音特电子
YINT ELECTRONICS

Improvement, innovation, saving, win-win

Electromagnetic compatibility and innovative solutions for electric bed electronic circuits

http://www.yint.com.cn

Table of contents

音特电子
YINT ELECTRONICS

1. Analysis of international and domestic standards in the electric bed industry

1.1 Interpretation of International Industry Standards

Household Electric Beds

IEC 60335-1 "Safety of Household and Similar Electrical Appliances - Part 1: General Requirements"

IEC 60335-2-109 "Particular Requirements for Household Electric Beds"

Safety Standard for Household Electric Beds (UL 60601-1 / UL 962)

Electric Medical Beds

IEC 60601-1 "Medical Electrical Equipment - Part 1: General Requirements for Basic Safety and Essential Performance"

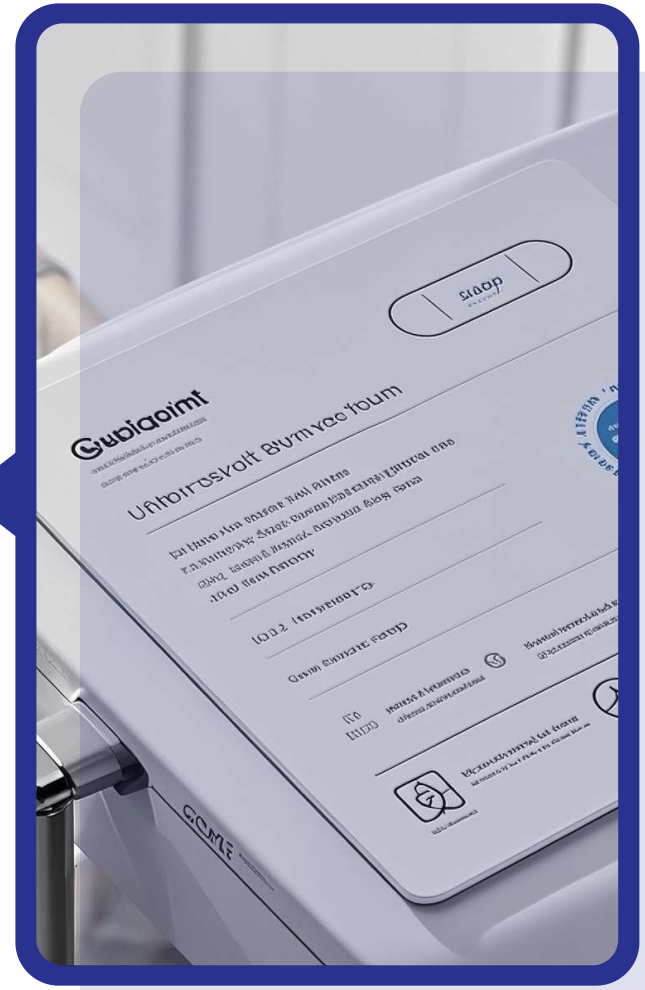
IEC 60601-2-52 "Particular Requirements for Medical Beds"

EU (CE Marking) EMC Directive (2014/30/EU)

US (FDA & UL Certification)

FDA 21 CFR Part 890

Medical beds must be FDA registered (Class I or II medical devices)



1.2 Domestic Industry Standards

National Standard for Smart Beds (GB/T 45231-2025)

GB 4706.1 & GB 4706.108 National Standard for Household Electric Beds

Equivalent to IEC 60335

GB 9706.1 Safety of Medical Electrical Equipment (Equivalent to IEC 60601-1)

CCC Certification

Some electric beds may require mandatory certification (depending on their specific functionality)

音特电子
YINT ELECTRONICS

2. Detailed explanation of EMC test requirements

2.1 Radiated disturbance test content

Home Electric Beds & Consumer Electronics

① CISPR 11 (Industrial, Scientific, and Medical Equipment)
② CISPR 14-1 (Household Appliances)
③ CISPR 32 (Multimedia Equipment, replaces CISPR 13/22)
④ EN 55032 (EU, equivalent to CISPR 32)
⑤ FCC Part 15 Subpart B/C (US)

Electric medical bed

a. IEC 60601-1-2 (EMC standard for medical devices, citing CISPR 11)
b. EN 60601-1-2 (EMC standard for medical devices in the European Union)

2.2 Radiated disturbance test limit requirements

standard	Equipment Category	Frequency range	Limit (dBμV/m)	Test distance
CISPR 11	Industrial/Scientific/Medical (Class A)	30 MHz~230 MHz	QP: 40	10m / 3m*
		230 MHz~1 GHz	QP: 47	230 MHz ~ 1 GHz
CISPR 32	Home use (Class B)	30 MHz~230 MHz	QP: 30	3m
		230 MHz~1 GHz	QP: 37	
FCC Part 15	Class B (Home)	30 MHz~88 MHz	40.0	3m
		88 MHz~216 MHz	43.5	
		216 MHz~960 MHz	46.0	
IEC60601-1-2	medical devices	30MHz~6 GHz	Refer to CISPR 11 Class B	3m

Note: CISPR 11 allows for 10m testing, but 3m is more common (limits must be converted: 10m limit = 3m limit + 10dB).

QP = Quasi-Peak, AV = Average. The FCC typically uses Peak testing.

2.3 Detailed test contents of conducted disturbance

The system primarily detects electromagnetic interference transmitted from electric beds to the power grid or other devices via power lines, signal lines, and other conductive pathways. For example, high-frequency interference generated by the switching power supply of an electric bed can be transmitted through the power line to the power grid, potentially affecting other electrical appliances.

Test standard:

CISPR 14-1, EN 55014-1, etc., corresponding to GB 4343.1 in China

- **Home electric beds & consumer electronic devices**

  CISPR 11 (Industrial, Scientific, and Medical Equipment)

  CISPR 14-1 (Household Appliances)

  CISPR 32 (Multimedia Equipment)

  EN 55014-1 (EU, equivalent to CISPR 14-1)

  FCC Part 15 Subpart B (US)

- **Electric medical bed**

  IEC 60601-1-2 (EMC standard for medical devices, citing CISPR 11)

  EN 60601-1-2 (EMC standard for medical devices in the European Union)

2.4 Detailed limit requirements for conducted disturbances

Frequency range	CISPR 11/CISPR 14-1 limits (dBμV)	FCC Part 15 limit (dBμV)
150 kHz ~ 500 kHz	QP: 79, AV: 66	QP: 66 ~ 56*
500 kHz ~ 5 MHz	QP: 73, AV: 60	QP: 56
5 MHz ~ 30 MHz	QP: 73, AV: 60	QP: 60

Note: FCC limits are divided into Class A (industrial) and Class B (home use), with Class B being more stringent. Medical devices generally refer to CISPR 11 Class B. Specific standards may differ.

2.5 ESD Electrostatic Discharge Immunity Test

Device Type	ESD test standards	Remark
Home electric bed	IEC 61000-4-2 / EN 61000-4-2	General electronic equipment standards (CE certification applies)
Electric medical bed	IEC 60601-1-2	Dedicated to medical devices, stricter than general standards
Export to the US market	ANSI C63.16 (referenced by IEC 61000-4-2)	FCC certification may require additional

Electric beds for household use (IEC 61000-4-2)

Test items	Test voltage	Number of tests	Judgment criteria
Contact discharge	±4 kV (metal parts)	10 times/polarity	Temporary functional abnormalities are acceptable (Grade B)
Air discharge	±8 kV (insulation surface)	10 times/polarity	No damage allowed (D-level failure)

Electric medical beds (IEC 60601-1-2)

Test items	Test voltage	Number of tests	Judgment criteria
Contact discharge	±6 kV (metal parts)	10 times/polarity	No functional interruption allowed (A/B level)
Air discharge	±8 kV (insulation surface)	10 times/polarity	Life support equipment requires a ±2kV margin

2.6 Electrical Fast Transient Burst Immunity Test

Household electric beds (IEC 61000-4-4）

Test port	Test voltage (kV)	Pulse repetition frequency (kHz)	Testing Time	Judgment criteria
Power port	±1 kV / ±2 kV	5 kHz / 100 kHz	60s per polarity	B-level acceptable
Signal/control port	±0.5 kV / ±1 kV	5 kHz / 100 kHz	60s per polarity	B-level acceptable

Electric medical bed (IEC 60601-1-2)

Test port	Test voltage (kV)	Pulse repetition frequency (kHz)	Testing Time
Power port	±2 kV	5 kHz	A-level must meet
Signal port	±1 kV	5 kHz	A-level must meet

Note: Class A: The device operates normally with no performance degradation (required for medical devices). Class B: Automatically recovers after a brief abnormality (acceptable for household electric beds).

音特电子
YINT ELECTRONICS

3. Focus on industry EMC pain points

3.1 Five major EMC pain points and countermeasures in the electric bed industry

Sorted by certification failure frequency, 1. Motor conducted interference and 2. Wireless radiation account for more than 70% of industry problems.

Ranking	Pain points	Related standards	Typical phenomenon	root cause	Solution
1	**Motor conducted disturbance exceeds standard**	CISPR 11/32 EN 55032	The test failed in the 150kHz~30MHz frequency band, especially the 500kHz~5MHz	Motor PWM harmonics are reversely conducted through the power line	Install a π-type filter (common mode choke + X/Y capacitor) and shield the motor cable and ground it at a single point.
2	**Wireless module radiation interference**	FCC Part 15 CISPR 32	30MHz~1GHz radiation exceeds the standard, 2.4GHz interferes with surrounding equipment	Improper antenna layout or PCB high-frequency noise coupling	Use pre-certified wireless modules. Keep the antenna away from the motor to shorten the RF trace. Add a metal shield.
3	**ESD causes the control board to freeze**	IEC 61000-4-2 GB/T 17626.2	After the ±8kV discharge, the MCU resets and the display screen becomes abnormal.	Static electricity couples to sensitive circuits through gaps/interfaces	Interface with TVS diode/ESD protection chip Non-metallic panel with anti-static coating Single-point grounding design
4	**EFT pulse group causes power supply instability**	IEC 61000-4-4 GB/T 17626.4	Motor malfunctions or restarts under ±2kV pulses	Insufficient power supply filtering due to transient grid noise penetration	Power input stage with EFT filter (common mode inductor + TVS) using isolated power module and software watchdog mechanism
5	**Medical beds have insufficient radiation immunity**	IEC 60601-1-2	Sensor false alarm or communication interruption in 3V/m radiation field	The signal line is not shielded or the MCU anti-interference design is weak	Use twisted-pair shielded cables for critical signal lines. MCUs are protected by metal shielding cases. Perform EMC risk analysis (ISO 14971).

音特电子
YINT ELECTRONICS

4. EMC innovative solutions

4.1 Select high-performance EMC components

01

Select low-noise, high-anti-interference electronic devices, such as low-noise operational amplifiers and shielded inductors, to reduce the electromagnetic interference generated by the devices themselves and improve circuit stability.

02

Add filters, such as common-mode filters and differential-mode filters, to the power input and signal transmission lines to effectively suppress conducted interference and ensure the purity of power and signals.

4.2 Strengthening shielding and grounding measures

- Key components of electric beds, such as motors and controllers, should be shielded with metal shielding to prevent electromagnetic radiation leakage. For example, enclosing the motor in a metal shield can reduce its impact on surrounding circuits.

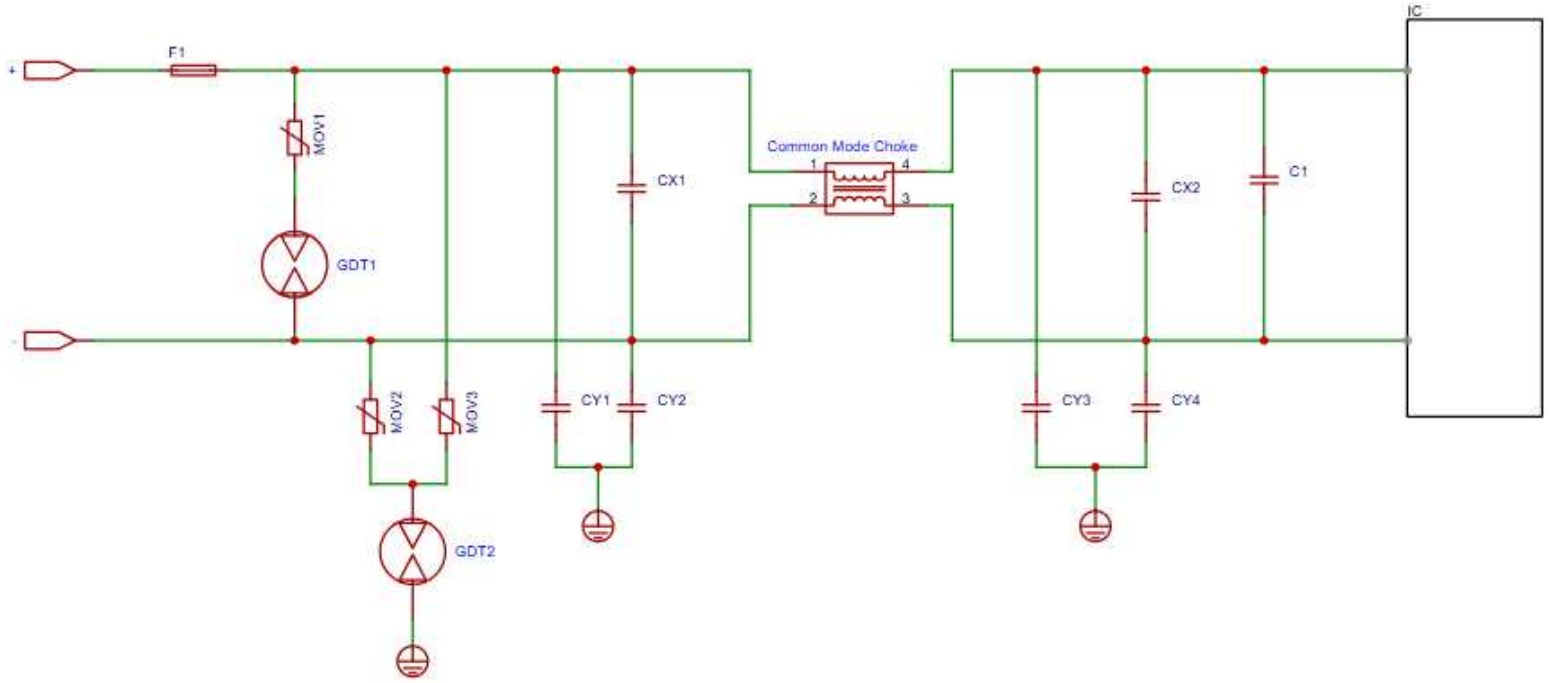
- Design a well-designed grounding system to ensure reliable grounding of the equipment and direct static electricity and electromagnetic interference to the ground. A combination of multi-point grounding and star grounding can be used to reduce ground resistance and improve interference immunity.

- Plan the circuit layout appropriately, separating analog and digital circuits to reduce signal interference. For example, isolating the motor drive circuit from the sleep monitoring circuit prevents electromagnetic interference from the motor from affecting the accuracy of monitoring data.

- Shorten high-frequency signal traces to reduce electromagnetic radiation. Use multi-layer PCBs with a well-defined power and ground planes to improve circuit interference immunity. For example, a four-layer PCB can effectively reduce electromagnetic interference.

4.3.1 AC Power Interface EMC and Reliability Design

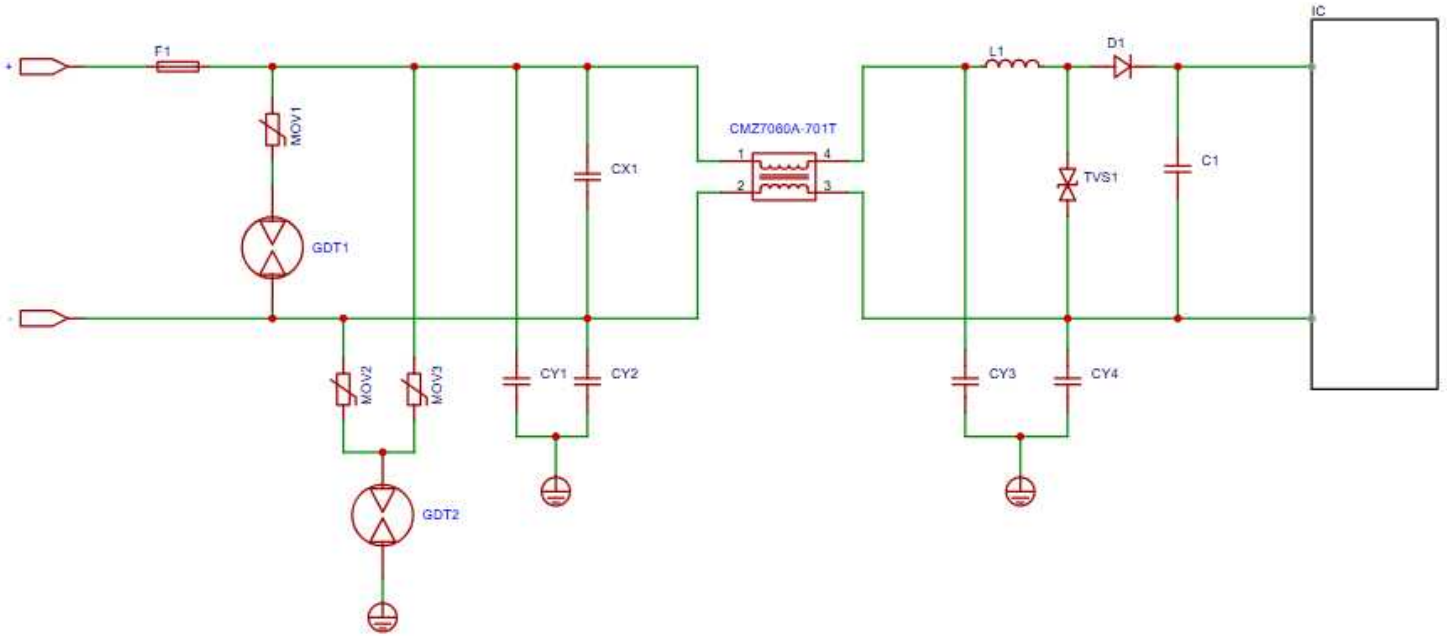
AC power interface: used to connect external 220V AC input



model	Device Type	Use Location	effect	Encapsulation
2R600L	GDT	Power interface	Surge and lightning protection (for outdoor products, pay attention to the issue of continuous current)	2RXXXL
14D561K/14D511K	MOV	Power interface	Surge and lightning protection	14D
CMZ/CML	EMI common-mode suppressors	Power interface	Common-mode rejection	SMD

4.3.2 12V/24V DC Power Interface EMC and Reliability Design

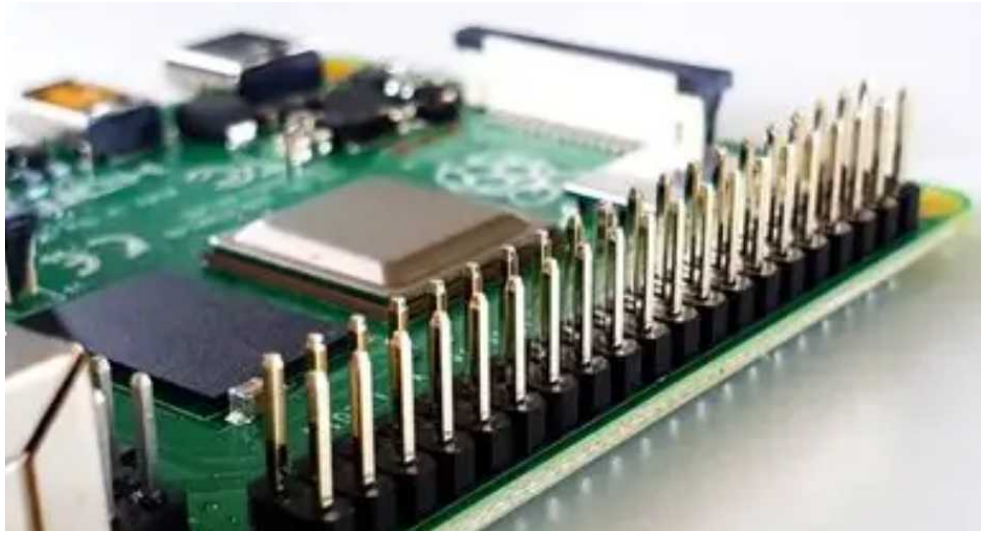
DC power interface: used to connect external 12V/24V DC power input, supports offline use

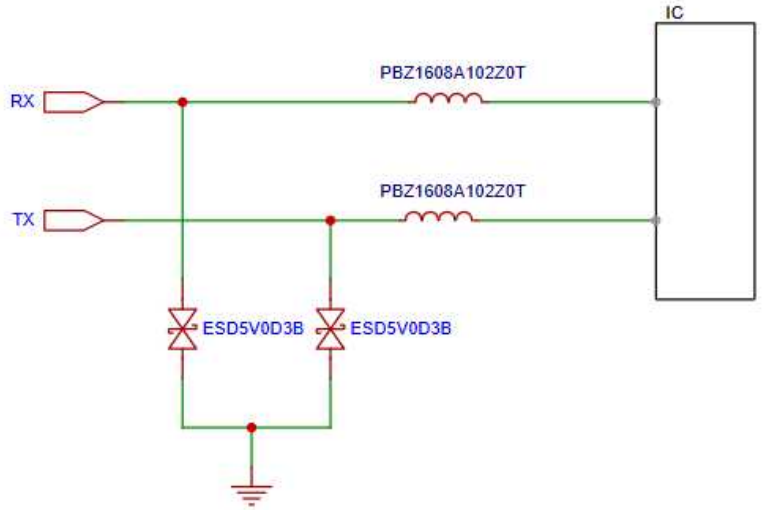


model	Device Type	Use Location	effect	Encapsulation
2R090L	GDT	Power interface	Surge and lightning protection (for outdoor products, pay attention to the issue of continuous current)	2RXXXL
20D820K	MOV	Power interface	Surge and lightning protection	20D
CMZ7060A-701T	EMI common-mode suppressors	Power interface	Common-mode rejection	7060
SMBJ15CA/SMBJ28CA	TVS	Power interface	Surge, load dump	SMB

4.3.3 GPIO/UART/I2C Interface EMC and Hot-Swap Reliability Design

GPIO interface (general purpose input and output): used to connect sensors, actuators and other peripherals, supporting custom programming control

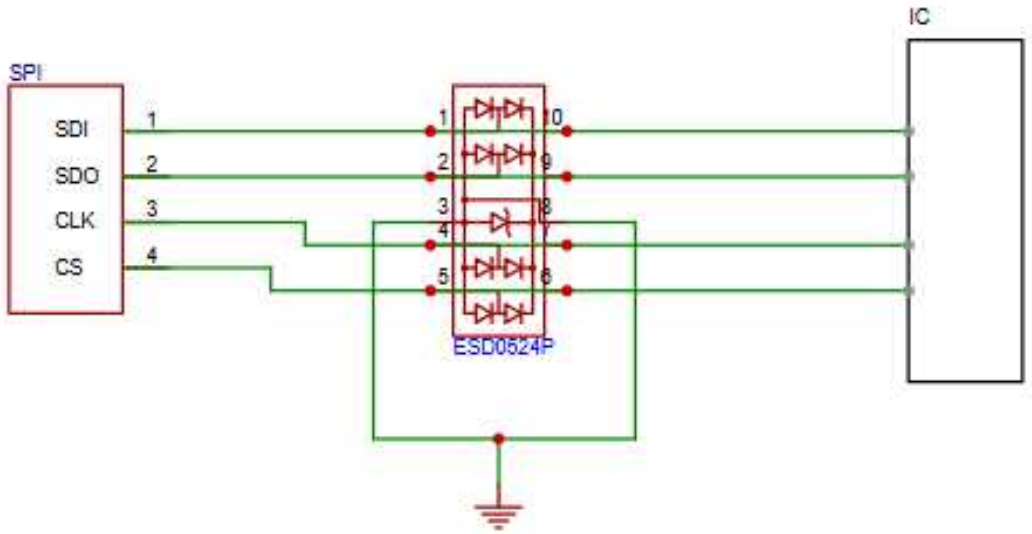


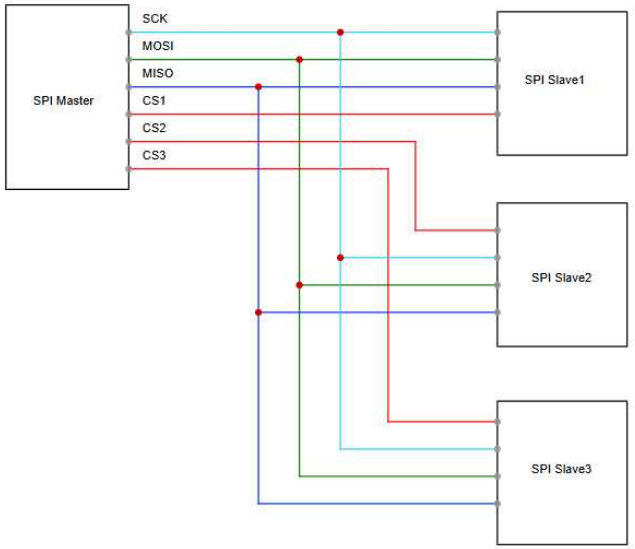


model	Device Type	Use Location	effect	Encapsulation
ESD5V0D3B	ESD	GPIO interface	Surge, static electricity	SOD323
PBZ1608A102Z0T	magnetic beads	GPIO interface	Eliminate high-frequency interference	1608

4.3.4 SPI Interface EMC and Hot-Swap Reliability Design

SPI interface: high-speed serial communication interface, used to connect memory chips, display screens, etc.



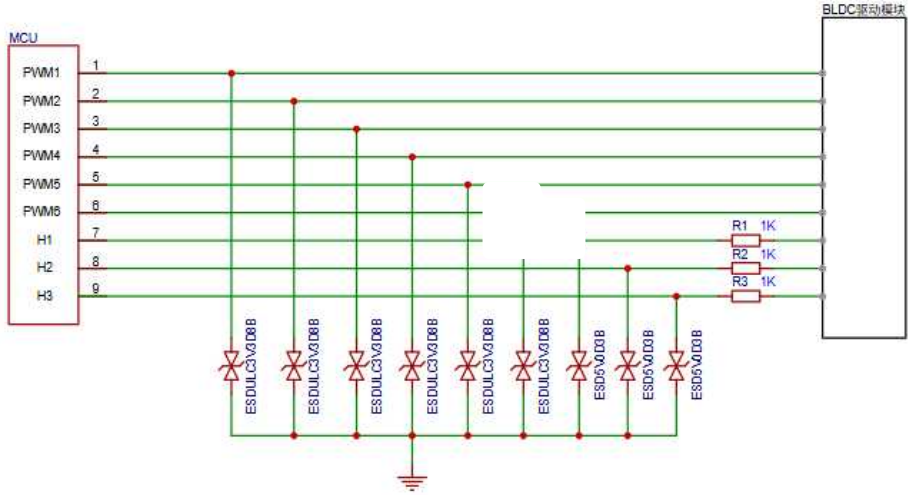


model	Device Type	Use Location	effect	Encapsulation
ESD0524P	ESD	SPI interface	Surge, static electricity	DFN2510

4.3.5 MCU drives BLDC motor module

MCU Interface: MCU control of a BLDC (brushless DC) motor typically involves multiple interfaces, including PWM output and Hall sensor input.

Pin Definition: The MCU outputs six PWM signals for controlling the upper and lower arms of the three-phase bridge. Additionally, three Hall sensor inputs are used to obtain rotor position information for correct commutation.



model	Device Type	Use Location	effect	Encapsulation
ESDULC3V3D8B	ESD	MCU interface	Surge, static electricity	SOD882
ESD5V0D3B	ESD	MCU interface	Surge, static electricity	SOD323

音特电子
YINT ELECTRONICS

Improvement, innovation, saving, win-win

Foor 4,No.9 Building,Tus-Caohejing(Zhongshan)Science Park No.199,East Guangfulin Road,Songjiang District,Shanghai,China

Tel：+86-21-22817269　　Fax：+86-21-67689607　　Email：sales@yint.com.cn

http://www.yint.com.cn

Supporting organizations: Shimai Digital Pharmaceutical Industry (Hangzhou) Co., Ltd.

Shimai Pharmaceutical Consulting (Shanghai) Co., Ltd.

WeChat official account