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Data sheet TD2-230-X-XX-X

Triple Touch DIMMER for Low Power LEDs
Rev. 1.3 – 08/2011

Triple Touch DIMMER for Low Power LEDs

Features

- Controlling of three low power LED strings (e.g. RGB LEDs) via touch sensors
- One further sensor for common ON-OFF control for all three strings
- Controlling 3 x 72 LEDs directly from mains voltage without transformer or power adaptor
- Digital storage of DIMMER value (optional with Flash version)
- Integrated EMI filter fulfils relevant EMI regulations
- Low power consumption and high efficiency
- Supervision of mains voltage
- Automatic adaptation to number of connected LEDs during power up
- *Lumi-Con Master-Slave-Interface* for synchronizing further DIMMERs
- Optional *SPI Interface* (coming soon)
- Extremely small volume
- Operating class IP20 (dry ambient)

Applications

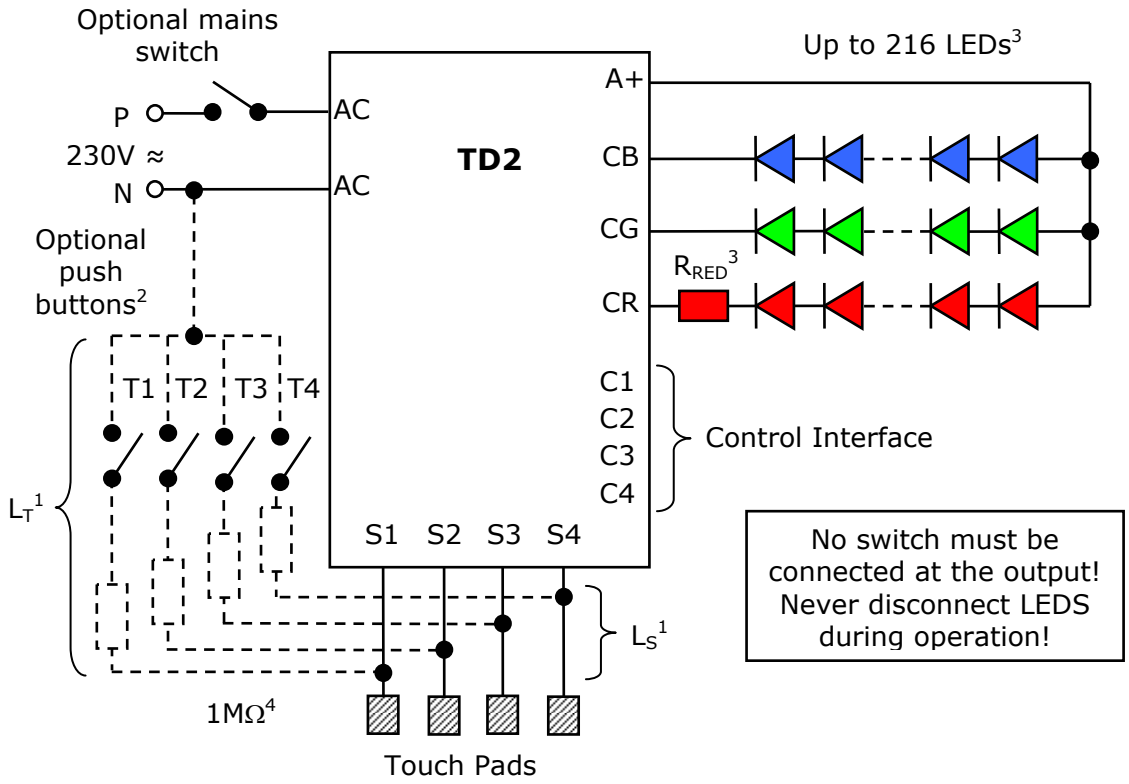
- Driving up to 72 LEDs per string, total 216 LEDs
- Especially suited for low power RGB-LEDs with up to 20mA current
- Decorative illumination
- Advertising
- Picture back ground and TV back ground illumination
- Furniture lighting (kitchen, sideboards, etc.)
- Staircase illumination (e.g. integration into handrail)
- Illumination of show cases

Caution!

Set up should be done by skilled personnel only!
All circuit parts including LEDs are connected to mains supply (230V AC)!
Please read carefully the instructions on last page.

1 Description

1.1 Connecting the Module



1) Maximum wire length L to S1 or S2 is approx. 0.5m. L_T might be increased up to 10m with a decoupling resistor of 40…80 MΩ for each switch (T1 …T4), also in parallel to touch pads. Resistor must be connected close to S1…S4 input.
2) Pushbuttons (T1…T4, dotted line) must be connected (for safety reasons) only to grounded power line (N) or protective earth conductor. A 1MΩ resistor is recommended close to the switch.
3) It is recommended to connect a Lumi-Con lighting module (e.g. LED stripes). Otherwise check carefully operating conditions. The RED diode string needs a series resistor for forward voltage adaptation.
4) For larger length to switch (up to 10m) replace the 1MΩ by a 100MΩ resistor.

Fig. 1: Module Connections

1.2 Detailed Description

The DIMMER module can be connected directly to the mains voltage (230V≈/50Hz) without transformer or power adaptor. 3x72 series connected low power (RGB-) LEDs can be driven with up to 20mA for each string. We recommend Lumi-Con lighting units (e.g. stripes) to be used with this DIMMER.

As shown in figure 2 the module consists of an internal power supply, the controller as well as the driver transistor (T1, T2, T3 operating as switched mode LED supply). The power supply generates the controller supply as well as the DC supply for the LED switch mode controller from mains voltage. Only 0.4W are consumed during stand-by-operation (LED power off) which accumulates to only 1.7kWh per year and fulfils the EU directive *EuP 2005/32/EG (ECO Design of Energy Using Products)*.

The DIMMER is controlled via the sensors interface or the control interface.

The control interface provides either the Lumi-Con Master-Slave interface or the digital serial SPI interface.

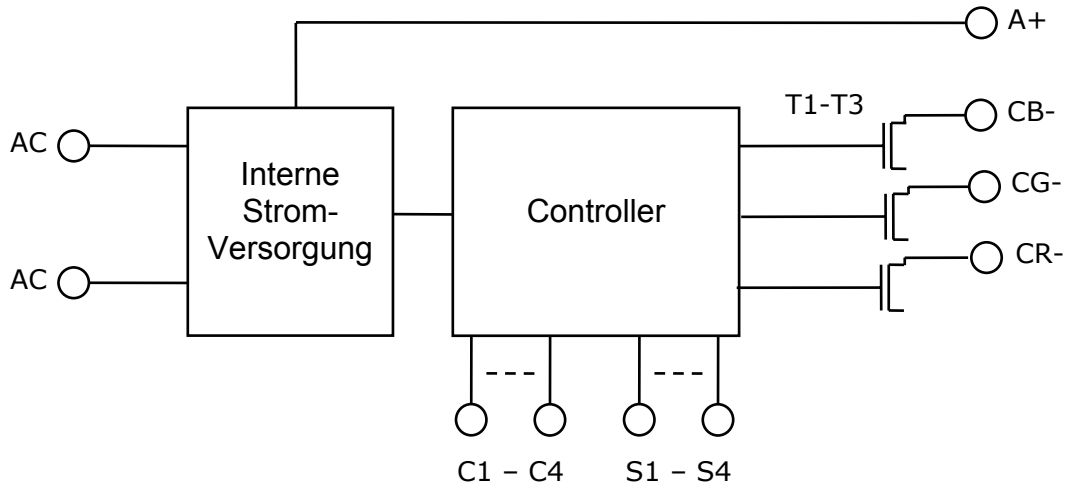


Fig. 2: Block Diagram

1.3 Sensor Interface

The sensor pad is a simple metal pad connected to the sensor interface. This DIMMER needs 4 sensors for full function. Three sensors (S1 – S3) control the three LED strings respectively (e. g. three colours) and the forth sensor (S4) is used to switch on and off the three colours commonly. Thus one can adjust an individual colour and switch on and off the same colour again.

The controller checks the sensor pads and adjusts the LED currents accordingly. The maximum LED current is 20mA per string. Through dimming the LED currents can be adjusted continuously. Hundreds of colours are therefore adjustable.

Controlling the LEDS via touch pads works as described:

- *Short touch of S1-3 (0,1 to 0,4 seconds):*
  - Switching on respective LED string to maximum value if the LED string was off.
  - Switching off the LED string if the respective LEDs string was on. It doesn't matter whether the LEDs have been in ON mode or in DIMMER mode before.
  - Touching shorter has no effect; i. e. noise is filtered out (de-bouncing).
- *Long touch of S1-S3 (longer than 0,5 seconds):*
  - Starting DIMMER operation: If the LEDs are off they are switched to minimum current and the current is increased slowly as long as the sensor is touched. If the maximum current is reached the LED current is reduced again. If the minimum is reached it is increased again.
  - If the LEDs have been switched on before the LED current is decreased or increased depending on history. If the previous operation was increasing the current, the minimum current was reached or the LED was off the current is increased. If the previous operation was decreasing the current or maximum was reached the current is decreased.
- *Short or long touch of S4:*
  - Switching on all LEDs to maximum value if all LEDs were off to the predefined value (one or two string maybe off if predefined).
  - Switching off all LEDs if at least one string was on.
  - Touching shorter has no effect; i. e. noise is filtered out (de-bouncing effect)).

The predefined DIMMER value of the three LED currents (red, green, blue) is stored in the controller memory and is available after switching off from mains voltage (Flash version). Thus the DIMMER can be also switch on via an AC switch (230V) instead of S4. The memory however is erased if the number of connected LEDs is changed during switch off. Only If a different forward voltage is used for one or two strings a sufficient resistor must connected in addition (e.g. for red LEDs). The maximum forward voltage must be always connected to the blue output (CB) without a resistor. If not three LED strings are connected always connect a string to the blue output (CB). We recommend Lumi-Con LED lighting modules. Connection of other modules is on your own risk.

1.4 Control Interface

Versions

The module incorporates 4-pin control interface which can be configured in different ways. The following table gives an overview about the available versions.

Table 1: TD2-Versions

Part number [1)]	S1	S2	S3	S4	C1	C2	C3	C4	Notes
TD2-230-X-N-M	√	√	√	√	M-GND	--	M/S OUT	VDD	[2)]
TD2-230-X-F-M	√	√	√	√	M-GND	--	M/S OUT	VDD	[2)]
TD2-230-X-N-S	√	√	√	--	M-GND	--	M/S IN	VDD	[2)]
TD2-230-X-F-S	√	√	√	--	M-GND	--	M/S IN	VDD	[2)]
TD2-230-X-C2-M	√	√	√	√	GND	CLK	OUT	--	[3)]
TD2-230-X-C2-S	--	--	--	--	GND	CLK	IN	--	[3)]
TD2-230-X-C3-M	√	√	√	√	GND	CLK	OUT	EN/nSS	[4)]
TD2-230-X-C3-S	--	--	--	--	GND	CLK	IN	EN/nSS	[4)]

1) M = Master module, S = Slave module, N = Normal Version, F = Flash Version (Storage)

2) Lumi-Con Master-Slave-Interface active, touch sensor inputs are working, S4 only for Master

3) Two wire SPI-Interface, touch sensor only active for master module (coming soon)

4) Three wire SPI-Interface, touch sensor only active for master module (coming soon)

Lumi-Con Master-Slave Interface

The Lumi-Con Master-Slave-Interface provides a simple interface to synchronize several DIMMERs. The Master module delivers a master signal (12kHz/3V_{Pk-Pk}) at the M/S-Output (M/S OUT) if the LED current is switched on.

The Slave module receives this signal and switches on the light when applied to the slave input.

Both pins (M/S und M-GND) are AC coupled and allow a maximum voltage of 50V relatively to the internal GND. For this reason we recommend to use only Lumi-Con modules to be interconnected at this interface. In addition **all modules interconnected by the Master-Slave Interface must be connected to the same phase of the mains supply**. **Note: the Master–Slave reference ground termination (M-GND) is different to the power ground or protective earth conductor.** You can connect maximum 2 slave modules to one master module. Furthermore, you can supply an external circuit with the provided VDD (3.3V) and GND pin at the control interface.

SPI-Interface

There are versions available shortly with a digital serial interface (SPI) which can be connected via the control interface.

1.5 Voltage Supervisor

The module incorporates an internal voltage supervisor for the LED voltage (at CB only!) as well as for the AC supply. The LED current will be adjusted accordingly if the AC voltage changes. Never disconnect the LEDs during operation. Separate from mains voltage if you modify LED connections.

1.6 Terminal Assignment

Table 2: Terminal Assignment

AC	Mains supply 230V AC, 50Hz*
A+	LED Anode, (+), common anode for all LED strings
CB	Cathode for blue string ***, controlled by S1
CG	Cathode for green string ***, controlled by S2
CR	Cathode for red string ***, controlled by S3
C1…C4	Control I/O
S1…S4	Sensor inputs **

*) All modules connected with master slave interface must be connected to same mains voltage (same phase).

**) Push button may be connected according figure 1. Maximum wire length is 0.5m.

***) Never disconnect the LEDs from module during operation. The module must be disconnected from mains supply. Never operate the module without load (LEDs).

2 Operating Conditions and Electrical Data

			Min	Typ	Max	Note*
Operating temperature, ambient	T_{amb}	°C	0		40	
Humidity	RH	%			90	1
Supply voltage (mains voltage)	V_{AC230}	V_{eff}	210		250	
Periodic peak reverse voltage at AC-AC	V_{AC-PK}	V_{PK}			800	2
Supply (AC-AC) current (wattless current)	$I_{AC-BLIND-0}$	mA_{eff}		7		3
Maximum supply current (AC-AC)	I_{AC-100}	mA_{eff}		55	70	4
Forward voltage of the LEDs	U_{F-LED}	V	40		260	5
Recommended resistor for red LEDs	R_{LED-R}	Ω		56		6
Maximum LED drive current per string	$I_{LED-MAX}$	mA		20		
Minimum DIMMER output power		%		5		7
Input resistance at S1-S4	R_{IN}	MΩ	10			
External capacitance at S1-S4 to GND	C_{IN}	pF			20	8
Timing limit for ON, OFF	t_{ON-OFF}	sec	0,1		0,4	
Timing limit for entering DIMMER mode	t_{DIMM_ON}	sec	0,5			9
Timing limit for stopping DIMMER mode	t_{DIMM_OFF}	sec	0,5			10
Duration of the DIMMER-Ramp	t_{DIMM_DUR}	sec		5		11
Master-Slave-Output: amplitude	U_M	V_{pk-pk}		3		
Master-Slave-Output: source resistance	R_{M-OUT}	kΩ		10		
Master-Slave-Output: coupling capacitor	C_{MS}	nF		22		12
Master-Slave-Output: frequency	f_M	kHz		12		
Master-Slave-Terminals: maximum voltage	$U_{M-MAX-PK}$	V			50	13
VDD output voltage (C1)	U_{VDD}	V	3	3,4	3,7	14
VDD output maximum current (C1)	I_{VDD}	mA			1	14

Anmerkungen:

1) Operation only in dry ambient; condensing ambient not allowed (operating class IP20).
2) An additional surge protection for a limited number of surges up to 1000V is included.
3) LEDs are OFF; active power supply current of the modules, approximately 0,4W; an additional wattles power is consumed due to the noise reduction capacitor (approx. 7mA).
4) The current consumption depends on the number of connected LEDs as well as on the DIMMER adjustment; it includes wattles power.
5) Maximum 72 blue or white LEDs, 20mA.
6) Series resistance per each red LED connected, typical value
7) Referred to the maximum light output
8) Refers to a wire length of about 0.5m, significant parameter is however the external capacitance referred to GND (grounded mains conductor or protective earth conductor).
9) If the sensor S1 is touched longer than 0.5sec DIMMER operation is started. The current is slowly increased respectively decreased as long as the sensor S1 is touched.
10) If the sensor S1 is not touched for 0.5sec DIMMER operation is stopped.
11) Duration of the DIMMER ramp, current increase or decrease from 0% to 100% or from 100% to 0%.
12) Coupling capacitance on terminal M/S and M-GND.
13) Peak voltage for both M/S and M-GND terminal, referred to internal circuit ground (see board dimensions drawing, fig.4).
14) For supply of external circuits, voltage level without load, output resistance 560 Ω

*) All current and voltage values are mean square root values if not otherwise noted.

3 Dimensions

3.1 Cable Preparation

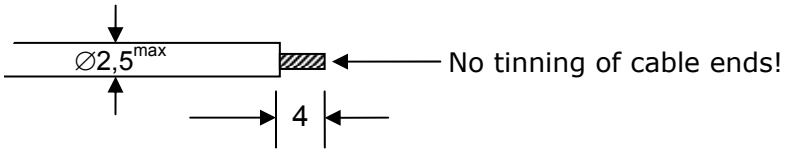


Fig. 3: Cable preparation

Maximum cross section for AC terminal clamps (230V) is 2.5 mm^2, for all other terminals 1mm^2; maximum outer cable diameter is 2.5mm. The terminal clamps have a wire protection mechanism. It may be necessary to re-bend the protection mechanism when repeatedly connected.

3.2 Board-Version

This drawing shows also the pinning for the packaged version, view into open package.

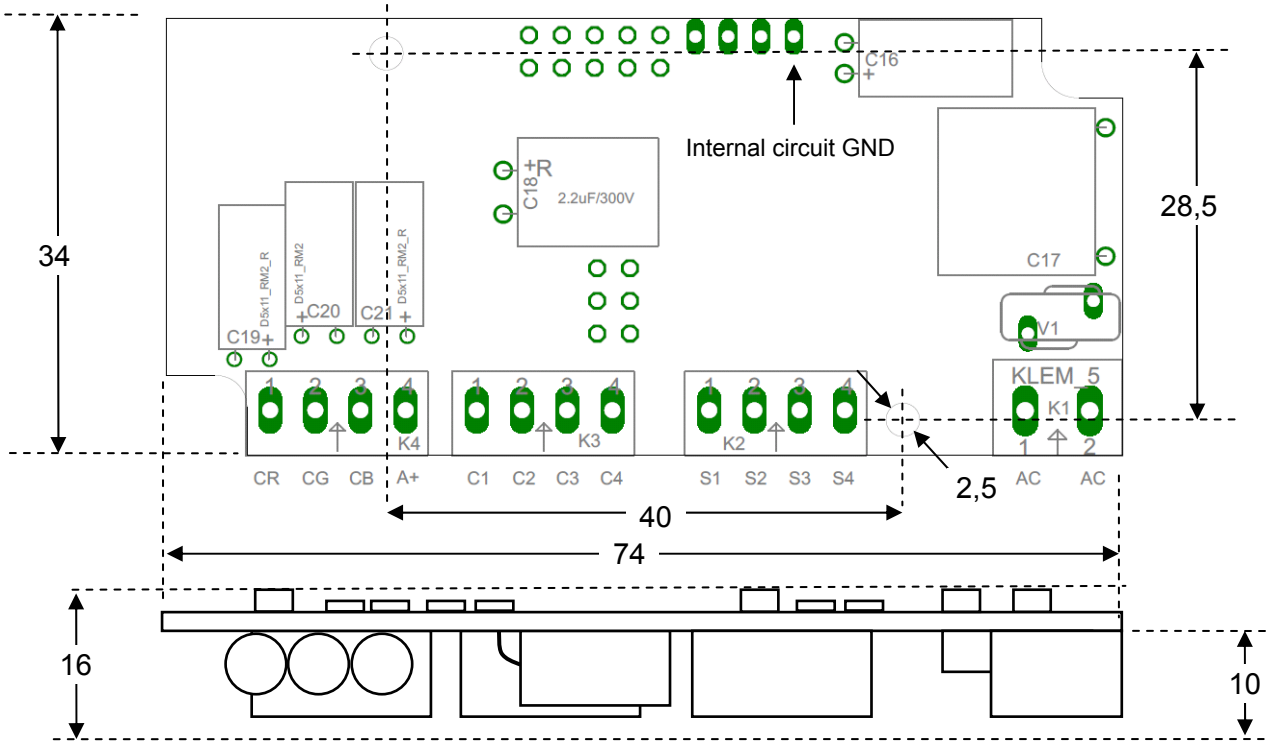


Fig. 4: Board version and pin out (dimensions in mm)

3.3 Package Version

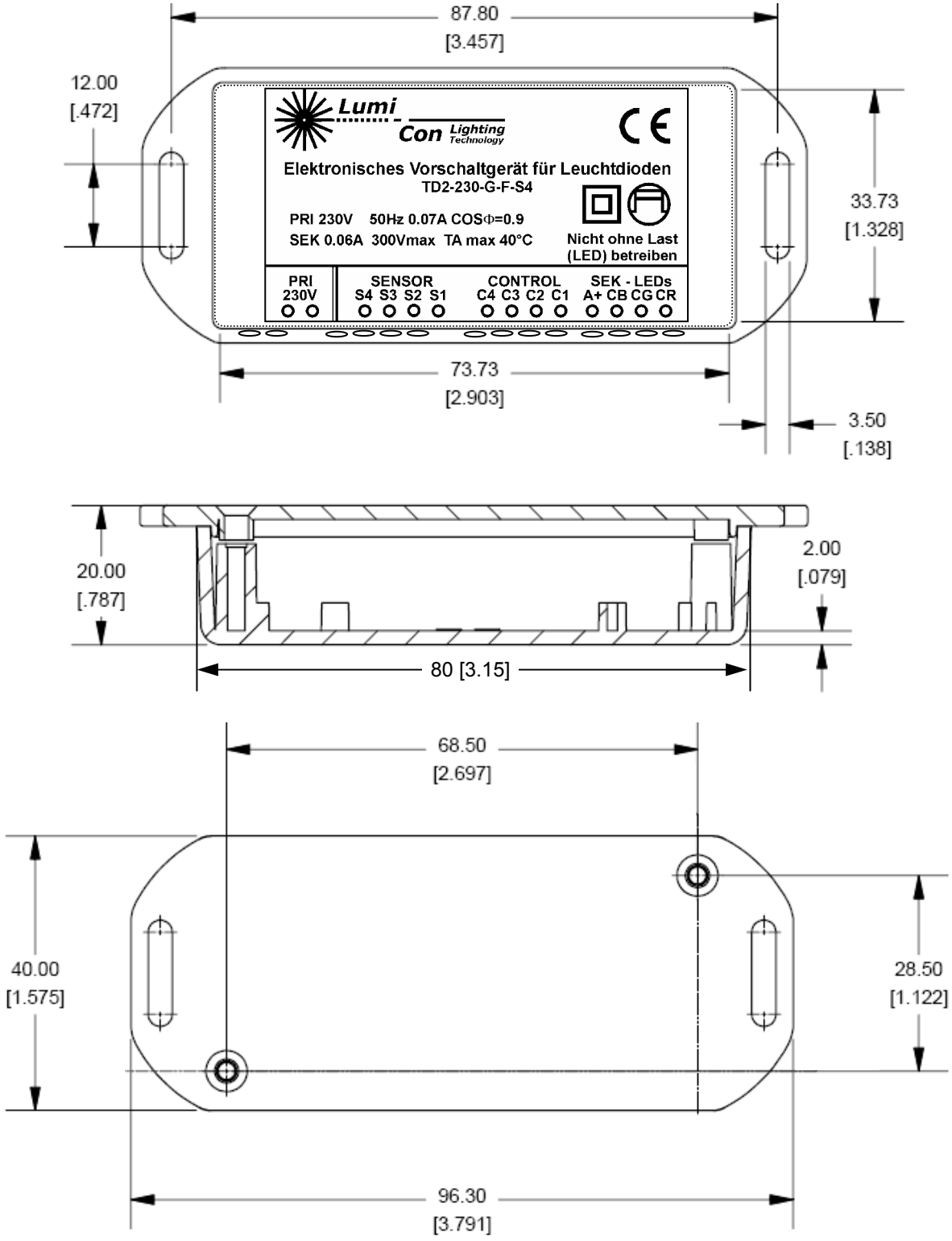


Fig. 5: Packages version, dimensions in mm [inch]

4 The Lumi-Con Master-Slave Interface – Synchronisation of Three DIMMERs

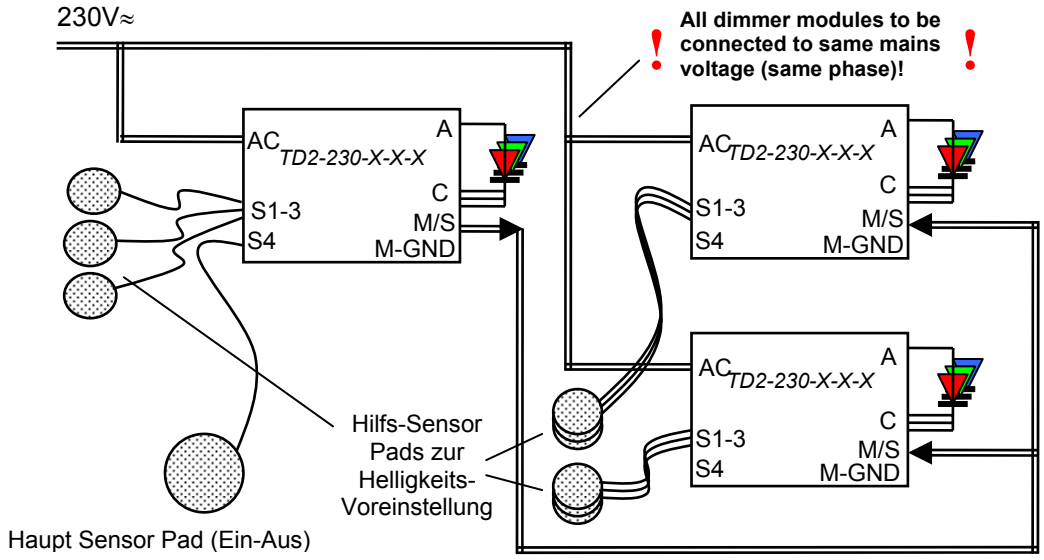


Fig. 6: The Lumi-Con Master-Slave Interface

Lumi-Con dimmers (Normal and Master version) provide a 12 kHz signal at the Master output (M/S OUT) with an amplitude of about 3V when the light is switched on. This signal is able to switch on a Slave module (SC2-230-X-S…). Maximum two Slave modules can be driven from a Master module. **All DIMMER-Modules interconnected through M/S and M-GND must be attached to the same mains supply (same phase).**

5 Part Numbers

TD2-230-X-XX-X

M = Master S = Slave
N =Normal Version F= Flash Version (permanent storage) C2 = SPI-Interface, 2 wire C3 = SPI-Interface, 3 wire
B = Board version G = Package version I = Improved isolation version – coming soon
230 = 230V AC, 50Hz Other supply voltages on request

6 Installation and Precautions

The module is normally directly connected to mains voltage (230V≈). Before you connect to mains voltage (initially) please make sure that all necessary connections are correct. Assure that you have **protection against contact** for all wires including the circuit, mains voltage wires, wires and LEDs thus no occasional contact can happen (exception: sensor inputs S1, S2). The module must not be operated in wet ambient or outside except it is protected accordingly.

The whole circuit including the attached components (e. g. the LEDs) and wires may show up to 350V peak voltage referred to ground. **Please do not touch the circuit and the connected components including the LEDs** if the circuit is powered up. In case of failure please switch of or separate from mains voltage immediately. Do not try to repair the module even it seems simple; this includes also broken fuses.

If you use switches please do only connect to protective earth conductor or to the grounded conductor (as shown in the figure on 1st page).

To measure the circuit (for example the LED current) you need isolated or battery operated instruments or eventually an isolating transformer for the module mains voltage. Caution: During power up an isolating transformer may generate high voltage peaks which can destroy the circuit. Hence, first switch on the isolating transformer, then connect the circuit to it.

After disconnecting the module from mains voltage the onboard capacitors are charged to high voltages. Hence please wait a minute until capacitors are discharged before you touch the circuit and the connected components (LEDs).

The modules fulfil the *EC Low Voltage Directive 2006/95/EC*, the *EC EMC Directive 2004/108/EC* as well as the RoHS compliancy (*EC Directive 2002/95/EC*). In addition they are compliant to *EuP Directive 2005/32/EG: Eco-Design of Energy Using Products*.

Attention please!

The information herein is given to describe certain components and shall not be considered as warranted characteristics. Terms of delivery and rights to technical change reserved.

We hereby disclaim any and all warranties, including but not limited to warranties of non-infringement, regarding circuits, descriptions and charts stated herein.

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