CURRENT/VOLTAGE HARMONICS IN AC SUPPLY LINE OF AC/DC CONVERTERS

CURRENT HARMONICS (theoretical values)

The theoretical values of current harmonics[1] are:

harmonic	6 pulses converters	12 pulses converters
1°	100,00 %	100,00 %
5°	20,00 %	--
7°	14,29 %	--
11°	9,09 %	9,09 %
13°	7,69 %	7,69 %
17°	5,88%	--
19°	5,26%	--
23°	4,35%	4,35 %
(…)	(…)	(…)

The ideal working conditions occurs when both the conditions a) and b) listed below take place.

a) Smoothed DC current

It occurs if one (at least) of the following conditions takes place:

- Working at rated voltage
- Inductive load
- Converter equipped with a proper smoothing filter

b) Null Network Reactance

CURRENT HARMONICS (practical values)

By considering the **actual cases** (network reactance **not** null) the current harmonic values are lower in comparison with the theoretical ones.

They can be obtained by the diagrams published in **IEC 60146** standard, that consider both the **inductance voltage drop and the firing angle** (control by means of SCR).

In addition **IEEE Std 519** publish a table of approximated values that could be very helpful in working practice:

REMARK: please note that for the above explained reasons, the values can slightly differ from one standard to another.

Current harmonics according to IEEE Std 519[2]

HARMONIC ORDER	CURRENT HARMONIC AMPLITUDE	
	SIX pulses	TWELVE pulses
5	**0,192**	**0,0192**
7	**0,132**	**0,0132**
11	**0,073**	**0,073**
13	**0,057**	**0,057**
17	**0,035**	**0,0035**
19	**0,027**	**0,0027**
23	**0,020**	**0,020**
25	**0,016**	**0,016**
29	**0,014**	**0,0014**
31	**0,012**	**0,0012**
35	**0,011**	**0,011**
37	**0,010**	**0,010**
41	**0,009**	**0,0009**
43	**0,008**	**0,0008**
47	**0,008**	**0,008**
49	**0,007**	**0,007**

[1] in percentage of the fundamental harmonic amplitude and considering the **IDEAL CASE**
[2] The values are referred to the 1st order harmonic

VOLTAGE HARMONICS

If the network reactance is known, the **TOTAL HARMONIC VOLTAGE DISTORTION (THD)** can be calculated on the base of the following formula:

THD = 2,25 X I for 6 pulses converters

THD = 1,463 X I for 12 pulses converters

Where:

- **THD** **is the absolute value referred to the phase value**
- **X** is the network reactance (of one phase)
- **I** is the rated current of the converter

In order to have the **minimum voltage distortion of the network**,

its reactance must be low enough (which means high short circuit power)