

# Conducted immunity requirements for LED lighting equipment





**Largest range of impulse test equipment up to 100 kV and 100 kA**

## **EMC PARTNER AG**

- ✓ Founded in 1994
- ✓ Swiss private company, headquarters in Laufen (CH)
- ✓ Largest choice of impulse generators
- ✓ Market leader, reputed worldwide
- ✓ Development, production and testing in house
- ✓ Global representative network



## Domains

EMC Partner provides conducted immunity test solutions for a broad range of sectors:



Lighting  
equipment



Avionics



Components



Military



Industry &  
Household



Telecom

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# Introduction

Electric lighting was introduced in 19th century: lamps with incandescent bulbs.  
Evolution is driven by **efficiency**.



Incandescent lamps



Fluorescent lamps



LED lamps



## Application

In order to market LED lamps, EMC requirements apply according to region:  
IEC/EN norms for Europe, ANSI/IEEE,UL norms for US, others

EMC Partner provides immunity test equipment for:

- ✓ LED interior lamps
- ✓ LED luminaries
- ✓ LED outdoor lamps
- ✓ LED street lights
- ✓ Other LED devices



## Norm overview

IEC/EN 61547 :2009	Equipment for general lighting purposes	EMC immunity requirements
IEC/EN 61000-3-2: 2014	EUT current < 16A	Limits for harmonic current emissions
IEC 61000-3-3:2013	EUT current < 16A	Limitation of voltage changes, fluct. and flicker
ANSI C136.2 :2014	Roadway and area lighting equipment	Electrical immunity and dielectric withstand
ANSI C82.77 :2002	Related power quality requirements for lighting equipment	Harmonic emission limits

## IEC/EN 61547:2009

### 5.2 ESD test

Twenty CD pulses will be applied on all accessible metallic parts, air discharges will be applied where no contact discharges can be applied.

IEC 61000-4-2	$\pm 4$ kV	CD	150 pF / 330 $\Omega$
	$\pm 8$ kV	AD	





## IEC/EN 61547:2009

### 5.4 Power frequency magnetic field

Applicable only to equipment containing components susceptible to magnetic fields: Hall sensors, magnetic field sensors etc.

IEC 61000-4-8	Field freq.	50 Hz, 60 Hz	If other mains, then mains freq. applies
	Test level	3 A / m	

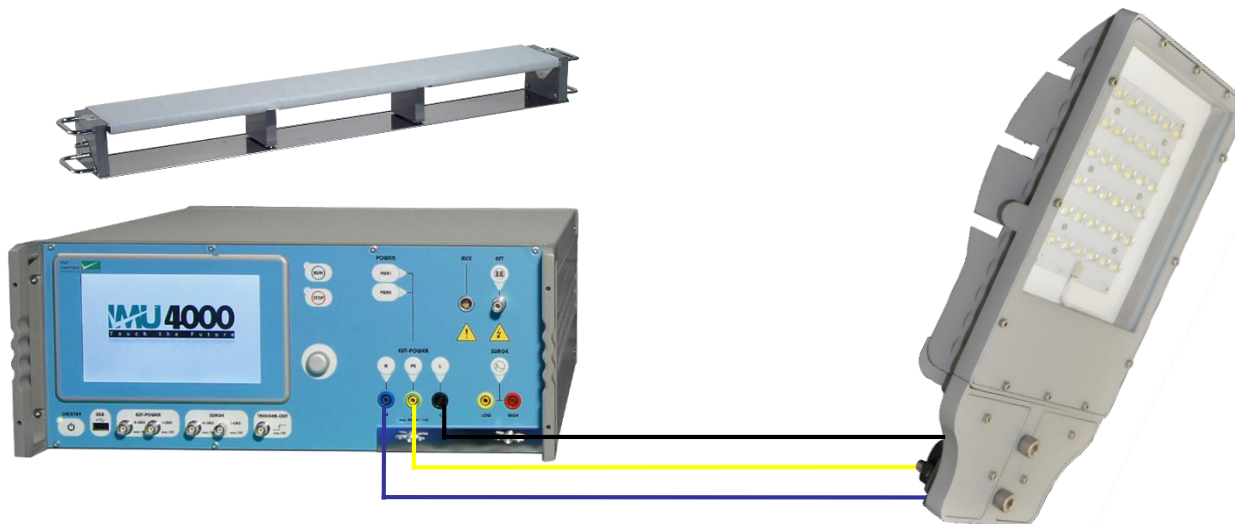


# IEC/EN 61547:2009

## 5.5 Fast transients (Burst test)

Two minutes each polarity.

IEC 61000-4-4	I/O lines	$\pm 0.5$ kV	Burst frequency: 5 kHz
	DC supply lines	$\pm 0.5$ kV	
	AC supply lines	$\pm 1$ kV	

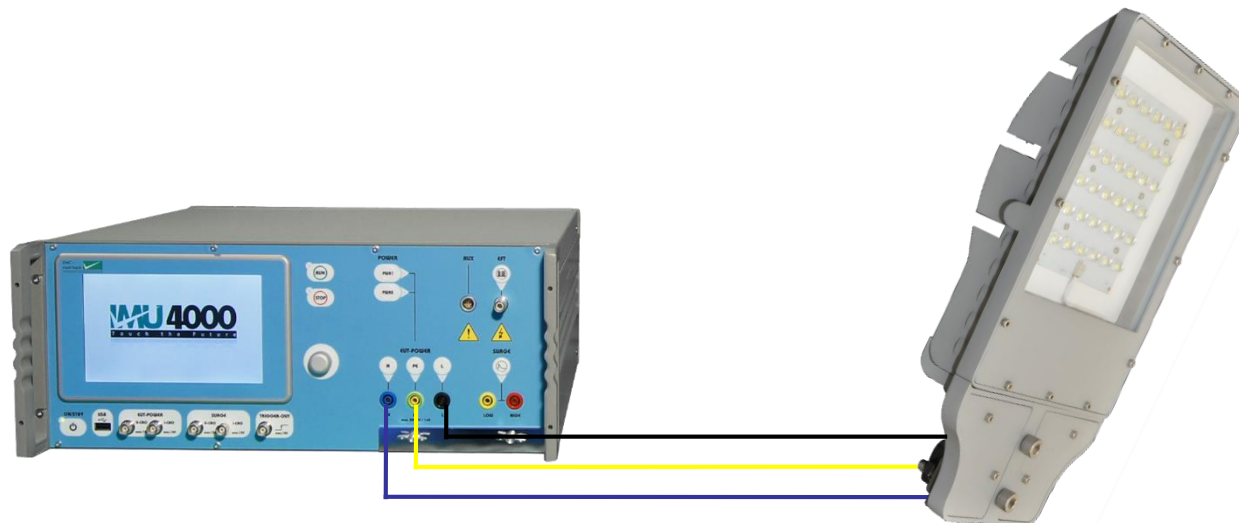


# IEC/EN 61547:2009

## 5.7 Surges

Coupling only on AC supply lines: 5 pos. pulses @ 90°, 5 neg. pulses @ 270°.

IEC 61000-4-5	Coupling	Self ballasted lamps, semi-luminaries	Luminaries and independent auxiliaries	
			<25 W	>25 W
	Line – Line	± 0.5 kV	± 0.5 kV	± 1 kV
	Line – Ground	± 1 kV	± 1 kV	± 2 kV

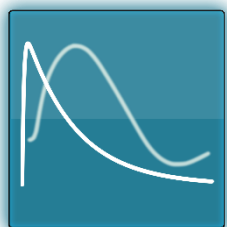


# IEC/EN 61547:2009

## 5.7 Surges

### 5.7 Surges

These tests are carried out according to IEC 61000-4-5, with test levels as given in Table 10 of this standard. Lower levels need not to be tested. Pulses shall be applied to the a.c.



**Table 10 – Surges – Test levels at input a.c. power ports**

NOTE In addition to the specified test level, all lower test levels as detailed in IEC 61000-4-5 should also be satisfied.



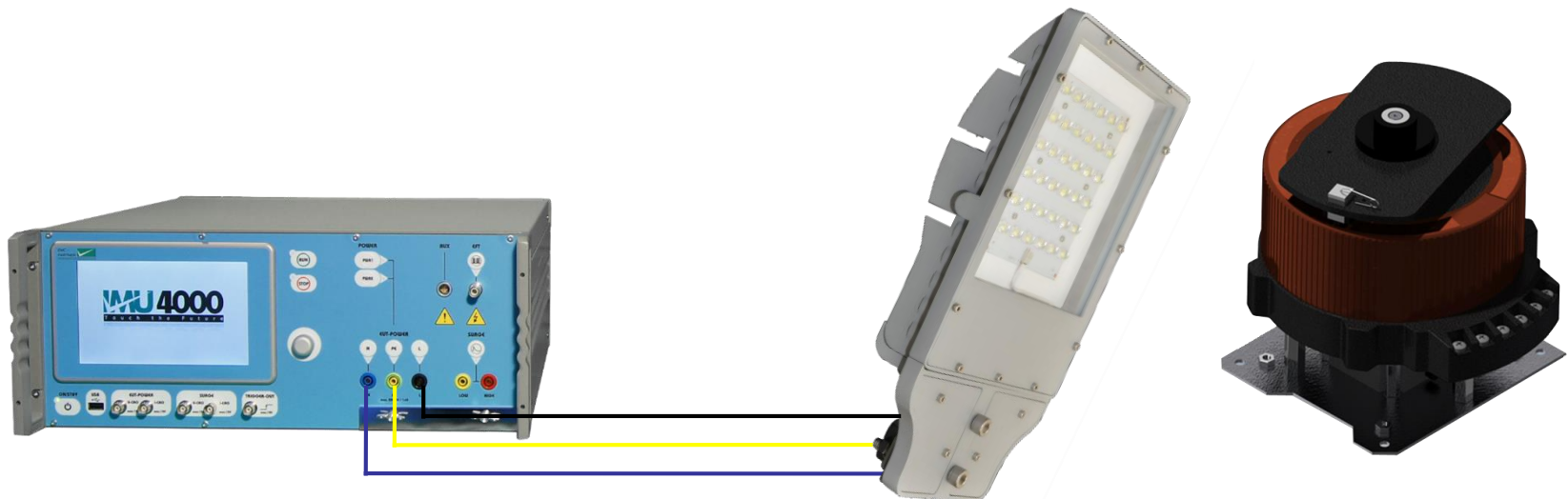
- ✓ EMC Partner recommends to test lower levels as well.

# IEC/EN 61547:2009

## 5.8 Voltage dips and short interruptions

Test starts at zero crossing. Voltage fluctuations: part of the product standards.

	Characteristics	Voltage dips	Short interruptions
IEC 61000-4-11	Level	70 %	0 %
	No. of periods	10	0.5

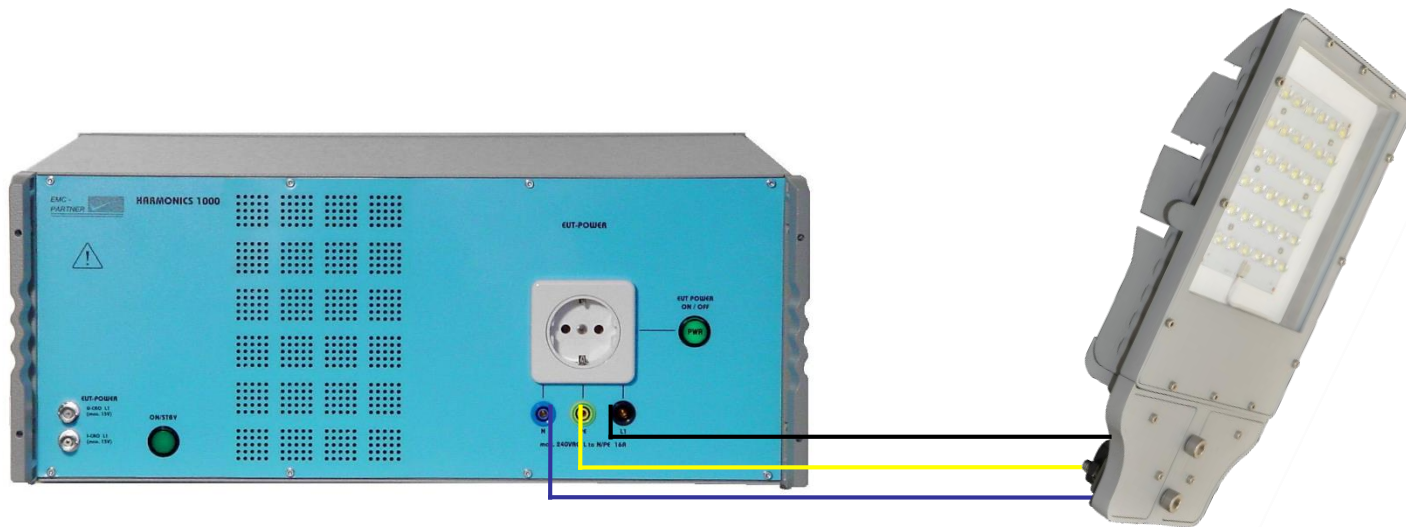


## IEC/EN 61000-3-2

Limits for harmonic current emissions

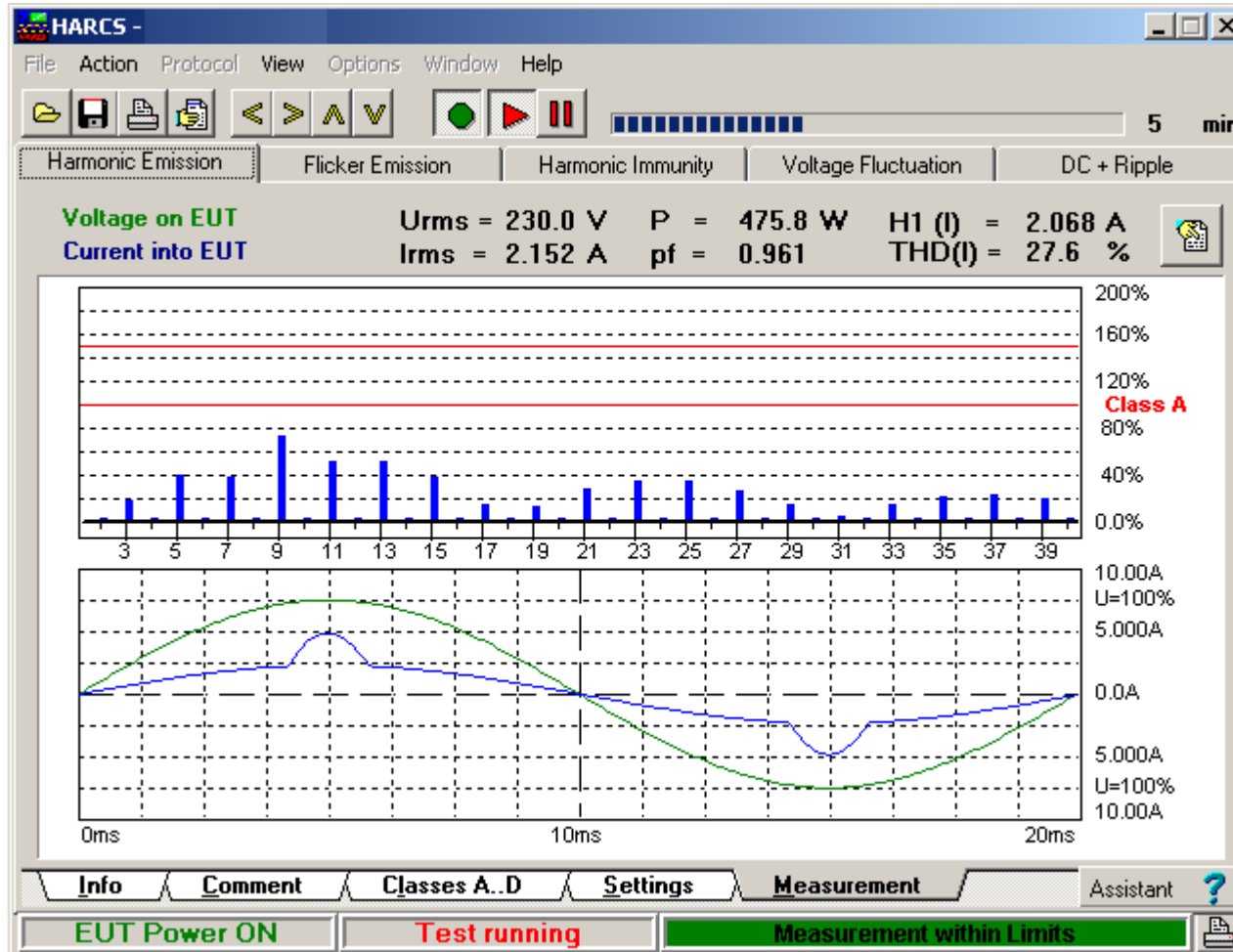
Class C: Lighting equipment

Different requirements for equipment up to and below 25 W



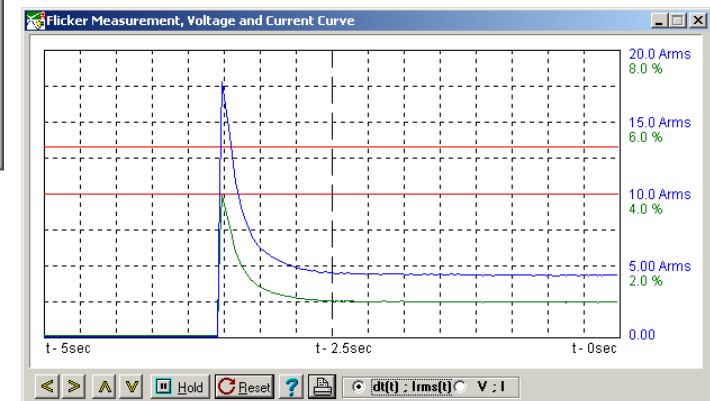
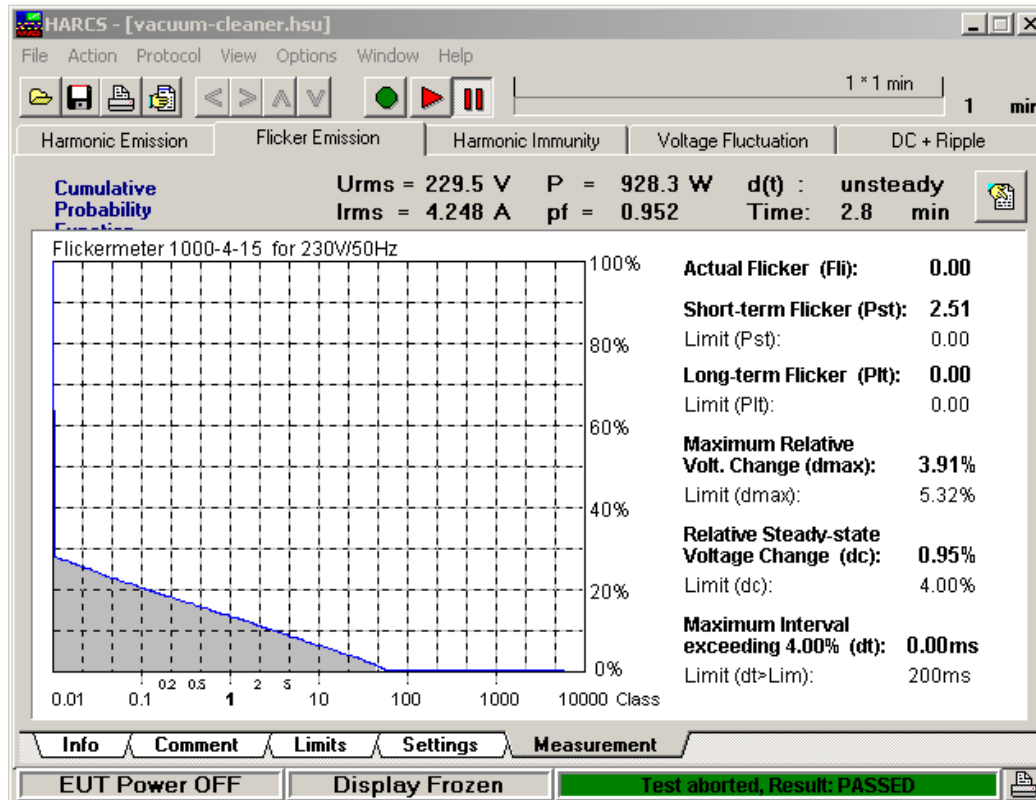
# IEC/EN 61000-3-2

## Limits for harmonic current emissions



# IEC/EN 61000-3-2

## Limitation of voltage changes, fluctuation and flicker





# ANSI C136.2:2014

Roadway and area lighting equipment - electrical immunity and dielectric withstand  
ANSI C136.2:2014 already included in technical requirements

Municipal Solid-State  
STREET LIGHTING  
**CONSORTIUM**

Sponsored by the U.S. Department of Energy

## MSSLC Model Specification for LED Roadway Luminaires

Version 2.0

July 2014

# ANSI C136.2:2014

## Roadway and area lighting equipment - electrical immunity and dielectric withstand

### Annex D

### Appendix — Product Submittal Form

Luminaire designation	Luminaire			
Luminaire manufacturer				
Luminaire model number				
Nominal IES TM-15 BUG ratings	B =	U =	G =	
Product family testing	<input type="checkbox"/> Submitted product is identical to tested product		<input type="checkbox"/> Submitted product differs from tested product(s) as explained in attached letter	
Housing finish color				
Tenon nominal pipe size	inches			
Nominal luminaire weight	lb			
Nominal luminaire EPA	ft <sup>2</sup>			
Nominal luminaire input voltage	V			
Control interface	<input type="checkbox"/> None	<input type="checkbox"/> ANSI C136.10 (3-pin)	<input type="checkbox"/> ANSI C136.41, 5-pin	<input type="checkbox"/> ANSI C136.41, 7-pin
LED driver	<input type="checkbox"/> Not dimmable	<input type="checkbox"/> Dimmable, 0-10V (IEC 60929)	<input type="checkbox"/> Dimmable, DALI (IEC 62386)	
Electrical immunity—ANSI C136.2 combination wave test level	<input type="checkbox"/> Basic (6kV / 3kA)	<input type="checkbox"/> Enhanced (10kV / 5kA)	<input type="checkbox"/> Elevated (20kV / 10kA)	
Upon failure of electrical immunity system	<input type="checkbox"/> Possible disconnect		<input type="checkbox"/> No possible disconnect	
ANSI C136.31 vibration test level	<input type="checkbox"/> Level 1 (Normal)		<input type="checkbox"/> Level 2 (bridge/overpass)	
Thermal management	<input type="checkbox"/> Liquids or moving parts		<input type="checkbox"/> No liquids or moving parts	
Luminaire warranty period	Years			



## ANSI C136.2:2014

Roadway and area lighting equipment - electrical immunity and dielectric withstand



MIG 1206 1P:  
basic and enhanced levels  
(12 kV surge)



MIG 2412 SPD 1P:  
basic, enhanced, elevated lev.  
(24 kV surge)

## ANSI C136.2:2014

- ✓ It is not clear yet when the FDIS documents will be released
- ✓ Burst and Ring wave requirements are expected additional to surge
- ✓ It has been noticed that LED producers offer selectable surge protection for certain products at additional cost
- ✓ From testing point of view, all levels should be required (up to 20 kV surge)
- ✓ EMC Partner covers basically all norms and test levels required



## ANSI C82.77

US product requirements refer to ANSI C82.77 as to a basic norm.

Power factor requirements Lamp type	PF Energy Star	Method of measurement
Fluorescent	Residential: PF $\geq 0.5$ Commercial: PF $\geq 0.5$	ANSI C82.77
Solid state (LED)	P $\leq 5$ W: PF $\geq 0.5$ P $\geq 5$ W: Residential PF $\geq 0.7$ P $\geq 5$ W: Commercial PF $\geq 0.9$	ANSI C82.77
Halogen incandescent (outdoor only)	Exempt	

*ENERGY STAR® Program Requirements for Luminaries (Light Fixtures) Eligibility Criteria Version 1.0*

## ANSI C82.77

Harmonic emission limits - Related power quality requirements for lighting equipment

Example of PF requirements for residential indoor hard-wired and portable luminaries

Input power	Minimum PF	Maximum Line $I_{THD}$ [%] from $I_0$
$P \leq 120 \text{ W}$	PF $\geq 0.5$	200 %
$120 \text{ W} \leq P \leq 150 \text{ W}$	PF $\geq 0.9$	32 %
$P \geq 150 \text{ W}$	PF $\geq 0.9$	20 %

Example of PF requirements for commercial indoor hard-wired luminaries

Input power	Minimum PF	Maximum Line $I_{THD}$ [%] from $I_0$
All	PF $\geq 0.9$	32 % and Annex A req.

## ANSI C82.77

Harmonic emission limits comparison: ANSI vs IEC

Harmonic limits expressed in % to fundamental: **IEC more restrictive**

Harmonic rank	IEC 61000-3-2 Categ. C	ANSI C82.77 Annex A
Fundamental	100%	100 %
2nd	2 %	5 %
3rd	30 · PF %	30 %
5th	10 %	-
7th	7 %	-
9th	5 %	-
11 ≤ n ≤ 39	3 %	7 %
Odd triples	-	30% · I <sub>RMS</sub> 3,9,15,21...
THD fundamental	-	32 %

## ANSI C82.77

Harmonic emission limits - Related power quality requirements for lighting equipment

Example test report according to LM 79 / ANSI C82.77 for a LED lamp

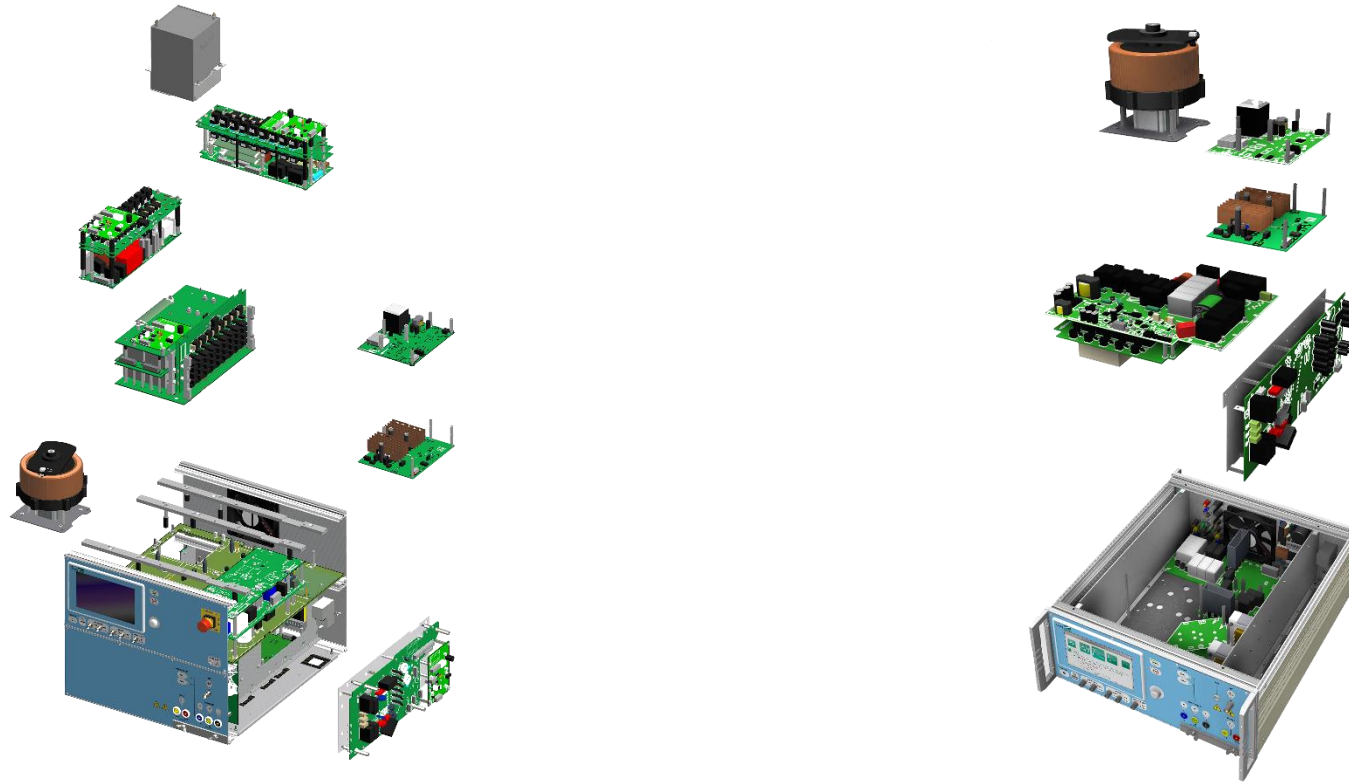
### Test Result Summary

#### Electrical data

Criteria Item	Result	
	Input Voltage	120.09 V~60Hz
Input Current	0.1545 A	0.0750 A
Total Power	18.0 W	18.25 W
→ Power Factor	0.970	0.879
→ I-THD	22.5%	17.1%
Off-state Power	0.0 W	0.0 W



# EMC Partner equipment for LED lamps, luminaries



- ✓ IMU series allows choosing between 4.1 kV, 6.6 kV and 8.1 kV solutions
- ✓ Unbeatable repetition rate reduces test time and costs
- ✓ Optimal range of external CDNs for **Burst and Surge** up to 200A

## How to choose an IMU generator: ESD; EFT, Ring wave

Application	IMU 4000	IMU 3000 6 kV	IMU 3000
ESD	10 kV /16 kV	10 kV /16 kV	10 kV /16 kV
Burst	5 kV	5 kV	6 kV
Surge 1.2/50 $\mu$ s	4.1 kV	6.6 kV	8 kV
Telecom surge 10/700 $\mu$ s	-	6.6 kV	8 kV
Magnetic Field	yes	yes	yes
Magnetic Pulse	yes	yes	yes
AC dips, drops, interr.	yes	yes	yes
Ring wave	-	6.6 kV	8 kV
Common mode	yes	yes	yes
Differential mode	yes	yes	yes
DC dips, drops, interr.	yes	yes	yes

# EMC Partner equipment for LED lamps, luminaries

## Surge generators 20 kV+



MIG 1206 1P



MIG 1206 3P



MIG 2412 SPD 1P

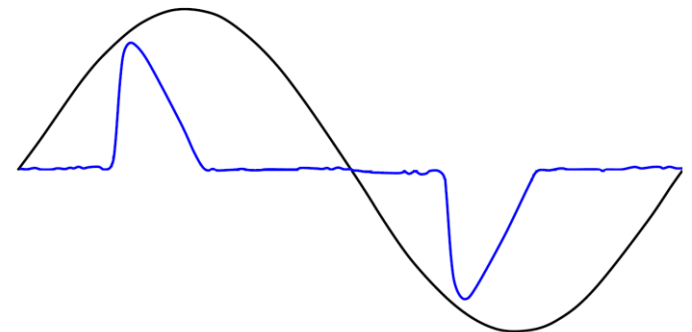
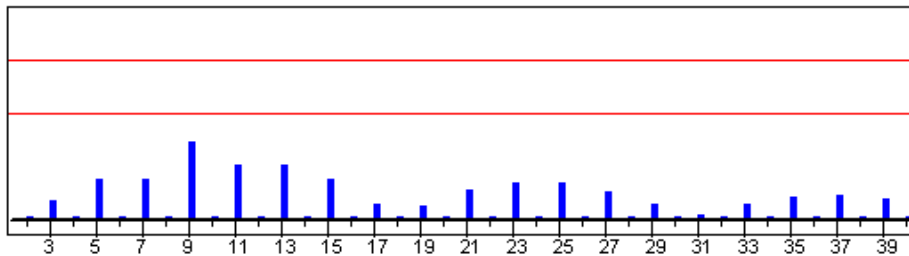
# EMC Partner equipment for LED lamps, luminaries Harmonic & Flicker



HAR 1000



(optional PS3)





[www.emc-partner.com](http://www.emc-partner.com)

