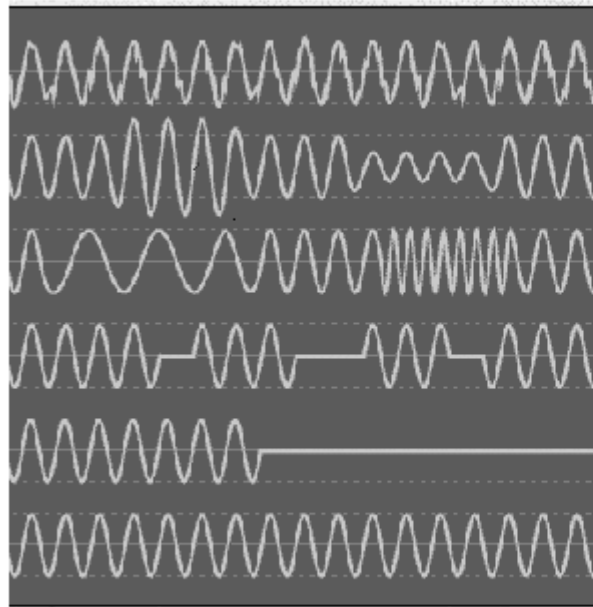


TACKLING POWER QUALITY ISSUES IN MODERN HIGH RISE BUILDINGS DESIGN CONSIDERATIONS

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WHAT IS POWER QUALITY ? HOW IS PQ DEFINED?



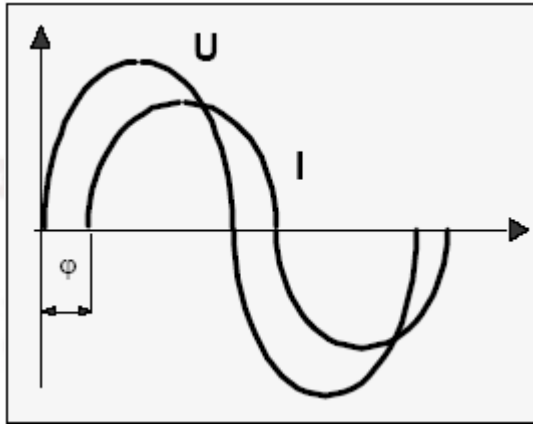
- ▶ Transients - Harmonics
- ▶ Voltage fluctuations
- ▶ Frequency fluctuations
- ▶ Micro-cuts
($t < 10$ ms)
- ▶ Power cuts
(short : 10 to 300 ms)
(long : > 300 ms)
- ▶ Perfect power

HOW TO OVERCOME BAD QUALITY ?

- POWER CUTS – GENERATORS & UPS
- MICRO CUTS – NO ACTION
- VOLTAGE FLUCTUATIONS – STABILIZERS, AVR
- FREQUENCY FLUCTUATIONS – UPS
- TRANSIENTS - SPD, TVSS
- HARMONICS - ?? SELF GENERATED !

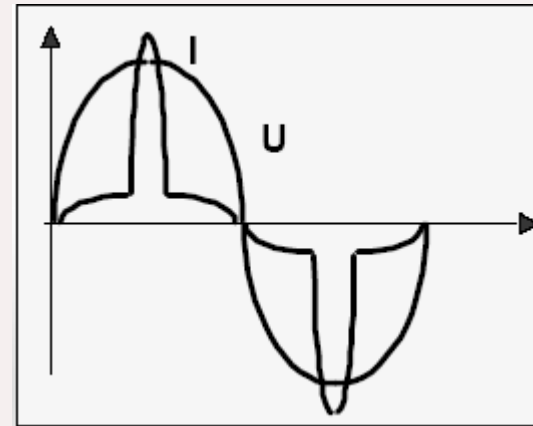
GOOD DESIGN PRACTICE

WHAT ARE HARMONICS? HOW ARE HARMONICS PRODUCED ?



Linear loads

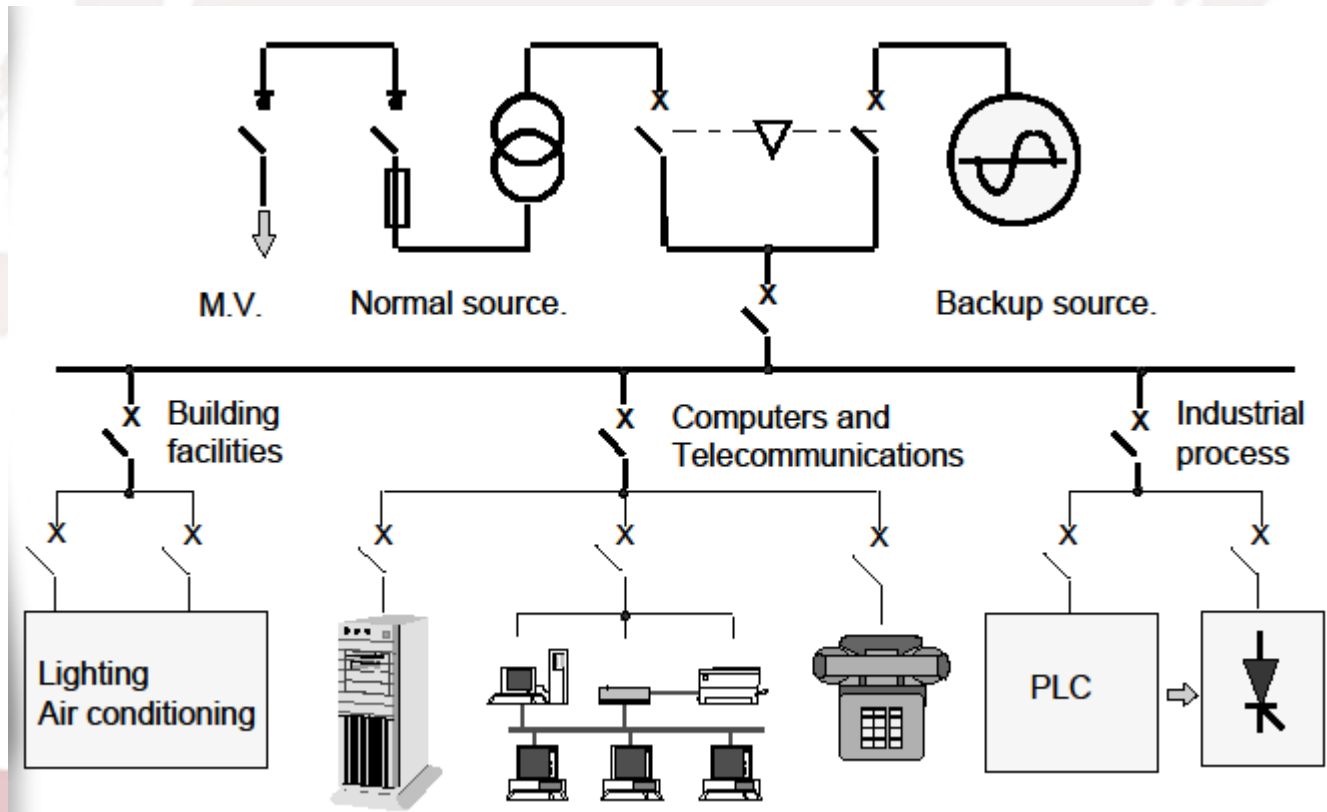
Filament Lamps
Fans, Heaters
Motors



Non-Linear loads

Computers, Servers, UPS,
Electronic Ballasts, Microwave
Ovens, Variable Speed Drives,
LCD TV

TYPICAL POWER DISTRIBUTION IN HIGH RISE COMMERCIAL BUILDING



EFFECTS OF HARMONICS ?

- HIGHER IMPEDENCE – OVER HEATED CABLES
- SKIN EFFECT - OVER HEATED CABLES
- HIGHER NEUTRAL CURRENT – HALF NEUTRAL ?
- HIGHER N-E VOLTAGE
- MALFUNCTIONING OF SENSITIVE ELECTRONICS
- DERATING OF TRAFOS & GENSETS
- EARLY AGING OF EQUIPMENTS
- LOWER POWER FACTOR

HOW TO AVOID HARMONICS ?

DESIGN FEATURES :

- ELIMINATION OF SOURCE
- ISOLATING & ARRESTING
- FILTERING AND/OR ABSORBING
- OVERSIZING CABLES & EQUIPMENTS

ELIMINATION OF SOURCE

PROPER SPECIFICATION & SELECTION OF EQUIPMENTS

- UPS & VFD : THD < 5%, PF > 0.95
- SERVERS : THD < 3%, PF > 0.98
- ELECTRONIC BALLAST : THD < 10%
- DESK TOP PC : ??
- TV, AV EQUPT. ETC : ??

ISOLATING & ARRESTING HARMONICS

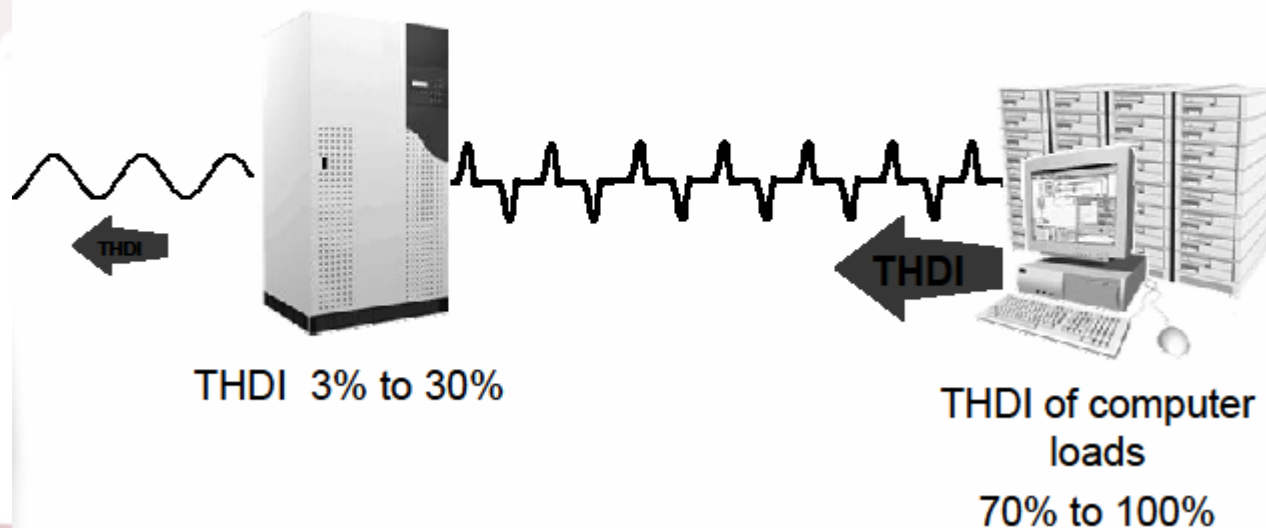
USE OF SPECIAL EQUIPMENTS -

- UPS
- PDUs WITH DELTA-STAR ISOLATION TRANSFORMER (K-20 RATED)
- ZIGZAG / PHASE SHIFTING / HARMONIC CANCELING TRANSFORMER
- DUAL/QUAD OUTPUT TRANSFORMER

USE OF UPS - ALSO ACTS AS FILTER !

► Reduction of harmonic currents upstream of the installation

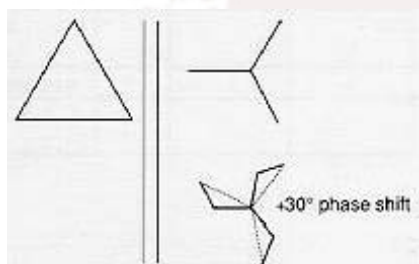
> A double-conversion UPS acts as a filter



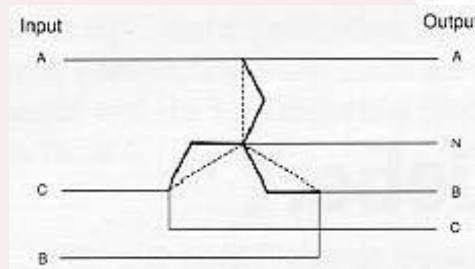
USE OF SPECIAL PURPOSE TRANSFORMERS



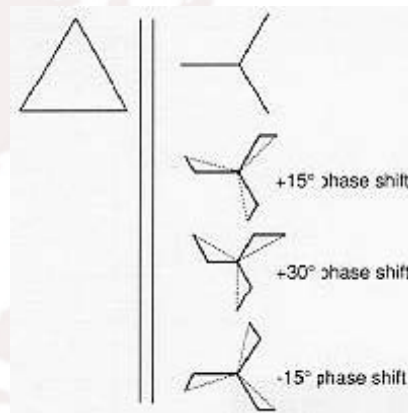
ISOLATION (DELTA-STAR)
(ARRESTS ALL TRIPLEN)



ISOLATION (DUAL OUTPUT)
(TRIPLEN + 5TH, 7TH, 17TH, 19TH)

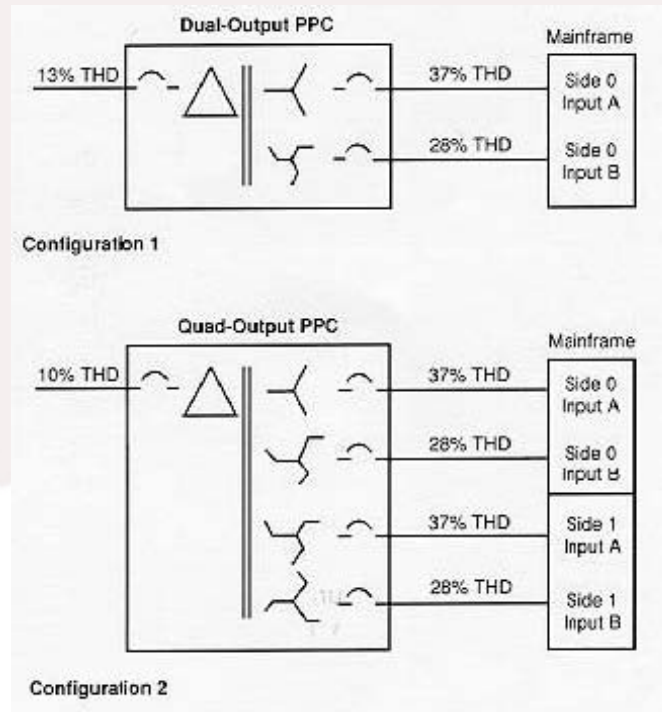


AUTO TRAF0 – ZIGZAG
(CANCELS ALL TRIPLEN)



ISOLATION (DUAL OUTPUT)
(TRIPLEN + 5TH, 7TH, 11TH, 13TH, 17TH, 19TH, 29TH, 31ST)

REDUCTION IN HARMONICS WITH USE OF SPECIAL PURPOSE TRANSFORMERS



POWER DISTRIBUTION UNIT (PDU) WITH SPECIAL TRANSFORMERS (ARRESTS HARMONICS)

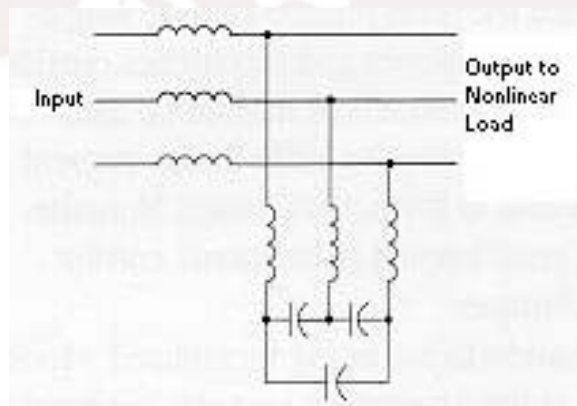
SOURCE



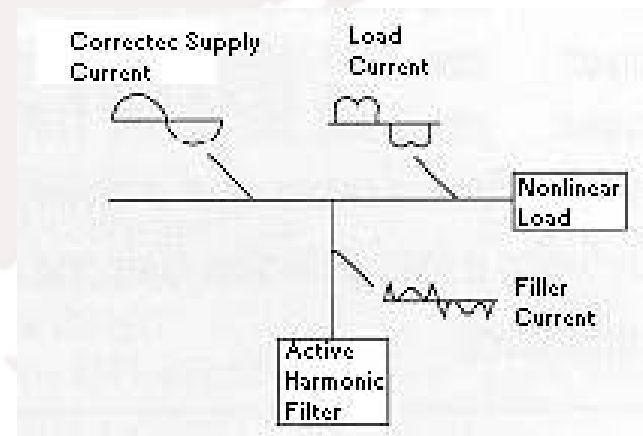
LOAD

FILTERING AND/OR ABSORBING HARMONICS

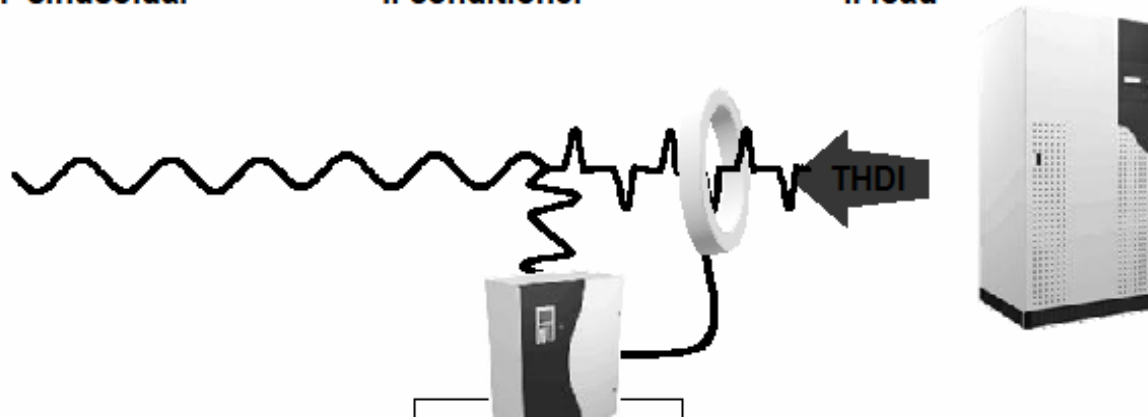
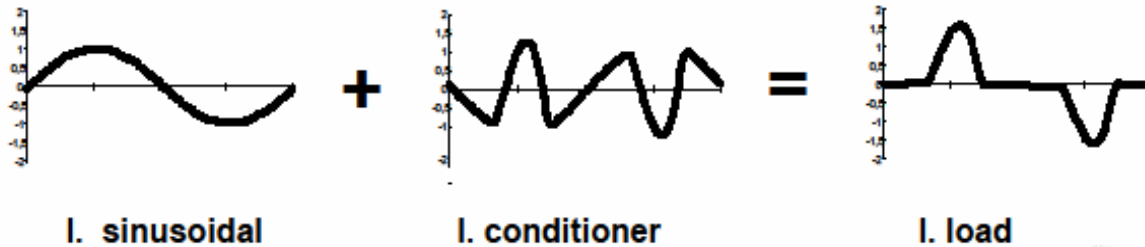
PASSIVE FILTER



ACTIVE FILTER



USE OF ACTIVE FILTER



OVERSIZING CABLES & EQUIPMENTS

- FULL SIZE OR DOUBLE NEUTRAL
- DERATING OF CABLES
- DERATING OF TRANSFORMERS
- DERATING OF GENERATORS

STANDARDS GOVERNING HARMONICS

- IEEE 519-2 (FOR USA)
- IEC 555-2, IEC 1000-3-2 (FOR EUROPE)
- IS - ???



THANKS

QUESTIONS