LED DRIVERS & DIMMING

February 3, 2021

MODULAR
LIGHTING —
INSTRUMENTS

Drivers are our 2nd biggest product family
(in turnover)

Training content

- Understanding drivers
- Dimming
- Specifying drivers

Understanding drivers

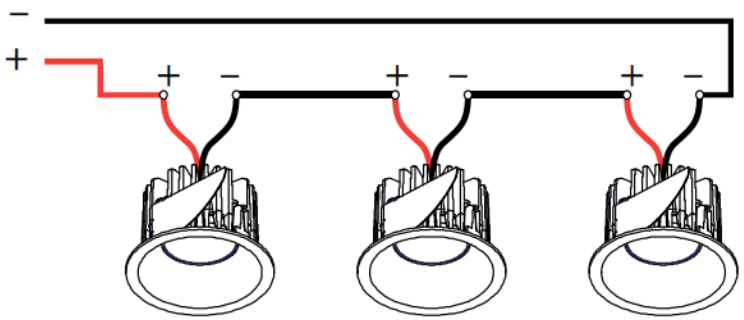
Why do LEDs require a driver?

CONSTANT CURRENT

LED COB, LED BOARDS

120 – 220 V AC

250-1400mA



CONSTANT VOLTAGE

LED STRIP

120 – 220 V AC

24-48V

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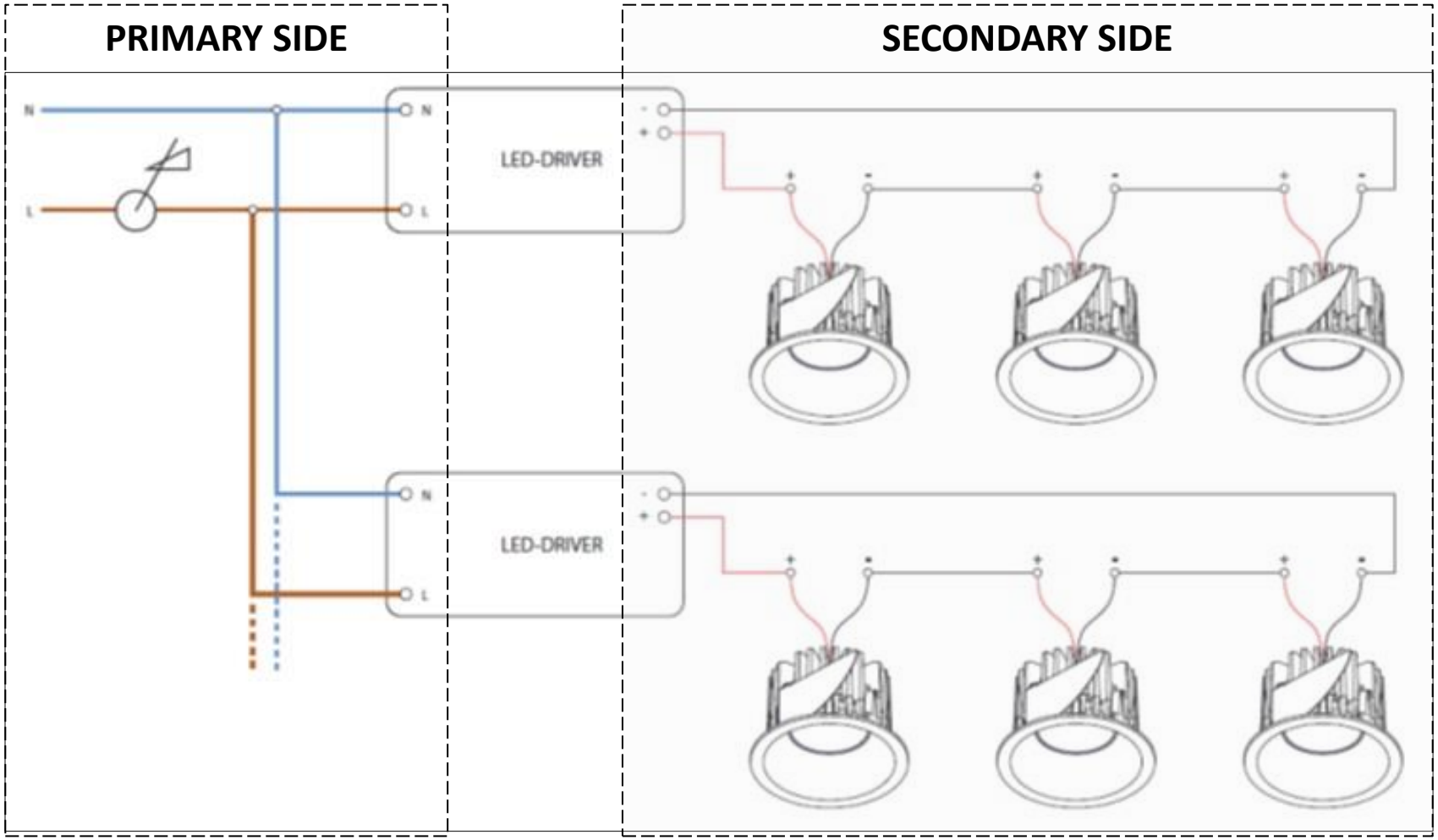
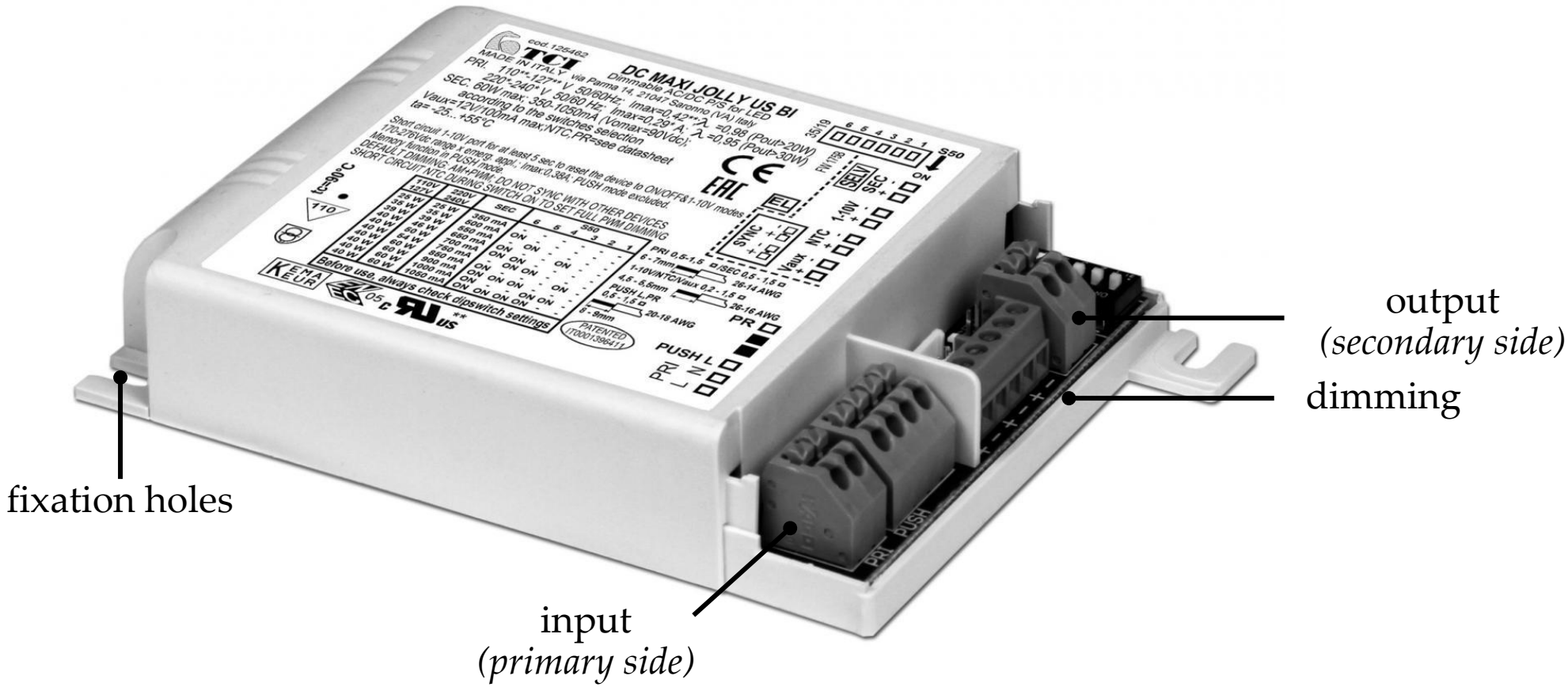
Primary and secondary side



Typical driver layout



Adjust the output current

Remote driver vs built-in

REMOTE
For use in false ceilings and electrical cabinets

BUILT-IN
ONLY for integration in luminaires

Cable length

constant current (mA)	cable section (mm²)	max advised lenght of cable (m)
350mA	0,75	60 m
	1,5	60 m
500mA	0,75	45 m
	1,5	60 m
700mA	0,75	30 m
	1,5	60 m
900mA	0,75	12 m
	1,5	25 m
Modular advises not to go further then 60m due to EMC!		
Cable length is the distance to the furthest LED!		

System length 48V

Calculate maximum length of total Pista system on one 48V power supply (Pouillet's law)

fill in
result

R=(Rho x L)/A

whereas:

Rho: electrical resistivity of the conductor (copper: 1,75 x 10^{-8} Ωm)

L: conductor length (in meter)

A: section of the conductor (in mm²)

Rho	1,75E-08	
L1	100	distance from power supply to Pista power feed (in meter)
L2	10	distance of total Pista rail on this power feed (in meter)
L3	110	Total system length (in meter)
A	0,5	wire section in mm²
W	100	total system wattage on the power supply (sum of all products) (in W)

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Voltage drop:

8,020833 Volt **Voltage drop can be maximum 6V for the 48V Pista system**

CONCLUSION

For a total system length of **110** meter and wire section of **0,5** mm²

and a total rated luminaire power of **100** W the total voltage drop is **8,020833** Volt

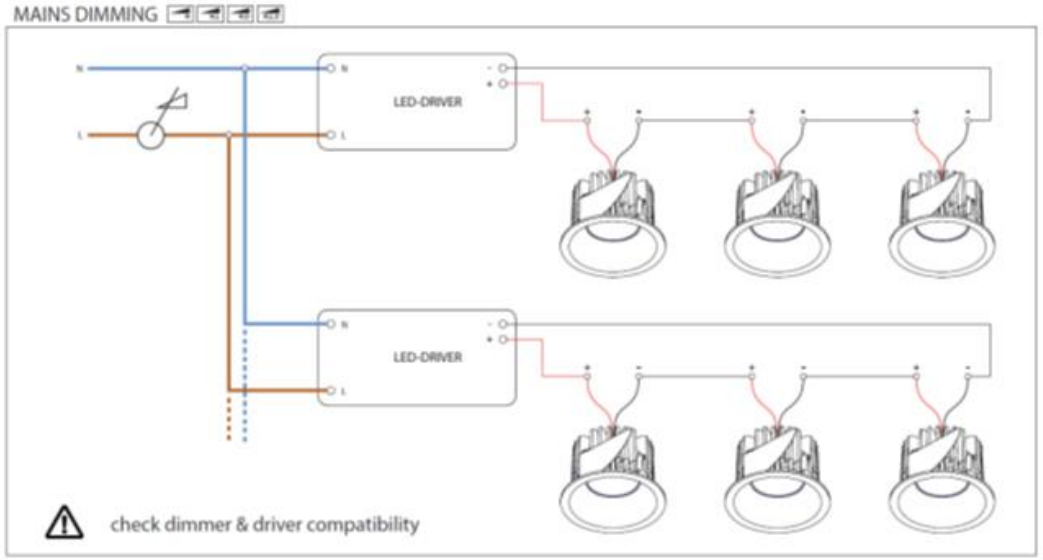
Keep distances as short as possible (EMC regulation)

Dimming

- Dimming protocols
- Dimming technology
- Deep dim drivers
- Flicker

Dimming protocols

MAINS	PUSH	1-10V	DALI	WIRELESS



Mains dimming

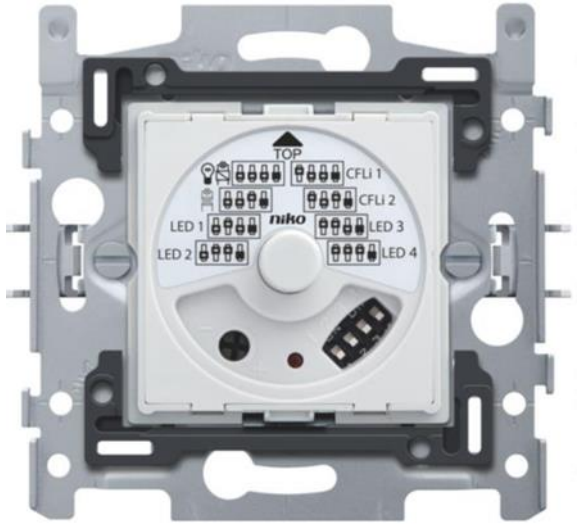
Based on halogen 230V

No additional wires needed (dimming on primary wires)

Most cost-efficient system

Unstable system depending on load, driver/dimmer combination

Often trial and error



Mains dimming

What dimmers to use?

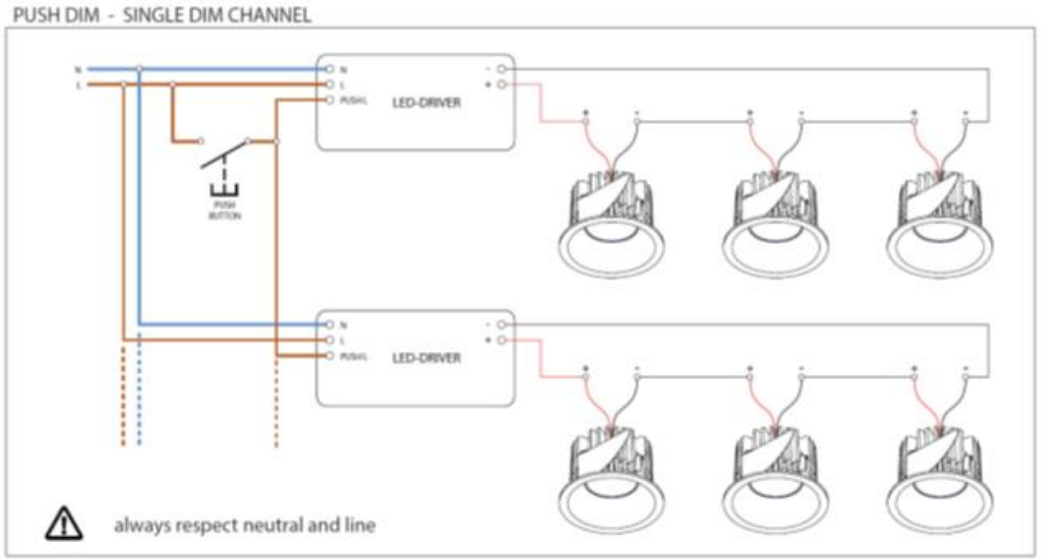
- Choose for a trailing edge (tre dim) dimmer (R, C)
- Check compatibility onsite. A lot of factors influence proper working (which can’t be simulated in lab environment)

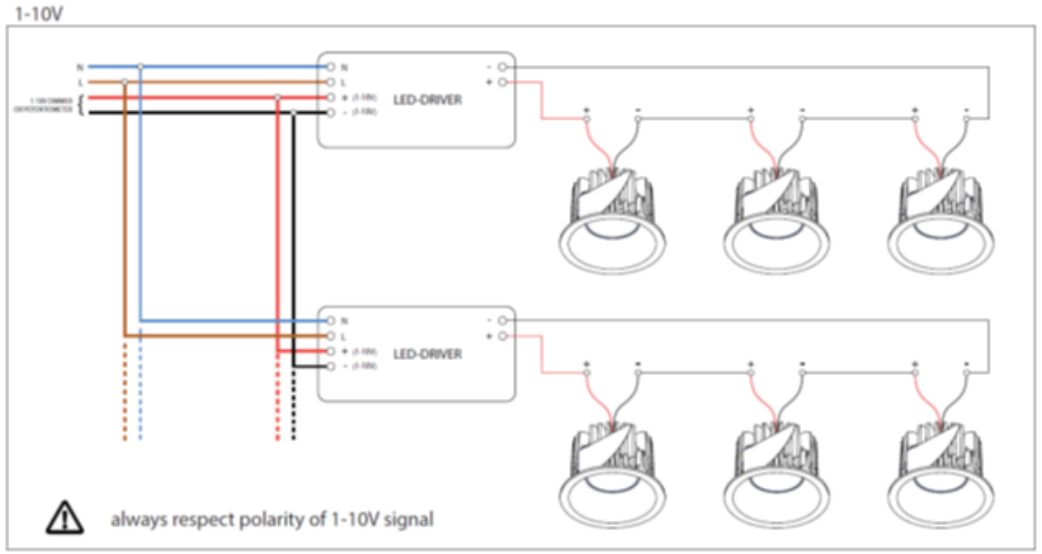
Push dimming

Use of “normally open” push button

Easy wiring (1 additional wire)

Use of sync cables if more than 4 drivers are installed on a push button.





1-10V

Separate analogue dimming signal

Standardized system

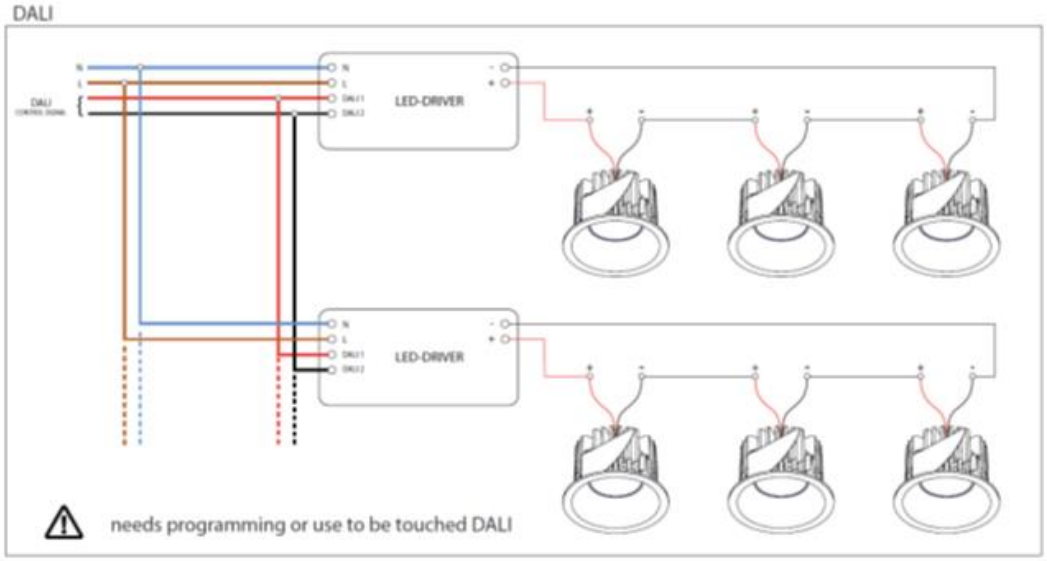
Widely used in home automation

Two extra dimming wires needed

Respect polarity of dimming

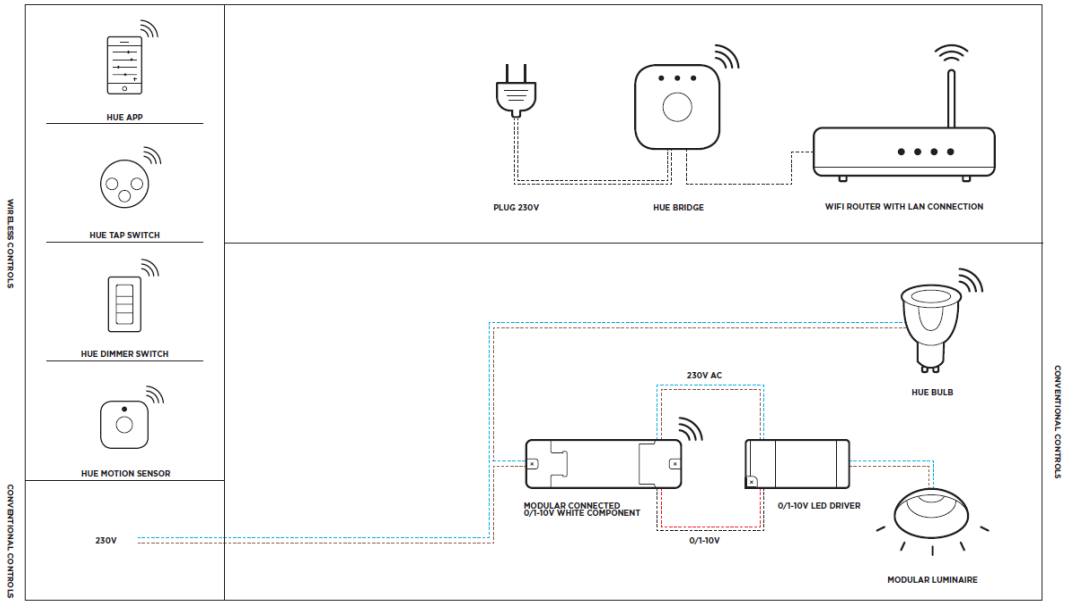
DALI

- Digital signal
- Re-programming after installation possible
- Flexibility of system
- Enables complex controls (e.g. color icw intensity)
- All components (switches, sensors..) need to be DALI
- Highly skilled professional needed for installation



DALI-2

- Latest, improved version of the DALI protocol
- DALI drivers recommended if DALI system doesn’t carry the official DALI-2 logo
- DALI edition is described in our driver matrix and on My Modular (GI fixtures)



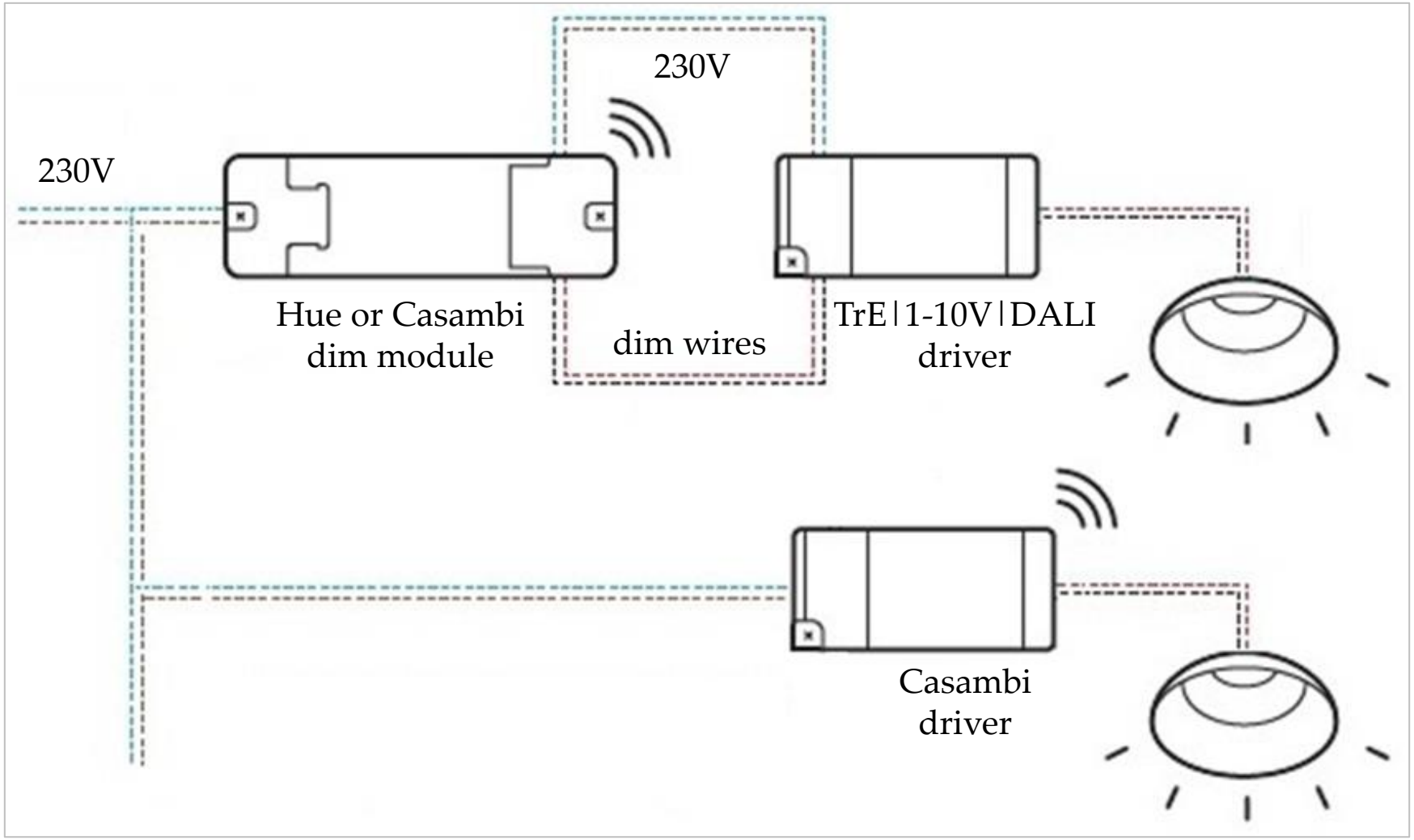
Wireless

- No wiring
- Easy installation & updates
- Cost-efficient light control
- Tap into the world of connected lighting and smart home
- Incompatibility issues between different systems

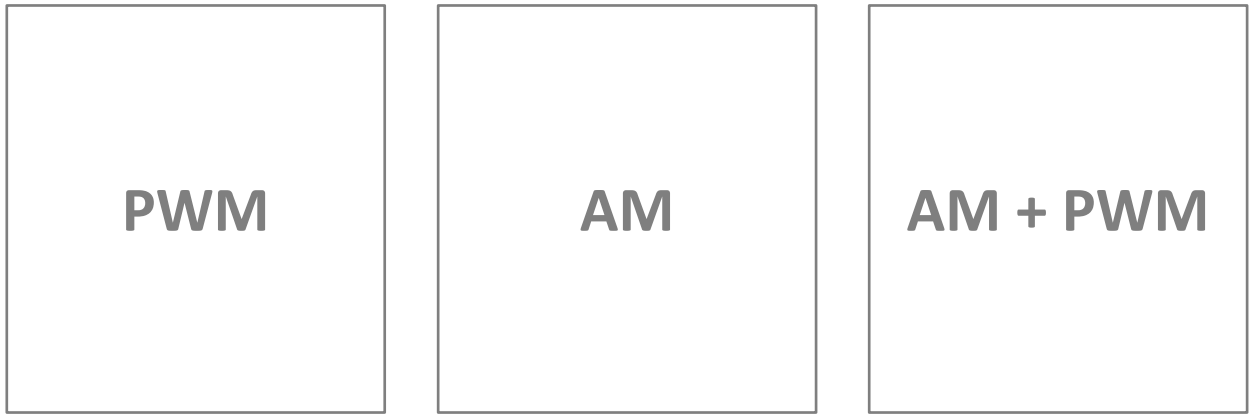
Dim module + driver vs all-in-one

❶

❷



Dimming technology



Pulse Width Modulation (PWM)

How it works

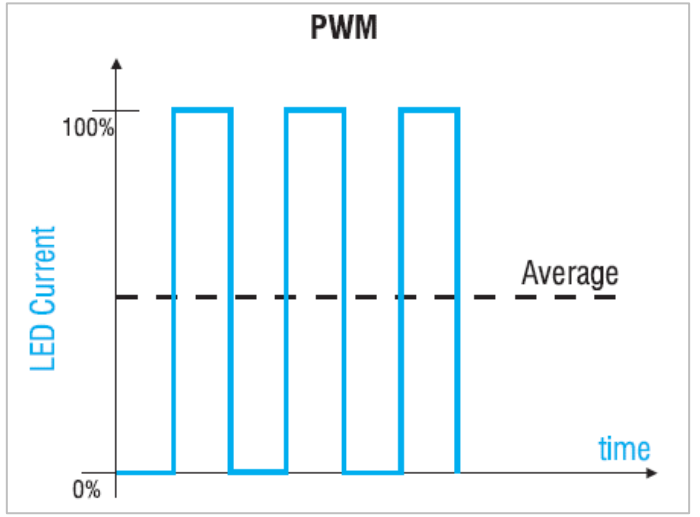
- LEDs are turned ON and OFF rapidly
- High frequency pulse prevents eye from seeing the LEDs change or flicker
- Average light intensity is observed

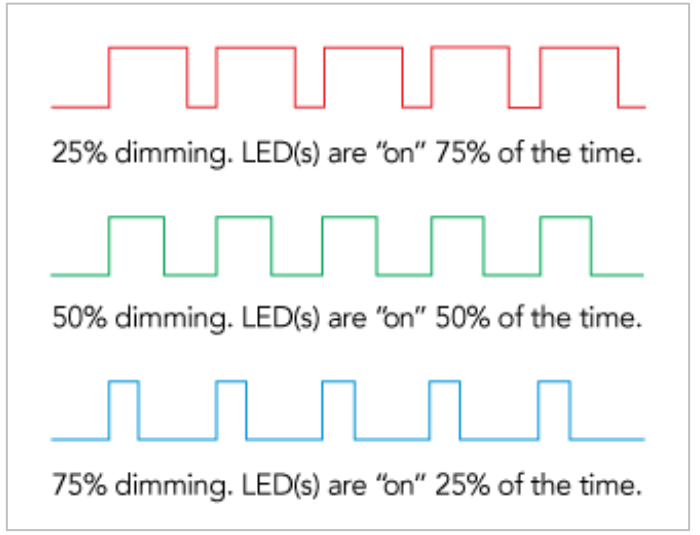
Advantages

- Precise dimming regulation at lower output levels
- Color consistency over various dimming levels

Disadvantages

- Doesn't support warm dim
- Flicker can be recorded on video

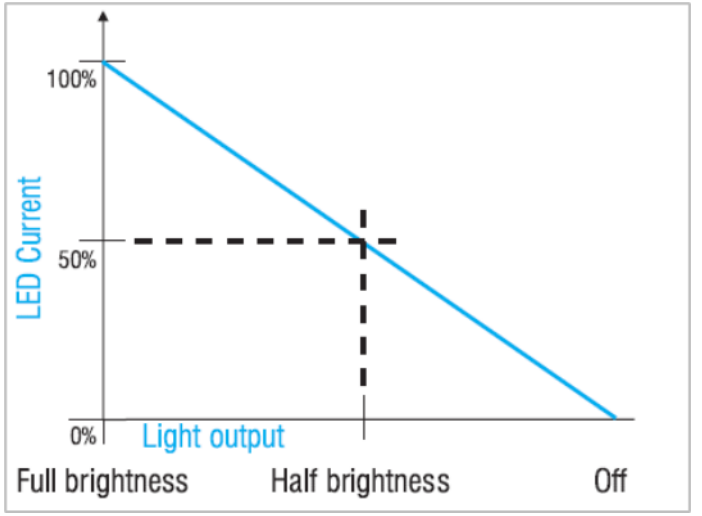




Amplitude Modulation (AM)

How it works

- Current flowing through the LED is reduced or increased based on whether the LED is to be dimmed further or made brighter
- The lighting level is proportional to the current flowing through the LED



Advantages

- Flicker-free even when the driver frequency is low
- Supports warm dim

Disadvantages

- Doesn't support deep dimming

Hybrid (AM+PWM)

How it works

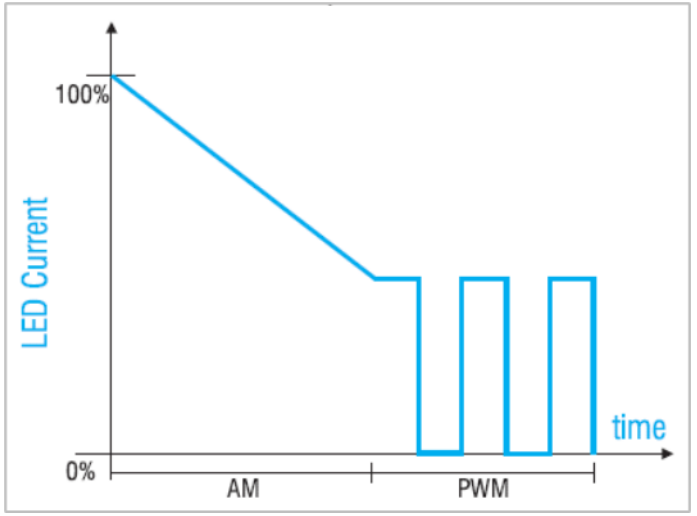
- 1%-25% Pulse Width Modulation
- 25%-100% Amplitude Modulation

Advantages

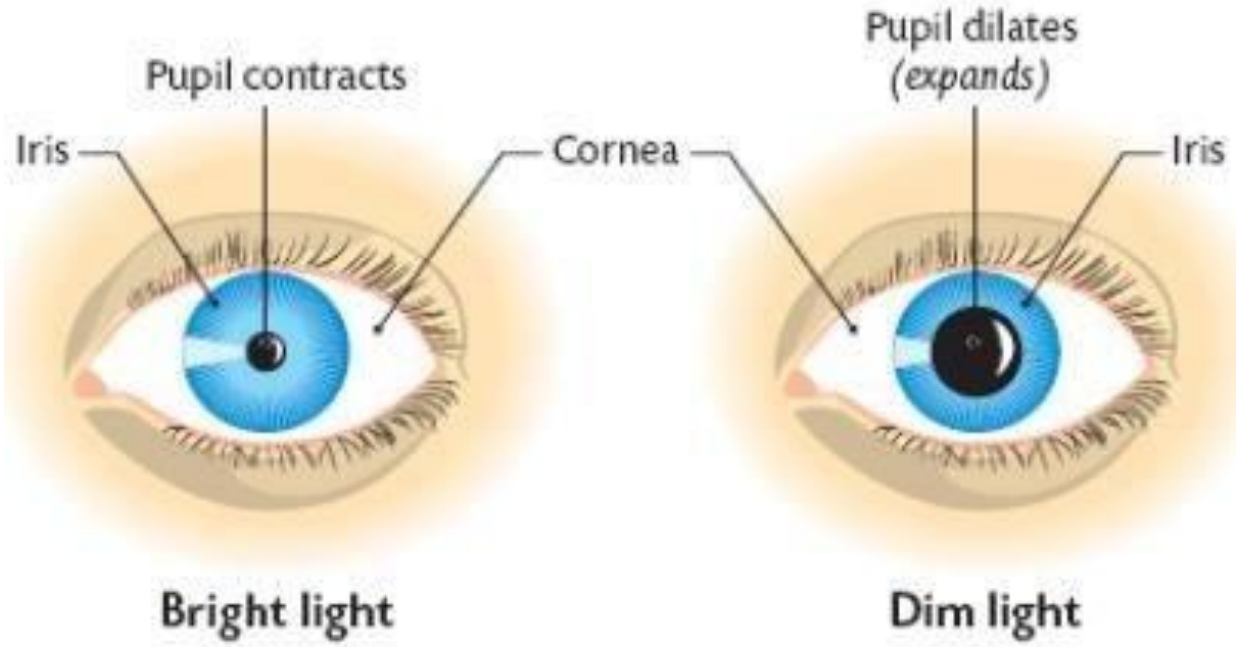
- Best of both worlds
- No black lines during dimming (100%-25%) and best LED dimming results in low light intensity (25%-1%)

Disadvantages

- Supports warm dim but without CCT changes at lower light levels



Deep dimming

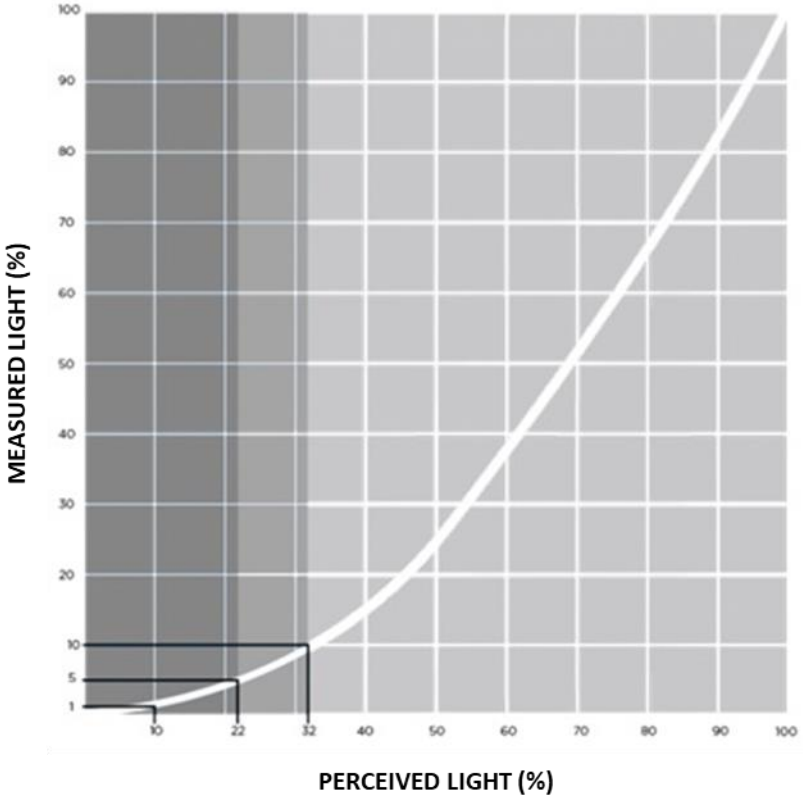


Deep dimming – measured vs perceived light

The response of the human eye varies according to the light present

At low light levels, humans perceive the light brighter than it is

- 10% measured light = 32% perceived light
- 1% measured light = 10% perceived light



Deep dimming – drivers

smooth dimming
at all light levels

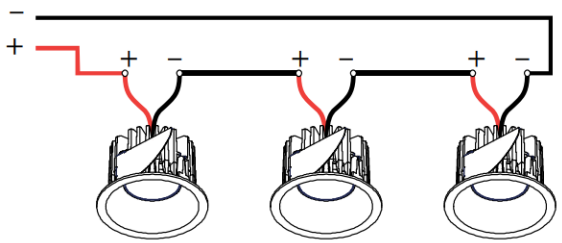
dim to dark

About flicker

LED's require a smooth and clean input signal, if not, flicker will be present

120 – 220 V AC

250-1400mA



Input signal

- provided by the LED driver
- can be impacted by dim protocol, dim technology, dimmer, fluctuations power grid

3 types of flicker

• Unstable light output (fluctuations power grid)	**avoid mains dimming**
• Flicker at low light levels (PWM driver)	**choose for AM driver**
• Stroboscopic effect (moving object appears to stand still)	**choose for AM driver**

What to do about flicker

Goal of the customer

- Video recording? (TV studio, conference room)
  ➔ Use deep dim drivers for GE fixtures
- Need to comply to specific norm? (IEEE1789, NEMA77, Title 24, BREEAM,…)

What can R&D do

- Check if drivers or GI fixtures comply to a specific norm
  ➔ propose alternative driver
- Test new drivers on flicker performance

What you can do

- Create a test set-up at the customer

Specifying drivers

Why buy drivers from Modular?

Best guarantee for high-quality lighting

- Modular lives and breathes superior quality
- Drivers in our driver matrix passed our performance & artifact tests

Convenience and reassurance of a one-stop shop

- Save time by buying fixtures and drivers from a single source
- Have one single point of contact for all after sales services

Driver selection made easy

- Tools that help you select a matching driver for your Modular fixture
- A Customer Service team that is there to help

Value-based pricing

Modular offers 5-year warranty on drivers

Why?

- Modular carefully selects high-quality components
- Our fixtures already come with a 5-year warranty

Terms & conditions 5-year warranty drivers

- warranty period commences on the date of delivery
- properly fitted and operated according to instructions

Take the lead

Light Planning
(projects specified by Modular)

- Specify superior dimming performance at a small surcharge (i.e. deep dim drivers)

Customer Service
(projects registered/ordered by partners)

- Look for the underlying motives when drivers aren't registered/ordered
- Offer matching drivers optionally if the opportunity presents itself
- Use the project discount to be competitive if necessary

3rd party driver compatibility requests

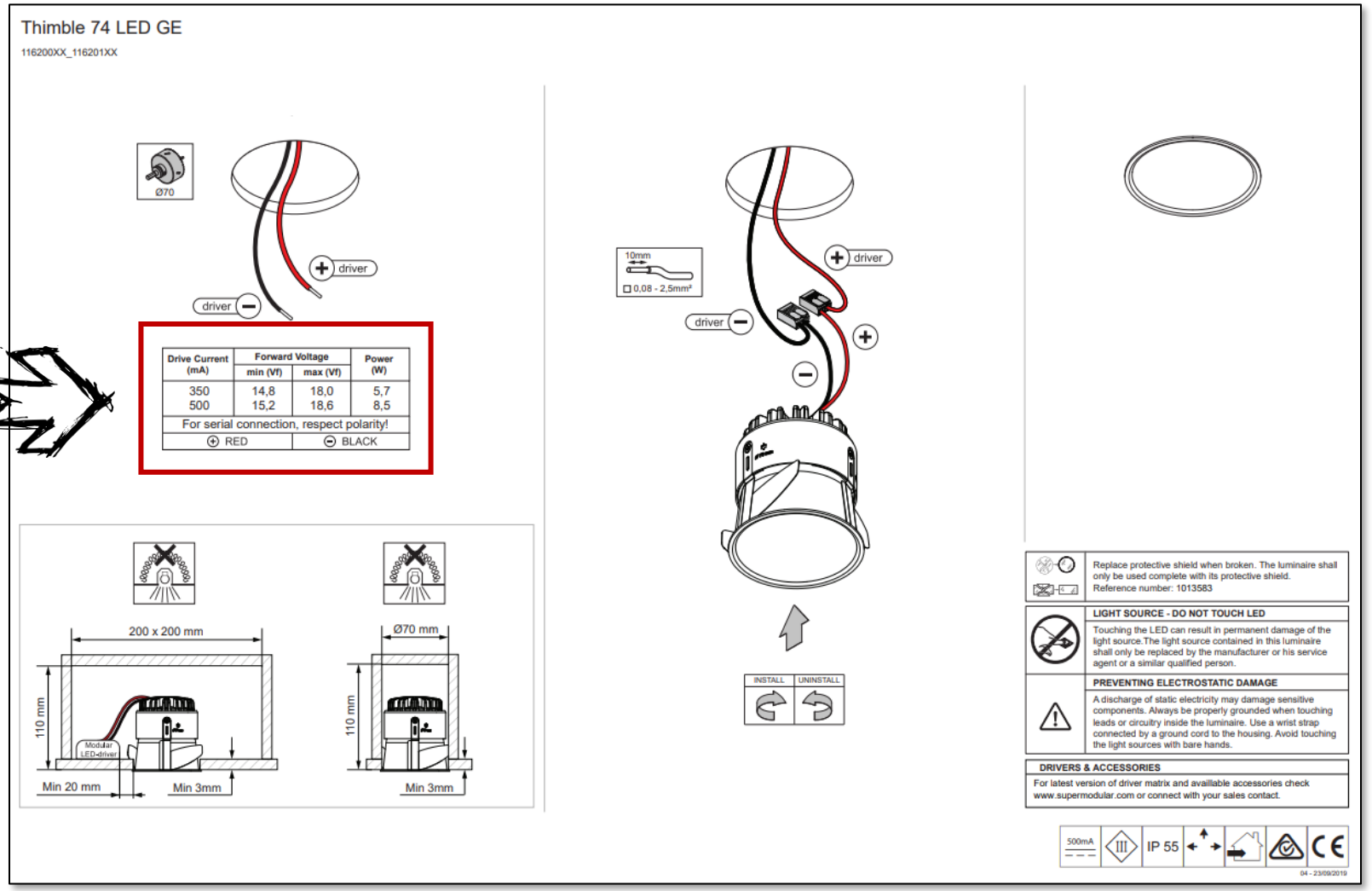
Question
Can driver X from brand Y be used in combination with Modular's fixture Z?

Answer

- Modular doesn't test the compatibility of 3rd party drivers with our fixtures
- Modular's can only provide specs so that the customer can assess the compatibility on paper
- Modular can however not guarantee that the actual performance will be free of artifacts (e.g. flicker, buzzing)
- Modular can provide an informal offer for a product from our driver matrix

Note: proper testing of 3rd party driver compatibility needs to be requested via Project Care

Fixture installation instruction



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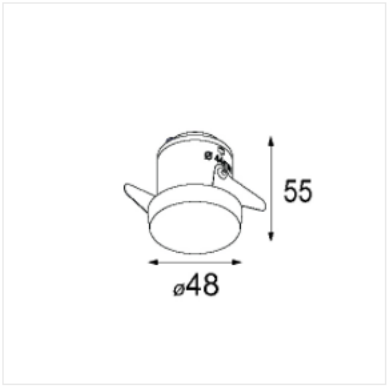
Website – driver accessories

MODULAR LIGHTING — INSTRUMENTS

ABOUT MODULAR L.I. | MY MODULAR | EN | EUROPE

LUMINAIRES | LINEAR LIGHTING | GOODIES | INSPIRATION | DOWNLOADS | BROCHURES | DEALERS | CONTACT | INFO COVID-19 | search



Article Nr.	Colour	Reflector	Colour temperature	PDF
12882132	black struc	medium / 25°	warm white / 2700K	
12882109	white struc	medium / 25°	warm white / 2700K	
12882146	gold	medium / 25°	warm white / 2700K	
12882032	black struc	medium / 25°	warm white / 3000K	
12882009	white struc	medium / 25°	warm white / 3000K	

Art. Nr. 12882209

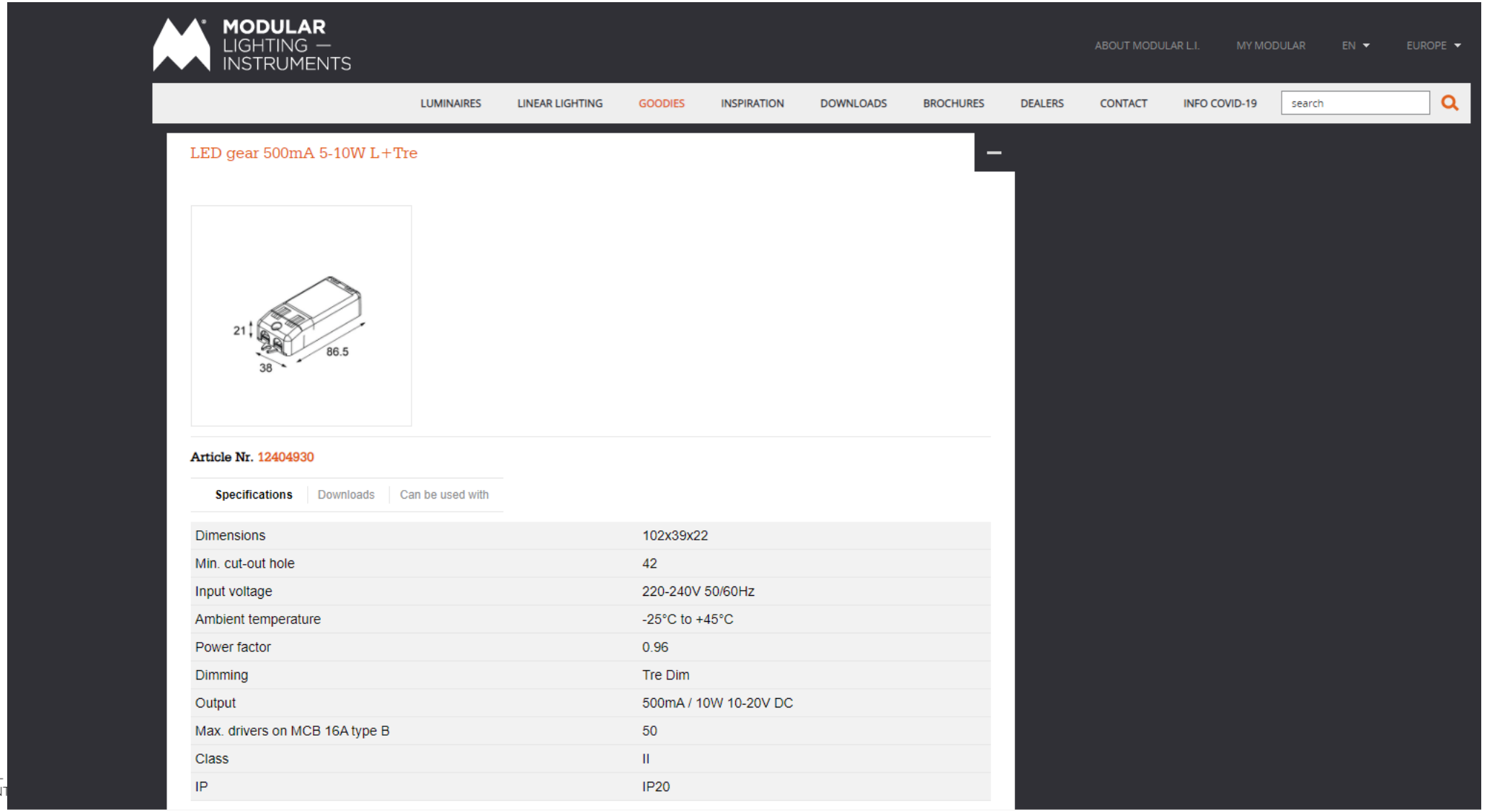
Specifications | Accessories | Photometric | Downloads | **Drivers**

trailing edge dimmable

350mA | **500mA**

	Min. fixtures	Max. fixtures	
12404930 - LED gear 500mA 5-10W L+Tre	2	2	
12404330 - LED Gear 500mA 20W L+Tre	3	4	⚠ Driver does not fit through cutout hole of fixture
12400330 - LED Gear 350-700mA 17-32W UNID	1	4	⚠

Website – driver pages



Driver matrix – available in XLS and PDF format

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LIGHTING —
INSTRUMENTS

FIXTURE	Smart Cake / Kup / Lotis /+ (asy) 48 (IPS4) LED GE			reference	12404830	
fixture cutout hole	Ø	44	(all dimensions in mm)	driver ref	1012163	
fixture LED	1	x LED			MAINS	
max current	500	mA			AM	
			☐ check for only one LED	Dimensions (LxWxH)	102x38x21	
				min. cutout hole	42	
				COMMENT		
				Number of LED output channels	1	
				Price	33	
				Max drivers on MCB 16A type B	50	
				mA	min	max
DIMMING	trailing/leading edge (mains dimming)			250	-	-
				350	2	2
				500	-	-
					-	-
					-	-
					-	-
					-	-
					-	-
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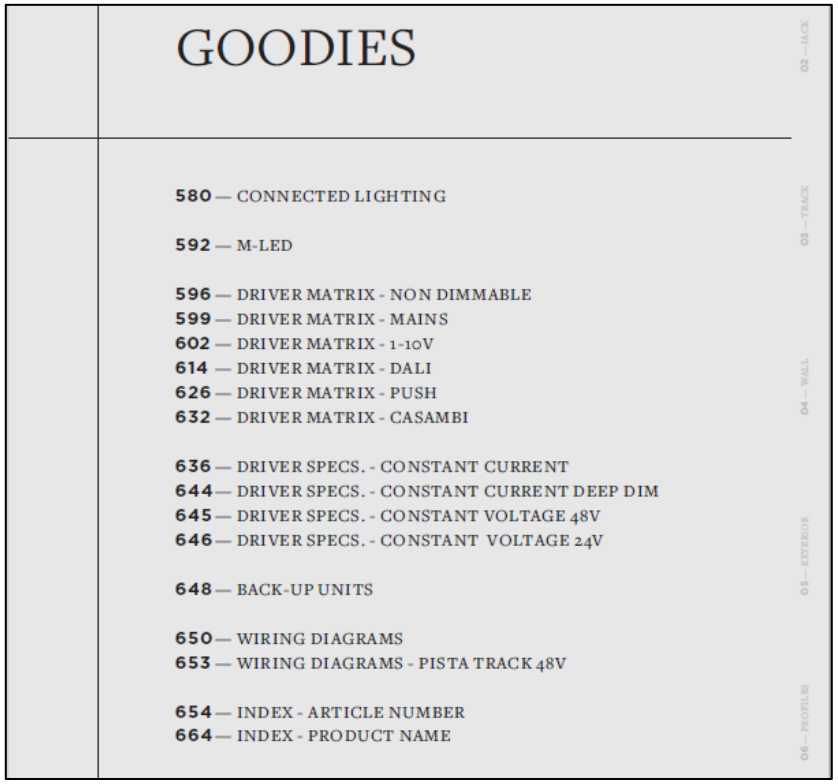
					-	-
					-	-

XLS

my.supermodular.com



GOODIES

580 — CONNECTED LIGHTING

592 — M-LED

596 — DRIVER MATRIX - NON DIMMABLE
599 — DRIVER MATRIX - MAINS
602 — DRIVER MATRIX - 1-10V
614 — DRIVER MATRIX - DALI
626 — DRIVER MATRIX - PUSH
632 — DRIVER MATRIX - CASAMBI

636 — DRIVER SPECS. - CONSTANT CURRENT
644 — DRIVER SPECS. - CONSTANT CURRENT DEEP DIM
645 — DRIVER SPECS. - CONSTANT VOLTAGE 48V
646 — DRIVER SPECS. - CONSTANT VOLTAGE 24V

648 — BACK-UP UNITS

650 — WIRING DIAGRAMS
653 — WIRING DIAGRAMS - PISTA TRACK 48V

654 — INDEX - ARTICLE NUMBER
664 — INDEX - PRODUCT NAME

02 — JACK
03 — TRACK
04 — WALL
05 — EXTERIOR
06 — PROFILES

PDF

supermodular.com

Driver matrix (XLS)

MODULAR LIGHTING — INSTRUMENTS

❶	FIXTURE	Smart Cake / Kup / Lotis /+ (asy) 48 (IP54) LED GE				reference	12404830		12404930		12407230		12404230		12404330		12408530		12400330		12405730	
	fixture cutout hole	Ø	44	(all dimensions in mm)		driver ref	1012163		1012165		1013551		1011648		1011570		1014164		1009582		1012965	
	fixture LED	1	x LED				MAINS		MAINS		MAINS		MAINS		MAINS		MAINS		MAINS/PUSH		MAINS/PUSH	
	max current	500	mA				AM		AM		AM		AM		AM		AM		PWM		PWM	
				☐ check for only one LED		Dimensions (LxWxH)	102x38x21		102x38x21		102x38x21		111x52x22		111x52x22		111x52x22		166x46x34		163x83x35	
						min. cutout hole	42		42		42		54		54		54		56		88	
						COMMENT							Looping		Looping		Looping		Looping / Sync		Looping	
						Number of LED output channels	1		1		1		1		1		1		1		1	
						Price	33		33		25,94		38,51		38,51		38,51		85,89		101,21	
						Max drivers on MCB 16A type B	50		50		50		50		50		50		50		30	
❷	DIMMING	trailing/leading edge (mains dimming)				mA	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max
						❸ 250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
						350	2	2	-	-	-	-	4	5	-	-	-	-	1	4	-	-
						500	-	-	2	2	-	-	-	-	3	4	-	-	1	4	-	-
							-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
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							-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

❶ Fixture

❷ Dimming protocol

❸ Driver current

❹ Driver

❺ Driver specifications (& pricing)

❻ # fixtures

Driver matrix (PDF)

Driver matrix - mains dimmable ❶
(number of products allowed per driver)

❹

TRAILING/LEADING EDGE (MAINS DIMMING)		12404830		12404930		12407230		12404230		12404330		12408530		12400330		12405730	
		MAINS		MAINS		MAINS		MAINS		MAINS		MAINS		MAINS/PUSH		MAINS/PUSH	
Dimensions (LxWxH)		102x38x21		102x38x21		102x38x21		111x52x22		111x52x22		111x52x22		166x46x34		163x83x35	
min. cutout hole		42 ❺		42		42		54		54		54		56		88	
Number of LED output channels		1		1		1		1		1		1		1		1	
Max drivers on MCB 16A type B		50		50		50		50		50		50		50		30	
FIXTURE	mA	min	max	min	max	min	max	min	max	min	max	min	max	min	max	min	max
Qbini general 2X LED GE	350	1	2	-	-	-	-	3	4	-	-	-	-	1	3	-	-
	500	-	-	1	1	-	-	-	-	2	3	-	-	1	3	-	-
Qbini general 4X LED GE	350	1/2	1	-	-	-	-	1	2	-	-	-	-	1/2	1	-	-
	500	-	-	1/2	1/2	-	-	-	-	1	1	-	-	1/2	1	-	-
Rektor recessed LED GE	350	-	-	-	-	-	-	1	1	-	-	-	-	1	1	-	-
	500	-	-	-	-	-	-	-	-	1	1	-	-	1	1	-	-
Rektor recessed warm dim LED GE	350	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
Scotty 270 adjustable LED GE	350	-	-	-	-	-	-	1	1	-	-	-	-	1	1	-	-
Scotty 270 LED GE	350	-	-	-	-	-	-	1	1	-	-	-	-	1	1	-	-
	500	-	-	-	-	-	-	-	-	1	1	-	-	1	1	-	-
Shellby 176 trimless LED GE	350	1	1	-	-	-	-	2	2	-	-	-	-	1	2	-	-
	500	-	-	1	1	-	-	-	-	1	2	-	-	1	2	-	-
	700	-	-	-	-	-	-	-	-	-	-	1	1	1	2	-	-
Shellby 176 trimless warm dim LED GE	350	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
Shellby 184 LED GE	350	1	1	-	-	-	-	2	2	-	-	-	-	1	2	-	-
	500	-	-	1	1	-	-	-	-	1	2	-	-	1	2	-	-
	700	-	-	-	-	-	-	-	-	-	-	1	1	1	2	-	-
Shellby 184 warm dim LED GE	350	-	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-
Slide IP54 LED GE	350	1	1	-	-	-	-	2	2	-	-	-	-	1	2	-	-
	500	-	-	1	1	-	-	-	-	1	2	-	-	1	2	-	-
Smart Cake / Kup / Lotis / (asy) 48 (IP54) LED GE	350	4	9	-	-	-	-	9	17	-	-	-	-	1	15	-	-
	500	-	-	4	6	-	-	-	-	6	13	-	-	1	15	-	-
Smart Cake / Kup / Lotis / (asy) 48 warm dim (IP55) LED GE	250	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-
Smart Cake / Kup / Lotis /+ (asy) 48 (IP54) LED GE	350	2	2	-	-	-	-	3	5	-	-	-	-	1	4	-	-
	500	-	-	2	2	-	-	-	-	2	4	-	-	1	4	-	-

❷ ❸ ❻

❶ **Dimming protocol**

❷ **Fixture**

❸ **Driver current**

❹ **Driver**

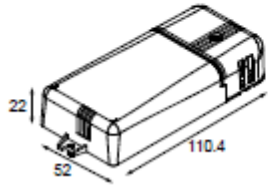
❺ **Driver specifications**

❻ **# fixtures**

MODULAR LIGHTING — INSTRUMENTS

Driver matrix (PDF) – driver specifications

Driver specs. - constant current



IP20

R, C

Reference	**12404230**	**12404330**	**12408530**
Dimensions (LxWxH)	111x52x22	111x52x22	111x52x22
Input	220-240V 50/60Hz	220-240V 50/60Hz	220-240V 50/60Hz
Ambient temperature	-25°C to +50°C	-25°C to +45°C	-25°C to +45°C
Power factor (max)	0.95	0.95	0.95
Dimming	TRAILING EDGE/LEADING EDGE (AM)	TRAILING EDGE/LEADING EDGE (AM)	TRAILING EDGE/LEADING EDGE (AM)
Max drivers on MCB 16A type B*	50	50	50
Output	**350mA** / 8-18W 25-51V DC	**500mA** / 8-20W 16-40V DC	**700mA** / 8-20W 16-28V DC

MODULAR LIGHTING — INSTRUMENTS

Installation instruction

LED Gear 350mA-700mA 12W 1-10V

12409130

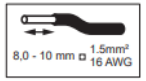
MODULAR LIGHTING — INSTRUMENTS

0/1...10V diagram

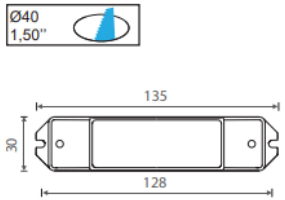
Dip - switch

350mA	8.4W	10-24Vdc	
500mA	12W	10-24Vdc	
700mA	12W	10-17Vdc	

Wiring



Dimensions



Frequency
50...60 Hz

AC Operation range
100 ÷ 240 V

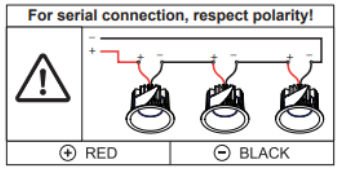
Power
1 ÷ 12 W

Temperature
Tc = 85°C
Ta = -30...+50°C

max. Efficiency
78%

Maximum current output ripple
≤ 2%

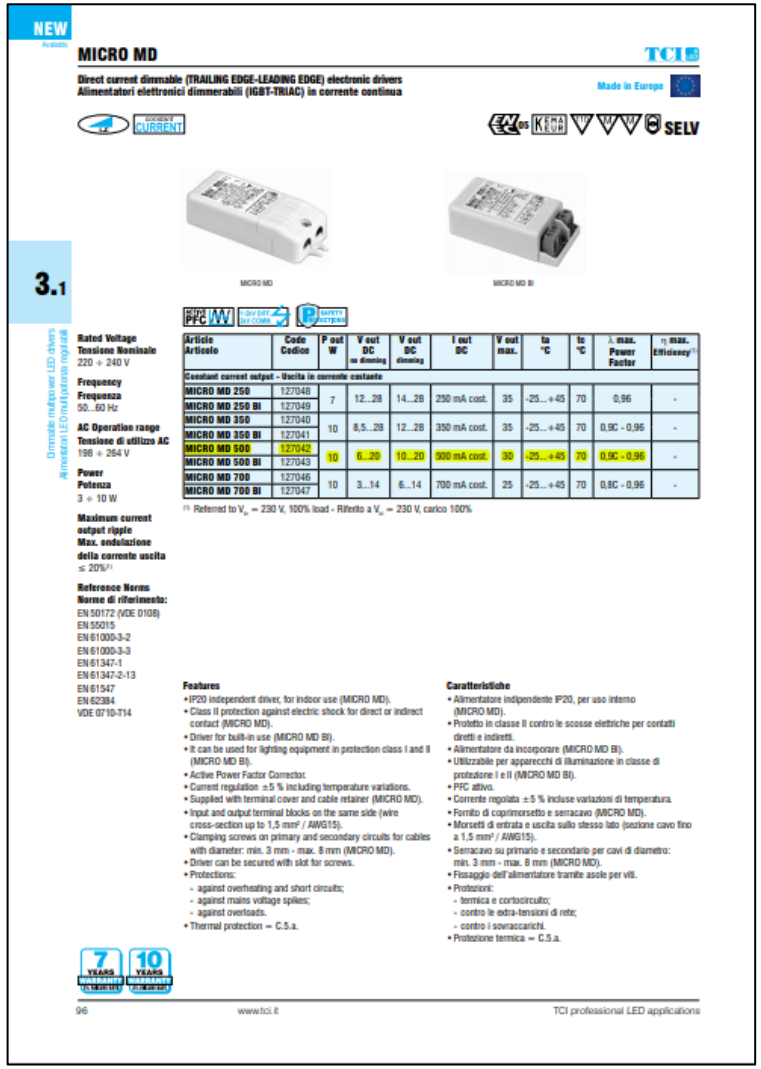
Reference Norms
EN61347-1
EN61347-2-13
EN55015
EN61000-3-2 Class C
IEC61000-3-3
EN61000-4-2,3,4,5,6,8,11
EN61547
IEEE 1789



SELV IP 20 1-10V

02 - 17/09/2020

Driver datasheet – for internal use



NEW

MICRO MD

TCI

Direct current dimmable (TRAILING EDGE-LEADING EDGE) electronic drivers
Alimentatori elettronici dimmerabili (IGBT-TRIAC) in corrente continua

Made in Europe

CURRENT

SELV

3.1

Dimmable multipower LED drivers
Alimentatori LED multipotenza regolabili

MICRO MD

MICRO MD BI

Rated Voltage
Tensione Nominale
220 ÷ 240 V

Frequency
Frequenza
50...60 Hz

AC Operation range
Tensione di utilizzo AC
198 ÷ 264 V

Power
Potenza
3 ÷ 10 W

Maximum current output ripple
Max. ondulazione della corrente uscita
≤ 20%[1]

Reference Norms
Norme di riferimento:
EN 50172 (VDE 0108)
EN 55015
EN 61000-3-2
EN 61000-3-3
EN 61347-1
EN 61347-2-13
EN 61547
EN 62384
VDE 0710-T14

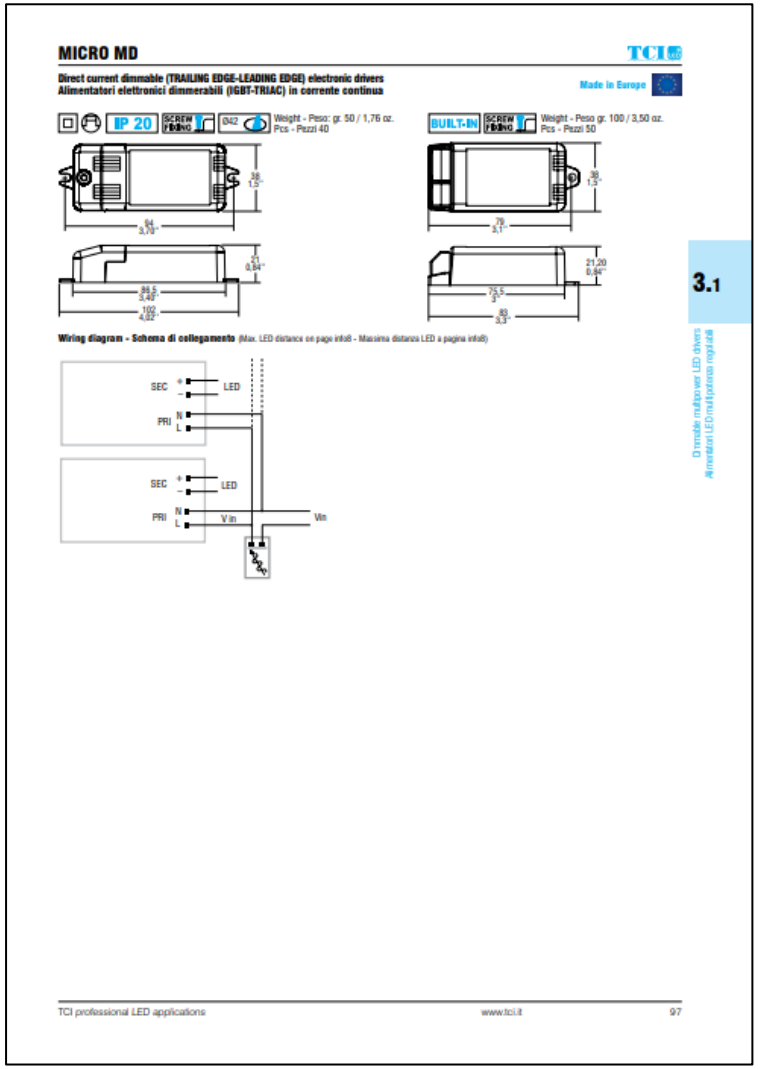
Article Articolo	Code Codice	P out W	V out DC no dimming	V out DC dimming	I out DC	V out max.	ta °C	tc °C	λ max. Power Factor	η max. Efficiency[1]
Constant current output - Uscita in corrente costante										
MICRO MD 250	127048	7	12...28	14...28	250 mA cost.	35	-25...+45	70	0,96	-
MICRO MD 250 BI	127049									
MICRO MD 350	127040	10	8,5...28	12...28	350 mA cost.	35	-25...+45	70	0,9C - 0,96	-
MICRO MD 350 BI	127041									
MICRO MD 500	127042	10	6...20	10...20	500 mA cost.	30	-25...+45	70	0,9C - 0,96	-
MICRO MD 500 BI	127043									
MICRO MD 700	127046	10	3...14	6...14	700 mA cost.	25	-25...+45	70	0,8C - 0,96	-
MICRO MD 700 BI	127047									

[1] Referred to V_{in} = 230 V, 100% load - Riferito a V_{in} = 230 V, carico 100%

Features
- IP20 independent driver, for indoor use (MICRO MD).
- Class II protection against electric shock for direct or indirect contact (MICRO MD).
- Driver for built-in use (MICRO MD BI).
- It can be used for lighting equipment in protection class I and II (MICRO MD BI).
- Active Power Factor Corrector.
- Current regulation ±5 % including temperature variations.
- Supplied with terminal cover and cable retainer (MICRO MD).
- Input and output terminal blocks on the same side (wire cross-section up to 1,5 mm² / AWG15).
- Clamping screws on primary and secondary circuits for cables with diameter: min. 3 mm - max. 8 mm (MICRO MD).
- Driver can be secured with slot for screws.
- Protections:
  - against overheating and short circuits;
  - against mains voltage spikes;
  - against overloads.
- Thermal protection = C.5.a.

Caratteristiche
- Alimentatore indipendente IP20, per uso interno (MICRO MD).
- Protetto in classe II contro le scosse elettriche per contatti diretti e indiretti.
- Alimentatore da incorporare (MICRO MD BI).
- Utilizzabile per apparecchi di illuminazione in classe di protezione I e II (MICRO MD BI).
- PFC attivo.
- Corrente regolata ±5 % incluse variazioni di temperatura.
- Fornito di coprimorsetto e serracavo (MICRO MD).
- Morsetti di entrata e uscita sullo stesso lato (sezione cavo fino a 1,5 mm² / AWG15).
- Serracavo su primario e secondario per cavi di diametro: min. 3 mm - max. 8 mm (MICRO MD).
- Fissaggio dell'alimentatore tramite asole per viti.
- Protezioni:
  - termica e cortocircuito;
  - contro le extra-tensioni di rete;
  - contro i sovraccarichi.
- Protezione termica = C.5.a.

7 YEARS 10 YEARS



MICRO MD

TCI

Direct current dimmable (TRAILING EDGE-LEADING EDGE) electronic drivers
Alimentatori elettronici dimmerabili (IGBT-TRIAC) in corrente continua

Made in Europe

IP 20 — Weight - Peso: gr. 50 / 1,76 oz. Pcs - Pezzi 40

BUILT-IN — Weight - Peso gr. 100 / 3,50 oz. Pcs - Pezzi 50

Wiring diagram - Schema di collegamento (Max. LED distance on page info8 - Massima distanza LED a pagina info8)

3.1

Dimmable multipower LED drivers
Alimentatori LED multipotenza regolabili

MODULAR LIGHTING INSTRUMENTS

MODULAR
LIGHTING —
INSTRUMENTS