



LED LIGHTING FLICKERING IN SPORT EVENTS”

Giacomo Mazzullo
Regional Manager
MEAN WELL EUROPE

LED EVENT 2017

Design en engineering trends voor LED-applicaties

BE **WOENSDAG 29 NOVEMBER 2017**
TECHNOPOLIS, MECHELEN
NL **DONDERDAG 30 NOVEMBER 2017**
CONGRESCENTRUM 1931
BRABANTHALLEN, DEN BOSCH

- About MEAN WELL
 - WHY LED?
 - FLICKER
 - WHY?
 - ELECTRICAL – OPTICAL TRANSFORMATION
 - FRAMES vs LIGHT PULSES
 - EXAMPLE
 - SLOW MOTION VIDEO REQUIREMENTS
 - SUGGESTIONS TO REDUCE FLICKERING
 - MEAN WELL DRIVERS FOR SLOW MOTION APPLICATIONS
 - CONCLUSIONS
-
- FLICKER IMPACT TO HEALTH

GROUP OVERVIEW



MEAN WELL ENTERPRISES CO., LTD

Established in 1982

in New Taipei City, Taiwan



**SZMW
2006**



**MWEU
2006**



**GZMW
1993**



**GZ New Factory
(MWHW)
2017**



**MWUSA
1999**

- **Total Employees: ~2500 persons**
- **Core Business: Standard Switching Power Supplies**
- **Group Turnovers: USD 840M (2016)**
- **Production capacity : 100 Mpcs per year**

WHY LED?

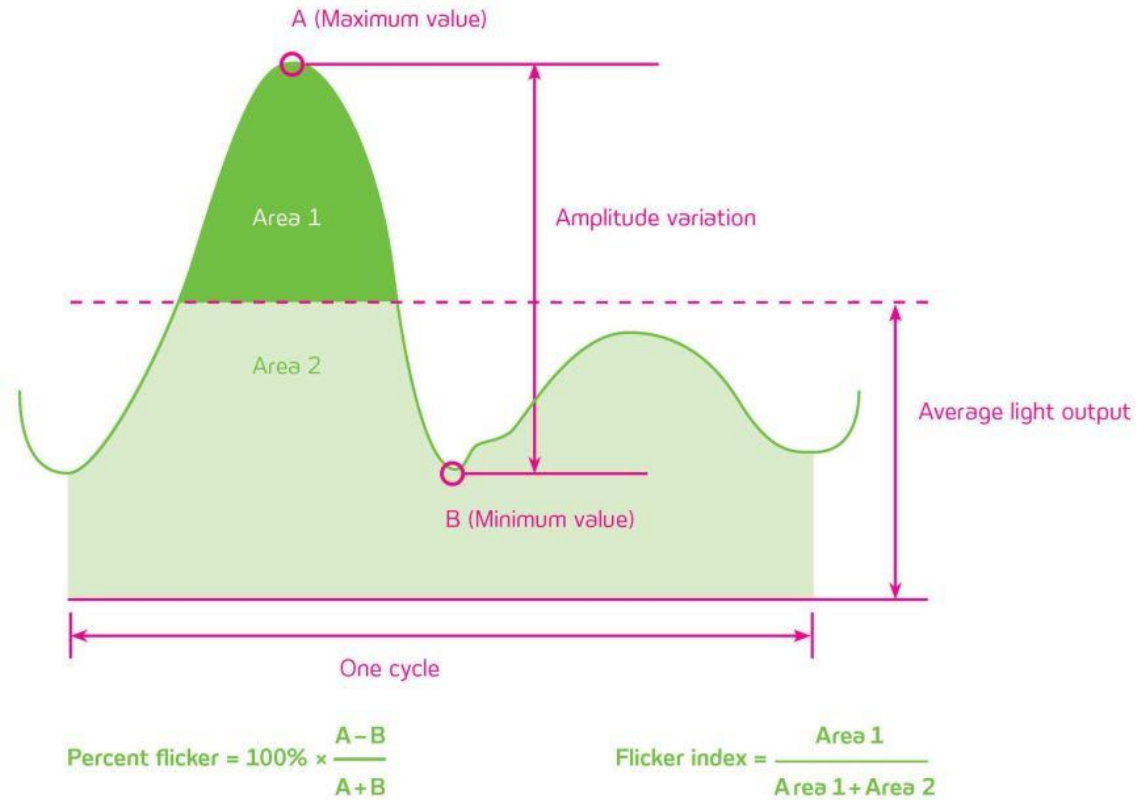


1. Energy saving
2. Dimming
3. A uniform light distribution
4. Better light rendering (CRI>80)

- 5. Lower light scattering
- 6. No waiting time for Full Brightness
- 7. Longer product life cycle
- 8. Low flickering behavior which conforms the requirement for slow motion capturing

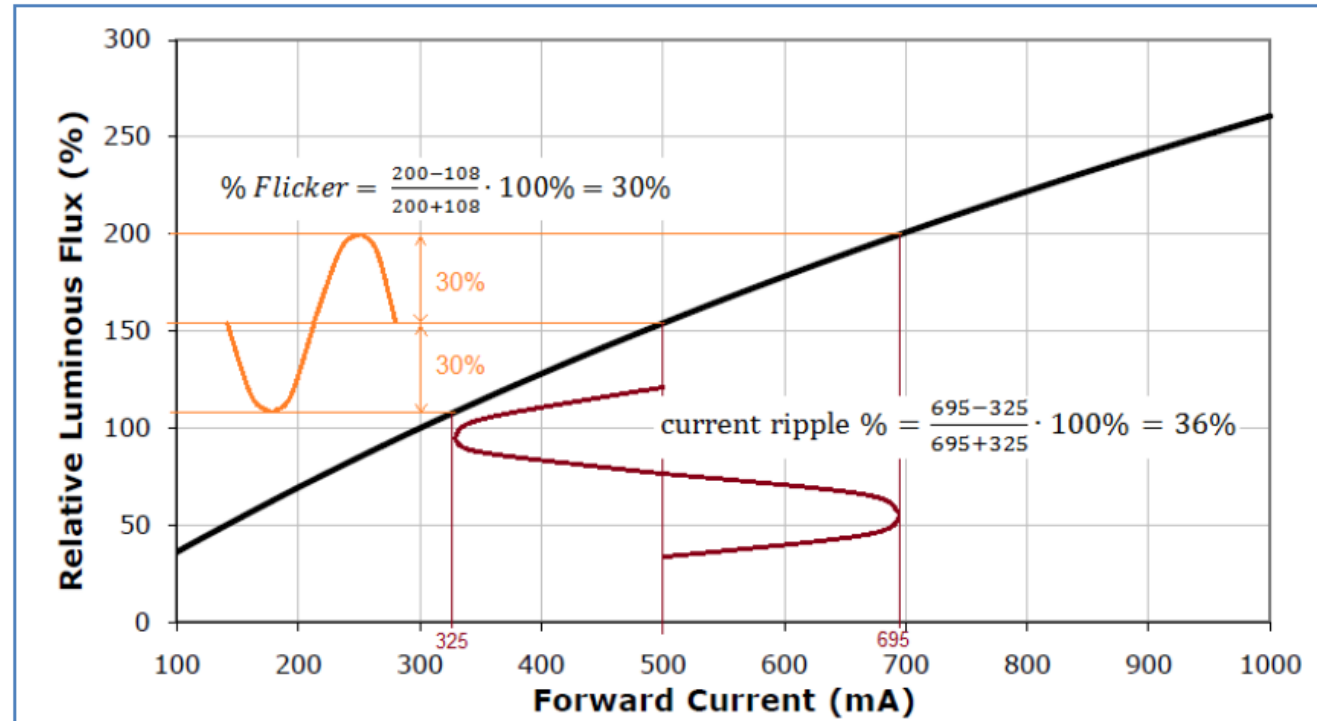
LOW FLICKERING...
ARE WE SURE?

Calculating Flicker Metrics



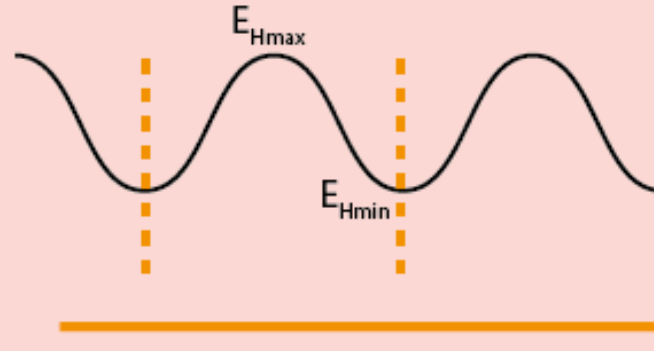
Human eye will perceive only the “Average Light Output”

FLICKER: ELECTRICAL – OPTICAL TRANSFORMATION



Any changes in electrical current will be presented into the optical light of LED

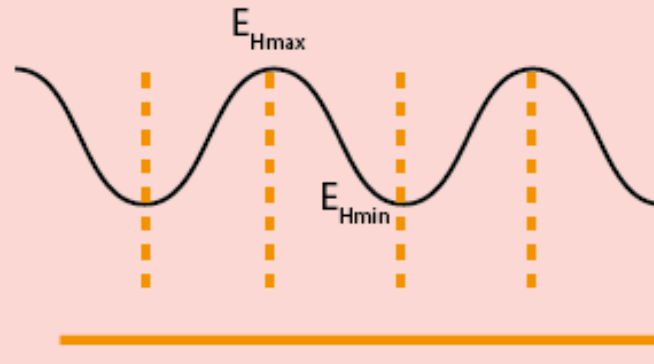
NO FLIKERING



Result: Equal light each frame

Frames

FLIKERING



Result: Unequal light each frame

2 x Frames

EXAMPLES



SLOW MOTION VIDEO REQUIREMENTS



FLICKER FACTOR / LED RIPPLE	RESULT
<1%	FLICKER FREE
<6%	Barely Visible - Acceptable
<10%	Visible, might be accepted
>10%	Unacceptable Flicker

UEFA REQUIREMENTS for 300 fps Slow Motion

10.7 24-point flicker factor test

Elite level A	
12 or 24-point average	< 5%
Maximum value	<5%
Level A	
12 or 24-point average	< 12%
Maximum value	< 15%
Level B	
12-point average	< 12%
Maximum value	< 15%
Level C	
12-point average	< 20%
Maximum value	< 30%

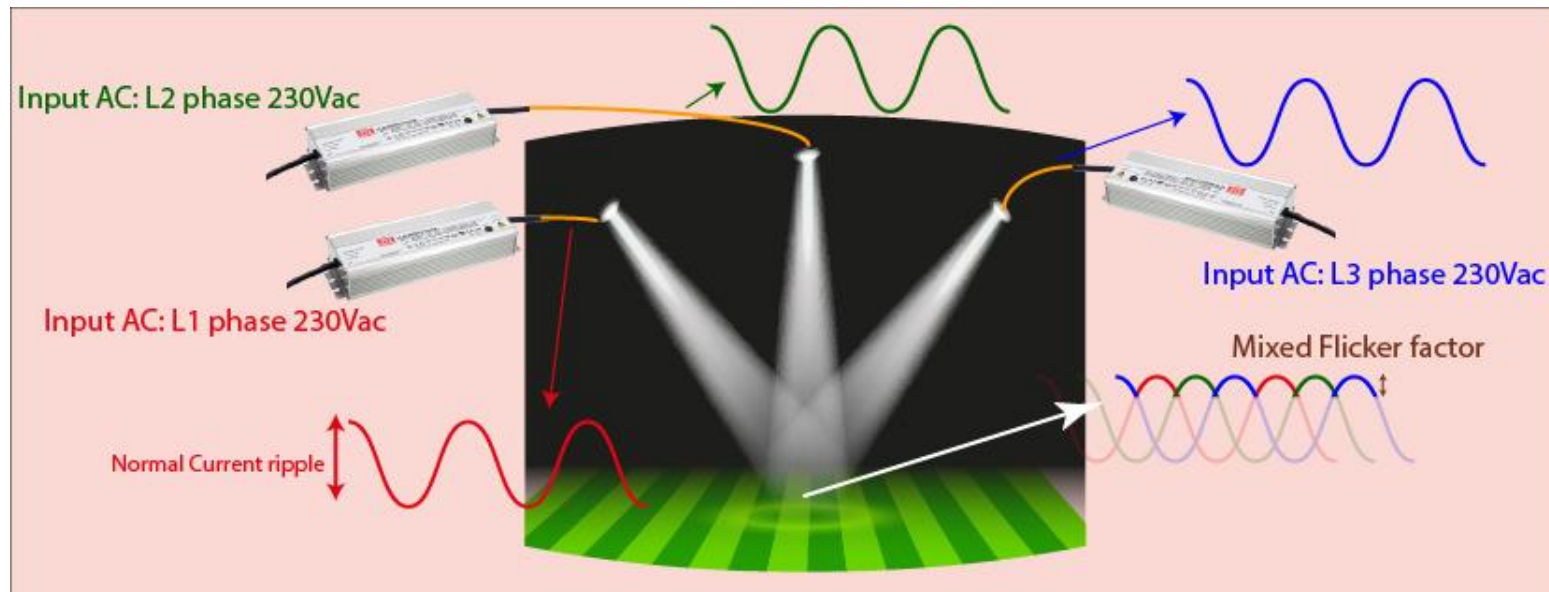
10.2 Flicker factor reference table

Type of illuminance system	FF value (guide only)
Natural daylight	0%
LED luminaires (flicker dependent on the type of LED power supply used)	< 3%
Discharge lamps with 100% electronic ballasts	< 4%
Discharge lamps with magnetic ballasts spread uniformly across three-phase power supply	8–20%
Discharge lamps with magnetic ballasts on single-phase power supply	30–50%

SUGGESTIONS TO REDUCE FLICKERING


1. Increase the switching frequency
2. Reduce the current ripple
 - Use drivers with lower ripple
 - Proper installation arrangement
3. Post video processing (software)

WE DON'T WANT POST-PROCESSING!



MEAN WELL DRIVERS FOR SLOW MOTION APPLICATIONS





HLG-320H-C series

320W Constant Current Mode LED Driver

SPECIFICATION

MODEL		HLG-320H-C700	HLG-320H-C1050	HLG-320H-C1400	HLG-320H-C1750	HLG-320H-C2100	HLG-320H-C2800	HLG-320H-C3500
OUTPUT	RATED CURRENT	700mA	1050mA	1400mA	1750mA	2100mA	2800mA	3500mA
	RATED POWER	299.6W	320.25W	320.6W	320.25W	319.2W	319.2W	318.5W
	CONSTANT CURRENT REGION <small>Note.2</small>	214 ~ 428V	152 ~ 305V	114 ~ 229V	91 ~ 183V	76 ~ 152V	57 ~ 114V	46 ~ 91V
	OPEN CIRCUIT VOLTAGE (max.)	435V	311V	234V	187V	156V	118V	95V
	CURRENT ADJ. RANGE	Adjustable for A-Type only (via built-in potentiometer)						
		350 ~ 700mA	525 ~ 1050mA	700 ~ 1400mA	875 ~ 1750mA	1050 ~ 2100mA	1400 ~ 2800mA	1750 ~ 3500mA
	CURRENT RIPPLE	5.0% max. @rated current						
	CURRENT TOLERANCE	±5%						
	SET UP TIME	<small>Note.4</small> 1000ms/115VAC, or 500ms/230VAC						
INPUT	VOLTAGE RANGE	<small>Note.3</small> 90 ~ 305VAC 127 ~ 431VDC (Please refer to "STATIC CHARACTERISTIC" section)						
	FREQUENCY RANGE	47 ~ 63Hz						
	POWER FACTOR (Typ.)	PF > 0.98/115VAC, PF > 0.95/230VAC, PF > 0.92/277VAC @full load (Please refer to "POWER FACTOR (PF) CHARACTERISTIC" section)						
	TOTAL HARMONIC DISTORTION	THD < 20% (@ load > 50% /115VAC, 230VAC; @ load > 70%/277VAC) (Please refer to "TOTAL HARMONIC DISTORTION (THD)" section)						
	EFFICIENCY (Typ.)	94%	94%	94%	94%	94%	94%	94%

■ DESIGN VERIFY TEST				
OUTPUT FUNCTION TEST				
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	CURRENT TOLERANCE	±5%	I/P: 230 VAC I/P: 115VAC O/P: FULL LOAD Ta: 25°C	1.3898A /230VAC@CV MAX-1V 1.3892A /230VAC@CV MIN 1.3904A /115VAC@CV MAX-1V 1.3911A /115VAC@CV MIN 0.14%
2	CONSTANT CURRENT REGION	CH1: 114 V~ 229V	I/P: 230 VAC O/P: FULL LOAD Ta: 25°C	0.5V~228V /230VAC
3	OPEN CIRCUIT VOLTAGE (max.)	234V	I/P: 230 VAC O/P: NO LOAD Ta: 25°C	230V
4	CURRENT ADJ. RANGE	CH1: 700mA~ 1400mA	I/P: 230 VAC I/P: 115VAC O/P: CV MIN & CV MAX-1V Ta: 25°C	0.560A~ 1.629 A /230VAC@CV MAX-1V 0.558A~ 1.625 A /230VAC@CV MIN 0.561A~ 1.629A /115VAC@CV MAX-1V 0.558A~ 1.629A /115VAC@CV MIN
5	CURRENT RIPPLE	5.0% max. @rated current	I/P: 230 VAC O/P: FULL LOAD Ta: 25°C	1.14%
6	SET UP TIME (Max)	230VAC/ 500 ms (Max) 115VAC/ 1000ms (Max)	I/P: 230 VAC I/P: 115 VAC O/P: FULL LOAD Ta: 25°C	230VAC/ 230 ms 115 VAC/ 280 ms

MEAN WELL HLG-320H-CXXXX is suitable for UEFA ELITE LEVEL A STADIUM FIXTURES*

*HVG/HLG are both <2% Ripple Drivers

LOW RIPPLE DRIVERS FROM MEAN WELL



FLICKER FACTOR / LED RIPPLE	RESULT	MEAN WELL DRIVER (Constant Current)
<1%	FLICKER FREE	HLG – HVG – Selected Models
<6%	Barely Visible - Acceptable	IP65/67: HLG – HVG – ELG IP20 : LCM – IDLC -
<10%	Visible, might be accepted	IP20: PLM
>10%	Unacceptable Flicker	

MEAN WELL, HIGH PERFORMANCE AT THE RIGHT PRICE

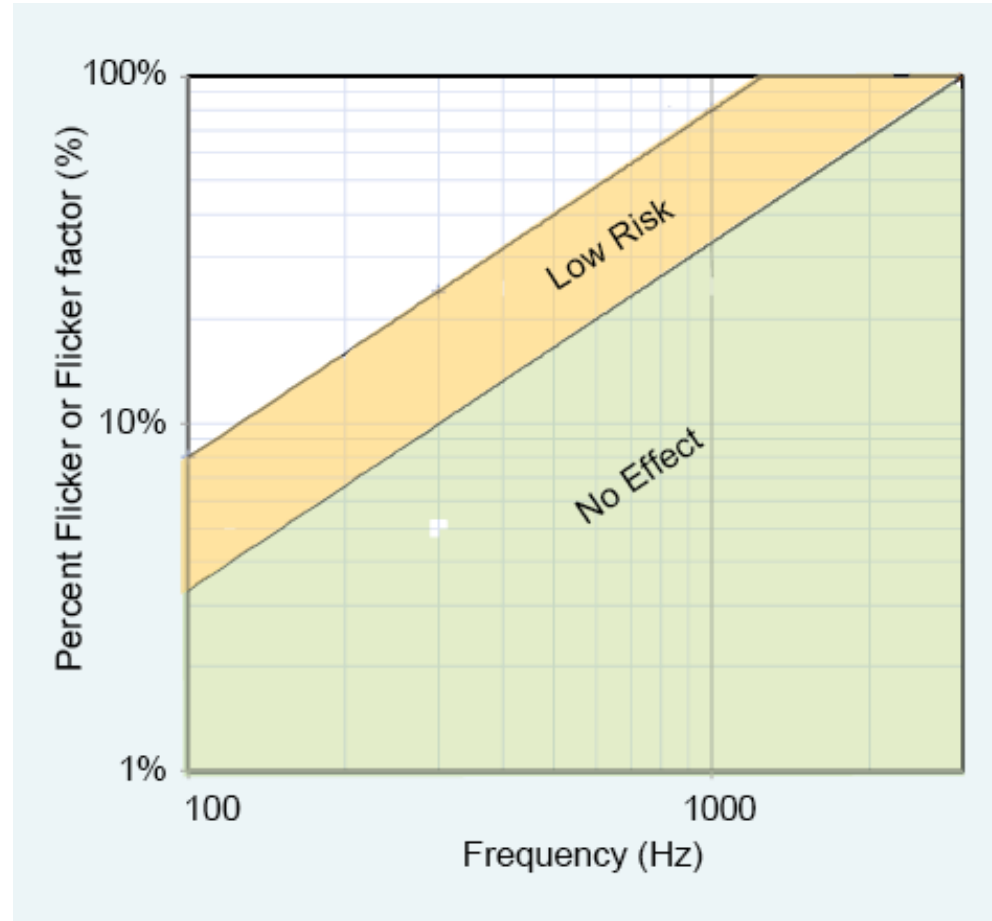
Flickering impact on slow motion capturing

Driver is the key component to determine the flicker performance

Installation can improve Flicker Perception

Post Production is required if low quality drivers are used

MEAN WELL provides High End Solutions compatible to UEFA ELITE A Requirements



NOTE: Flicker is important also for our Health. Chose always the right driver!



Q&A

LED EVENT 2017

Design en engineering trends voor LED-applicaties

BE **WOENSDAG 29 NOVEMBER 2017**
TECHNOPOLIS, MECHELEN
NL **DONDERDAG 30 NOVEMBER 2017**
CONGRESCENTRUM 1931
BRABANTHALLEN, DEN BOSCH



Thanks!

Giacomo Mazzullo
Regional Manager
MEAN WELL EUROPE

LED EVENT 2017

Design en engineering trends voor LED-applicaties

BE WOENSDAG 29 NOVEMBER 2017
TECHNOPOLIS, MECHELEN
NL DONDERDAG 30 NOVEMBER 2017
CONGRESCENTRUM 1931
BRABANTHALLEN, DEN BOSCH