| 2 | UART1_RTS | Request to Send Output for UART1 |
| 3 | SPIM_SS _n 3 | Slave Select 3 Output for SPI Master |
| 4 | SPIM_SCK | Serial Clock Output for SPI Master |
| 5 | SPIM_MISO | Master In Slave Out for SPI Master |
| 6 | SPIM_MOSI | Master Out Slave In for SPI Master |
| 7 | VDD_3V3 | 3.3V Power Supply |
| 8 | GND | Ground |

Table 9 - MikroBUS 2 Interface Pin Out

4.9 I²S Interface and CAN Bus

CleO50 module has a combined interface of full I2S signals and CAN bus through **CN16**, 1X10 position 2.54mm pitch female header.

See Table 10 for connector CN16 pinout.

| Pin No. | Name | Description |
|---------|------------|---|
| 1 | I2SM_CLK24 | I2S Master External 24.576MHz Clock Input |
| 2 | I2SM_CLK22 | I2S Master External 22.5792MHz Clock Input |
| 3 | I2S_MCLK | I2S Master Transmitter Clock Output |
| 4 | I2S_LRCLK | Left / Right Clock Line Output for I2S Master Transmitter or Input for I2S Slave Receiver |
| 5 | I2S_BCLK | Bit Clock Line Output for I2S Master Transmitter or Input for I2S Slave Receiver |
| 6 | I2S_SDAI | Serial Data Line Input for I2S Master or Slave |
| 7 | I2S_SDAO | Serial Data Line Output for I2S Master or Slave |
| 8 | GND | Ground |
| 9 | CAN0_RXD | CAN0 Receiver Input |
| 10 | CAN0_TXD | CAN0 Transmitter Output |

Table 10 – CN16 Pin Out

4.10 Power and Program Interface

The power interface **CN10**, 1X8 position 2.54mm pitch female header, may be driven by *NerO* or an Arduino UNO.

Users can use the USB connector **CN4** for FT900 firmware upgrades. For the details of the tool operation, refer to [AN 325 FT900 Tool Chain Installation Guide document](#).

| Pin No. | Name | Description |
|---------|--------|----------------------|
| 1 | - | No Connection |
| 2 | IOREF | IO Reference Voltage |
| 3 | RESET | FT900 Reset Pin |
| 4 | - | No Connection |
| 5 | VDD_5V | 5V Power Supply |
| 6 | GND | Ground |
| 7 | GND | Ground |
| 8 | - | No Connection |

Table 11 – CN10 Pin Out

4.11 MCU Interrupt Interface

There is a jumper selection for the FT900 interrupt request through **CN9**. Users have 2 options to choose from.

| Pin No. | Description |
|---------|--------------------------------------|
| 1-2 | Connect to Arduino/NerO MCU int0(D3) |
| 3-4 | Connect to Arduino/NerO MCU int1(D2) |

Table 12 – CN9 Jumper Selection

4.12 External Real Time Clock (RTC)

CleO50 has an external RTC through I2C1 channel and supplied by backup battery (CR-1220) during off-mode.

5 Devices Characteristics and Ratings

5.1 Electrical Specification

| Parameter | Value | Unit | Conditions |
|---|---------------|-----------|------------|
| Storage Temperature | -30°C to 80°C | Degrees C | |
| Ambient Operating Temperature (Power Applied) | -20°C to 70°C | Degrees C | |

Table 13 - Temperature Parameter

DC Characteristics (Ambient Temperature = -20°C to +70°C)

| Parameter | Description | Minimum | Typical | Maximum | Units | Conditions |
|-------------------|---------------------------|---------|---------|---------|-------|---------------------------|
| V _{bus} | USB Power Supply | 4.75 | | 5.25 | V | |
| V _{DC} | DC Power Supply | 4.75 | | 5.25 | V | External Source |
| I _{usb} | USB Power Supply Current | | | 500 | mA | |
| I _{DC} | DC Supply Current | | | 1 | A | DC=5V, external source |
| I _{idle} | DC Current in Idle Mode | | 426 | | mA | With LCD and Backlight On |
| V _{io} | 3.3 Vio Voltage Reference | 3.0 | 3.3 | 3.6 | V | |
| V _{ih} | Input High Voltage | 2 | | | V | |
| V _{il} | Input Low Voltage | | | 0.8 | V | |
| V _{oh} | Output High Voltage | 2.4 | | | V | |
| V _{ol} | Output Low Voltage | | | 0.4 | V | |

Table 14 – Operating Voltage and Current

5.2 Display Specification

| Item | Spec | Units | Notes |
|------------------|------------------------------|---------|-----------------|
| Display Area(AA) | 108.00(W) * 64.8(H) | mm | 5 Inch Diagonal |
| Driver Element | TFT Active Matrix | mA | |
| Display Colors | 16.7M | - | |
| Number of Pixels | 800(RGB)*480 | dots | |
| Viewing Angle | 12:00 | o'clock | Landscape View |
| Display Mode | Transmissive/ Normally White | - | |

| Item | Spec | Units | Notes |
|---------------|-----------|-------------------|-------|
| LCD Luminance | 400 | cd/m ² | |
| Touch Screen | Resistive | - | |

Table 15 – Display Specification

5.3 Optical Specification

| | | | | | | | | |
|-------------------------|----------------|------------------------------------|------------------------------------|------|------|-------------------|-----|---|
| Brightness (With TP) | Bp | $\theta=0^\circ$ $\Phi=0^\circ$ | | 400 | - | Cd/m ² | 1 | |
| Uniformity | Δ Bp | | 75 | - | - | % | 1,2 | |
| Viewing Angle | 3:00 | Cr \geq 10 | - | 60 | - | Deg | 3 | |
| | 6:00 | | - | 45 | - | | | |
| | 9:00 | | - | 60 | - | | | |
| | 12:00 | | - | 60 | - | | | |
| Contrast Ratio | Cr | | 300 | 500 | | - | 4 | |
| Response Time | T _r | $\theta=0^\circ$ $\Phi=0^\circ$ | - | 10 | - | ms | 5 | |
| | T _f | | - | 10 | - | ms | | |
| Color of CIE Coordinate | W | x | | 0.28 | | - | 1,6 | |
| | | y | | 0.33 | | - | | |
| | R | x | | 0.51 | | - | | |
| | | y | | 0.34 | | - | | |
| | G | x | $\theta=0^\circ$ $\Phi=0^\circ$ | | 0.31 | | | - |
| | | y | | | 0.56 | | | - |
| | B | x | | | 0.15 | | | - |
| | | y | | | 0.14 | | | - |
| NTSC Ratio | S | | 50 | 60 | - | % | | |

Table 16 – 5.0 Inch TFT Optical Specification

Note: The parameter is slightly changed by temperature, driving voltage and material

Note 1: The data are measured after LEDs are turned on for 5 minutes. LCM displays full white.
The brightness is the average value of 9 measured spots. Measurement equipment PR-705 (Φ8mm)

Measuring condition:

- Measuring surroundings: Dark room.
- Measuring temperature: $T_a=25^{\circ}\text{C}$.
- Adjust operating voltage to get optimum contrast at the center of the display.

Measured value at the center point of LCD panel after more than 5 minutes while backlight turning on.

Note 3: The definition of viewing angle:

Refer to the graph below marked by θ and ϕ

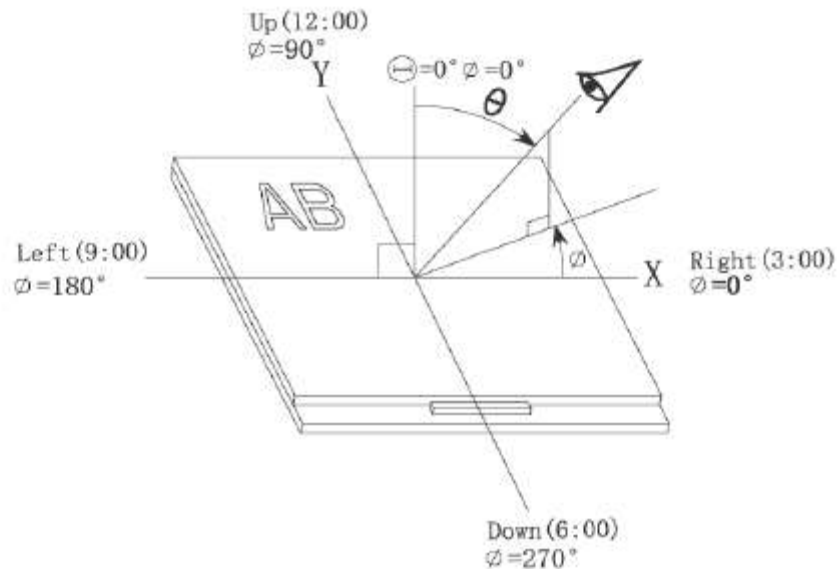


Figure 7 – Viewing Angle of the LCD

6 Board Schematics

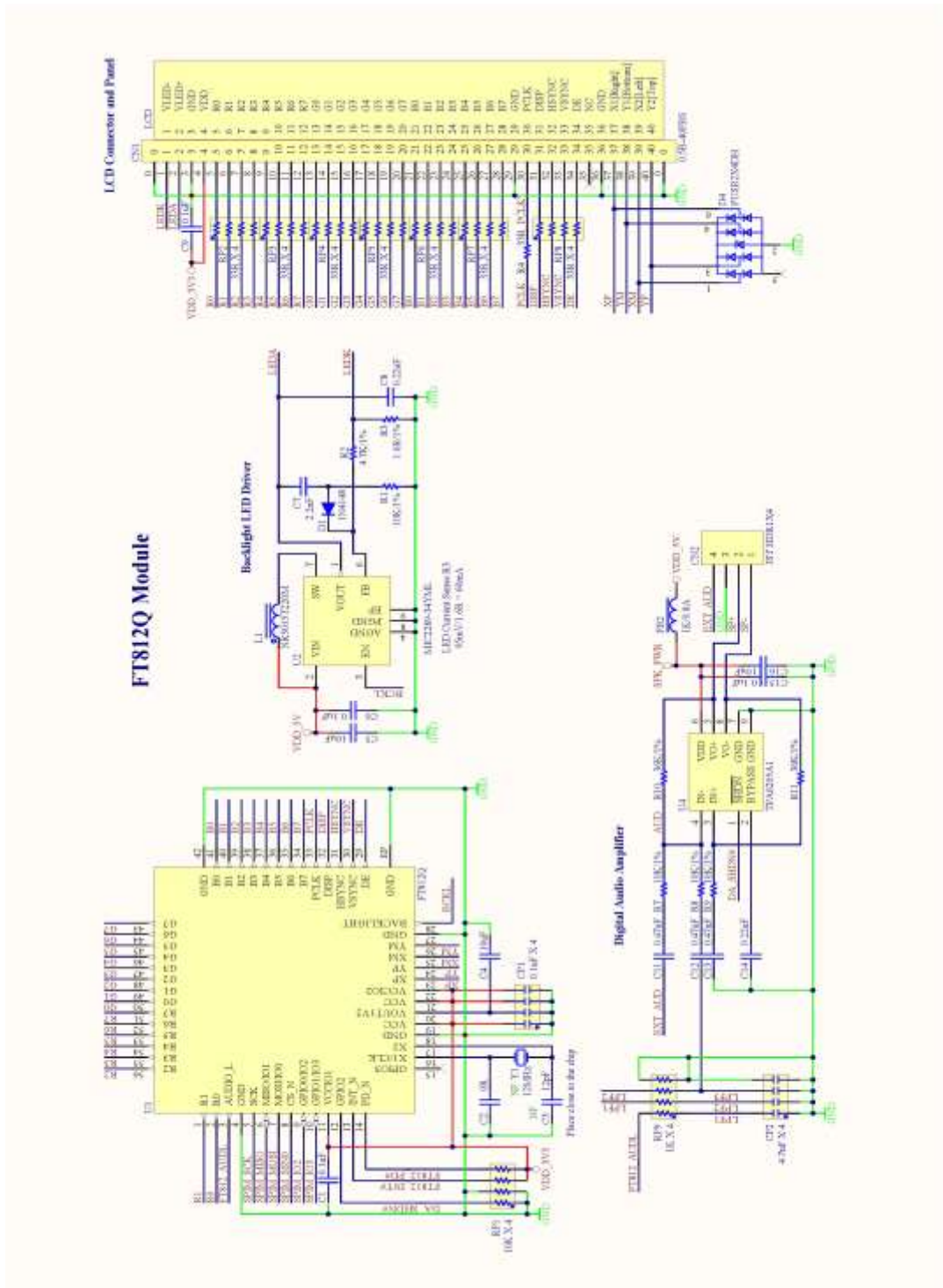


Figure 8 – Sheet 1 – FT812Q Connection

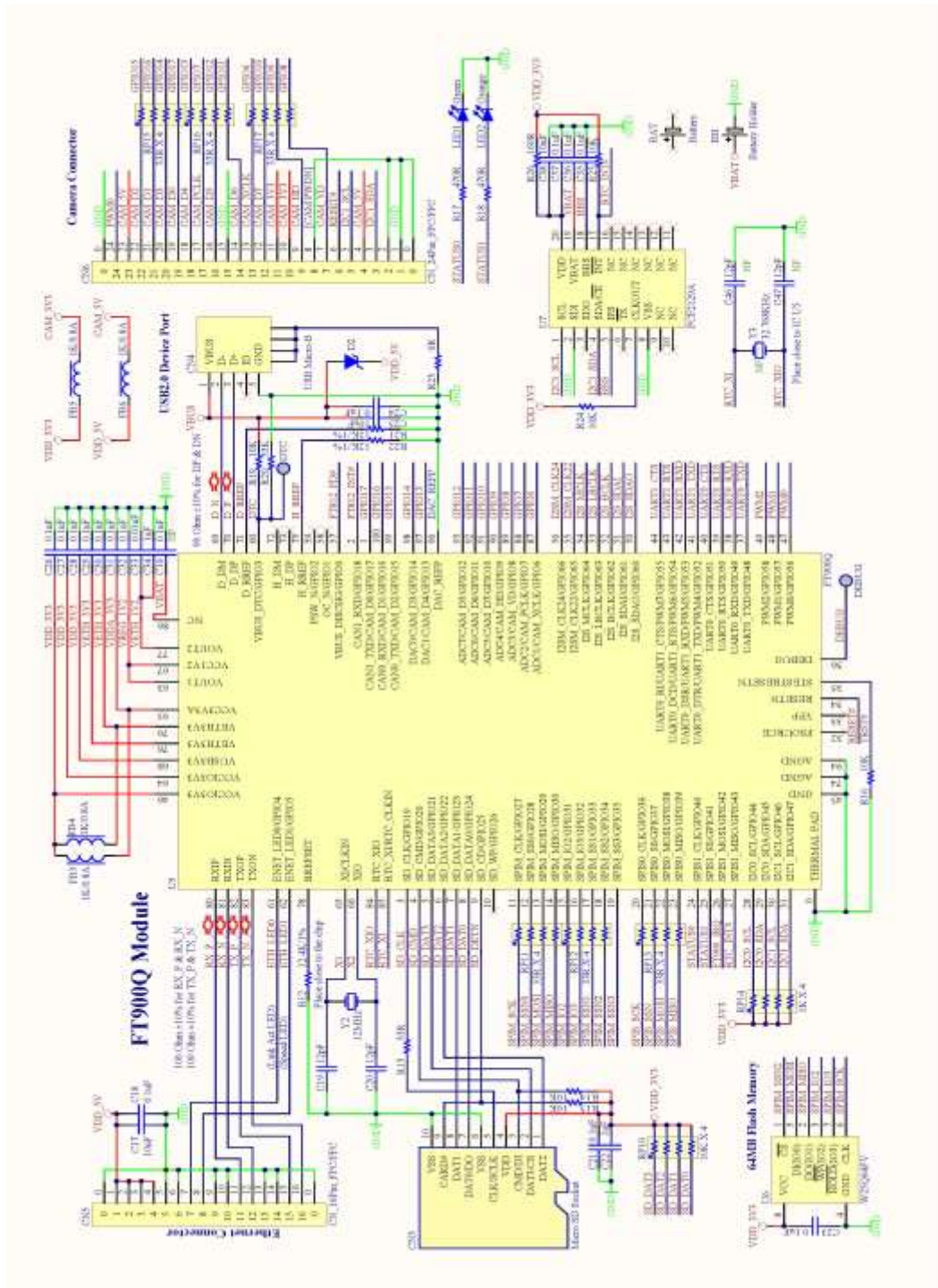


Figure 9 – Sheet 2 – FT900Q Connection

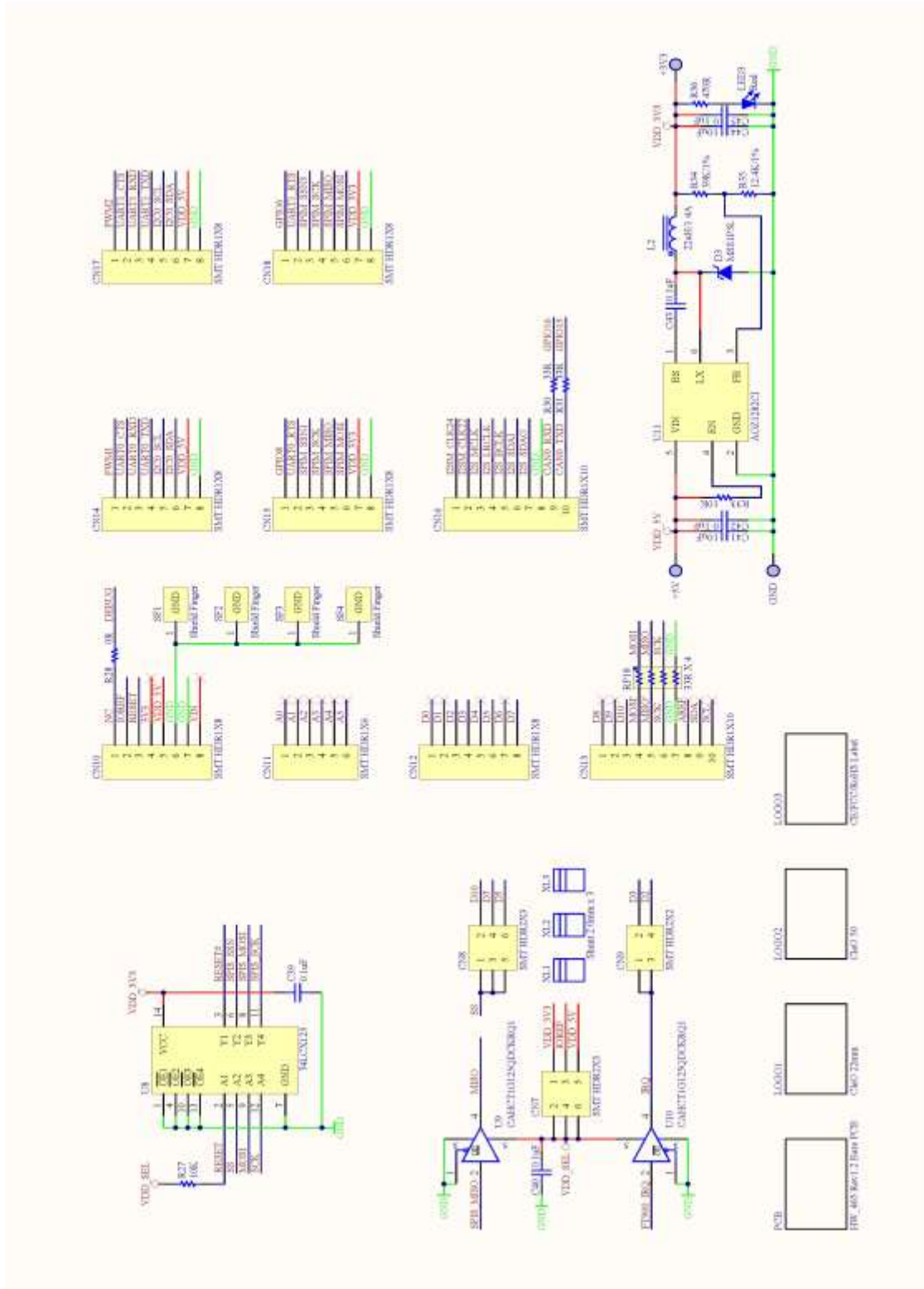


Figure 10 – Sheet 3 – Power and Connectors

7 Block Diagram

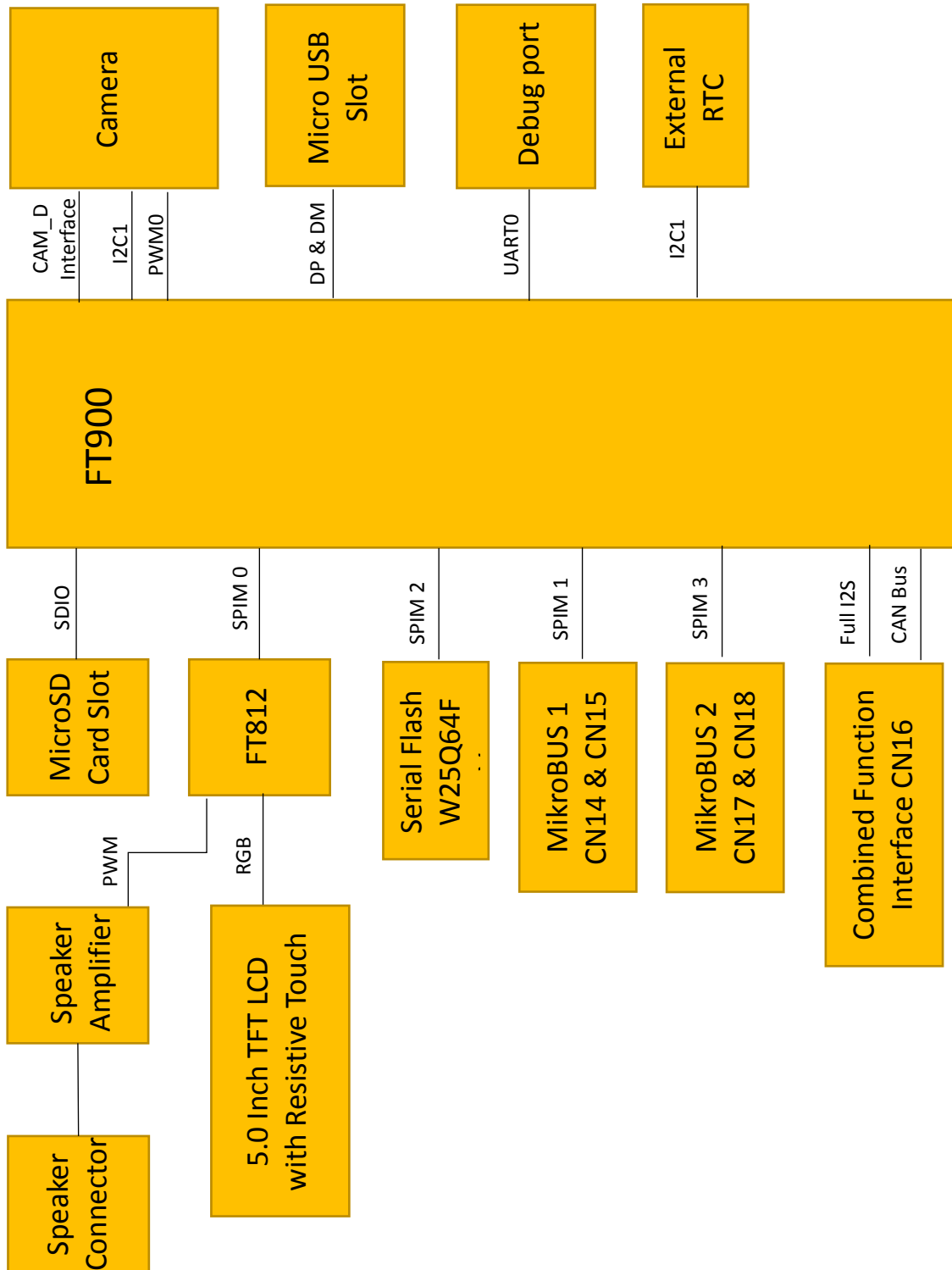


Figure 11 - CleO50 Block Diagram

8 Mechanical Dimensions

8.1 CleO50 Module Dimensions

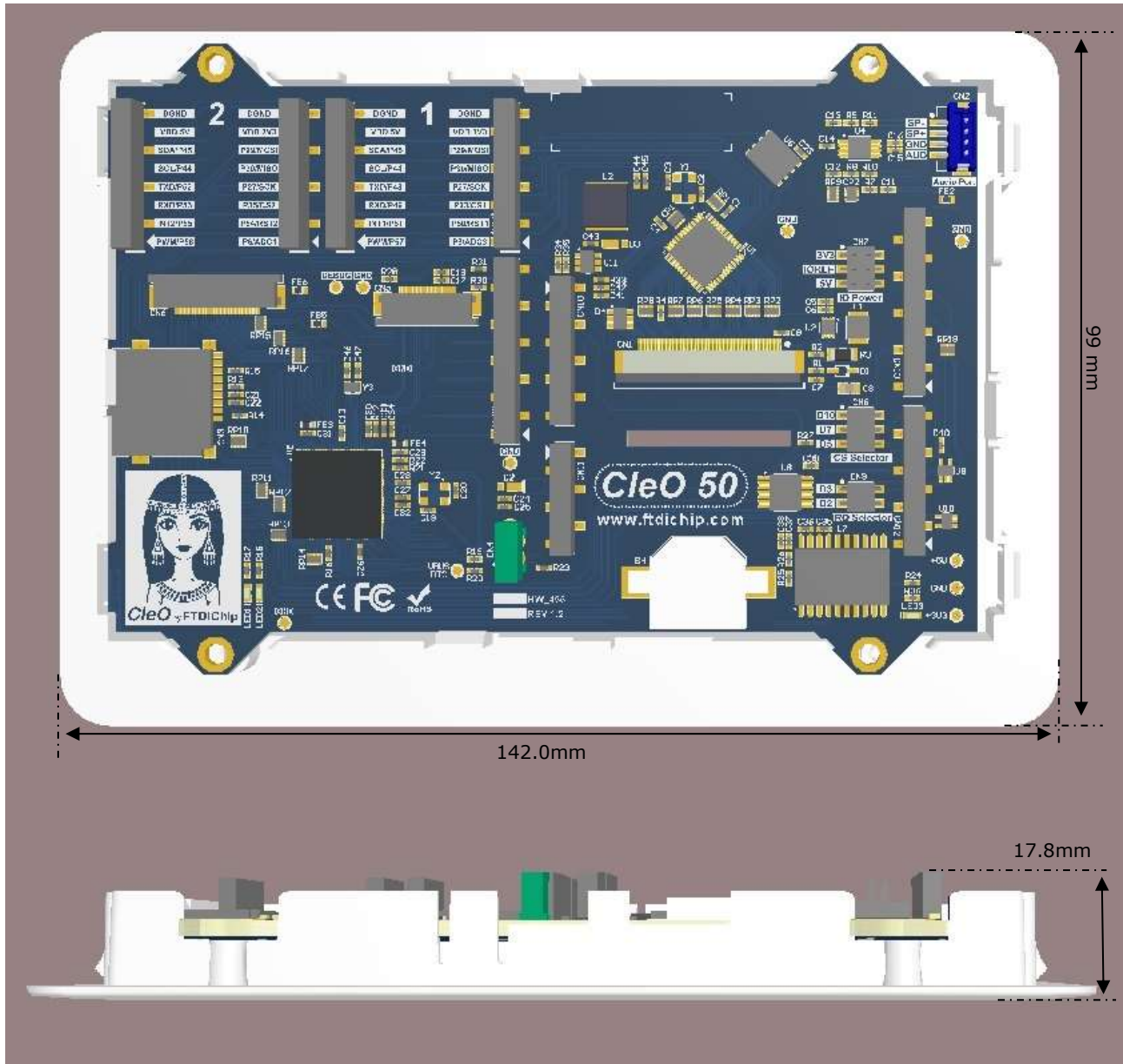


Figure 12 – CleO50 Module Dimensions

8.2 Bezel Drawing

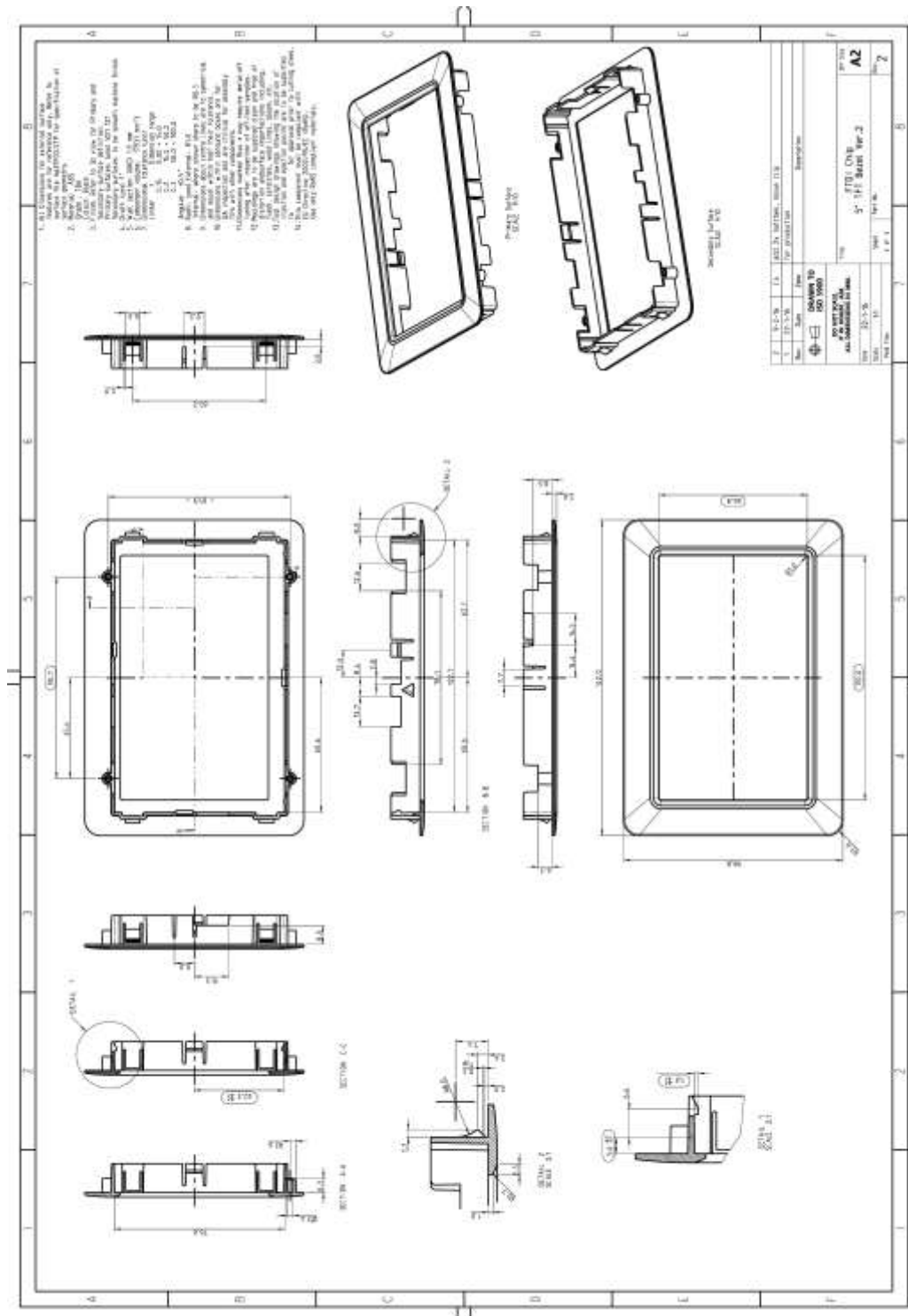


Figure 13 – CleO50 Bezel Drawing

8.3 Speaker Cable Drawing

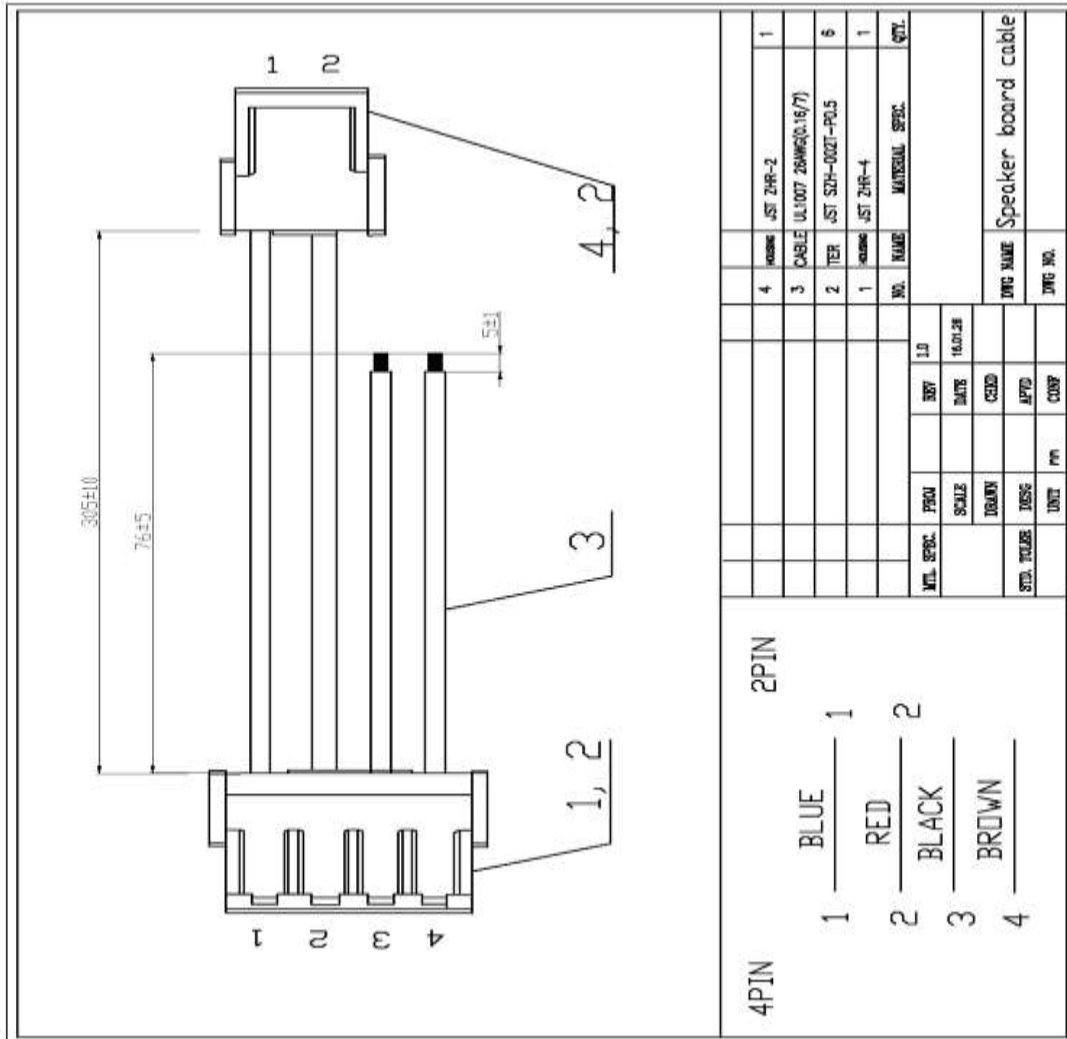


Figure 14 – Speaker Cable Drawing

| Pin No | Pin Description | Cable Colour |
|--------|---------------------------|--------------|
| 1 | Speaker Negative Terminal | Blue |
| 2 | Speaker Positive Terminal | Red |
| 3 | Ground | Black |
| 4 | External Line In | Brown |

Table 17 – Cable Pin Out Definition

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Appendix A – References

Document References

For module documentations, please refer to URL below:

FT81x series datasheet: [FT81x datasheet](#)

FT90X series datasheet: [FT90X Series Datasheet](#)

FT900 tool chain installation guide : [FT900 Tool Chain Installation Guide](#)

FT900 Bootloader DFU usage guide: [FT900 Bootloader DFU Usage Application Note](#)

mikroBus: <http://www.mikroe.com/mikrobus/>

Arduino: <https://www.arduino.cc/>

CleOStuff tools: [CleOstuff](#)

Acronyms and Abbreviations

| Terms | Description |
|-------|---|
| DC | Direct Current |
| QFN | Quad-flat no-leads |
| LED | Light-emitting diode |
| MCU | MicroController Unit |
| VQFN | Very Thin Quad Flat Non-Leaded Package |
| USB | Universal Serial Bus |
| UART | Universal Asynchronous Receiver/Transmitter |

Appendix B - List of Figures and Tables

List of Tables

| | |
|---|----|
| Table 1 – LCD Connector Pin Out..... | 9 |
| Table 2 – Camera Connector Pin Out..... | 10 |
| Table 3 – Audio Connector Pin Out..... | 11 |
| Table 4 – CN7 Jumper Selection | 12 |
| Table 5 – CN8 Jumper Selection | 12 |
| Table 6 – CN13 Pin Out | 13 |
| Table 7 – CN12 Pin Out | 13 |
| Table 8 - MikroBUS 1 Interface Pin Out | 14 |
| Table 9 - MikroBUS 2 Interface Pin Out | 14 |
| Table 10 – CN16 Pin Out | 15 |
| Table 11 – CN10 Pin Out | 15 |
| Table 12 – CN9 Jumper Selection | 16 |
| Table 13 - Temperature Parameter | 17 |
| Table 14 – Operating Voltage and Current | 17 |
| Table 15 – Display Specification | 18 |
| Table 16 – 5.0 Inch TFT Optical Specification | 18 |
| Table 17 – Cable Pin Out Definition..... | 26 |

List of Figures

| | |
|--|----|
| Figure 1 - <i>CleO50</i> Bottom View | 5 |
| Figure 2 - Power Supply | 6 |
| Figure 3 – MicroSD Interface | 7 |
| Figure 4 – LCD Interface | 9 |
| Figure 5 – Camera Interface | 11 |
| Figure 6 – Speaker Amplifier Circuitry | 12 |
| Figure 7 – Viewing Angle of the LCD | 19 |
| Figure 8 – Sheet 1 – FT812Q Connection..... | 20 |
| Figure 9 – Sheet 2 – FT900Q Connection..... | 21 |
| Figure 10 – Sheet 3 – Power and Connectors | 22 |
| Figure 11 – <i>CleO50</i> Block Diagram | 23 |
| Figure 12 – <i>CleO50</i> Module Dimensions..... | 24 |
| Figure 13 – <i>CleO50</i> Bezel Drawing | 25 |
| Figure 14 – Speaker Cable Drawing | 26 |

Appendix C – Revision History

Document Title: CleO50 Module Datasheet
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Clearance No.: BRT#045
Product Page: <http://brtchip.com/m-cleo50/>
Document Feedback: [Send Feedback](#)

| Revision | Changes | Date |
|-------------|--|------------|
| Version 1.0 | Initial Release | 2016-10-26 |
| Version 1.1 | Document migrated from FTDI/BRT Dual branding to BRT Added information related to <i>CleO</i> Speaker | 2017-09-21 |



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