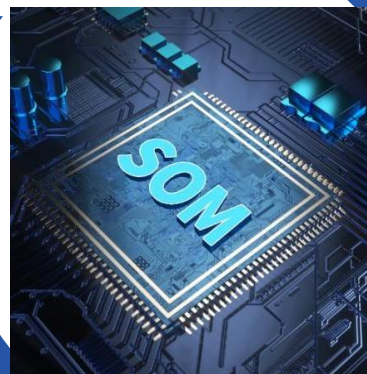


MYC-YF13X

Hardware Design Guide



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1. Overview

This document is designed to help hardware engineers design board-level circuits based on MYC-YF13X core modules, and please fully understand the document before you start your design. The document contains common information such as reference design instructions, Layout recommendations and design checks to assist the hardware engineer in design work.

The references cited in this document are from the MYIR Electronics Limited website and are included in the hardware collection of MYC-YF13X products. You can download the following address at any time.

Data download link: <http://d.myirtech.com/MYD-YF13X/>

In addition, MYIR Electronics Limited will provide the following resources to accelerate your design:

- ◆ Core board / evaluation board product manual;
- ◆ Evaluation board schematic diagram source file;
- ◆ Related device manuals.

1.1. Supported products

This document applies to all models of the MYC-YF13X series core board.

1.2. Disclaimer

- ◆ Some of the reference circuits in the documentation are based on the MYIR Electronics evaluation board and are not guaranteed to be applicable for all application scenarios. If your product has special requirements for application scenarios or technical indicators, please adjust the design according to the actual situation.
- ◆ The reference circuit and Layout recommendations in the document are for reference only and do not necessarily include all the precautions, please adjust them according to the actual situation.
- ◆ MYIR Electronics Limited does not assume any form of technical liability and joint liability for any proposal contained in any document.



2. Power supply design

The design of the power supply system is crucial in the design of embedded products, engineers not only need to consider the basic electrical parameters of the power itself, but also consider the stability of the power design, such as electromagnetic compatibility, temperature range, safety design, three design factors, any negligence factors can lead to the whole system cannot work normally. Before starting to design the power supply system for a new product, the engineer should thoroughly understand the actual requirements of the whole system, and comprehensively demonstrate the feasible design scheme combined with the cost and efficiency, and choose an appropriate power supply method for the system.

2.1. Reference Design

The normal operation of the core board requires a voltage of 5V, and the full load power consumption is close to 1W. Considering the product on the instant current is larger, and the performance of the circuit itself will have drop, if the power power will cause the system cannot start normally, so the power design with a certain amount to ensure the system stable and reliable work, suggest to use more than 1A power chip alone to the core board. It is not recommended to drive loads outside the core board, especially some high-power load devices.

Power chip can be selected LDO or DCDC, LDO has the advantages of simple use, low cost, small electromagnetic interference, but the heat generation is relatively large; DCDC has the advantages of strong current output capacity, high conversion efficiency, small heat generation, but the electromagnetic interference is relatively large. If the input voltage is close to 5V, the LDO power chip can be used. If the input voltage is far from 5V, the DCDC power chip is recommended.

The core board supplies power at 5V. Please add the energy storage capacitor and decoupling capacitor near the 5V voltage input pin of the core board. A 0.25R resistance is reserved to assess the core board power consumption. Using the multimeter MV gear to measure the voltage of its two ends, the current flowing through the resistance can be calculated by ohm's law $I=U/R$, and finally the power consumption of the core board can be assessed.

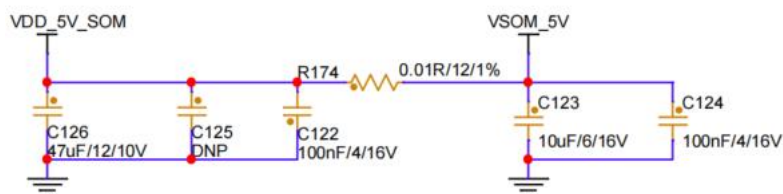


Fig. 2-1 Core board 5V power supply

2.2. Power protection

In order to ensure the reliability of the power supply system, it is not recommended to directly supply the external untreated input voltage to the load end of the rear stage. You can refer to the protection circuit in the following figure before processing the power supply, so as to improve the reliability and safety of the input power supply and reduce electromagnetic interference. The floor input power supply in the reference design is 12V, as an example only, the value of the input power supply shall be determined according to your actual requirements.



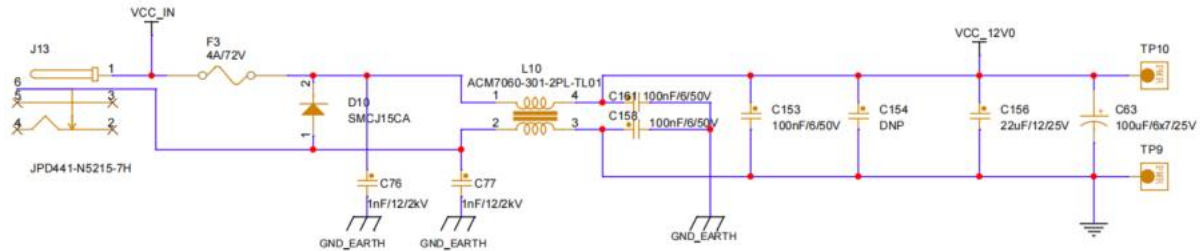


Figure 2-2 General power input circuit

2.3. Power Sequence

The design of the power supply system must follow a certain power timing and the corresponding steady state regulations. Only in this way can we ensure the reliable work of the chip. In the design, it is recommended that the core board is given priority to power on, and then the bottom board peripheral I / O equipment power on. If the power timing can not be met, it may lead to the following situation:

- ◆ The I / O current outside the bottom board is inverted to the processor, and the processor cannot start normally;
- ◆ The I / O current is poured back to the processor, and the worst case causes irreversible damage to the processor.

2.4. Layout Guidelines

- ◆ The distance between different power supply planes is at least 20 mil;
- ◆ Expand the width of the power cord and the ground wire as far as possible, to meet the required rated current value, the width of the feedback signal should not be too narrow, it is recommended to be more than 10 mil;
- ◆ If DCDC is used, the signal line is not recommended in the area below the inductance;
- ◆ If DCDC is used, the path of the current circuit is as short as possible, and the inductors and capacitors are placed as close to the chip as possible, namely the red and green path below;

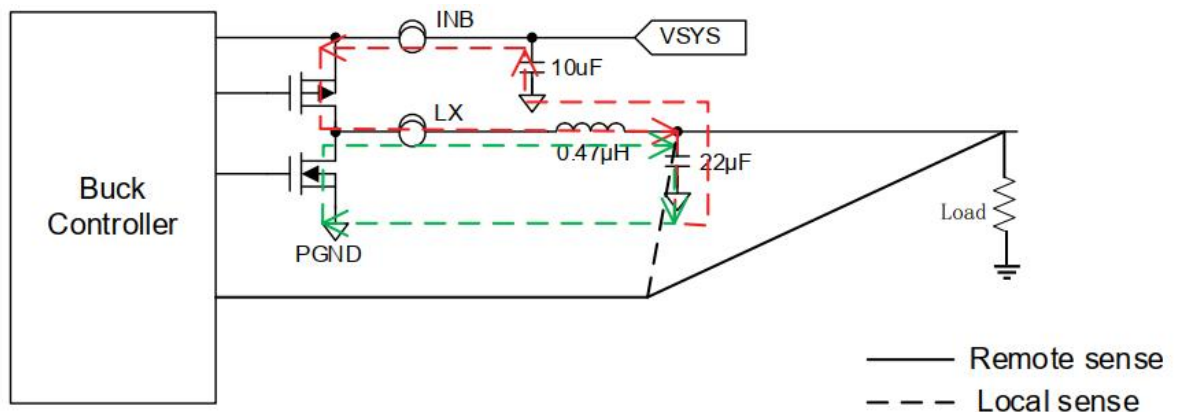


Figure 2-3 DCDC current back flow path

- ◆ If you use LDO, we should pay attention to the thermal resistance of LDO chip, because the heat loss of LDO chip is relatively high, it is recommended to add the grounding pad, and make more grounding holes on the welding pad;





- ◆ The output should to a small ESR capacitor;
- ◆ The power chip with digital and analog ground should separate the two, only at a single point at the total power input, and the analog ground cannot be connected to the ground pad.



3. Boot Configure

3.1. Start up the configuration circuit design

The MYC-YF13X core board supports the following startup sources: UART and USB download, EMMC startup, QSPI NAND FLASH startup, and Micro SD startup. At startup, the boot source used by the internal Boot ROM are selected by BOOT Pin and OTP bytes.

The MYC-YF13X core board has pulled down BOOT0, BOOT1 and BOOT2 inside the CPU.

BOOT[2:1:0]	Boot Device	Remarks
000	UART and USB	Download image
010	eMMC	Boot from eMMC
101	SD Card	Boot from Micro SD
111	QSPI Nand Flash	BOOT from QSPI Nand Flash

Table 3-1 Boot Start mode configuration

When designing the bottom board circuit, please pay attention to the external upper / drop resistance that does not affect the default level value to avoid the startup failure. When the following table lists the design base board, you only need to reconfigure a few boot pins to start EMMC, NAND FLASH start, Micro SD start.

PIN	Signal name	Default level	eMMC	SD Card	QSPI Nand Flash
83	BOOT 2	0	0	1	1
84	BOOT 1	0	1	0	1
85	BOOT 0	0	0	1	1

Table 3-2 Boot Device Boot pin default Set



3.2. Boot Reference circuit

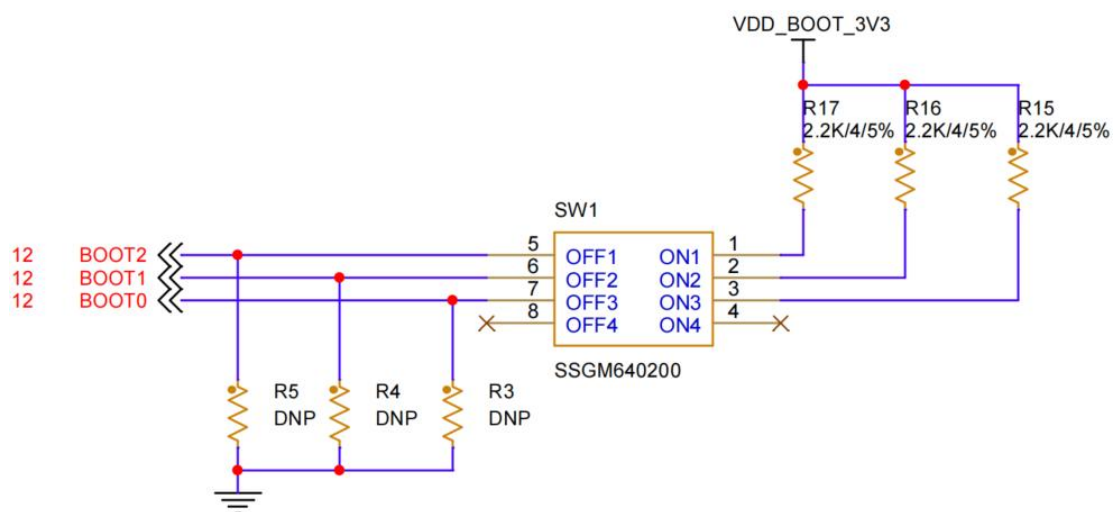


Figure 3-1 Startup set reference circuit



4. Key Circuit Design

The MYC-YF13X core board provides special functional pins, respectively NRST, User Key signals are usually used for external buttons. Functions are as described in Table 4-1.

Because the key signal is more sensitive, a simple RC filter with resistance and capacitor can be used. On the one hand, it can filter out the jitter interference when the key is pressed, and filter out the interference introduced outside to affect the reset signal. In the harsh electromagnetic environment, in order to eliminate the electrostatic interference from the keys and ensure the more reliable operation of the system, another ESD device can be connected in parallel. If there are more stringent requirements for stabilization, consider using logic circuits such as RS trigger to build a reset circuit.

Special function pin	description
NRST	3.3V level logic. The core board has a design upper pull resistance of 10K Ω . Hardware-reset input.
PI1	3.3V level logic. User keys to generate the corresponding event / interrupt.

Table 4-1 Special function pins

4.1. Reference circuit

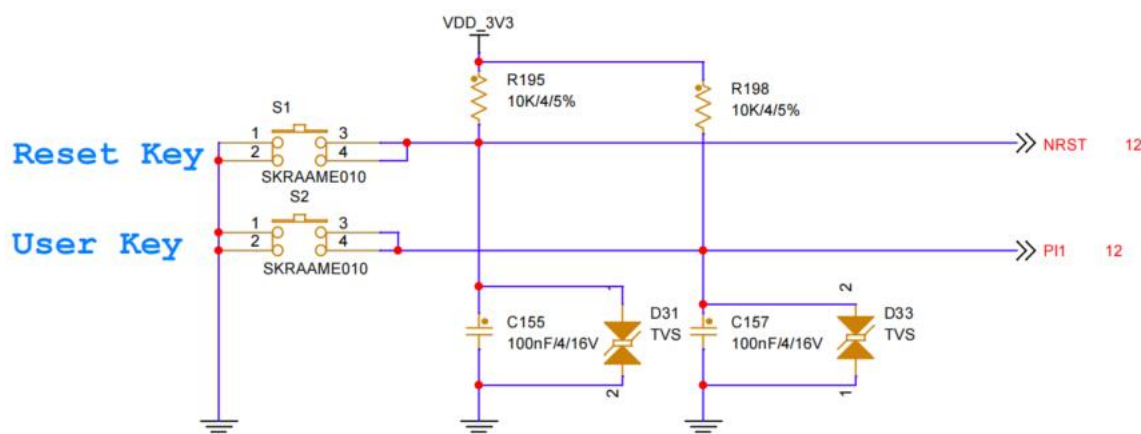


Figure 4-1 Key circuit

4.2. Layout

- ◆ The key reset signal line width should not be too narrow, and it is recommended not to be less than 8 mil;
- ◆ The reset signal is a sensitive signal, it is recommended to package processing;
- ◆ The TVS tube is placed as close to the keys as possible.



5. Interface circuit design

5.1. SDHC

The MYC-YF13X core board is equipped with 1 SD interface to design the communication interface between modules with SDIO interface.

5.1.1. Reference circuit

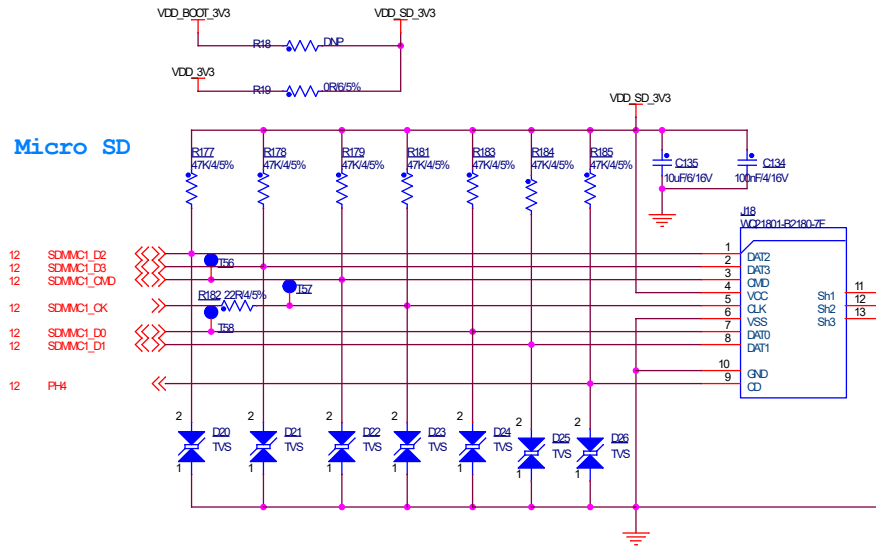


Figure 5-1 Micro SD Reference circuit

5.1.2. Layout

- ◆ Traces should be routed with 50-Ω impedance to ground
- ◆ The data line control line is as long as possible, with error less than ± 100 mil
- ◆ If the wiring space is sufficient, Keep a minimum distance of four times the trace width between adjacent copper in a single trace. If not, pull the clock signal from the distance from the other signals and follow the 3W rule.



5.2. UART

The MYC-YF13X core board has up to 8 channels. The core board is configured with 3 serial ports by default, one TTL signal for debugging, one RS232 signal for communication, and another for RS485 communication.

When UART directly connects for debugging serial port, connect to the PC with UART to USB transfer cable. The common USB to UART TTL module is shown in the figure below.

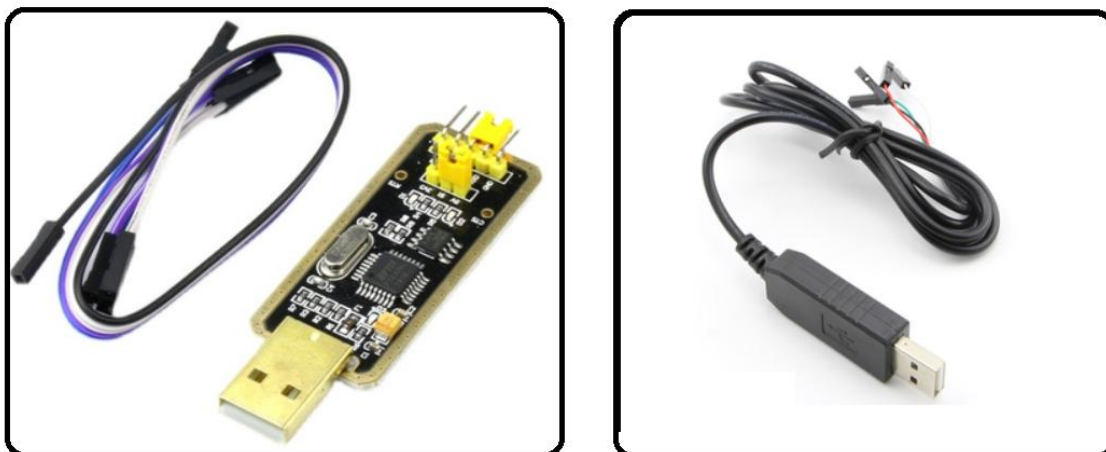
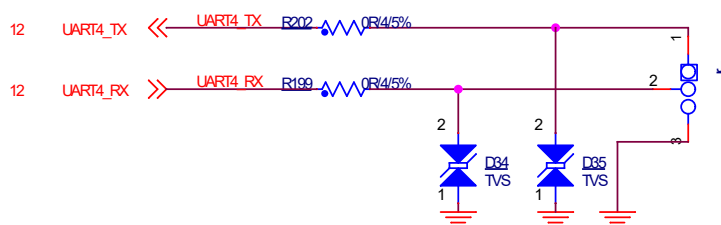


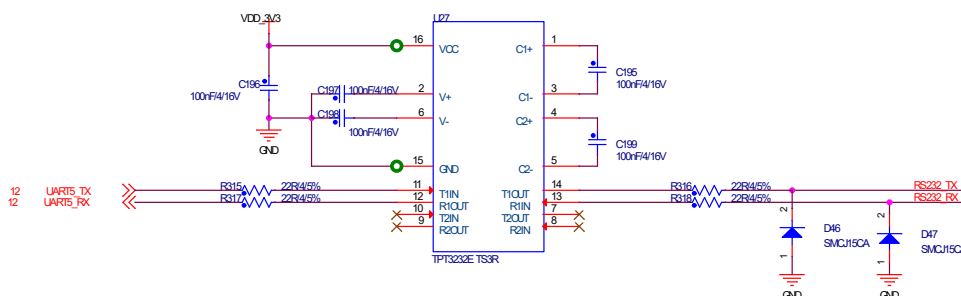
Figure 5-2 USB to UART TTL module

5.2.1. Reference circuit

Debug Uart



RS232



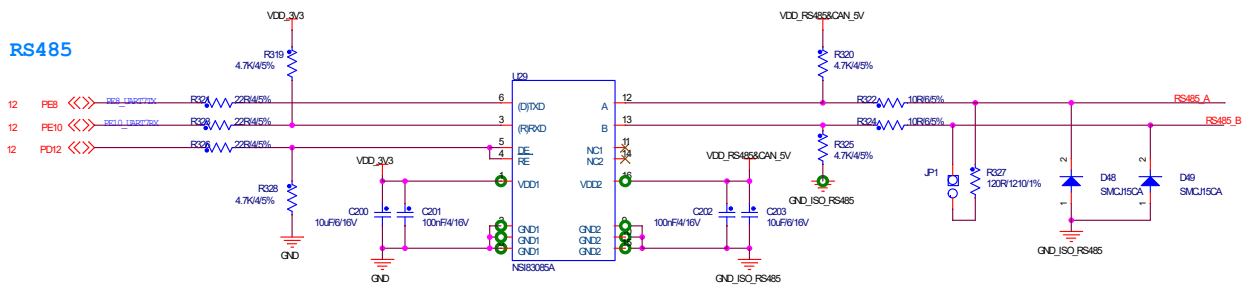


Figure 5-3 UART reference circuit

5.2.2. Layout

- ◆ Keep sufficient spacing between the signals and power supply planes before and after isolation;
- ◆ The TVS tubes are placed immediately adjacent to the connector;

5.3. USB

The MYC-YF13X core board provides two USB2.0 interfaces. USB1 is used for HOST and USB2 is used for OTG.

USB 2 is directly connected to the USB Type C seat son and supports OTG / DRP mode. The other USB 1 uses USB 2.0 HUB chip to expand 4 USB Host ports; the expanded 4 ports are 2 directly through the double-layer USB Type A connector; the third route is used to connect the 4G module; the fourth route leads to the 4-pin seat connector.

USB signal recommendation plus TVS tube, common mode inductance.

5.3.1. Reference circuit

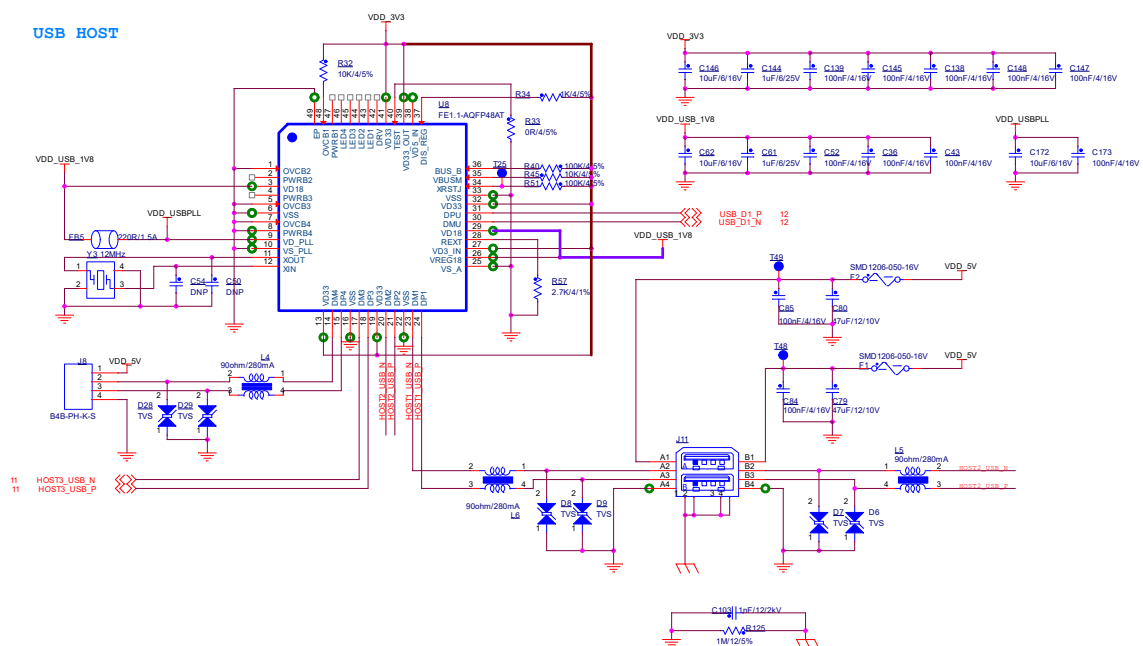


Figure 5-4 USB HUB and HOST ports Reference circuits



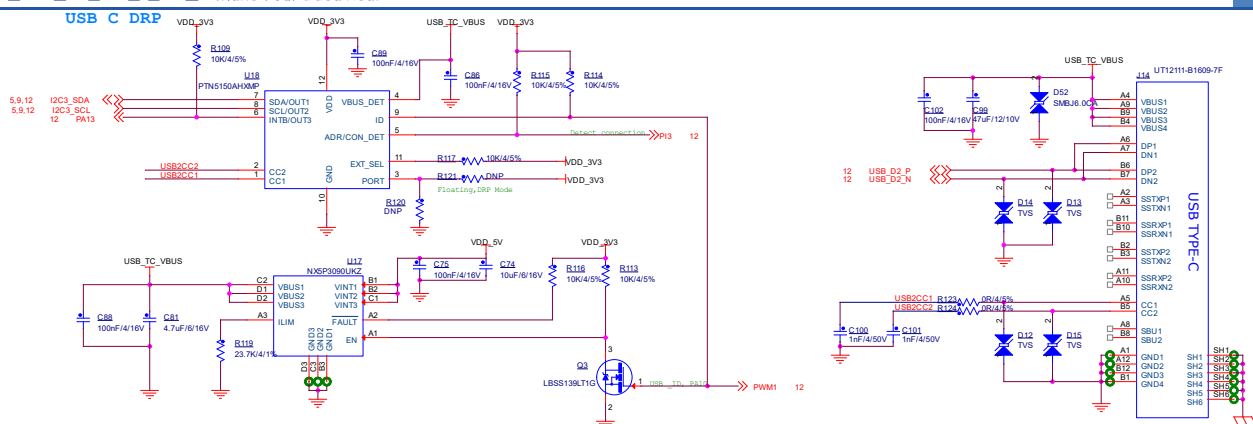


Figure 5-5 USB DRP interface reference circuit

5.3.2. Layout

- ◆ USB signal routing for equal length control, error range ± 25 mil;
- ◆ The differential impedance of the USB signal is controlled at 90Ω ; the USB signal line is as short as possible;
- ◆ USB signal should not change the layer as far as possible. If the layer is changed, it is necessary to place GND reflux hole 50 mil from the layer through hole;
- ◆ Ensure that the reference plane is continuous, and the USB signal does not cross the segmentation;
- ◆ USB signal is recommended to walk in the TOP / BOTTOM layer;
- ◆ USB signals are far away from other clocks, digital signals.

5.4. CAN

There are 2 CAN interfaces in the MYC-YF13X core board. At present, the core board only leads to a CAN interface, which customers can design according to their own needs.

5.4.1. Reference circuit

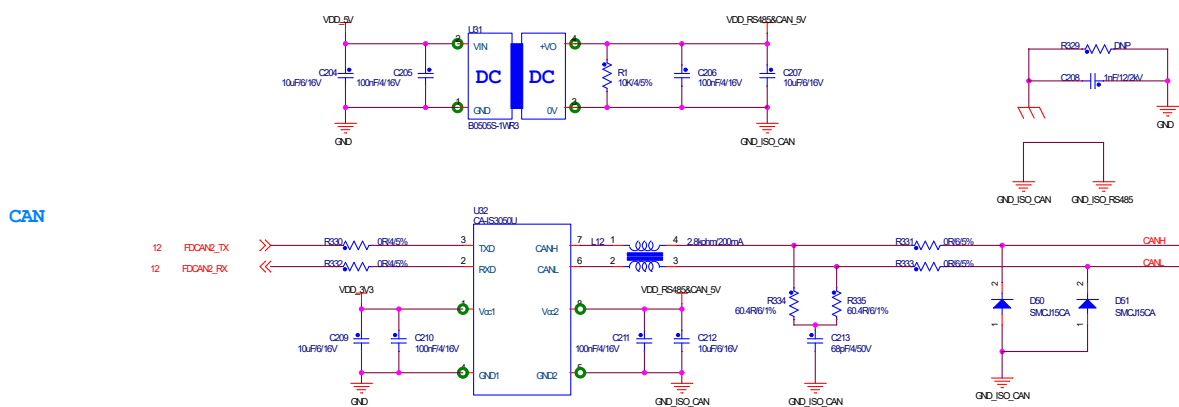


Figure 5-6 reference circuit





5.5.2. Layout

- ◆ RGMII difference pair needs to do equal spacing control, equal length error ± 5 mil;
- ◆ The PHY chip is placed near the core board, far away from the network transformer;
- ◆ Network transformer is placed near the RJ 45 interface;
- ◆ The power pin of the PHY chip is placed near the PHY chip;

5.6. I2C

The MYC-YF13X core board supports up to 5 buses, where I2C3 is used for E2PROM in the core board, and I2C3 is also introduced to the core board interface. Therefore, the maximum support in the MYC-YF13X core board.

Several devices can be mounted under the same I2C bus, and the following points should be paid attention to in the schematic design:

- ◆ Check whether the equipment address under the same bus is conflicting;
- ◆ Ensure that each I2C bus has a pair of pull resistors, the resistance value is recommended to be 2.2K~10K, but do not add repeatedly;
- ◆ Check whether the I2C interface level of the equipment is 3.3V, if not, the level conversion circuit is required.
- ◆ Do not overcount the equipment under the same bus, otherwise it may exceed the Load Capacitance limit of 400 pF required by the I2C specification and affect the signal waveform.

5.6.1. Reference circuit

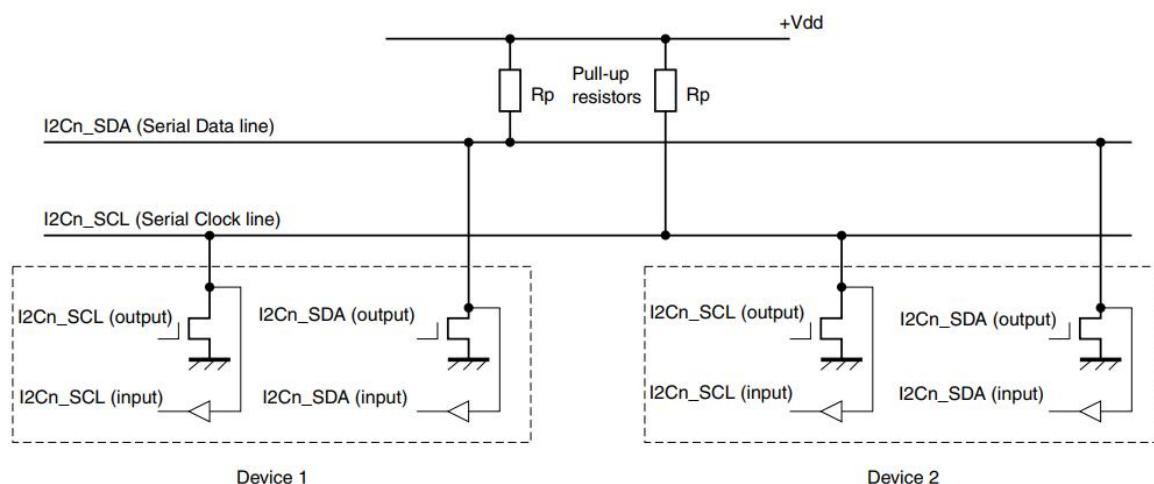


Figure 5-8 I2C reference circuit

5.6.2. Layout

- ◆ I2C signal line width should not be too narrow, it is recommended to be 6 mil and above;
- ◆ The position of each equipment should be planned before the I2C wiring. The wiring should not be wound too much. If the I2C wiring is too long, the Load Capacitance of the bus will also be increased;



- ◆ Avoid the interference source wiring, and the adjacent line spacing is more than 10 mil.

5.7. SPI

The MYC-YF13X core board supports a maximum 5-channel SPI controller and supports primary / slave modes. SPI signals include SPI _ CLK, SPI _ MOSI and SPI _ MISO. Design, confirm the relationship between primary and slave devices, and then confirm the direction of MOSI and MISO signals.

Due to the pin multiplexing relationship, the core board has the SPI 5 interface configured by default. If you want to use more SPI interfaces, check the chip manual and modify the pin configuration in the driver.

5.7.1. Reference circuit

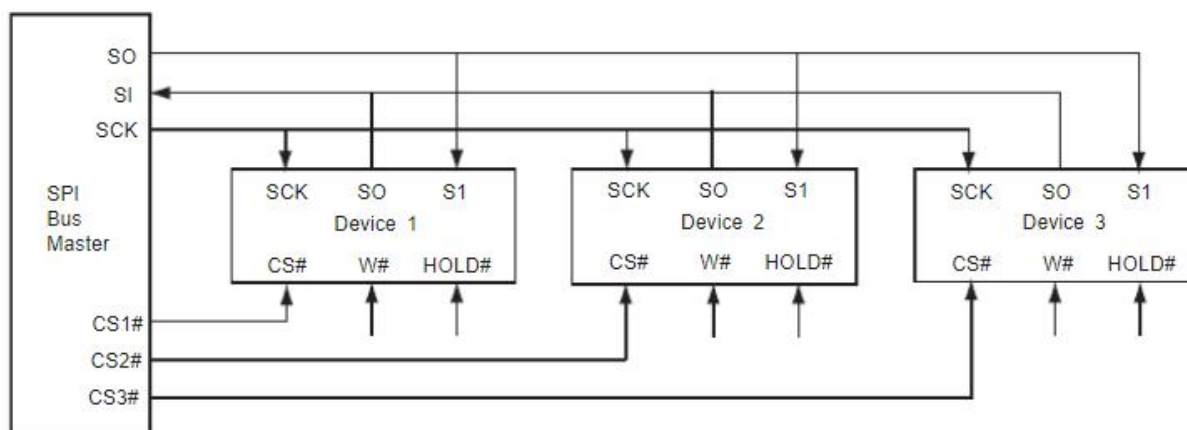


Figure 5-9 SPI reference circuit

5.7.2. Layout

- ◆ SPI signal single-end impedance control of 50Ω;
- ◆ The SPI clock and data line follow the 3W principle;
- ◆ Ensure that the reference layer of the signal is continuous.

5.8. DCMi

The MYC-YF13X core board supports a 1-channel DCMi digital camera interface. For the external camera input signal. The camera interface uses a 0.5mm FPC seat, and users can choose the MY-CAM011B camera module of MYIR Electronics.

Reference circuit selects the FPC connector as the camera input interface, the connector model is FPC05030-17205.



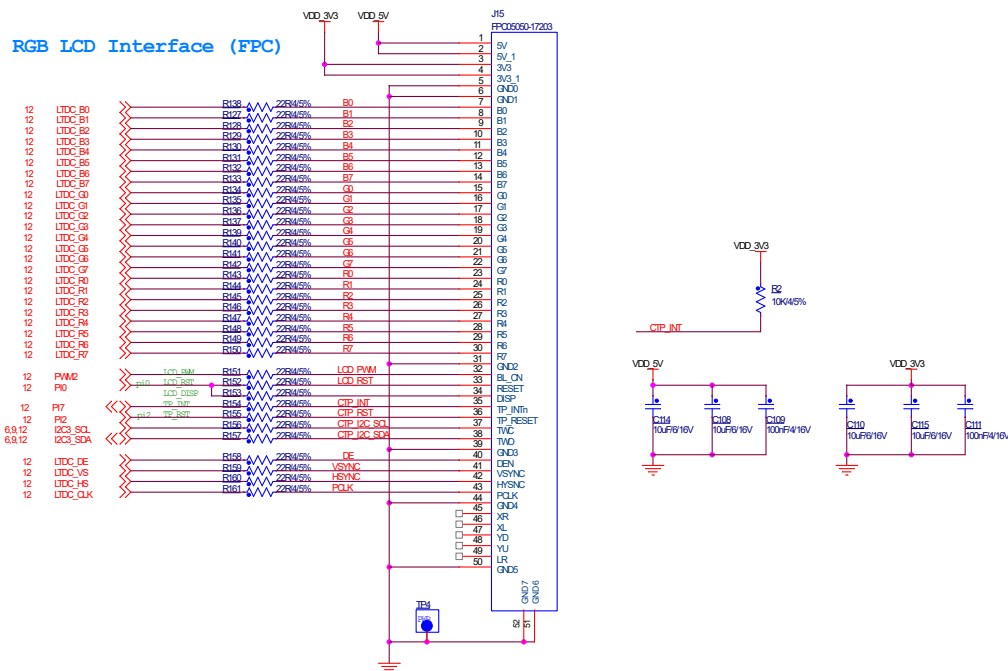




Item	Parameters	Unit
LCD Size	7 inch (Diagnoal)	
Driver element	a-Si TFT active matrix	
Resolution	800 x 3 (RGB) x 480	pixel
Display mode	Normally white, Transmissive	
Dot pitch	0.0642 (W) x 0.1790 (H)	mm
Active area	154.08 (H) x 85.92 (H)	mm
Module size	164.9 (W) x 100.0 (H) x 5.7 (D)	mm
Surface treatment	Anti-Glare	
color arrangement	RGB-stripe	
interface	Digital	
Weight	130g	

Figure 5-12 MY-TFT070CV2 Liquid crystal module

5.10.1. Reference circuit



5.11. RTC

The evaluation board is equipped with a backup battery seat for a button battery. When the system loses power, it can be used to maintain the operation of the RTC part. Its circuit structure is shown in the figure below:

5.11.1. Reference circuit

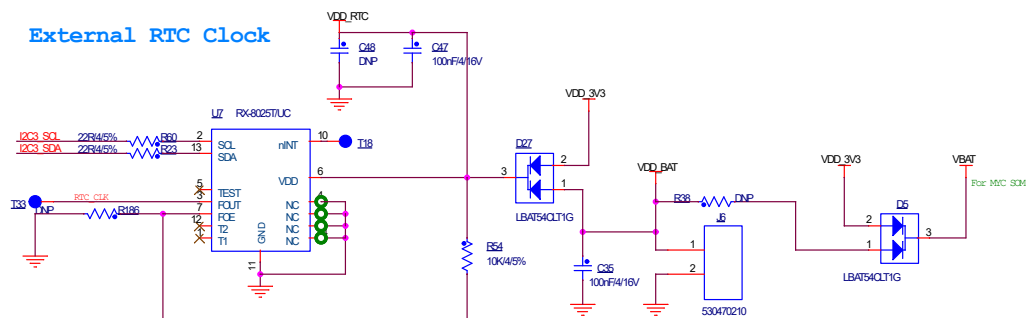


Figure 5-14 RTC reference circuit

5.11.2. Layout

- ◆ I2C signal line width should not be too narrow, it is recommended to be 6 mil and above;
- ◆ I2C wiring should be planned before the position of each equipment, wiring should not be too around;



6. Design check item

6.1. Power supply design

Check item	Recommended solution
Core board supply voltage	Recommended value: 5V, and absolute value: 4.5V-5.5V
Core board power decoupling capacitor	47 uF and above the capacity value
IO level of carrier board peripherals	The IO level of the peripheral should match the corresponding interface level of the core board
core module power sequence	It is recommended that the core board power supply starts before the peripheral power supply
Temperature rise of power chip	Confirm the thermal resistance of the power chip, and combine the power consumption of the core chip to calculate the maximum temperature rise of the power chip, to ensure that the final temperature is within the specified range of the power chip

Table 6-1 Power supply checklist

6.2. System startup circuit design

Check item	Recommended solution
BOOT pin configuration	Select the appropriate BOOT MODE according to the product requirements
Reset	The RESET _ IN _ N pin is suggested to receive it
Micro SD Circuit	Convenient to burn the procedures, it is recommended to keep

Table 6-2 System startup checklist





6.3. Peripheral circuits design

Category	Check box	Proposal
USB	Capacitance value of the USB D+ / D- signal ESD device	The capacitance value of the ESD device is suggested to be less than 2 pF
	Whether the capacitor of the power supply pin is in series resistance	The interface 5V capacitor requires a 1-ohm resistor in series to limit the voltage surge at the USB port
Ethernet (RGMII/RMII/MII)	The PHY chip layout	<ul style="list-style-type: none"> As close to the core board layout as possible. Keep the RGMII line running as short as possible. RGMII The transmitted and received signals are grouped separately, and the same length + -25 mil in the Layout routing group. There is no requirement between groups.
	PHY chip	The PHY chip power supply is isolated with magnetic beads
	Clock signal source of the PHY chip	Use of external active crystalline vibration or passive crystalline vibration.
	Connecting method of PHY side of network transformer	Depending on the type of PHY chip, it can be found in the chip manual. If the PHY is current-driven, the tap needs to be pulled up to the PHY supply voltage. If the PHY is voltage-driven, the tap does not need to be pulled up. If not found in the manual, use a reference circuit or reserved pull-up resistor
I2C	How much to pull the resistance of I2C	The more bus load equipment, the smaller the resistance value, the greater the reverse; the recommended resistance value 1.5K/2.2K/4.7K;
	How many pull resistance is connected to each I2C signal wire	One or more are available.
	What is the pull-up voltage	The pull-up resistance must be connected to a voltage matching with the I / O level
MMC	Whether DATA and CMD signals are up-up	Need to pull up, the resistance value of 47K or 10K to pull up to 3.3V
CAN	Whether the CAN circuit needs to be isolated	Scenario Complex electrical environment high reliability requirements CAN interface cable length is long. If any of the preceding conditions are met, isolate the CAN converter and its power supply circuit
UART	Linkage of the UART signal	UART signal can not be directly connected to RS232/RS485 interface, the application of special conversion chip conversion can be connected to the corresponding interface

Table 6-3 External circuit checklist





7. Hardware problems

7.1. The advantages and disadvantages of the core board connection mode explain

If the board to board connector scheme is used, the advantage is the plug and pull scheme, but it also has the following disadvantages:

- ◆ Poor seismic performance;
- ◆ Can not be used for thin and light products;
- ◆ Plug and pulling is easy to cause P CBA internal injury;
- ◆ The yield of the mass production patch is not high.
- ◆ At least a pair of female connectors are required for the highest increase cost.

If the golden finger scheme is adopted, inserting and pulling will be more convenient, but it also has the following disadvantages:

- ◆ The bottom board needs to put a high quality base, increase the cost;
- ◆ Goldfinger production process cost is high;
- ◆ Cannot be used for lightweight products.
- ◆ The number of tube feet is more than the stamp hole board.

The connection mode of the stamp hole is a little good, no additional connector to reduce the cost and other advantages, but there are also some disadvantages.

- ◆ The size is not suitable for large, the number of tube feet is limited;
- ◆ The overall weight of the core board as a module should not be too heavy, otherwise the suction ability of the patch machine can lead to the failure or poor patch.
- ◆ The bottom board PCB may need to be slotted for devices on the back of the stamp hole core board.

In conclusion, MYC-YF13X is more suitable for the connection of stamp holes.



Appendix A

Warranty & Technical Support Services

MYIR Electronics Limited is a global provider of ARM hardware and software tools, design solutions for embedded applications. We support our customers in a wide range of services to accelerate your time to market.

MYIR is an ARM Connected Community Member and work closely with ARM and many semiconductor vendors. We sell products ranging from board level products such as development boards, single board computers and CPU modules to help with your evaluation, prototype, and system integration or creating your own applications. Our products are used widely in industrial control, medical devices, consumer electronic, telecommunication systems, Human Machine Interface (HMI) and more other embedded applications. MYIR has an experienced team and provides custom design services based on ARM processors to help customers make your idea a reality.

The contents below introduce to customers the warranty and technical support services provided by MYIR as well as the matters needing attention in using MYIR's products.

Service Guarantee

MYIR regards the product quality as the life of an enterprise. We strictly check and control the core board design, the procurement of components, production control, product testing, packaging, shipping and other aspects and strive to provide products with best quality to customers. We believe that only quality products and excellent services can ensure the long-term cooperation and mutual benefit.

Price

MYIR insists on providing customers with the most valuable products. We do not pursue excess profits which we think only for short-time cooperation. Instead, we hope to establish long-term cooperation and win-win business with customers. So we will offer reasonable prices in the hope of making the business greater with the customers together hand in hand.

Delivery Time

MYIR will always keep a certain stock for its regular products. If your order quantity is less than the amount of inventory, the delivery time would be within three days; if your order quantity is greater than the number of inventory, the delivery time would be always four to six weeks. If for any urgent delivery, we can negotiate with customer and try to supply the goods in advance.

Technical Support

MYIR has a professional technical support team. Customer can contact us by email (support@myirtech.com), we will try to reply you within 48 hours. For mass production and customized products, we will specify person to follow the case and ensure the smooth production.

After-sale Service

MYIR offers one year free technical support and after-sales maintenance service from the purchase date. The service covers:

Technical support service

MYIR offers technical support for the hardware and software materials which have provided to customers;

- To help customers compile and run the source code we offer;
- To help customers solve problems occurred during operations if users follow the user manual documents;
- To judge whether the failure exists;



- To provide free software upgrading service.
- However, the following situations are not included in the scope of our free technical support service:
- Hardware or software problems occurred during customers' own development;
- Problems occurred when customers compile or run the OS which is tailored by themselves;
- Problems occurred during customers' own applications development;
- Problems occurred during the modification of MYIR's software source code.

After-sales maintenance service

The products except LCD, which are not used properly, will take the twelve months free maintenance service since the purchase date. But following situations are not included in the scope of our free maintenance service:

- The warranty period is expired;
- The customer cannot provide proof-of-purchase or the product has no serial number;
- The customer has not followed the instruction of the manual which has caused the damage the product;
- Due to the natural disasters (unexpected matters), or natural attrition of the components, or unexpected matters leads the defects of appearance/function;
- Due to the power supply, bump, leaking of the roof, pets, moist, impurities into the boards, all those reasons which have caused the damage of the products or defects of appearance;
- Due to unauthorized weld or dismantle parts or repair the products which has caused the damage of the products or defects of appearance;
- Due to unauthorized installation of the software, system or incorrect configuration or computer virus which has caused the damage of products.

Warm tips:

- MYIR does not supply maintenance service to LCD. We suggest the customer first check the LCD when receiving the goods. In case the LCD cannot run or no display, customer should contact MYIR within 7 business days from the moment get the goods.
- Please do not use finger nails or hard sharp object to touch the surface of the LCD.
- MYIR suggests user purchasing a piece of special wiper to wipe the LCD after long time use, please avoid clean the surface with fingers or hands to leave fingerprint.
- Do not clean the surface of the screen with chemicals.
- Please read through the product user manual before you using MYIR's products.
- For any maintenance service, customers should communicate with MYIR to confirm the issue first. MYIR's support team will judge the failure to see if the goods need to be returned for repair service, we will issue you RMA number for return maintenance service after confirmation.

Maintenance period and charges

MYIR will test the products within three days after receipt of the returned goods and inform customer the testing result. Then we will arrange shipment within one week for the repaired goods to the customer. For any special failure, we will negotiate with customers to confirm the maintenance period.

For products within warranty period and caused by quality problem, MYIR offers free maintenance service; for products within warranty period but out of free maintenance service scope, MYIR provides maintenance service but shall charge some basic material cost; for products out of warranty period, MYIR provides maintenance service but shall charge some basic material cost and handling fee.





Shipping cost

During the warranty period, the shipping cost which delivered to MYIR should be responsible by user; MYIR will pay for the return shipping cost to users when the product is repaired. If the warranty period is expired, all the shipping cost will be responsible by users.

Products Life Cycle

MYIR will always select mainstream chips for our design, thus to ensure at least ten years continuous supply; if meeting some main chip stopping production, we will inform customers in time and assist customers with products updating and upgrading.

Value-added Services

- MYIR provides services of driver development base on MYIR's products, like serial port, USB, Ethernet, LCD, etc.
- MYIR provides the services of OS porting, BSP drivers' development, API software development, etc.
- MYIR provides other products supporting services like power adapter, LCD panel, etc.
- ODM/OEM services.

MYIR Electronics Limited

Room 04, 6th Floor, Building No.2, Fada Road,

Yunli Intelligent Park, Bantian, Longgang District.

Support Email: support@myirtech.com

Sales Email: sales@myirtech.com

Phone: +86-755-22984836

Fax: +86-755-25532724

Website: www.myirtech.com

