ELECTRO-MAGNETIC FIELD

Contents

1) What is EMF

2) Difference Between EMF & EMC

3) Effect of EMF to Equipment

4) Effect of EMF to Human Health

5) EMC for Cable Compliancet

6) Types of EMC Cables

7) Installations Methods of Cables

8) References

9) Biblography

What is EMF



Transmission Tower





Telecom Tower



Transformer &
Switchroom



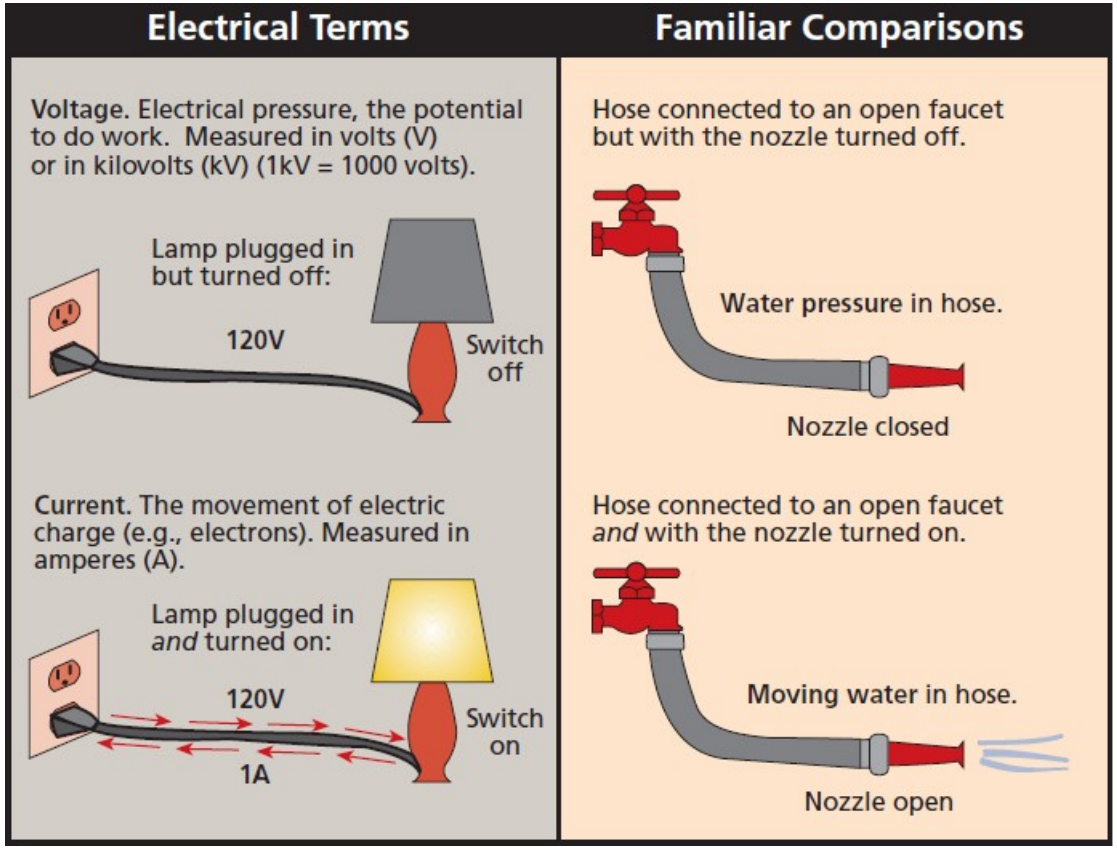
ISM Equipment



Stallite Station

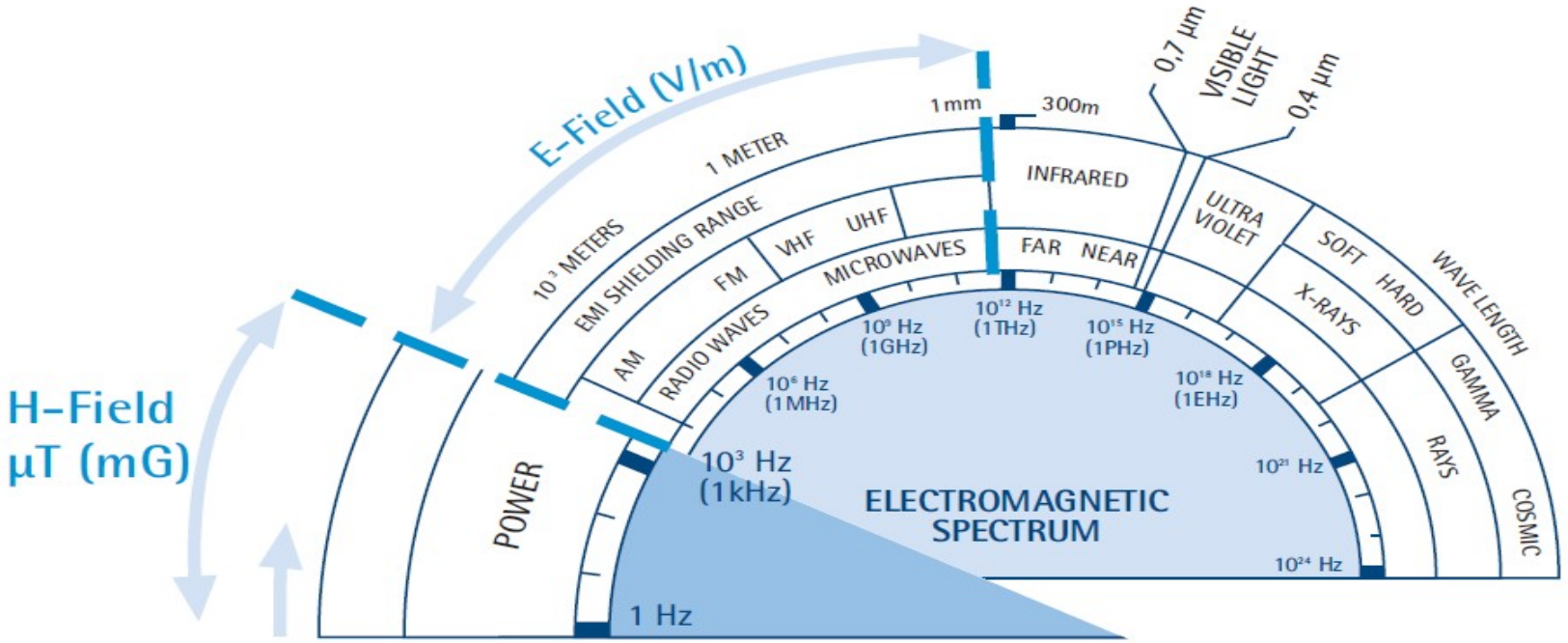
What is EMF

- Consist of Electric and Magnetic Field
- Invisible line of force that surround any electrical device
- Electric Field (E) increase in strength when voltage increase (V/m)
- Magnetic fields (H) are a result of current flow in the wires or devices (Testla or Gauss)



What is EMF

- **H Field** typically occurs in power systems, industrial smelting and welding, and electric train
- **E field** normally found in mobile radio, radio and TV broadcasting, Satellite communication, Radar systems, Industrial processes, semicon production, microwave systems





Electric Field: E
- f (Voltage)
- High Freq.: above 30 KHz up to 1 THz

Magnetic Field: H
- f (Amperage)
- Low Freq.: above 0Hz up to 1-30 KHz

Effect of EMF to Equipment

- Electromagnetic Compatibility 2004/108/EC (old 89/336/EEC)
- To obtain the CE Mark, and therefore use products legally in the European Community, these Directives must be accomplished:
  - EN61000-6-4 (Old EN55081-2) Emission Standard
    - EN55011 – ISM
    - EN55022 – Radio Equipment
    - EN55014 – Electrical & Household Equipment

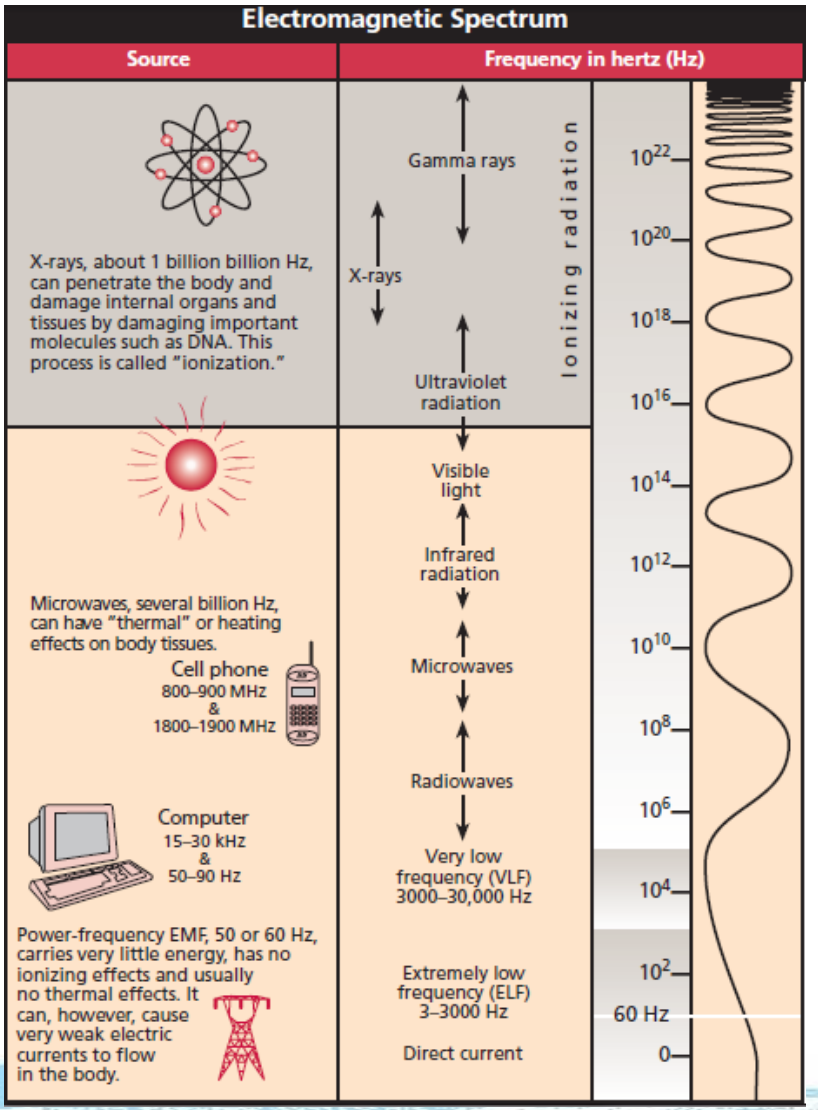
EMC – Electromagnetic Compatibility

- EN61000-6-2 (Old EN55082-2) Immunity Standard
  - EN61000-4-1: General Immunity Norm
  - EN61000-4-2: Immunity to ESD
  - EN61000-4-3: Immunity to Radio Electromagnetic Field
  - EN61000-4-4: Immunity to fast transients
  - EN61000-4-5: Immunity to lightning transients
  - EN61000-4-6: Immunity to Radiated Electromagnetic Field
  - EN61000-4-8: Immunity to Magnetic fields
  - EN61000-4-11: Immunity to Voltage Dips, Short Interruptions and Voltage fluctuations.

Effect of EMF to Human Health

- International Commission on Non-Ionizing Radiation Protection **(ICNIRP)**

- Corporation with the Environmental Health Division of World Health Organization **(WHO)**



Effect of EMF to Human Health

- The Effects of EMF are dependent of the following:
  - Frequency
  - Field Strength
  - Field Type (E or H Field)
  - Duration of Exposure
  - Extends of Exposure (Part or entire body)
  - Signal Shape



Effect of EMF to Human Health

- Electromagnetic Field have certain Biological effect which can be detrimental to Human Health.



Current density A/m	Consequences
Below 1	No clear effects; range of natural background current densities in most bodily organs
1 to 10	Subtle biological influences such as altered calcium flows or inhibition of melatonin production (which controls our day/night body rhythm, etc.). The background current density of the heart and brain are in this range.
10 to 100	Confirmed effects, e.g. changes in protein and DNA synthesis, changes in enzyme activity, clear visual (magnetophosphenes) and possible nervous effects; healing processes in broken bones can be accelerated or halted.
100 to 1000	Sensitivity of the central nervous system is altered; this is a range in which effects are observed in all tissue that is capable of stimulus
Over 1000	Minor to severe impairments of heart functioning; acute damage to health

Table 4. Reference levels for general public exposure to time-varying electric and magnetic fields (unperturbed rms values).

Frequency range	E-field strength E (kV m^{-1})	Magnetic field strength H (A m^{-1})	Magnetic flux density B (T)
1 Hz–8 Hz	5	$3.2 \times 10^4/f^2$	$4 \times 10^{-2}/f^2$
8 Hz–25 Hz	5	$4 \times 10^3/f$	$5 \times 10^{-3}/f$
25 Hz–50 Hz	5	1.6×10^2	2×10^{-4}
50 Hz–400 Hz	$2.5 \times 10^2/f$	1.6×10^2	2×10^{-4}
400 Hz–3 kHz	$2.5 \times 10^2/f$	$6.4 \times 10^4/f$	$8 \times 10^{-2}/f$
3 kHz–10 MHz	8.3×10^{-2}	21	2.7×10^{-5}

ICNIRP Guideline 2010 (Revised)

◀83V/m = 21A/m = 138dBuV/m

◀160A/m = 200uT = 2000mG

EMC for Cables Compliance

1) Specification

Equipments	Human Health
Electromagnetic Compatility 89/336/EEC (2004) 2004/108/EC (Latest)	**International Commission on Non-Ionizing Radiation Protection (ICNIRP)**
Emission EN55011 30MHz to 230MHz > 30 / 40 dBuV/m 230MHz to 1GHz > 37 / 47dBuV/m	General Public Exposure to time varying electric and magnetic fields
Immunity EN61000-4-3 80MHz – 1GHz > 10V/m 1.4GHz – 2.0GHz > 3V/m 2.0GHz – 2.7GHz > 1V/m EN61000-4-8 50Hz > 1A/m (12.5mG), 3A/m (37.5mG), 10A/m (125.9mG), 30A/m (377mG), 100A/m (1259mG) Additional X A/m to be defined by user if necessary	1Hz – 8Hz $4X10^{-2} / f^2$ 8Hz – 25Hz $5X10^{-3} / f$ 25Hz – 50Hz $2X10^{-4}$ (200uT or 2000mG) 50HZ – 400Hz $2X10^{-4}$ 400Hz – 3KHz $8X10^{-2} / f$ 3KHz – 10MHz $2.7 X 10^{-5}$ (138dBuV/m)

Types of VSD (EMC) Cables



XLPE/CT/AWA/PVC (XCAP)
XLPE/CT/AWA/LSZH(FRT-XCAH)



XLPE/CT/SWA/PVC (XCSP) (3C+E)
XLPE/CT/SWA/LSZH (FRT-XCSH) (3C+E)



XLPE/CT/PVC (XCP) (3C+E)
XLPE/CT/LSZH (FRT-XCH) (3C+E)



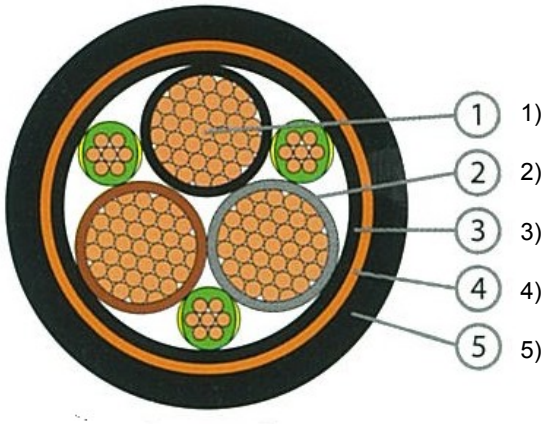
XLPE/CT/PVC (XCP) (3C+3E)
XLPE/CT/LSZH (FRT-XCH) (3C+3E)

Refer to LV Power Catalogue: Pg 28-31 (XLPE/PVC)
Pg 41-46 (FRT or LSZH)

Types of EMC Cables

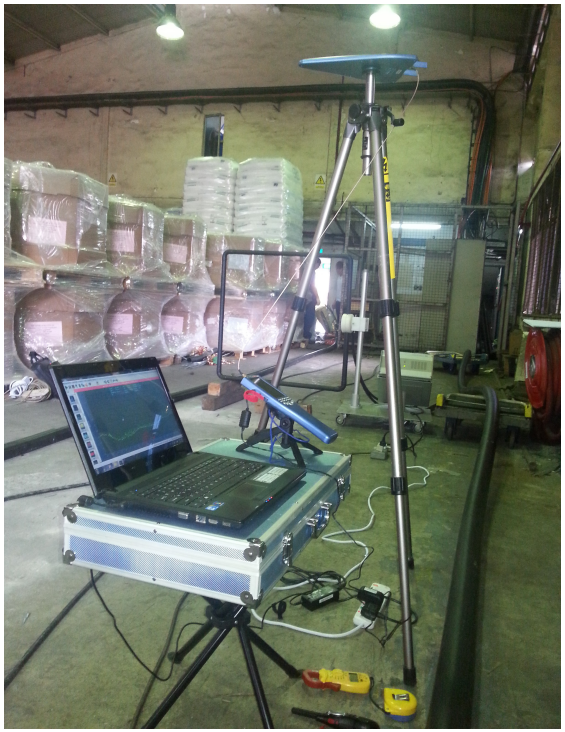


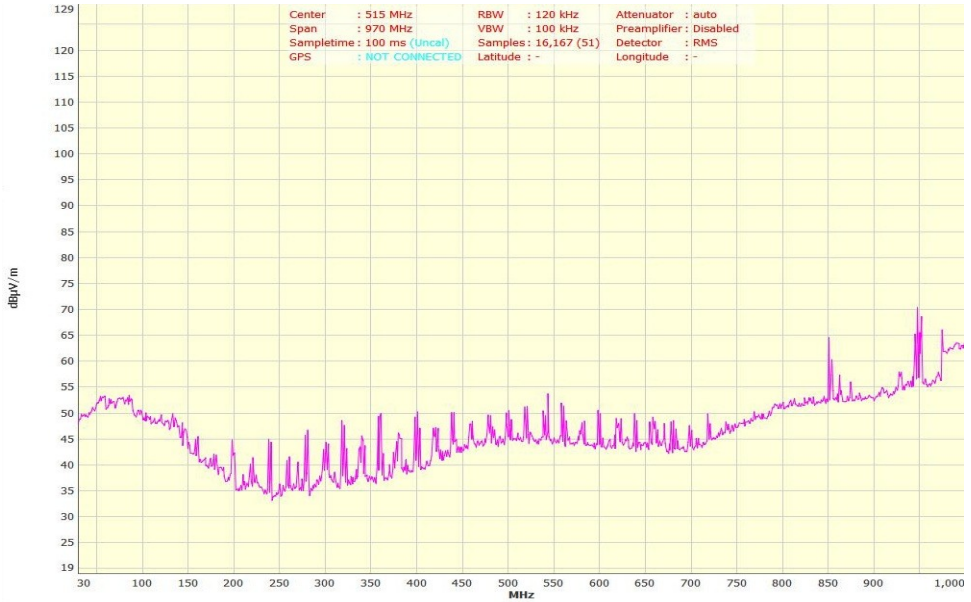
XLPE/CT/PVC (XCP) (3C+3E)
XLPE/CT/LSZH (FRT-XCH) (3C+3E)



1) Plain Annealed Copper Wire
2) Cross-linked Polyethylene Compound
3) Low Smoke Zero Halogen (LSZH) Compound
4) Copper Tape
5) Low Smoke Zero Halogen (LSZH) Compound

EMC Test for Taisin Cables





E-Field Emssion Test



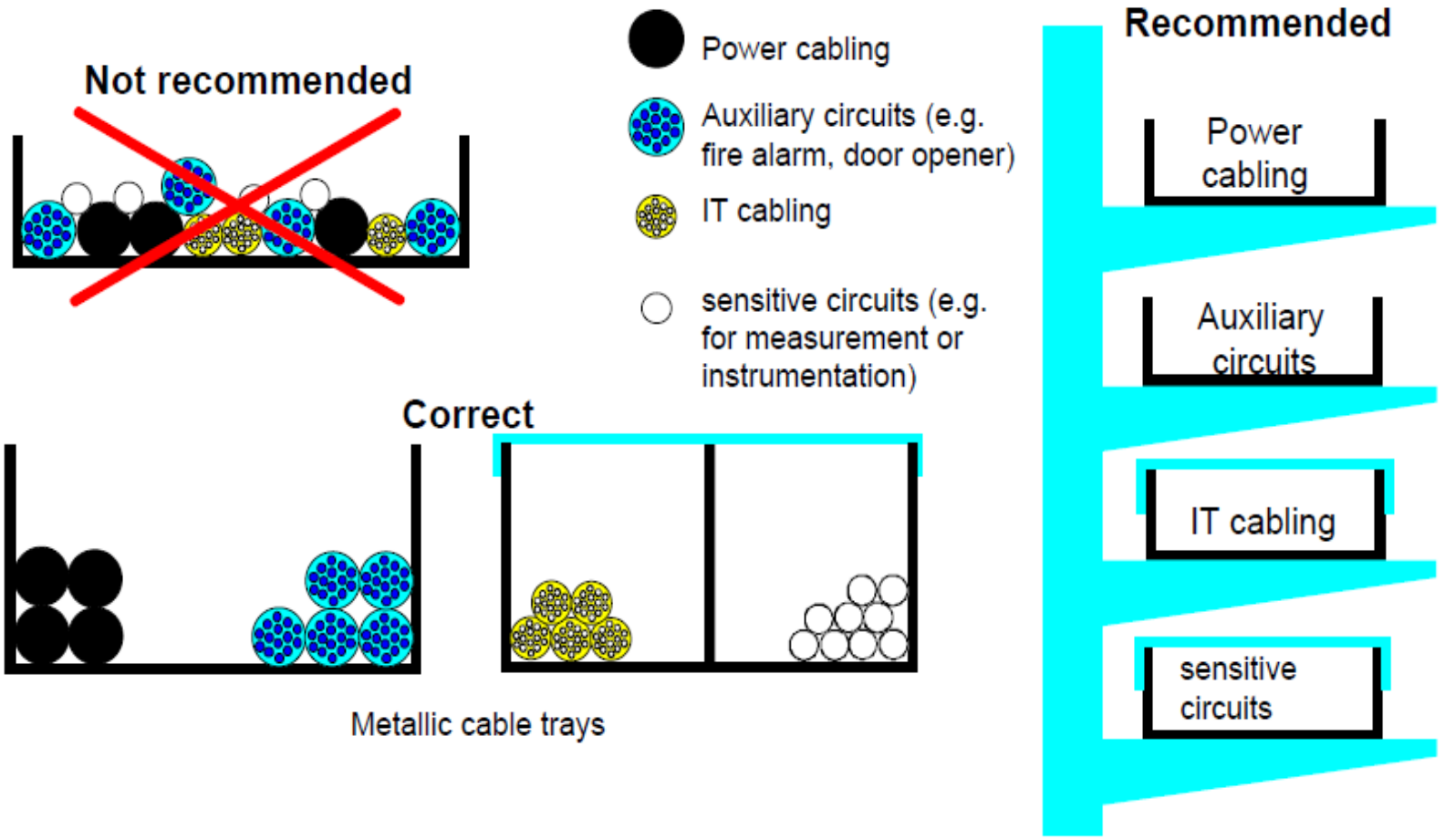
Power in your hands

EMC Test for Taisin Cables





H-Field Immunity Test



NOTE All metallic parts are electrically well bonded

Figure 8 — Separation of cables in cable management systems

Cable Seperation Distance

Information technology cable separation from power cabling

(Taken from prEN 50174-2: June 1998)

Type of installation	Without divider	With metallic divider (2)
Unscreened power lines and unscreened information technology lines	300mm	150mm
Unscreened power lines and screened information technology lines (1)	70mm	30mm
Screened power lines and unscreened information technology lines (1)	30mm	2mm
Screened power lines and screened information technology lines (1)	15mm	1mm
(1) The values of the distance (A) depend upon the way the screen and metallic divider is bonded and earthed. Here bonded and earthed screens and metallic dividers have been chosen.		

General Rules of Thumb

General Considerations

As a first step towards good EMC engineering practice, the following guidelines should be observed.

1. Mains cables, including power feeds and lighting circuits, carrying up to 230V should not be grouped with sensitive cables (i.e. data cables).
2. All data, telecommunications or sensitive cabling should not be placed near 3 phase cables as these are normally used for heavy electrical inductive loads e.g. air conditioning, welding equipment and motors.
3. All cabling should avoid any proximity to radio or television transmitters, beacons and overhead transmission lines.
4. High level impulse cables, due to their fast rise times, produce a large frequency distribution of disturbances. Special precautions need to be taken with these types of cabling; efficient screening, good earths at both ends and consideration of an increase in the separation with adjacent cables would need to implemented.
5. All cables should be terminated whenever possible in accordance with their intended terminating impedance, and as per the manufacturers instructed.
6. Cable trays of metallic construction should be considered. Where used these should have an adequate mesh for the frequencies in use and be properly earthed. The tray will effectively become screen or enclosure for the cables if it has a lid fitted.
7. Cable trunking of metallic construction or incorporating a metallic element, if correctly designed and installed, can effectively become a screen or enclosure for the cables.

Biblography

- Guideline for Limiting Exposure to Time Varying Electric, Magnetic and Electromagnetic Fields (1997 up to 300GHz) Updated to 2010 edition

  www.icnirp.de

- Electromagnetic Field – Health Science Authority

  www.hsa.gov.sg/...Par.../EMF-HealthSafetyGuidelines-final.pdf

- EN50174-2 – Information Technology – Cabling Installation Part 2: Installation Planning and Practices inside Building

Thank you for your Attention