

Line Impedance Stabilization Network

- ❖ **EM5040** (9kHz-30MHz/16A)
- ❖ **EM5040A** (9kHz/150kHz-30MHz, 16A)
- ❖ **EM5040B**(9kHz/150kHz-30MHz, 16A,with common mode and differential mode)
- ❖ **EM5040C**(100kHz-200MHz/100A)



Preface

First of all, thank you for purchasing our products, this instruction manual is the description about the function, usage, operation attention points, etc. Before use, please read the instructions carefully and use correctly.

Manual annotation will use the following symbols to distinguish.



This symbol means it is harmful to the machine and human body; you must strictly follow the instruction manual to operate.

Warning

In the case of wrong operation, the user risk injury. The content under this mark records the relevant matters needing attention to avoid such dangers.

Notice

The user may suffer minor injuries and material damage with the wrong operation. To avoid such situation, the matters under this mark need attention.

Note

This symbolizes important note about how to use the machine.

To the safely use the machine, you must abide by the following safety precautions strictly. The violation against the manual is likely to damage the protective function of the machine. In addition, the company is not responsible for any safety problem caused by the violation of matters needing attention in operation.



This product is designed according to the international EMC standard, so, theoretically there will be relatively large leakage current. If the ground condition is bad, there could be deadly electric shock. Thus, the company requires the users to check the following tips:

- ◆ **The ground must be good.(There're ground point on the sides and back of the device)**
- ◆ **The electric environments of many users have bad grounding but users don't know.**

This is critically dangerous so the company require the users to have double protection: users must install isolation transformer. Users can buy it on the market or use our EM5060 isolation transformer (0.9kA), which can satisfy most low power test requirement.

◆ **Do not open the case or try to connect lines during operation. Do not use the LISN in damp or explosive environment. Please keep the device surface dry and clean before operating.**

◆ **Must make sure the product is used in the rating voltage/ current range.**

◆ **If there's anything wrong with the product, please contact us immediately. Do not open the case and try to repair the device to avoid unwanted accident.**

1. Introduction

EM5040/5040A/5040B Line Impedance Stabilization Network is a kind of $(50\mu\text{H}+5\Omega) \parallel 50\Omega$ V type LISN. This product can provide stable impedance from 9 kHz to 30 MHz RF range for DUT and reference. At the same time, it isolated the useless signal from the electric network to measurement circuit and coupling the interference voltage of the DUT to the input port of the measurement receiver. The product's performance is compliant with standard requirements of CISPR16-1-2 for V-networks. It suits conducted disturbance voltage measurement for single phase equipment well. The standard BNC output port and 50Ω output impedance make the device compatible to the measurement equipment such as receiver and spectrum analyzer of any manufacturer. The artificial hand of the product can simulate the handle device to measure.

EM5040 is a type of single phase standard LISN. **EM5040A** has a limiter (with attenuation of 10dB) and an optional 150 kHz high pass filter. Users can choose to start from 9 kHz or 150 kHz according to corresponding standard. The built in transient limiter can effectively protect receiver or spectrum analyzer from damage caused by large signal. Users can connect EM5040A safely to those devices without other limiter.

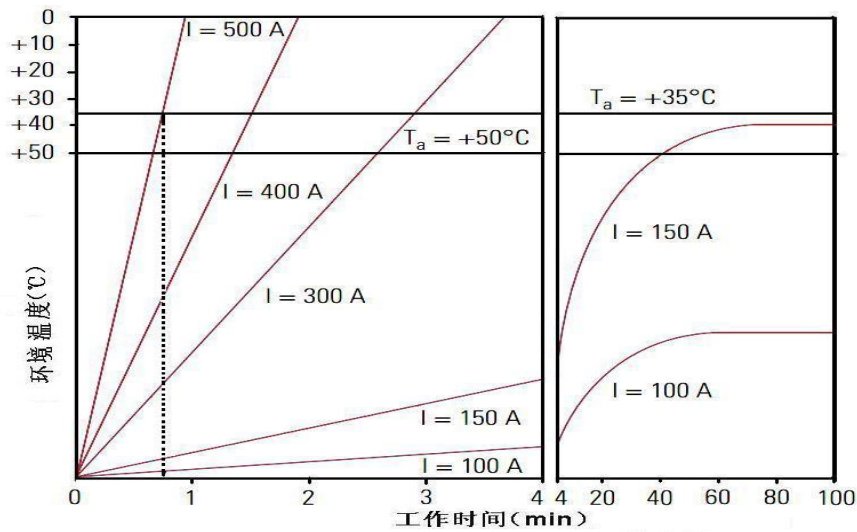
On the bases of EM5040A, **EM5040B** is added the function used for common mode and differential mode measurement, which will provide assistance for EMI debugging, especially for EMI filter.

EM5040C LISN is a type of single line $(5\mu\text{H}+1\Omega) \parallel 50\Omega$ LISN. This product can provide stable impedance from 100 kHz to 200MHz range for DUT and reference. At the same time, it isolated the useless signal from the electric network and measurement circuit and coupling the interference voltage of the DUT to the input port of the measurement receiver. It is compliant with VDE0876 Part1 (onboard power-supply systems), VDE0879 Part2, CISPR16-1-2(Low-impedance power supplies), CISPR25 and EMC Directive 95/94/EG, DIN40839, IS07637, MIL-STD-462, MIL-I-6181D, MIL-E-55031, DEF STAN59-41 and DO 160.

2. Electronic Specifications

	EM5040	EM5040A	EM5040B	EM5040C
Frequency range	9kHz—30MHz			100kHz—200MHz
Circuit type	(50uH+5Ω) 50Ω Type V			(5uH+1Ω) 50Ω
Measurement circuit phase number	Single phase two wire L/N1			Single wire
AC voltage/ frequency range	0~264VAC / 50~60Hz ±5%			0~250VAC / 0~400Hz
DC voltage range	0~55V DC			0~600V
Power supply output port	German standard power supply socket			M8 bolt
Output current	Rating 16A			Rating 100A Short-time maximum current (<30s) 500A
Ground protection	Side metal panel grounding Rear panel 4mm butterfly bolt grounding			2*M8 bolt The bottom metal panel (connected to the ground plane with screws)
Output port	Standard 50Ω BNC female,			Standard 50Ω N female
Artificial hand	Yes			No
Output signal filter	No	High-pass filter 9kHz/150kHz optional		No
Output signal limiter	No	Attenuation coefficient-10dB limit threshold 130dBuV		No
Output signal common mode and differential mode separator	No	No	Yes Add 2 output port CM/DM	No
Operating temperature range	0℃~45℃			
Storing temperature	-20℃~70℃			
Safety standard	EN61010-1			
Size	338mm (Length) ×237mm(Width)×133mm (Height)			322mm (Length) ×122mm(Width)×128mm (Height)
Weight	5kg	5.25kg		1.8kg

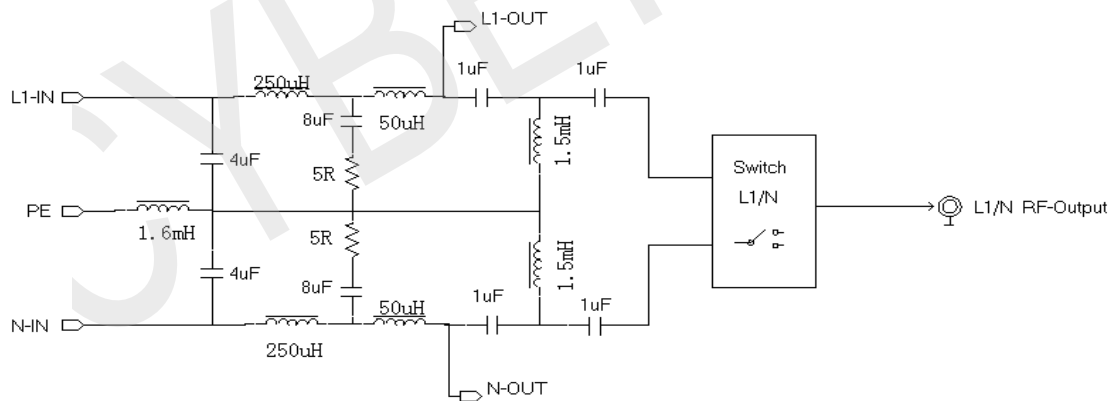
The max operating time for EM5040C in different operating current and different environment temperature



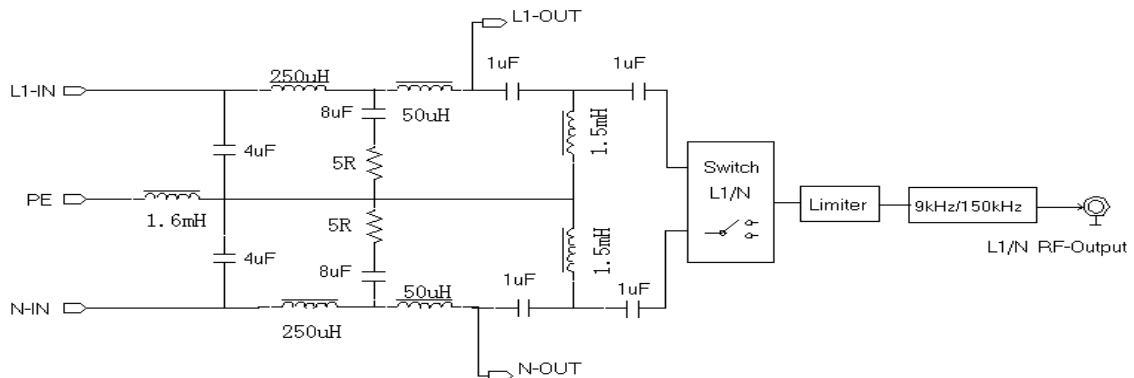
3. Basic Theory

EM5040/5040A/5040B's have a same V type LISN section. The difference is the subsequent signal processing section. EM5040 only contain the basic Type V LISN section. To protect the test receiver, users should add limiter to it, or users can choose our EM5010.

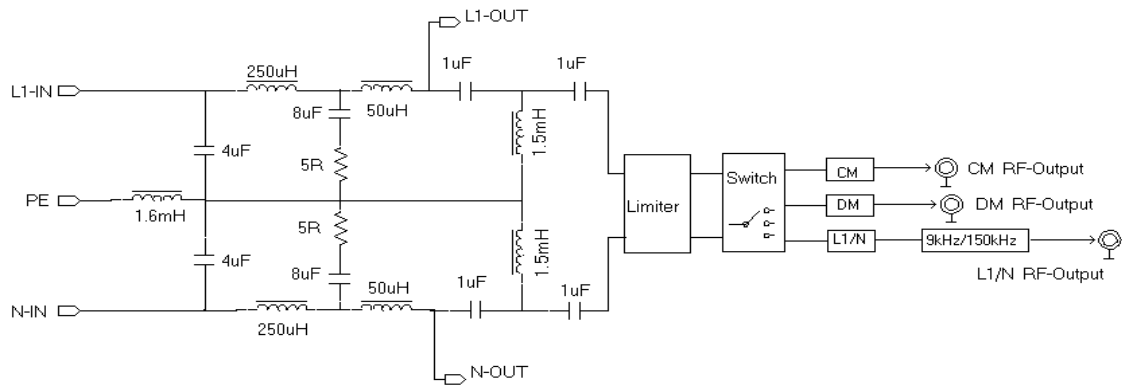
✦ **The theory of EM5040 is shown below:**



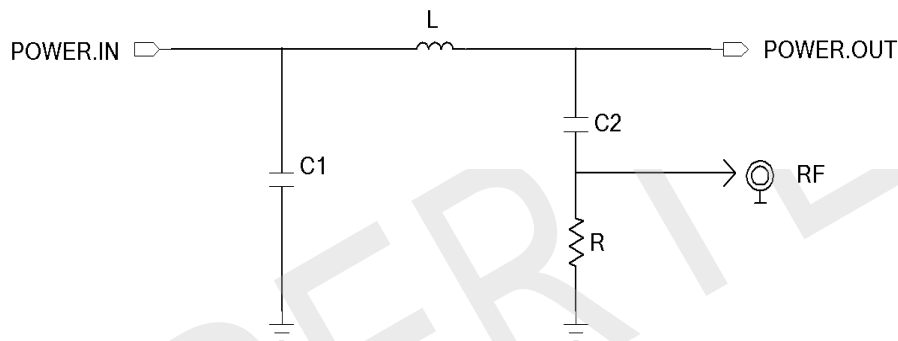
✦ **EM5040A is added with a limiter (10dB) and an optional 150kHz High Pass Filter shown below:**



- EM5040B is added with Common Mode and Differential Mode Voltage separator shown below:



- EM5040C single line Type V LISN shown below:



4. Introduction of EM5040/5040A/5040B/5040C

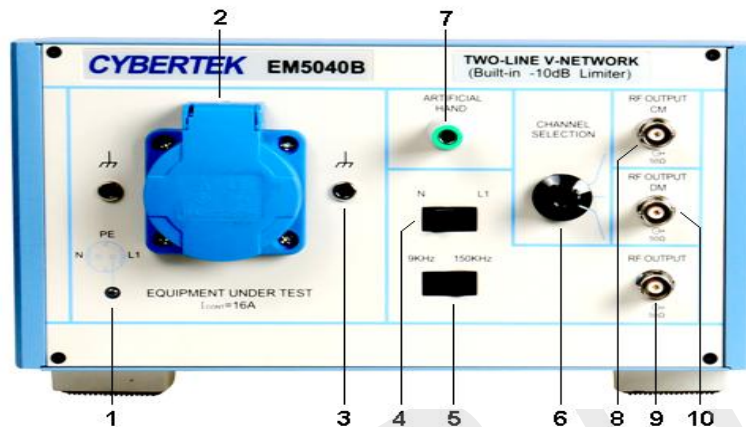
4.1 EM5040/5040A Front panel introduction



- 1 (L1 indicator):** When powered up, the indicator will be lighted up blue.
- 2 (EUT power port):** The product's power port is Germany Standard. At the same time the accessories in the product provide national standard adapter head.
- 3 (Reference Ground Port):** 4mm port used to connect the ground port of DUT.
- 4 (N/L1):** The switch selecting the phase line under test.
- 5 (9 kHz/150kHz Switch):** The filter switch. EM5040 doesn't have this function

- ❖ **6 (RF output port):** Standard BNC RF output port used for connecting receiver or spectrum analyzer. Because EM5040A has a 10dB transient limiter inside, so the receiver need to set corresponding correction factor
- ❖ **7 (Artificial Hand function):** This function will simulate the actual influence when human hand touched the metal part of the handle tool. It is composed with 510Ω resistor and 200pF network. 4mm port is used for connecting the metal part for human contact handle equipment

4.2 EM5040B Front panel introduction



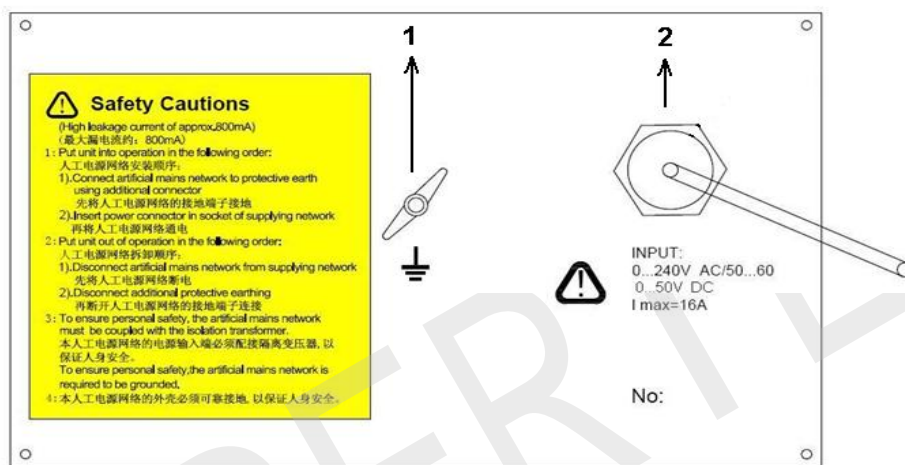
- ❖ **1 (L1 indicator):** When powered up, the indicator will be lighted up blue.
- ❖ **2 (EUT power port):** The product's power port is Germany Standard. At the same time the accessories in the product provide national standard adapter head.
- ❖ **3 (Reference Ground Port):** 4mm port is used for connecting the ground port of DUT.
- ❖ **4 (N/L1):** The switch selecting the phase line under test.
- ❖ **5 (9 kHz/150kHz Switch):** The filter switch.
- ❖ **6 (Channel Selection):** Switch the output signal to the corresponding ports including RF Output , CM Output , DM Output
- ❖ **7 (Artificial Hand function):** this function will simulate the actual influence when human hand touched the metal part of the handle tool. It is composed with 510Ω resistor and 200pF network. 4mm port is used for connecting the metal part for human contact handle equipment
- ❖ **8 (CM OUTPUT Port):** Standard BNC RF Female port is used for connecting receiver. Output voltage is $V_{out} = [V_N + V_L] / 2 - 10dB$. With fixed 10dB transient limiter inside, the receiver needs to set corresponding corrected attenuation factor.
- ❖ **9 (RF output port):** Standard BNC RF Female port is used for connecting 10dB transient limiter inside, so the receiver need to set corresponding corrected attenuation factor
- ❖ **10 (DM Output Port):** Standard BNC RF Female port is used for connecting receiver. Output voltage is $V_{out} = [V_N - V_L] / 2 - 10dB$. With fixed 10dB transient limiter inside, the receiver needs to set corresponding corrected attenuation factor.

4.3 EM5040/5040A/5040B Introduction about side metal ground panel and rear panel

Side metal ground panel is for ground protection

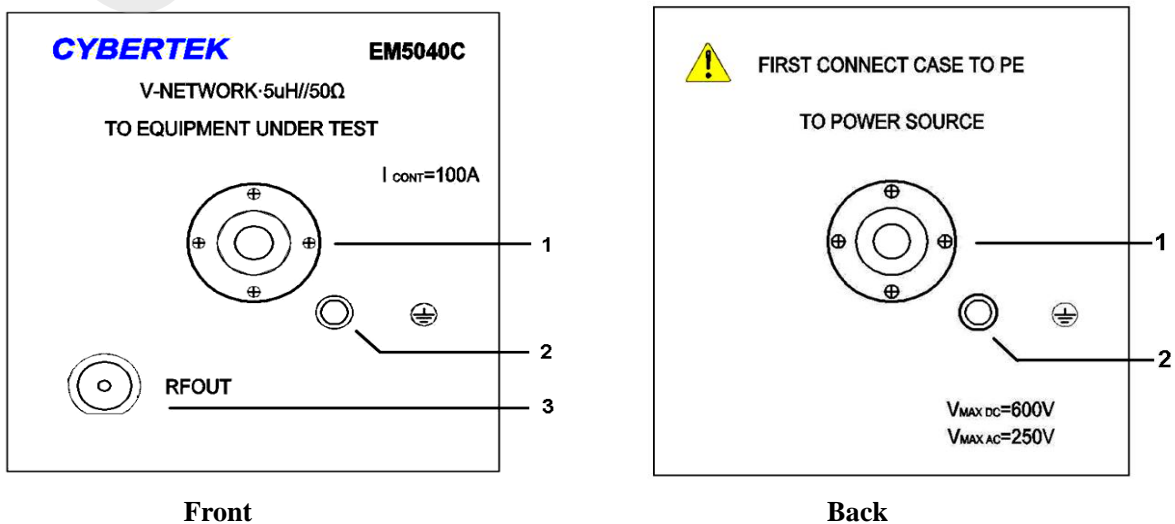


Rear Panel Introduction



- ❖ **Ground Port:** This port has 4mm butterfly bolt for ground protection only. This is not for reference ground.
- ❖ **Power input port:** Mainly for powering DUT

4.4 EM5040C Introduction about the front and back panel



- 1) **EUT power port:** power input port for EUT 1) **Power input port:** power supply input port
- 2) **Ground port:** the size of the bolt is 8mm, grounding 2) **Ground port:** the size of the bolt is 8mm, grounding
- 3) **Output port:** interference signal output port
with Type N female port

The bottom metal panel of EM5040C is the reference ground, users can connect it on the ground of lab with screw.

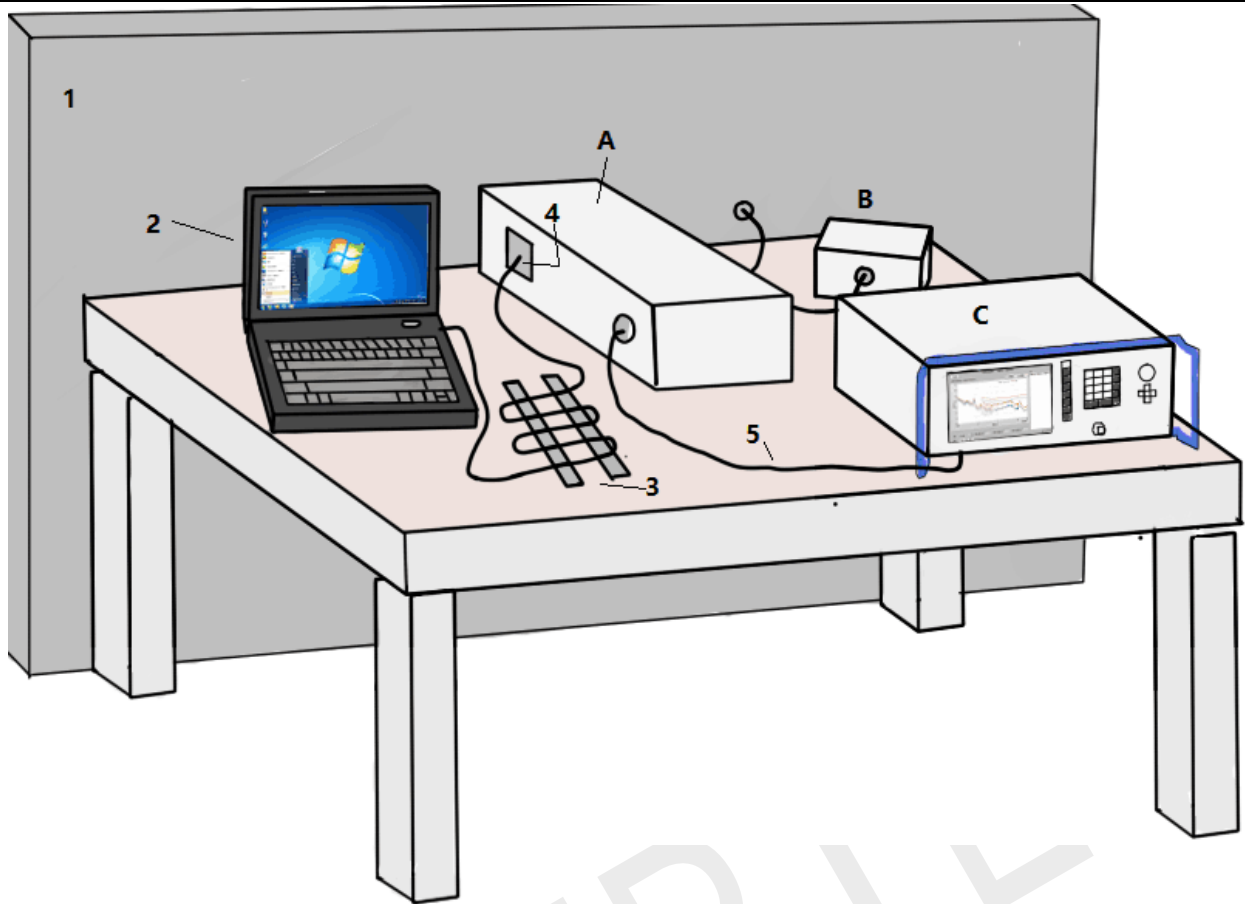
5. Construction of EMC test platform



Please read the instruction book carefully, learn the safety knowledge and measure according to correct step.

The product is designed according to national standard, so theoretically there will be large leakage of current to ground. A bad grounding can possibly cause deadly electric shock. As a result, the company requires the users:

- ❖ **The device must be well grounded (There're grounding point on the side and rear of the device)**
- ❖ **Isolation Transformer must be installed as double protection.**
Our company's EM5060 isolation transformer can fulfill the requirement for most tests.
- ❖ **Do not open the case and connect lines during operation. Do not use in damp or explosive environment. Please keep the device surface dry and clean before using it.**
- ❖ **Please make sure the product is working in rating voltage and current range.**
- ❖ **If there's anything wrong with the product, please contact us immediately. Please do not open the shell and try to repair it to avoid unwanted accident.**



term	Description
1	Metal Panel at least 2mX2m
2	EUT
3	The method to fold the cable when it is longer than 1 meter.
4	Power supply port for EUT
5	Output shielded line
A	LISN
B	Isolation transformer
C	Receiver

6. Application of Common mode and Differential mode technology Using EM5040B.

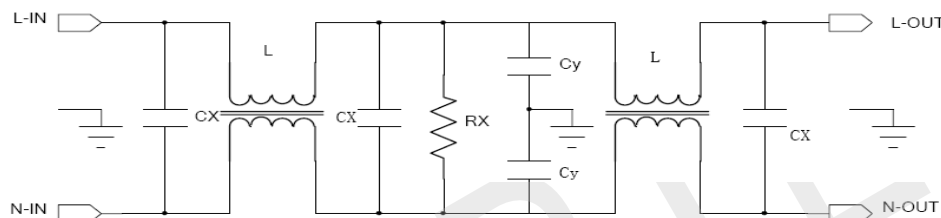
- ✧ The conduct disturbance voltage of the switch power supply can always be represented by differential mode and common mode voltage. Differential mode interference is the interference generated between Line and Neutral, and the common mode interference is the

interference generated between Line and ground or Neutral and ground. Set L/N interference voltage as V_L and V_N , and this signal can be seen as the combination of common mode voltage V_C and differential mode voltage V_D .

$$V_L = V_C + V_D$$

$$V_N = V_C - V_D$$

- ✧ The commonly efficient way to control differential mode interference signal and common mode interference signal is to add EMI filter on the switch power supply input circuit. The EMI filter on the power supply input port is a type of low pass filter consisted of capacitor and inductance. The immunity to interference fitting every unit is quite different.
- ✧ The figure below is a typical level two EMI filter.



- ✧ EMI filter include common mode choke L, differential capacitor Cx and common mode capacitor Cy.

L: Common mode choke is effective for common mode interference but not differential mode interference. Theoretically the controlling effect is better when inductance is great, but the increase of the turns of inductance will make the distribution capacitor larger and the common mode suppression worse in high frequency.

Cx: Differential mode capacitor always use Metalized Film Capacitors with value ranging between 0.1~1uF.

Cy: Used to control higher frequency common mode interference signal ranging between 2200~6800pF

Rx: The leak resistance for Cx

- ✧ As a result users can use EM5040B to analyze whether the problem is caused by common mode or differential mode interference and chose corresponding component: common mode choke L, differential capacitor Cx and common mode capacitor Cy to fulfill the debugging .
- ✧ Power Supply Filter is usually used to control the conduct disturbance below 30MHz, but it is also effective for radiation emission interference over 30MHz. According to the

characteristics of the power supply common mode and differential mode interference, the interference can be classified into 3 ranges by its distribution: 150kHz~500kHz is mainly for differential mode interference; 500kHz~5MHz is for differential mode and common mode interference; 5MHz~30 MHz is mainly for common mode interference.

7. Packing List

Packing List		
	EM5040/5040A/5040B	EM5040C
LISN	1	1
RF cable	BNC(male) 2 meter	N(male) 2 meter
BNC female to N male	1	N/A
Germany to national standard port	1	N/A
Instruction book	1	
Warranty card	1	
Test report	1	

CYBERTEK

SHENZHEN ZHIYONG ELECTRONICS CO., LTD.

Addr: Room A1702, Building 4, TianAn Cyber Park, HuangGe North Road, LongGang

District, ShenZhen City, China

Tel: +86-400 852 0005

+86-755-86628000

Q Q: 400 852 0005

Fax: +86-755-86620008

Email: cybertek@cybertek.cn

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