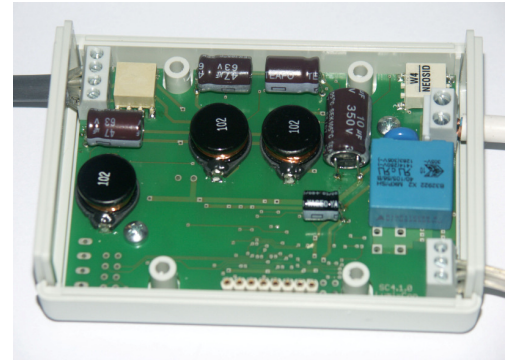


3-in1 Triple Touch DIMMER for High Power LEDs

Features

- 3-in-1 function: Touch-Dimmer, LED-Controller and mains power supply
- Triple LED-driver: 3 independent LED-Controller
- Controlling DIMMER- and ON/OFF via touch sensor or push button
- Controlling up to 48 high power LEDs directly from mains voltage (230V \approx)
- Up to 23W electrical LED power
- Digital storage of Dimmer value
- Soft ON/OFF
- Integrated EMI filter compliant to EU standards
- LED-current regulation and LED-voltage supervision
- Low power consumption – high efficient buck controller
- Very low stand-by power consumption of 0.2W (all LEDs off)
- Automatic adaptation to number of connected LEDs
- Optional *SPI or UART Interface – prepared for DMX*
- IP20 (dry ambient)



Application

- Controlling LEDs for Lighting
- Colour mixing and colour temperature control of lamps
- „Touch-Me“-lamps
- Suitable for high power LEDs up to 350mA
- Electrical power of up to 23Watt for more than 2000 Lumen light output with state of the art LEDs
- Touch Extension access available.

Caution!

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

1 Overview

1.1 Circuit

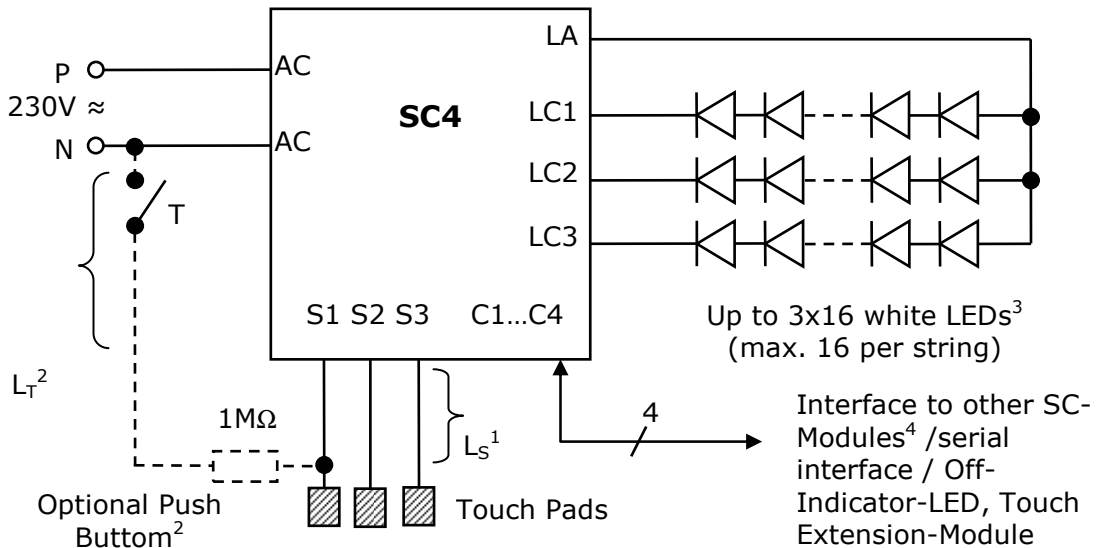


Fig. 1: Dimmer circuitry

- 1) Maximum wire length L_T and L_S is approx. 0.5m, for extension see page 4
- 2) Switch (dotted line) must be connected (for safety reasons) only to grounded (neutral) power line (N) or protective earth conductor. A $1M\Omega$ resistor is recommended close to the switch.
- 3) or accordingly higher number of LEDs with lower forward voltage
- 4) Master-Slave connection according application circuit on page 9 or serial interface

1.2 Block Diagram

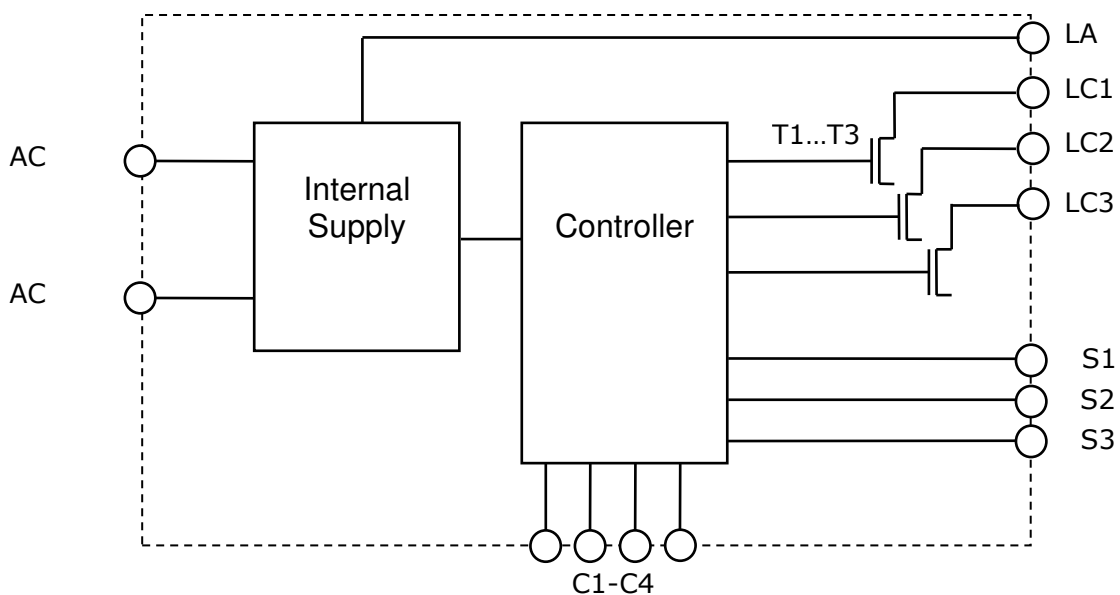



Fig. 2: Block Diagram of the Dimmer

www.lumi-con.de		LED-Beleuchtungstechnik	Data sheet
			SC4-230-X-H-X-X
Dr. Karl Schrödinger Setheweg 12 D-14089 Berlin			Triple High Power LED Touch DIMMER Rev. 1.3 - 04/2013

The SC4-DIMMER module can be connected directly to mains voltage (AC 230V, 50Hz) without using a transformer. It can drive up to 48 white LEDs at a current up to 300mA. The LED power is controlled via the touch pads (S1, S2, S3) or the control pins (C1 ... C4). A touch pad is a simple metal surface electrically connected to S1/S2/S3. The controller incorporates DIMMER and ON/OFF operation.

As shown in figure 2 above the module consists of an internal power supply, the controller as well as up to three drivers T1...T3 operating as switched mode LED supply. The power supply generates a 3.3V supply as well as the DC supply for the LED switch mode controller from mains voltage. During stand-by-operation (LED power off) only **0.2W** are consumed which accumulates to only **0.6kWh** per year and fulfils the EU directive *EuP 2005/32/EG (ECO Design of Energy Using Products)*. The Master signal is available at a control output and showing a 1kHz-signal when the light is switched on (see description of Master-Slave-operation). Further versions with serial SPI or UART interface are available (in development). There are versions with two (dual dimmer) and three (triple dimmer) LED controllers available.

The controller monitors the touch inputs (Sx) and/or control inputs (Cx) and controls the switch mode controller generating the LED current. During DIMMER operation the average DC LED current can be varied from minimum to maximum current (up to 300mA, the maximum current depends on the number of connected LEDs – see electrical data below).

2 Description of Main Versions

2.1 Normal-Version (-NYYY-)

The normal version is controlled via one to three touch sensors inputs (S1-S3). Touch sensor operation for each sensor is done in the following way:

- *Short touch (0.1 to 0.4 seconds):*
 - Switching ON the LEDs to maximum current if the LEDs have been switched OFF before.
 - Switching OFF the LEDs if the LEDs have been switched ON before. 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 (debouncing effect).
- *Long touch (longer than 0.5 seconds):*
 - Starting DIMMER operation: If the LED 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.

The normal version has either a Master output or a LED-OFF-Indicator output. Depending on the function not all touch inputs have same functionality.


Following Normal-Versions are available:

A) Normal-Version with 1 Sensor, three LED-Controllers (N13, triple dimmer)

One Sensor-Input (S1) and three LED-Controller/Dimmer, all are controlled synchronously via one Sensor (S1).

B) Normal-Version with 1-Sensor, two LED-Controller (N12A, dual dimmer)

One Sensor-Input (S1) and two LED-Controller/Dimmer, all are controlled synchronously via one Sensor (S1).

www.lumi-con.de		LED-Beleuchtungstechnik Dr. Karl Schrödinger Setheweg 12 D-14089 Berlin	Data sheet SC4-230-X-H-X-X
			Triple High Power LED Touch DIMMER Rev. 1.3 - 04/2013

C) Normal-Version mit 1-Sensor, two LED-Controller (N12B), e. g. for colour temperature control

One sensor (S1) and two LED-Controller/Dimmer, which are controlled in the following way:

- *Short touch of S1 (0.1 to 0.4 seconds): The two LED-strings (L1, L2) are switched in the following sequence:*
 - #1: OFF
 - #2: L1-ON
 - #3: L1-OFF, L2-ON
 - #4: L1-ON-100%, L2-ON-100%
 - #1: OFF usw.
- *Long touch of S1 (longer than 0.5 seconds):*
 - During OFF: no function
 - During ON: Dimming of the respective LED string(s)

D) Normal-Version with 2 Sensors, two LED-Controllers (N22, dual dimmer)

Two Sensor-Inputs (S1, S2) and two independent LED-Controller/Dimmer

E) Normal-Version with 3 Sensor, three LED Controller (N33, triple dimmer)

Three Sensor-Inputs (S1, S2, S3) and three independent LED-Controller/Dimmer (1,2,3), e.g. for RGB control or controlling 3 independent LED-strings.

For Version A, B and C the LED-Strings should of be equal length for better dimming behaviour.

2.2 Master-Version (-MYY_-)

All versions above are available with master output.

The module offers a so called *Master-Slave-Output* signal (1kHz, 3V_{PK-PK}) at the terminal M/S OUT when the LEDs are switched ON. This signal may be used to control Slave DIMMER-Modules. The output includes an appropriate reference terminal M-GND. Both outputs are coupled via capacitors suitable for a maximum voltage difference up to 50V referred to the internal signal ground. For this reason only Lumi-Con DIMMER-Modules are to be connected to these nodes. **Interconnected modules (through M/S and M-GND) must be connected to the same mains voltage phase!** Note that the Master-Slave reference ground termination (M-GND) is different to the power ground or protective earth conductor.

2.3 Slave-Version (-SYY_-)

All versions described under chapter 2.1 are available as slave version. The Slave input is used as additional input to switch on the LED controller to the, via touch sensor, predefined power value. The Salve input must be connected to a Master output of another module.

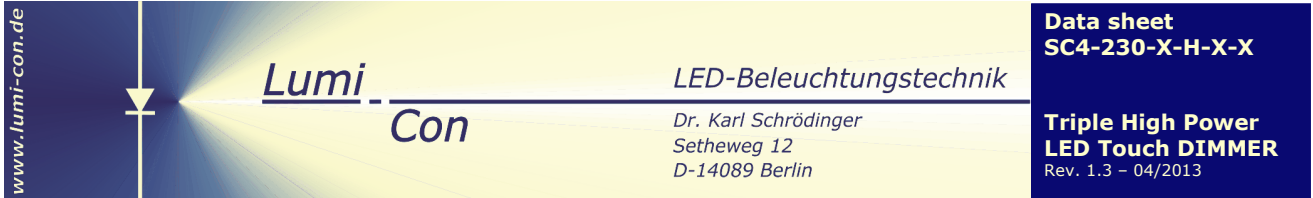
2.4 Controller-Versions (-CY__-)

These versions are controlled via the serial interface (SPI or UART, preliminary information, in development).

3 Available Sub Versions

3.1 Flash-Version (-YFYY-)

The **Flash-Version** is able to store the actual dimmer value in a non volatile memory (flash). Thus the DIMMER module "remembers" the latest driving conditions when disconnected from mains voltage. This latest driving condition is configured again after reconnecting to mains



voltage. This module is therefore suitable for lamps which are switched with „normal“ AC-switches while the DIMMER value is configured initially (for example to adjust the colour of a lamp). Please note that the number of LEDs must not be changed during interruption of mains supply, otherwise the circuit is reset and the DIMMER is in OFF-state after power on (due to necessary new initialization).

3.2 SOFT-ON/OFF (-YYSY-)

Modules with **Soft-ON/OFF-Function** are switching the light slowly on and off. The time of the ramp is about 1 second. The dimmer operation is working as described as above.

3.3 LED-OFF-Indicator (-NYYL-)

The **LED-OFF-Indicator** output is available for the normal version. A low power LED (approx. 1mA) can be connected to the pins MS I/O - VDD of this version (see page 9). This LED is switched on when the Lamp is off. This function can be used as a night light for your lamp. The master output is not available for this version. LED connection is not isolated from mains voltage (usage of 230V isolation).

3.4 Touch Extension Access (-NYYL-)

Touch Extension versions allow connecting a Touch Extension Module (TE1). Using this technology an up to 10m long cable to the touch sensor can be attached. Both touch extension input (S4) and sensor input (S1) can be used in parallel. Touch Extension versions are only available for single sensor input normal versions (others on request). Optional LED indicator can also be use. LED pins are modified for those modules. See table on page 7 for pinning. TE connection is not isolated from mains voltage (usage of 230V isolation, see more details in TE1 data sheet).


4 Package- / Board-Version

All versions are deliverable as packaged ("-G-") or board ("-B-") version. Please note that an appropriate isolation must be kept if the board version is mounted.

5 Current and Voltage Supervisor

The module contains an automatic current and voltage supervisor. It is guaranteed that the referred maximum current depending on number of LEDs connected is not exceeded (see Fig. 4). In addition the current is adjusted (regulated) to maximum current if the LED is in ON-mode (at the 100% level).

A voltage supervisor guarantees the correct operating mode or shuts down the module if the respective maximum voltage level is exceeded. The module is reset in this case and starts a new initialization adapting to the new Led count. If the absolute maximum voltage level (about 63V at terminals LA-LCx) is exceeded the module will not turn on.

 www.lumi-con.de	Lumi <hr style="width: 100%;"/> Con	LED-Beleuchtungstechnik Dr. Karl Schrödinger Setheweg 12 D-14089 Berlin	Data sheet SC4-230-X-H-X-X Triple High Power LED Touch DIMMER Rev. 1.3 - 04/2013
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6 Operating Conditions and Electrical Data

		*	Min	Typ	Max	Note
Operating ambient temperature	T	°C	0		40	
Relative humidity	RH	%			90	1
Input / supply voltage at AC-AC	V _{AC230}	V _{eff}	200		250	
Periodic peak reverse voltage at AC-AC	V _{AC-PK}	V _{PK}			800	2
Supply (AC-AC) current (active current)	I _{AC-ACT-0}	mA _{eff}		0.8		3
Supply (AC-AC) current (wattless current)	I _{AC-WATTL-0}	mA _{eff}		24		3
Maximum supply current (AC-AC)	I _{AC-100}	mA _{eff}			150	4
Forward voltage of the LEDs	U _{F-LED}	V	5		63	5
Maximum LED drive current, 100%-value,	I _{LED-MAX-3}	mA		350		6
Minimum DIMMER output power		%	2		10	7
Input resistance at S1, S2	R _{IN}	MΩ		10		
External capacitance at S1, S2 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 DIMMER Ramp	t _{DIMM_DUR}	sec		8		11
Duration of Soft-ON/OFF ramp	t _{RAMP_DUR}	sec		1		12
Master-Slave-Output: amplitude	U _M	V		3		
Master-Slave-Output: source resistance	R _{M-OUT}	KΩ		27		
Master-Slave-Output: coupling capacitor	C _{MS}	nF		22		13
Master-Slave-Output: frequency	f _M	KHz		1		
Master-Slave-Terminals: maximum voltage	U _{M-MAX-PK}	V			50	14
LED-OFF-Indicator current	I _{OFF-IND}	mA		1		15

Notes :

- 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) All LEDs are OFF; active power supply current of the modules, approximately 0,2W; an additional wattless power is consumed due to the noise reduction capacitor (24mA), normal version w/o night light.
 - 4) The current consumption depends on the number of connected LEDs as well as on the DIMMER adjustment; it includes wattless power.
 - 5) At maximum operating current (300mA); if higher voltage (i.e. more LEDs) is applied the module turns off to avoid destruction; see fig. 5, page 7. If less than 2 white LEDs are connected, a higher drive current may occur initially at the output.
 - 6) See fig. 4, page 7.
 - 7) Depending on the number of connected LEDs.
 - 8) Refers to a wire length of about 0.5m (e. g. normal mains cable), significant parameter is however the external capacitance referred to GND (grounded mains conductor or protective earth conductor)
 - 9) If the sensor Sx is touched longer than 0.5sec DIMMER operation is started. The current is slowly increased respectively decreased as long as the sensor Sx is touched.
 - 10) If the sensor Sx is not touched for 0.5sec DIMMER operation is stopped.
 - 11) Duration of DIMMER ramp, current increase or decrease from 0% to 100% or from 100% to 0%.
 - 12) Only Soft-ON-OFF version
 - 13) Coupling capacitance on terminal M/S and M-GND.
 - 14) Peak voltage for both M/S and M-GND terminal, referred to internal circuit ground (see board dimensions drawing, page 6).
 - 15) For a white or blue LED.
- *) All current and voltage values are mean square root values if not otherwise noted.

Fig.4: Maximum LED current and Power depending on connected LEDs

- 1) (green) 1 or 2 LED strings (2-16 LEDs per string)
- 2) (pink) 3 LED strings (2-16 LEDs per string, all string have same LED count)
- 3) (yellow) Maximum Power for 3 strings (right scale)

All curves valid for white LEDs with approx. 3.4V forward voltage.

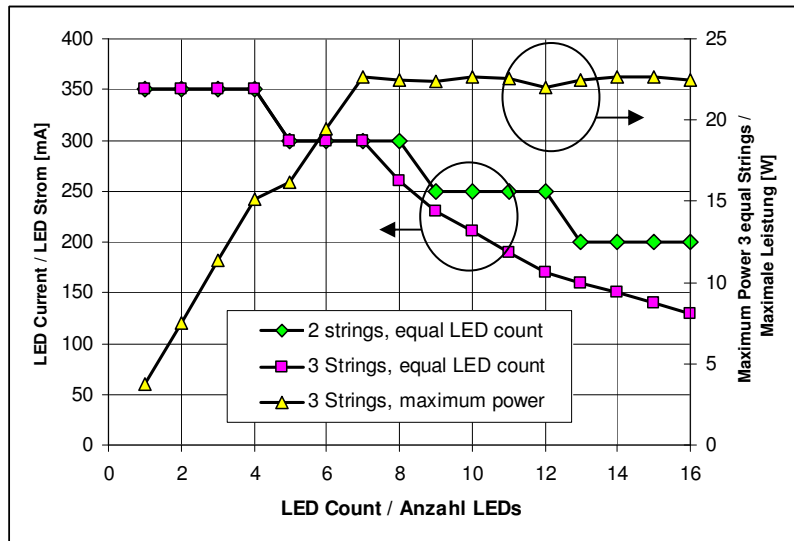
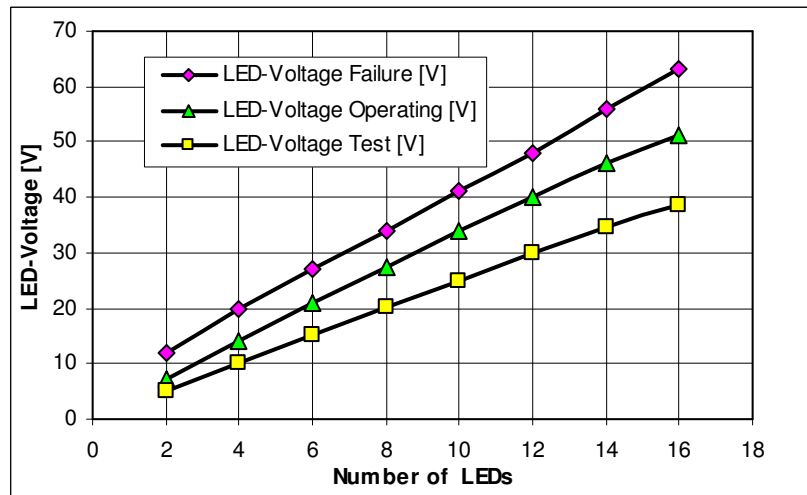


Fig.5: Forward voltage specification for connected LEDs

„Operating Voltage“: typical LED-forward voltage at maximum current;

„Test voltage“: LED-Forward voltage during initialization Led current <10% of maximum)

„Failure voltage“: above this voltage the module is switched off.



7 Operation with Switch and Larger Distance to Dimmer

If a larger distance to DIMMER to touch pad is requested **and** a switch or push button (T) is used a 40...80 MΩ resistor can be implemented to decouple the line-capacitance. The switch T must be connected to neutral line (see also our touch extension module TE1).

- 1) depends on line length of L_T
- 2) push button to ground or protected earth only

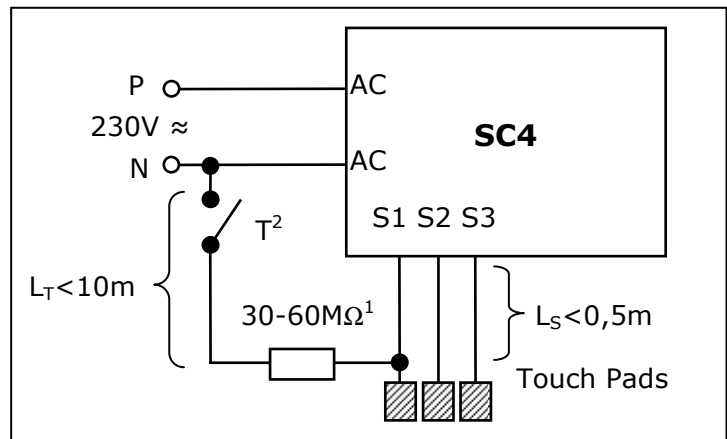


Fig. 3: Extension of Touch-Pad wire length

8 Pin Assignment

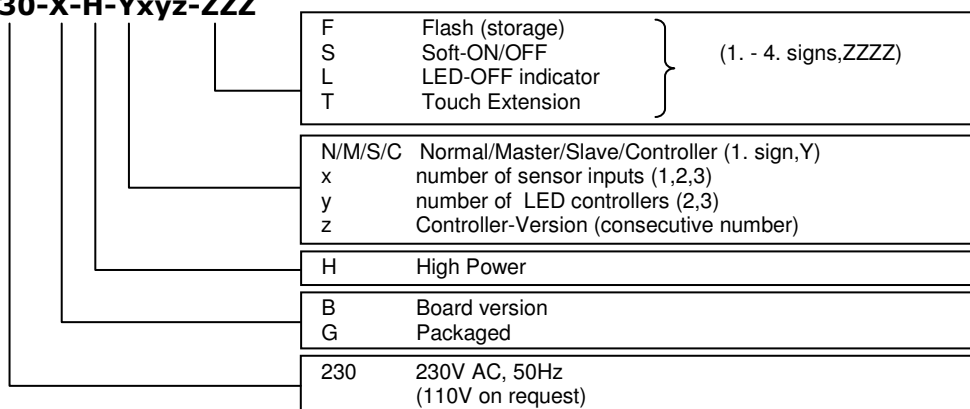
Order Number	C1	C2	C3	C4	Notes
High Power DIMMER					
SC4-230-X-H-N...	GND	./.	./.	VDD	Normal-Version
SC4-230-X-H-M...	GND	M-GND	M/S OUT	VDD	Master-Version
SC4-230-X-H-S...	GND	M-GND	M/S IN	VDD	Slave-Version
SC4-230-X-H-Nxy-YYL	GND	(M-GND)	LED-Cath	LED-An.	OFF-Indicator LED
SC4-230-X-H-N1y-YYLT	TGND		LED-An.**	TE-IN	Touch Extension Access
SC4-230-X-H-C1... *	GND	SPI-CLK-OUT	SPI-DOUT	VDD	SPI Master-Version
	GND	SPI-CLK-IN	SPI-DIN	VDD	SPI Slave-Version
SC4-230-X-H-C2... *	GND	--	DOUT	VDD	UART Master-Version
	GND	--	DIN	VDD	UART Slave-Version (DMX)
SC4-230-X-H-C3... *	GND	--	DOUT/IN	--	DALI Version

*) Advanced information, in development

**) connect LED Cath and TE-GND to GND.

Version Overview:

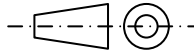
SC4-230-X-H-Yxyz-ZZZ



Explanation of the short cuts in the order numbers

- a. SC4: Dimmer Type
- b. 230: Mains voltage (110V on request)
- c. X: B/G: Board or Package Version
- d. H: High Power Dimmer
- e. Main versions (Y=N/M/S/C)
 - i. Y=N: Normal
 - ii. Y=M: Master
 - iii. Y=S: Slave
 - iv. Y=C2: SPI 2-wire interface, DIN = SPI Slave in
 - v. Y=C3: SPI 3-wire interface
- f. Number of Sensor Inputs (xy)
 - i. 13: 1 Sensor, 3 synchronous Controller
 - ii. 22A: 2 Sensors, 2 Controller
 - iii. 22B: 2 Sensors, 2 Controller
 - iv. 33A: 2 Sensors, 3 Controller (2 synchronously)
 - v. 33B: 3 Sensors, 3 Controller
- g. Controller Version (z)
 - i. 0 or _ : direct control of the dimmers
 - ii. serial number: customer specific control, e.g. colour temperature control
- h. Subversion (ZZZ)
 - i. F: Flash (Storage of the dimmer value)
 - ii. S: SOFT ON/OFF
 - iii. L: LED OFF INDICATOR (switches a low power LED on when the lamp is off (night light), only for normal version (N))
 - iv. T: Touch Extension access (only for single sensor input normal versions)

9 Dimensions



9.1 Cable Preparation

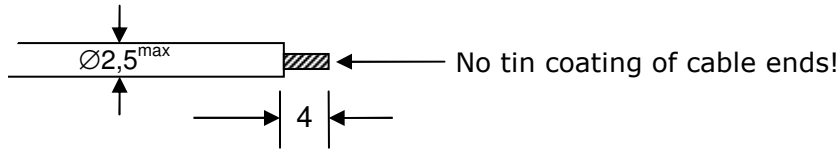


Fig. 6: Cable Preparation

Maximum wire cross section for AC (230V) 2.5 mm², all others 1mm², maximum outer cable diameter Ø2.5mm.

9.2 Board-Version

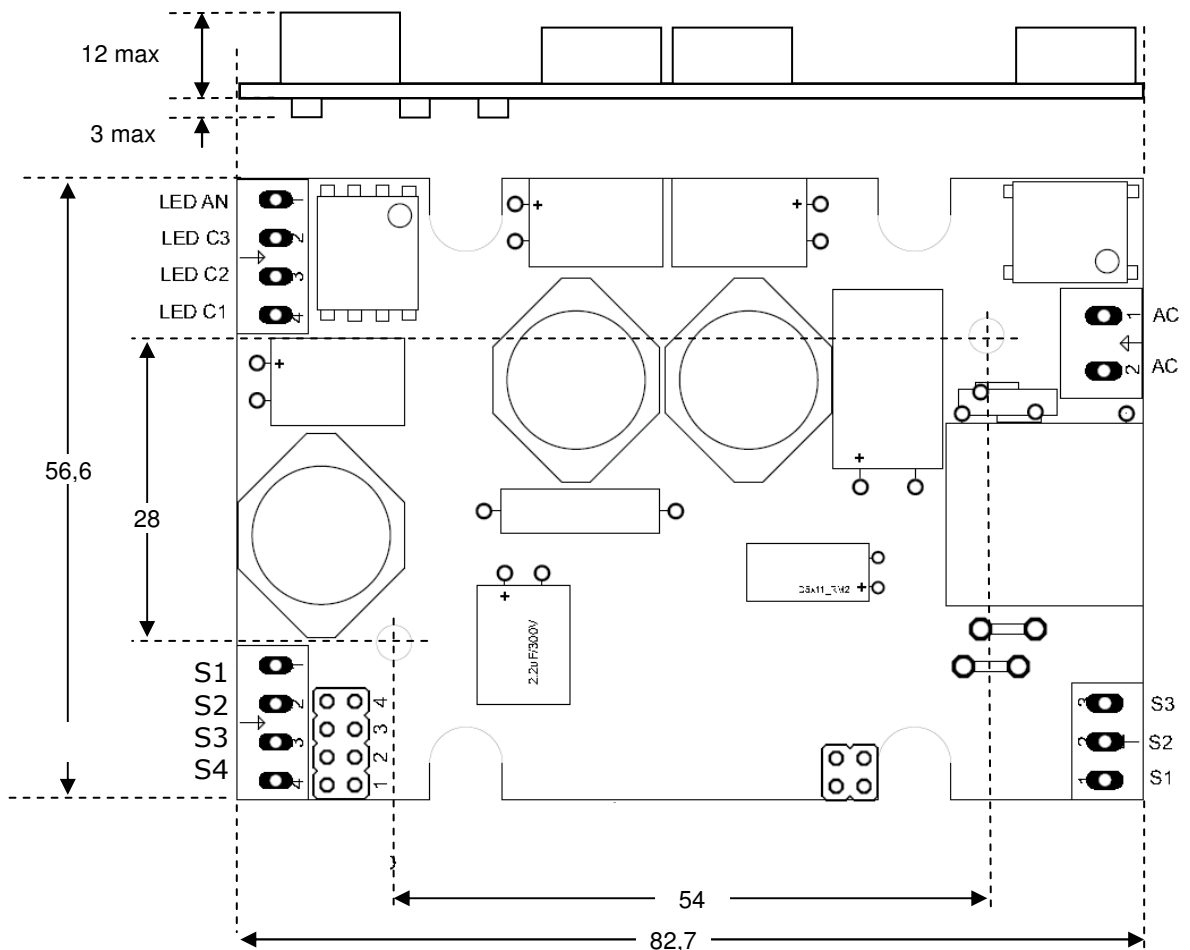


Fig. 7: Board version (view into package for packaged version), diameter of fixing holes Ø 3,2mm (2x), dimensions in mm

9.3 Package-Version

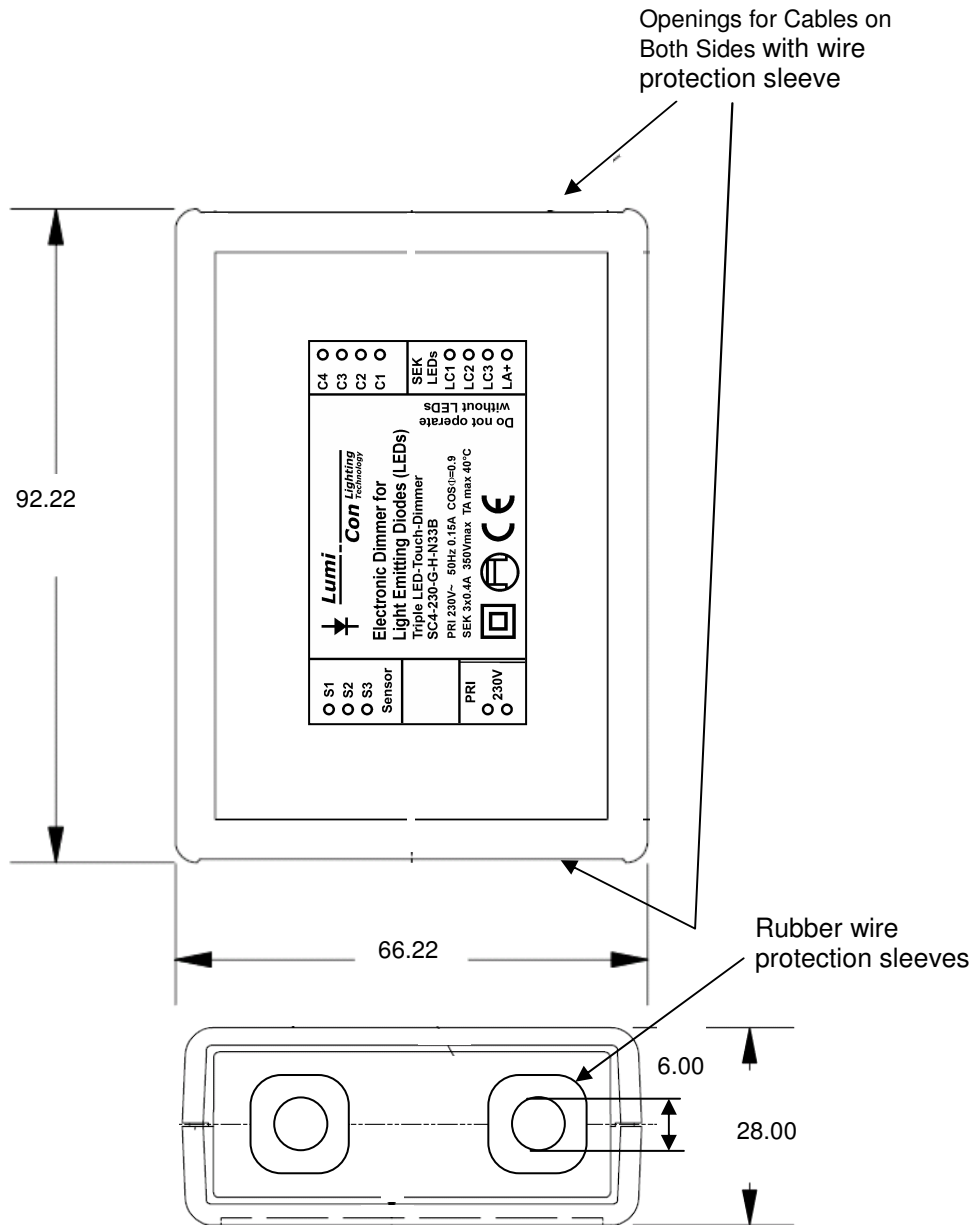


Fig. 8: Package version (Dimensions in mm)

10 The Lumi-Con Master-Slave-Interface – Synchronization of several LED-DIMMERS

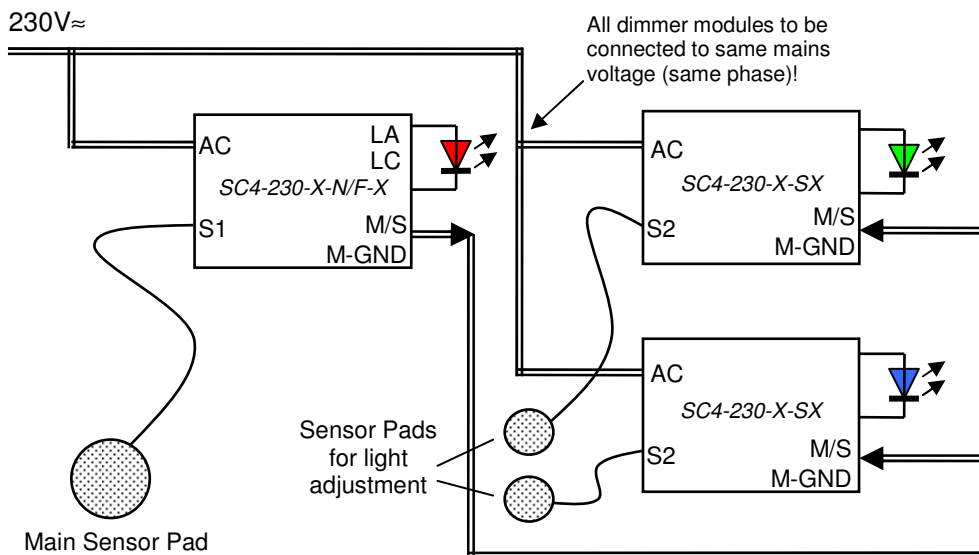


Fig. 9: Master-Slave Interface

Lumi-Con dimmers (Normal and Master version) provide a 1kHz 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 phase of mains supply.**

11 Installations and Precautions



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



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.

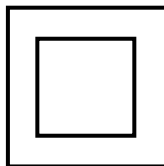
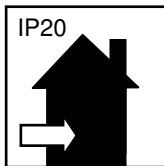
If you use **switches** please do only connect to protective earth conductor or to the grounded conductor (as shown in the figure on 1st page).

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 a 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* (former 73/23/EEC), 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.

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