# ELECTROTECHNICAL COMPONENTS





# RADIO INTERFERENCE SUPPRESSION CAPACITORS AND FILTERS

## COMPONENTS FOR RADIO-INTERFERENCE SUPPRESSION

• **RELEVANT FOR** ELECTRONIC, AUDIO AND VIDEO DEVICES, CHARGERS, MEASUREMENT INSTRUMENTS, ELECTRICAL HAND TOOLS, ELECTRICAL HOME APPLIANCES AND MACHINES

# FILTERS FOR RADIO-INTERFERENCE SUPPRESSION

• **RELEVANT FOR** HOME APPLIANCES, ELECTRICAL HAND TOOLS AND DC ELECTROMOTORS



# GENERAL INFORMATION

### ORIGIN AND SPREADING OF INTERFERENCE

THERE ARE TWO MAIN SOURCES OF RADIO INTERFERENCE:

- DEVICES, WHICH DUE TO THEIR CONSTRUCTION PRODUCE RF ENERGY. THESE INCLUDE GENERATORS FOR USE IN INDUSTRY, MEDICINE AND SCIENCE, AS WELL AS OSCILLATORS, RADIO AND TV RECEIVERS ETC.
- DEVICES, WHICH PRODUCE A WIDE SPECTRUM OF FREQUENCIES DUE TO RAPID VARIATIONS IN ELECTRICAL CURRENT INTENSITY. THESE INCLUDE DEVICES WITH SWITCHING COMPONENTS, THYRISTORS, TRIACS, COMMUTATORS AND SIMILAR.

INTERFERENCE FROM SOURCE TO RECEIVER IS SPREAD IN THREE WAYS: ALONG CONDUCTORS, BY COUPLING AND BY RADIATION. TO FREQUENCIES OF 30 MHZ APPROXIMATELY, INTERFERENCE IS SPREAD MAINLY ALONG THE INSTALLED ELECTRICAL CONDUCTORS. IN THIS RANGE INDUCTIVE AND CAPACITATIVE COUPLING ALSO OCCURS BETWEEN THE CONDUCTORS AND OTHER METAL PARTS OF THE DEVICES ACTING AS SUPPORTS OF INTERFERENCE TRANSFER.

FREQUENCIES HIGHER THAN 30 MHZ ARE SPREAD BY RADIATION SINCE INTERFERENCE SOURCE DIMENSIONS AND TERMINAL CONDUCTORS ARE IN ORDER OF SIZE TO THE WAVE LENGTH OF THE RADIATED INTERFERENCE. THE METAL PARTS THEREFORE, ACT AS ANTENNAS.

THE DEVICE CONNECTED TO THE MAINS SUPPLY PRODUCES TWO KINDS OF INTERFERENCE CURRENTS, RUNNING ALONG CONDUCTORS AS SEEN IN FIGURE 1.



SYMMETRICAL INTERFERENCE CURRENT RUNS IN DIFFERENT DIRECTIONS IN THE PHASE AND NEUTRAL CONDUCTORS. ASYMMETRICAL CURRENT RUNS IN THE SAME DIRECTION IN BOTH CONDUCTORS AND ENDS IN THE DEVICE VIA THE EARTHING CONNECTION. AN EARTHING CONNECTION CAN EITHER BE AN EARTHING CONDUCTOR OR CAPACITANCE BETWEEN THE DEVICE AND THE SURROUNDING. INTERFERENCE ON LONG OR MEDIUM RADIO WAVES IS GENERALLY GREATER IF THE DEVICE IS EARTHED. IN THIS CASE IMPEDANCE TO THE SURROUNDING IS SHORT CIRCUITED AND THE ASYMMETRICAL INTERFERENCE CURRENT INCREASES.

TWO TYPES OF INTERFERENCE APPEAR ACCORDING TO DURATION TIME; CONTINUOUS INTERFERENCE AND DISCONTINUOUS INTERFERENCE. THE LATTER OCCURS AS IMPULSES WITH LESS EFFECT THAN CONTINUOUS INTERFERENCE. THEY ARE TREATED AND SUPPRESSED FROM CONTINUOUS INTERFERENCE SEPARATELY. EXACT DEFINITIONS ARE GIVEN IN THE REGULATIONS E.G. CISPR PUBL.11, CISPR PUBL.14, EN 55011; EN 55014.

# GENERAL INFORMATION

### MAXIMUM PERMITTED INTERFERENCE LIMITS

IN ORDER TO GUARANTEE GOOD OPERATION OF COMMUNICATIONAL AND OTHER EQUIPMENT, RADIO INTERFERENCE MUST BE TOLERABLY LIMITED. LNTERFERENCE PRODUCED FROM THE SOURCE ARE MEASURED AS FOLLOWS:

- UP TO FREQUENCY 30 MHZ, INTERFERENCE VOLTAGES ARE MEASURED WHICH SPREAD ALONG THE TERMINAL IN THE SUPPLY NETWORK,
- ABOVE 30 MHZ, STRENGTH OF RADIATED FIELD OR RADIATED POWER ON THE TERMINAL IN THE SUPPLY NETWORK IS MEASURED.

PERMITTED LEVELS OF INTERFERENCE ARE GIVEN IN THE NATIONAL AND INTERNATIONAL REGULATIONS. RECOMMENDATIONS GIVEN BY CISPR (COMITE INTERNATIONAL SPECIAL DE PERTURBATION RADIOELECTRIQUES) ARE AS FOLLOWS: CISPR PUBL.11, CISPR PUBL.14, EN 55011; EN 55014; ETC.

OPERATIONAL METHODS DURING MEASUREMENT ARE PRESCRIBED WITH INDIVIDUAL STIPULATIONS AND ARE GIVEN IN THE RECOMMENDATIONS OF THE CISPR PUBL. 14.

## THE INTERFERENCE SUPPRESION

#### TWO METHODS:

- REDUCING INTERFERENCE ORIGIN,
- TAKING STEPS TO PREVENT INTERFERENCE FROM SPREADING FROM THE DEVICE OF ORIGIN.

SPREADING OF INTERFERENCE IS GENERALLY SUPPRESSED BY SUPPRESSION COMPONENTS CONNECTED TO THE TERMINAL OF THE POWER SOURCE OF THE DEVICE (NETWORK, BATTERY ...) AND IN CERTAIN CASES, ON THE SOURCE OF INTERFERENCE ON THE DEVICE (BRUSHES OF THE MOTOR, SWITCHES, RELAYS ...) OR BY SHIELDING THE DEVICE.

AS SUPPRESSION COMPONENTS USE IS MADE OF CAPACITORS, CHOKES, FILTER SETS CONSISTING OF CAPACITORS, CHOKES AND RESISTORS.

### CAPACITORS AND FILTERS FOR RADIO INTERFERENCE SUPPRESSION

REQUIREMENTS FOR CAPACITORS AND FILTERS FOR RADIO INTERFERENCE SUPPRESSION ARE GIVEN IN NATIONAL AND INTERNATIONAL STANDARDS:

- IEC 60384-14
- UL 60384-14
- CSA 60384-14

### DEFINITIONS TAKEN FROM STANDARDS

#### CLASS X CAPACITORS

CLASS X CAPACITORS ARE SUITABLE FOR APPLICATIONS WHERE THERE IS NO DANGER OF ELECTRICAL SHOCK IN CASE OF BREAKDOWN. CLASS X CAPACITORS ARE DIVIDED INTO THREE SUBCLASSES (SEE TABLE 1) ACCORDING TO THE PEAK VOLTAGES OF THE PULSES TO WHICH THEY ARE EXPOSED DURING OPERATION IN ADDITION TO THE LINE VOLTAGE. SUCH IMPULSES CAN BE CAUSED BY LIGHTNING IN OVERHEAD LINES, SWITCHING OPERATIONS IN NEIGHBOURING EQUIPMENT OR IN THE EQUIPMENT WHICH IS SHIELDED BY THE CAPACITOR.

TABLE 1						
SUB-CLASS	PEAK PULSE VOLTAGE IN SERVICE	APPLICATION	PEAK VALUE OF THE URGE VOLTAGE TO BE ADDED BEFORE ENDURANCE TEST			
X1	> 2.5 kV ≤ 4.0 kV	USE WITH HIGH PEAK-VOLTAGES	FOR C <sub>R</sub> ≤1.0 μF : Up=4.0 kV FOR C <sub>R</sub> >1.0 μF : Up=(4/√C <sub>R</sub> ) kV			
X2	≤ 2.5 kV	GENERAL REQUIREMENTS	FOR C <sub>R</sub> ≤1.0 μF : Up=2,5 kV FOR C <sub>R</sub> >1.0 μF : Up=(2,5/√C <sub>R</sub> ) kV			

#### CLASS Y CAPACITORS

CLASS Y CAPACITORS ARE SUITABLE FOR APPLICATIONS WHERE THE BREAKDOWN OF THE CAPACITOR CAN LEAD TO A DANGEROUS ELECTRIC SHOCK. CLASS Y CAPACITORS ARE SUBDIVIDED INTO THE 4 SUBCLASSES Y1, Y2, Y4 SHOWN IN TABLE 2:

TABLE 2						
SUB-CLASS	TYPE OF THE BY-PASS INSULATION	RATED VOLTAGE RANGE	PEAK IMPULSE VOLTAGE BEFORE ENDURANCE TEST			
¥1	DOUBLE OR REINFORCED INSULATION	≤ 500 V	8.0 kV			
Y2	BASIC OR SUPPLEMENTARY INSULATION	≥ 150 V ≤ 300 V	5.0 kV			
Y4	BASIC OR SUPPLEMENTARY INSULATION	< 150 V	2.5 kV			

#### NOTE:

THE INCREASED ELECTRICAL AND MECHANICAL SAFETY IS SUPPOSED TO RULE OUT SHORT CIRCUITS IN THE CAPACITOR; THE CURRENT FLOWING THROUGH THE CAPACITOR WHEN USING ALTERNATING VOLTAGE AND THE ENERGY CONTENT OF THE CAPACITOR WHEN USING DIRECT VOLTAGE, IS SUPPOSED TO BE REDUCED TO A SAFE LEVEL BY LIMITING THE CAPACITY.

Y CAPACITORS, BY FULFILLING THEIR TECHNICAL PURPOSE IN ELECTRICAL EQUIPMENT, MACHINES AND INSTALLATIONS, BRIDGE OVER THE PLANT/INDUSTRIAL INSULATION WHOSE SAFETY TOGETHER WITH ADDITIONAL PRECAUTIONARY MEASURES WILL AVERT DANGERS FOR HUMANS AND ANIMALS.

# CAPACITORS TYPE KNB2530, KNB2532, KNB2533







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#### **TECHNICAL DATA**

- CONSTRUCTION
- RATED VOLTAGE
- CAPACITANCE TOLERANCE
- CLIMATIC CATEGORY
- PASSIVE FLAMMABILITY
- TEMPERATURE RANGE
- TEST VOLTAGE
- MAX. PULSE RISE TIME du/dt, AT 622 V DC
- INSULATION RESISTANCE AT 20 °C , U<sub>m</sub> = 100 V DC, t = 1 min
- DIELECTRIC LOSS TANδ AT F = 1 kHz AND 20 °C
- SOLDERING
- RESISTANCE TO SOLDERING HEAT
- SELFINDUCTANCE
- COMPLIES TO
- PERMISSIBLE CONTINUOUS AC VOLTAGE
- PERMISSIBLE CONTINUOUS DC VOLTAGE
- APPLICATION

POLYPROPYLENE FILM, METALLIZED 440 V AC ± 10 %, ± 20 % 40/100/56 ACC. TO IEC 60068-1 ACC. TO IEC 60384-14 -40 ° TO +100 °C 4000 V DC, 2 s 6000 V / µS FOR PCM = 15 mm 3500 V / µS FOR PCM = 22.5 mm ACC. TO IEC 60384-14

#### $R_i \ge 15000 M\Omega$

 $\leq 1 \times 10^{-3}$ 

IEC 60068-2-20, max. 2 s IEC 60068-2-20, 260 °C ± 5 °C, 10 s ± 1 s APPROX. 10 nH/cm OF CAPACITOR LENGHT AND TERMINALS

IEC 60384-14, UL 60384-14 CSA 60384-14 750 V , 50/60 Hz 3000 V LINE TO GROUND

# CAPACITORS TYPE KNB2530, KNB2532, KNB2533

CASING: THERMOPLASTIC (PP OR ON REQUEST PBT HF) SEALED WITH SYNTHETICAL RESI

THERMOPLASTIC MATERIAL AND SYNTHETICAL RESIN ARE SELF-EXTINGUISHING ACCORDING TO UL 94. CLASS V-0.

TERMINALS		
TYPE	TERMINAL LENGHT	TYPE OF TERMINALS
KNB2530	3 <sup>+0.5</sup> , 4 <sup>±0.5</sup> , 6 <sup>-1</sup> , 9 <sup>+1</sup> , 15 <sup>±2</sup> , 20 <sup>±2</sup> , 25 <sup>+5</sup> , 30 <sup>+5</sup> , 50 <sup>±5</sup> mm, OTHER ON REQUEST	TINNED COPPER WIRE
KNB2532	20 TO 200 mm	INSULATED STRANDED WIRE 0.5 mm <sup>2</sup>
KNB2533	20 TO 200 mm	INSULATED STRANDED WIRE 0.8 mm <sup>2</sup> . END TERMINALS ON REQUEST

#### STANDARD VALUES KNB2530, KNB2532, KNB2533, 440 V AC, CLASS Y1

	DIMENSIONS							
CAPACITANCE C (pF)	L (mm)	H (mm)	W (mm)	PCM (mm)	ø (mm)	IEC 60384-14 440 V AC	UL 60384-14 US CSA 60384-14 440 V AC	EC 60384-14
470	18	11	5	15	0.8	•	•	•
680	18	11	5	15	0.8	•	•	•
1000	18	11	5	15	0.8	٠	•	•
1500	18	11	5	15	0.8	•	•	•
2200	18	12	6	15	0.8	•	•	•
2700	18	13	7	15	0.8	•	•	•
2800	18	13	7	15	0.8	•	•	•
3300	18	13	7	15	0.8	•	•	•
4700	18	14.5	8.2	15	0.8	•	•	•
5000	18	14.5	8.2	15	0.8	•	•	•
5600	18	16.5	8.5	15	0.8	•	•	٠
6800	18	18.5	9	15	0.8	•	•	•
10000	18	20	12.5	15	0.8	•	•	•
5600	26.5	14	6	22.5	0.8	•	•	•
6800	26.5	16	7	22.5	0.8	•	•	٠
10000	26.5	16.5	8.5	22.5	0.8	•	•	•
15000	26.5	18.5	10	22.5	0.8	•	•	•
22000	26.5	21.5	12.5	22.5	0.8	•	•	•

• APPROVALS IN USE

#### NOTE:

APPROVAL CQC ONLY FOR PBT HF CASE.



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