

# NOISE FILTER



# NOISE FILTER

## EXPLANATION

### ORDER

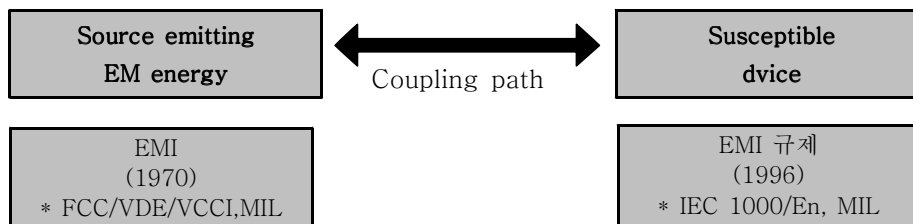
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## 1. Overview of interception of electromagnetic (EMI)

Electronic industry and technology of computer have faced brilliant development because of recent dramatic advance of digital technology and semiconductor etc. it is therefore possible to see lighter, smaller, speedy electric and electronic devices in a large area. On one hand, these can be operated by small energy to start. On the other hand, there are many problems caused by it. It operates so sensitively even by minute electromagnetic and causes error of operation, density of electromagnetic is increased as so many electric and electronic products are distributed to every corner of society which also causes worse environment of electronic wave. Devices which are installed under the environment mentioned above operate wrongly enough to cause confusion in the society or increase concern about the bad effect on human body.

There are many interception of electromagnetic in our society. With regard to trivial occasions occur in our daily life, there are when electronic shaving machine is used, noise occurs on TV screen, audio of vehicle is interfered by neighboring saw milling, wireless remote controller does not work under the flamboyant lamp etc.

The examples of more serious occasions are traffic accident occurs from unprepared start, stop, acceleration by interception of electronic wave of electronic controller, operator is killed as shelf head all of sudden operates because of electromagnetic interception of CNC shelf, emergent stop of nuclear reactor happens due to electromagnetic interception at electronic controller of atomic power station and possible harm on human body from electromagnetic etc. Though these phenomena were treated with unknown reason or regarded forgettable, they are now clarified in detail and fundamental measure from the victims.



In order to establish the issue of electromagnetic interception, source, coupling path and suscepter etc. basically must be available at the same time as per Picture 1. Though phenomena of electromagnetic interception occur from excessive electromagnetic from the source, they are also caused from insufficient tolerance of devices. In order to reduce the problem of electromagnetic, number or output of source must be decreased in order not to intercept other devices, strengthening the tolerance of electromagnetic of the devices so that they can operate as intended under the electromagnetic environment to some extent. Compatibility of electronic wave environment indicates that various electric and electronic devices coexist harmoniously and it is the ultimate objective of EMI/EMC study. Each country in the world have implemented EMI, restriction of electromagnetic since late 1970s to achieve the objective and more seriously started its regulation as EMS regulation mainly led by EU was announced in 1 Jan.1996.

Modern concept of compatibility of electronic has been developed very proactively and comprehensively from the perspective of the devices which we intent to operate. Particularly, it means the ability of electric and electronic devices operate as designed under the electromagnetic environment where the devices are planned to install and further, additional electromagnetic of new device or system do not impact on the existing electromagnetic environment without influencing the adjacent existing devices.

Definition of EMI/EMS which have been developed as mentioned above are now redefined by IEEE(ANSI/IEEE Std. 100-1988) as below.

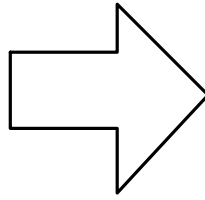
EMI: A measure of electromagnetic radiation from equipment

EMC: 1) A measure of equipment tolerance to external electromagnetic fields

2) The ability of a device to function satisfactorily in its electromagnetic environment without introducing intolerable disturbance to that environment (or to other devices)

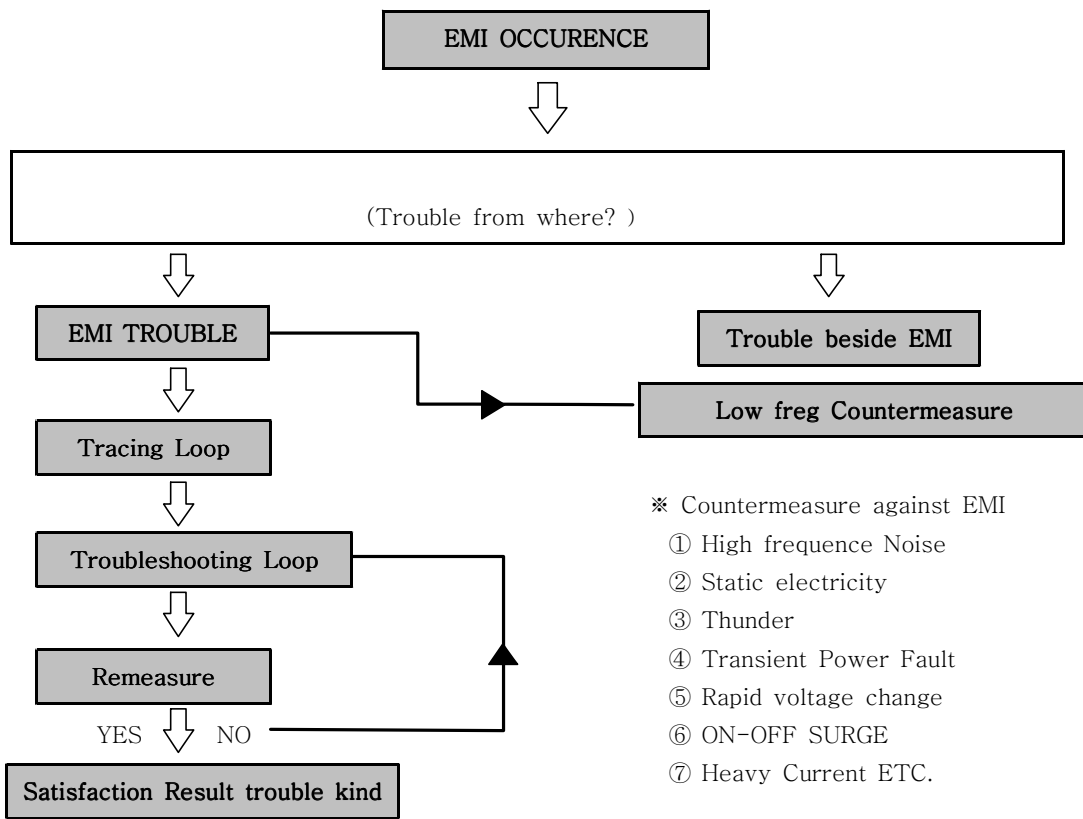
1 - 1. SOLUTION FOR EMI

1. (Shielding)
2. (Grounding)
3. (Matching)
4. (Filtering)
5. (Isolation)
6. (Impedance level)
7. (Countermeasure technics)



- Decreasing Noise Level
- Disconnecting OF Transion Loop
- Noise & filtering
- Immunity in force of equipment in effect

1 - 2. Countermeasure against EMI



NOISE MODE		TROUBLE KIND	Relation between Noise & Trouble
A	DC NOISE	<ul style="list-style-type: none"> <li>• Analog input is Data Shift</li> <li>• Disturbance of analog input Data</li> <li>• Digital input change</li> <li>• Pulse input change</li> <li>• Pulse input Data Shift</li> <li>• CPU stop</li> <li>• Wrong writting to memory</li> <li>• Data Transmission error</li> <li>• Wrong output</li> <li>• Destruction of parts</li> <li>• CRT distortion</li> </ul>	→ A, B, C
B	Frequency NOISE		→ B, C, D
C	RFI(EMI)		→ A, B, D
D	EFT		→ A, B
E	SURGE & ESD		→ E, F
			→ D, E, F
F	Transient Power Fault		→ D, E, F
		→ C, D, E	
G	EMI	→ D, E	
		→ A, B, D, E	
			→ G

2. Three factors of noise

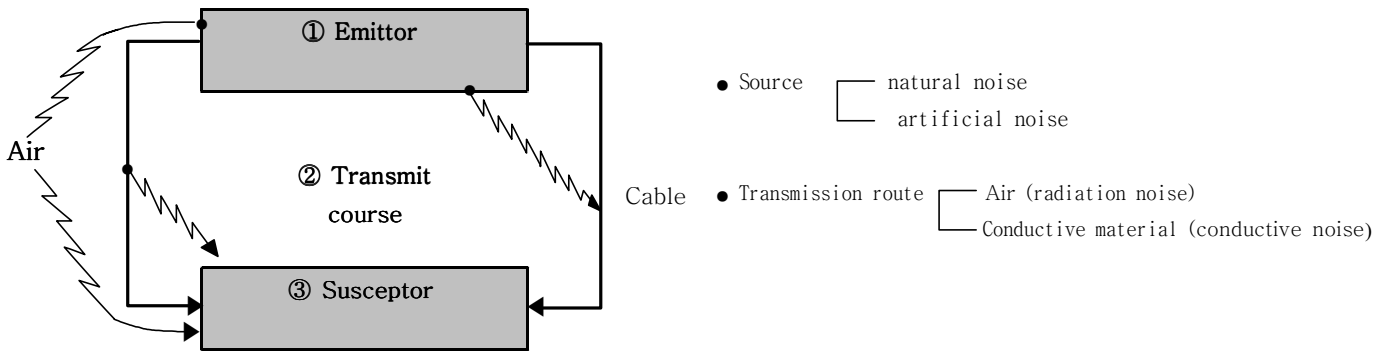


TABLE 1

2 - 1. Noise channel of electronic controller

There are two types including radiation noise which is transferred to the air and conductive noise which is delivered to the major electric power.

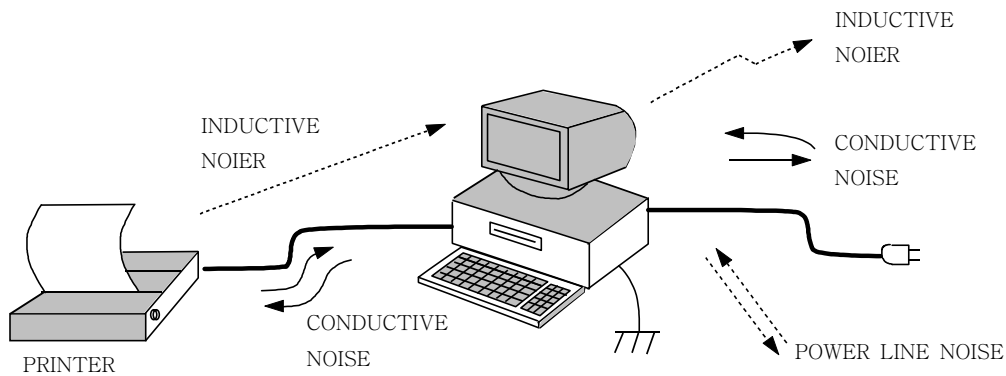


TABLE 2

2 - 2. Noise filer in general is component of EMC and can be said component to take measure of conductive noise.

### 3. Conductive noise

#### 3 - 1. COMMON MODE, NORMAL MODE NOISE

Concerning conductive noise, there are two types as manifested in Table 3 such as common mode noise which delivers between line and us and normal mode which moves around between lines. Other than exceptional case, these two type of noise always exist.

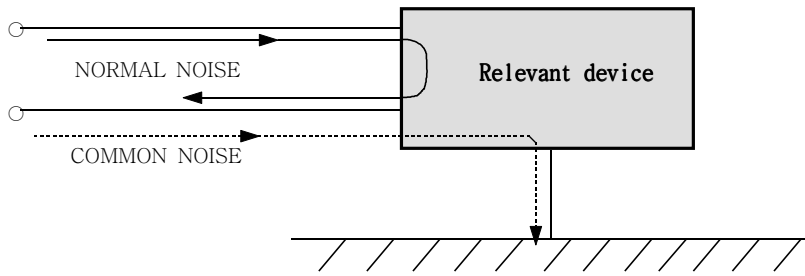


TABLE3

#### 3 - 2. Principle of noise filter

The most common circuit of noise filter is indicated in Table 4.

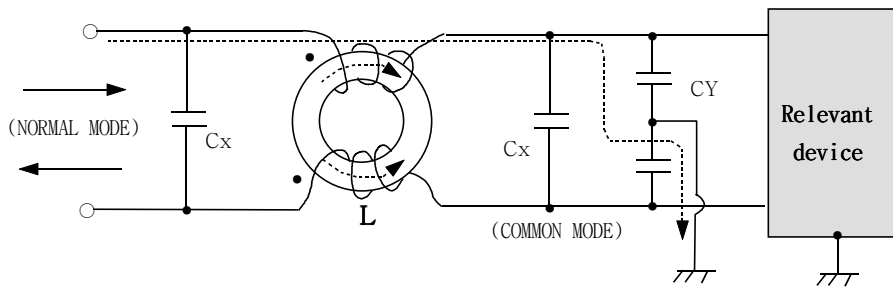


TABLE 4

Noise filter is kind of low filter and frequency of interception is reduced at the high frequency. Coil of noise filter is common mode chock coil and there are two coils in one core at the same phase. Because of it, internal electricity disappears at the electric current in general. Because inductance mostly disappears, the effect of reduction of normal noise is not great. It is a product which obtains large inductance for common mode current. It reduces substantially common noise with condenser CY to the ground. Reduction can be obtained by inserting condenser Cx in terms of normal mode noise. Filter at the Table 4 intervenes noise of both normal mode and common mode. Equivalent circuit of each mode is as indicated in Table 5.



TABLE 5

#### 4. Specification relevant to the regulation of electromagnetic and references

EMI regulation has been implemented in Korea since 1990 in order to prevent industrial accident resulted from impediment of communication and error of devices by electromagnetic of electric and electronic devices and to cope with the protective trade regime of developed countries so that domestic environment can be protected and international competitiveness of domestic products can be strengthened.

##### 4 -1. Registration of electromagnetic and devices to be applied in detail.

Relevant device	EMI	EMS	Detailed item
1) Device to use high frequency such as industrial science and medical - Medical devices by pharmaceutical and medial law. ● Breathing assistance, device to replace organ, device to care child ● Radiation device, diagnosis of non ionization, electric operating device etc. ● All medical devices relevant to electromagnetic.	97. 7. 1 98. 1. 1 99. 1. 1 2000. 1. 1	2000. 1. 1 98. 1. 1 99. 1. 1 2000. 1. 1	Equipment or devices for industrial, scientific/medical and housing application which are designed to create high frequency energy or partly use. They are governed by safety control law of electric devices and application and permission regulation of pharmaceutical law.
2) Engine machine for automobile and ignition ● Automobile ehicle of below 4.5ton, truck / special vehicle ● All automobiles	97. 1. 1 97. 1. 1 2000. 1. 1	97. 1. 1 99. 1. 1 2000. 1. 1	Devices which intercept electronic communication or broadcasting and must be approved according to law of automobile control other than vehicle of two wheels and automobile of which max. speed per hour is less than 25Km..
3) Transmission device for broadcast	97. 1. 1	2000. 1. 1	Voice and TV receiver to receive broadcast from 9KHz to 1GHz or similar data. And devices to create or renew voice or visual data by direct connect to them. They are governed by safety control law of electric goods in terms of specification..
4) Electronic devices and motor at home	97. 7. 1	2000. 1. 1	Electric device for home, portable tool, electric heating device and other electric devices. They are governed by safety control law of electric goods in terms of specification..
5) Fluorescent light and lighting etc.	97. 7. 1	2000. 1. 1	Devices or equipment with the function of fluorescent light and lighting etc. for in 9KHz to 400GHz. They are governed by safety control law of electric goods in terms of specification..
6) Facility of high voltage and annexed devices	To be decided	2000. 1. 1	It is subject to be decided later.
7) Information device etc.	97. 7. 1	2000. 1. 1	Device governed by registration of electromagnetic and article 2 and 3 (device which has a function of data/communication, input/output/save/search/transmit or control of message and operates for information transmission with more than one terminal port and has less than 600 volt supply other than wireless facility which is governed by article 2 and 4 frequency law) and components which have computer, relevant equipment and terminal port and wire communication terminal etc.

#### 4 -2. Detailed item of information devices

(Information devices in accordance with Article 2 .2 of registration of electromagnetic)

Relevant device	Detailed item	Contents
1) Computer	All computers such as large, medium and small sized personal computer workstation, POS terminal and word processor	
2) Relevant components of computer	<ul style="list-style-type: none"> <li>● External memory</li> <li>● External disk drive</li> <li>● Scanner      ● Digitizer</li> <li>● Mouse        ● Digital camera</li> <li>● Key board    ● Floater</li> <li>● Printer       ● Common device of printer and monitor</li> <li>● Terminal     ● Electronic game</li> <li>● Others</li> </ul>	
3) Components contained in internal computer with terminal port	<ul style="list-style-type: none"> <li>● Mother board                      ● Power supplier</li> <li>● Input/output interface card      ● Video card</li> <li>● Multimedia card (MPEG, sound and TV card etc)</li> <li>● Disk drive (hard, floppy, CD etc.)</li> <li>● Others</li> </ul>	
4) Wire communication terminal	<ul style="list-style-type: none"> <li>● Short distance communication device</li> <li>● LAN card              ● Transistor (LAN)</li> <li>● Bridge                ● Hub</li> <li>● Others</li> </ul>	Other than the device which has been approved for specification according to the basic law of electric communication. Proper to the score in case of application of spec. Enclosing score of registration.

#### 4 -3. Standard to prevent electromagnetic

Category		Regulation / Revision		
		Distance(m)	Frequency(MHz)	Strength (dBuV/m)
① Devices of high frequency such as industrial, scientific and medical	Standard of radiation	30	30 ~ 230 230 ~ 1000	30 37
	Standard of conduction	-	0.15 ~ 5 5 ~ 30	56 ~ 46 50
② Automobiles etc. ● Wide area ● Narrow area		10 10	30 ~ 1000 30 ~ 1000	34 ~ 45 24 ~ 35
	③ Receiver of broadcast	Standard of radiation	3 3	300이하 300 ~ 1000
Standard of conduction		-	0.15 ~ 30	56 ~ 46
④ Electric devices/motor at home	Standard of radiation	3	30 ~ 300	35 ~ 45 (dBpW)
	Standard of conduction	-	0.15 ~ 30	59 ~ 46
⑤ Fluorescent light and lighting etc.			● 4 standards loss of insertion of fluorescent light	
⑥ High voltage facility and components	-	-	-	To be decided

**⑦ Information devices**

## I) Standard of conduction

Category	Scope of frequency (MHz)	Limit (dB $\mu$ V)		Note1) if is within the limit of average, it is regarded as satisfactory .
		point	AVERAGE	
Level A device	0.15 ~ 0.5	79	66	
	0.5 ~ 30	73	60	
Level B device	0.15 ~ 0.5	66 ~ 56	56 ~ 46	Note2) decrease in a straight line as large increase of frequency.
		note 2	note 2	
	0.5 ~5	56	46	
	5 ~ 30	60	50	

## II) Standard of radiation


Scope of frequency (MHz)	Limit (dB $\mu$ V/m/m)	
	Level A device (10cm)	Level A device (10cm)
30 ~ 230	40	30
230 ~ 1000	47	37

**4 -4. EMS/Electromagnetic Susceptibility**

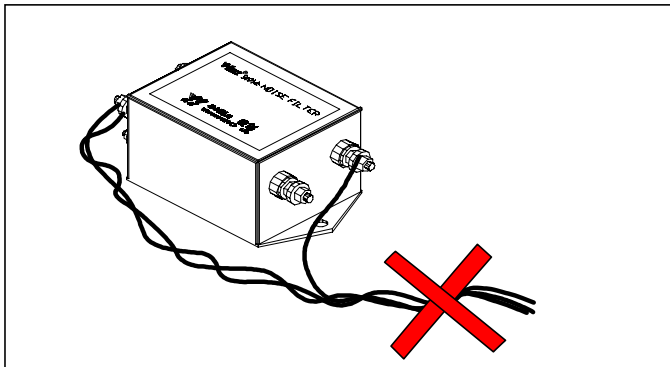
Category	Name of test	Frequency (MHz)	Standard	Remarks
① Devices of high frequency such as industrial, scientific and medical	Discharge of static electricity Radiation of electromagnetic	30 ~ 500	4KV 3V/m	-
② Automobiles	Radiation of electromagnetic	20 ~ 1000	20V/m	-
③ Receiver of broadcast	Radiation of electromagnetic RF conductive current	0.15 ~ 150 26 ~ 30	Voice, imagery S/N $\mu$ 40dB	Approved level 125dB $\mu$ V
④ Electric devices at home	Discharge of static electricity Radiation of electromagnetic Surge	80 ~ 1000	4KV 3V/m 1KV	-
⑤ Fluorescent light and lighting etc.	Discharge of static electricity Radiation of electromagnetic	- 30 ~ 500	4KV 3V/m	-
⑥ High voltage facility and components	Discharge of static electricity Radiation of electromagnetic	- 30 ~ 500	4KV 3V/m	-

**⑦ Information equipment**

Item to test	Terminal to apply	Susceptibility	Unit	Evaluation	Remarks
Discharge of static electricity	Surface terminal	8(discharge) 4(contact discharge)	KV	B	-
Radiation of electromagnetic	Surface terminal	80 ~ 1000	MHz V/m	A	-
Immediate/excessive electronic phenomena	Input/out exchange Terminal of power	1 5 / 50 5	KV Tr / Th ns KHz	B	-
	Input/out exchange Other than terminal of power	0.5 5 / 50 5	KV Tr / Th ns KHz	B	-
Surge	Terminal to apply	1 1.2 / 50	KV Tr / Th ns	B	-

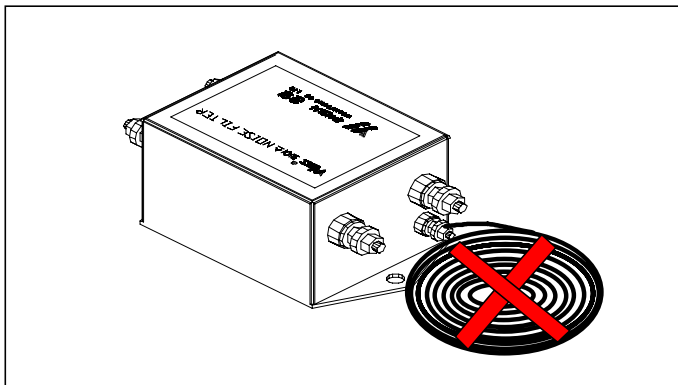
5. Precaution in using noise filter 

1) Please separate input and output of noise filter not to be loser each other.



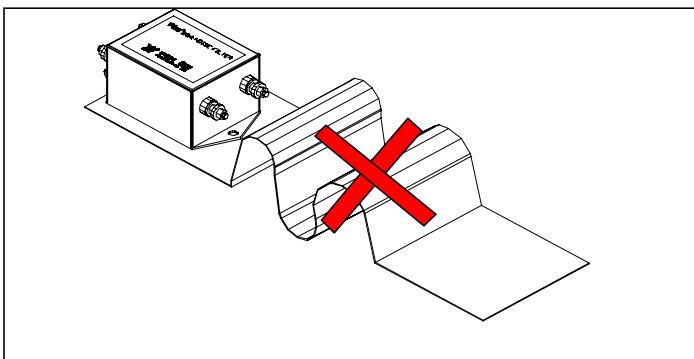
When input and output line are closer or combined, noise must be screened repeatedly by coupling of filter. If input line is wired together in the container though not combined, noise is radiated. Noise filter must be installed at the entry of device and wiring of input and output are required to be closed if possible.

2) Please connect linkage terminal of noise filter in the shortest distance



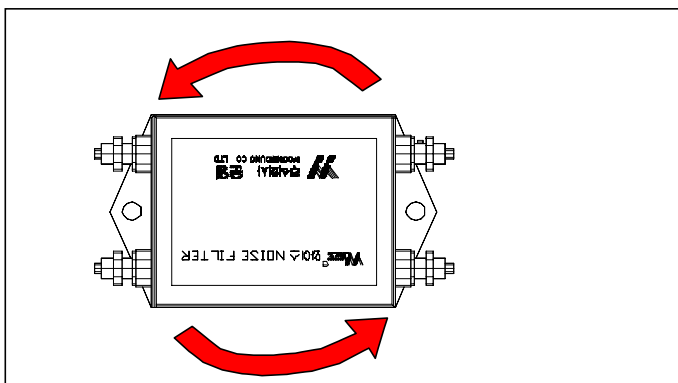
Common mode noise flows to us through condenser in the noise filter. If us line is tied long, either us impedance is higher or effect of decrease is weakened. Because metal case of filter is also linkage terminal, filter must be close to the container as much as possible.

3) Please shorten the linkage point between linkage point of noise filter and that of container as much as possible.



Common mode noise flows to us through condenser in the noise filter. If us line is tied long, either us impedance is higher or effect of decrease is weakened. Because metal case of filter is also linkage terminal, filter must be close to the container as much as possible.

4) Please be aware of the direction to insert filter at the noise filter

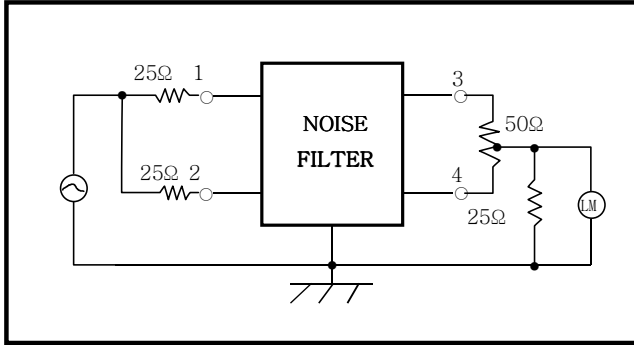


Though noise filter has an similar effect of leaking noise for external noise, internal circuit is commonly symmetry between input and output. Impedance of input and output are in general inconsistent with the frequency. Impedance of device of line to be used is also different. Though direction of input is indicated at noise filter, it is recommended to install in a consideration of the opposite direction.

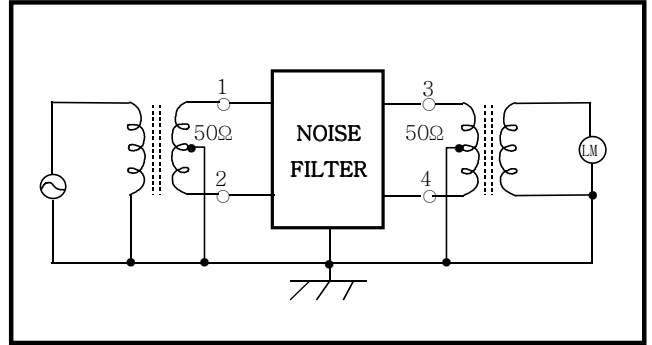
6. NOISE FILTER TEST MEATHODE

6-1. DECREASE SEPCIAL QUALITY & GRADE SEPCIAL QUALITY

● (COMMON MODE)

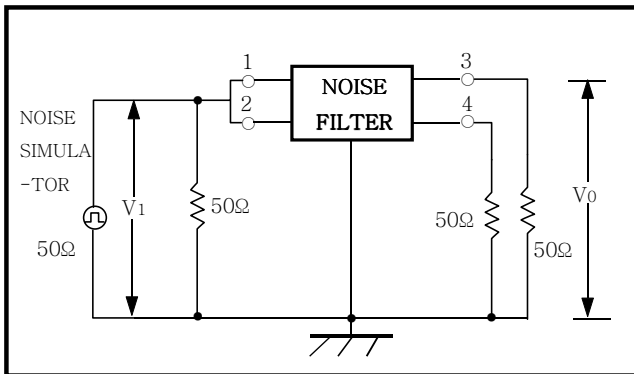


● (NORMAL MODE)

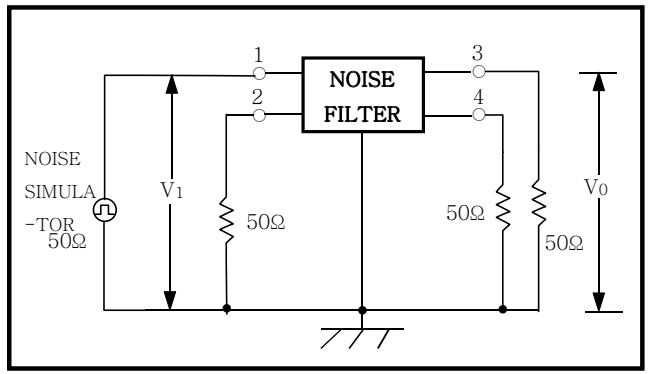


6-2. PULSE SEPCIAL QUALITY

● (COMMON MODE)

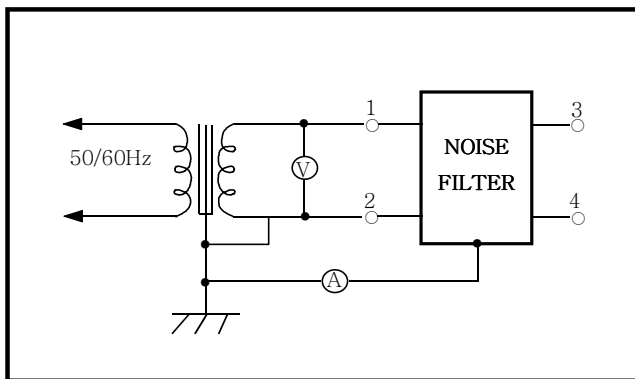


● (NORMAL MODE)



6-3. GROUND LEAKAGE CURRENT

● 1PHASE



● 3PHASE

