

# ESB101

## Inrush Current Limiter, Inrush Current Protection

For capacitive loads, 115Vac/230Vac 16A, 16 ⅓ Hz – 440Hz, - 40°C ... +60°C

### Short Specification:

- Peak- / R.M.S. current limiter
- 90-130Vac / 184-265Vac, 16A continuous
- DIN TS35mm DIN-Rail
- Wall mount (universal housing)
- Spring-type terminals 0,5-6mm<sup>2</sup> / 21-10AWG
- Integrated bypass relay
- Capacitive load 1.500uF to 10.000uF
- Integrated temperature protection
- IP20 UL94V-0 housing DIN43880 for DIN/VDE0603 cutout box

The ESB is a budget-priced inrush peak current limiter for high loads in LED-applications, complex automation systems and in the machine building. The ESB101 offers effective and interference free operation with capacitive loads. It is simple to integrate into existing equipment. The ESB101 is self-powering and does not require an external power supply.

## 16 ⅓ Hz – 440Hz

**No simple NTC-solution! It allows to reduce cabling sections and to install fast circuit breakers. 100% protection from tripping pre-installed circuit breakers or burning relay and line switch contacts.**

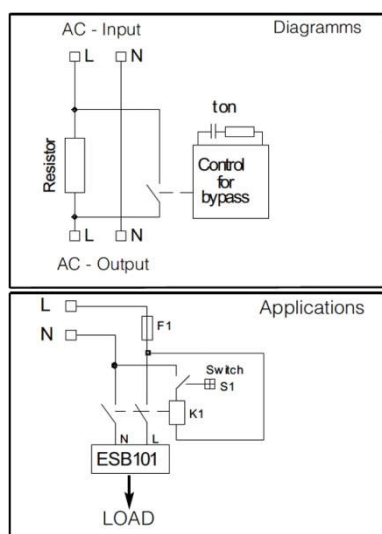


## Technical Table

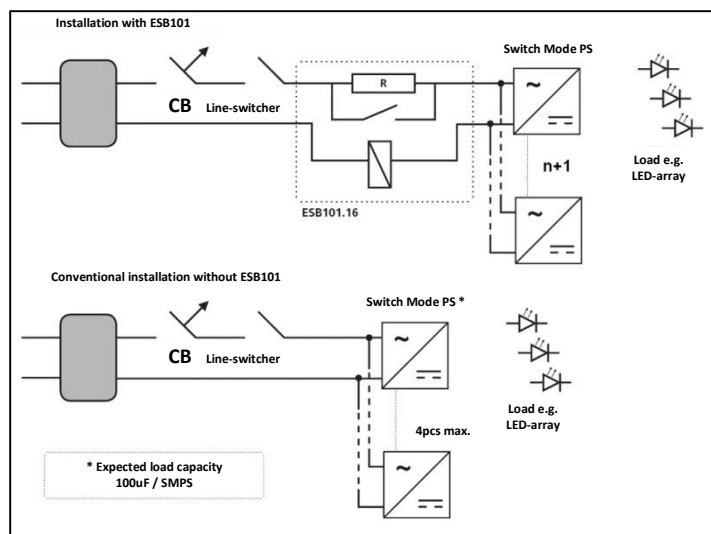
Model	ESB101.05UPS	ESB101.16	ESB101.23	ESB101.23S	ESB101.33	ESB101.LED.230VAC	ESB101.LED.115VAC	ESB101.23S.115VAC
Peak Current Limiting ±6%	5A	16A	23A	23A	33A	48A	43A	23A
R.M.S Current Limiting ±6%	3,5A	11,3A	16,3A	16,3A	23,3A	33,9A	30,4A	16,3A
Maximum Allowed Capacitive Load	1.000uF	1.500µF	2.000uF	2.000uF	4.000µF	6.000uF	10.000uF	4.000µF
Limiting Time (T <sub>on</sub> Power On)	900ms (±50ms)	300ms (±50ms)	300ms (±50ms)	500ms (±50ms)	300ms (±50ms)	300ms (±50ms)	300ms (±50ms)	500ms (±60ms)
Release Time (T <sub>off</sub> Low Voltage)	1400ms (±50ms)	500ms (±50ms)	500ms (±50ms)	800ms (±80ms)	500ms (±50ms)	550ms (±50ms)	550ms (±50ms)	900ms (±80ms)
Limiting Interval (T <sub>Interval</sub> for AC <sub>cont.</sub> )	≥ 900ms	≥ 900ms	≥ 900ms	≥ 1400ms	≥ 900ms	≥ 900ms	≥ 900ms	≥ 1400ms
Quickest advisable Circuit breaker at 30°C	A2A	A6A B4A Z6A	A10A B6A Z10A	A10A B6A Z10A	A13A B8A Z13A	B13A	A16A B13A Z16A	A10A B6A Z10A
AC Input Range	184-265Vac						90-130Vac	
AC Continuous Input Range	230Vac						115Vac	
Line Frequency	16 ½ Hz – 440Hz						16 ½ Hz – 440Hz	
Switch-On Voltage	144Vac						79Vac	
AC Lower Margin	52Vac (AC dump / drop out voltage)						28Vac (AC dump / drop out voltage)	
AC Current	16A continuous load current							
Power Supply	No external power supply required, item is self-powering							
Current Consumption	19mA constant at continuous operation (2,2W @ 115Vac / 4,4W @ 230Vac)							
Limiting Cycles	Between each limiting action shall be a break of 20 sec., to let the device cool down until the next limiting starts							
Internal Protection	Thermal fuse protects from overheat & fire							
Cooling	Natural convection							
Operation Temp.	Ambient temperature -40°C ... +60°C continuous (see operations temperature list for details in this manual)							
Storage Temp.	-40°C ... +85°C for 2 years							
EMI	EN55022 class B							
EMS	EN61000-6-2,3							
Safety Norms	EN60950-1, several units: ANSI/UL508 & CAN/CSA C22.2 (see product list for details in this manual), UL-File: E485106							
Safety Class II	VDE0805, VDE0100/ÖVE8001							
ROHS conformity	ROHS Directive 2011/65/EU							
REACH conformity	REACH Directive 1907/2006							
MTBF Calculation	300.000h (IEC/EN61709, Siemens SN29500)							
MTTF Calculation	384.000h (+30°C) (IEC/EN61709, Siemens SN29500)							
Humidity	95% (+25°C) not condensing							
Pollution Degree	2 (IEC/EN50178)							
Environmental	Thermal environment 3K3, mechanics 3M4 (IEC/EN60721)							
Altitude max.	4000m (13123 ft.) above sea level							
Dimensions (WxHxD)	(Wide=2TE), 36,5x110x62mm							
Housing Parameters	UL94V-0 (E45329), ABS/NH6020, RTI 110°C, housing for DIN/VDE0603 cutout box and for wall mount							
DIN-Rail	DIN-Rail TS35mm DIN/EN60715 (TS35/7,5 und TS35/15)							
Weight	121g / 0,27 lb							
Connections	Spring-type terminal with cable protection 0,5...6mm² 21...10AWG according with IEC/EN60664-1, IEC/EN61984 Use copper conductors only. Tightening torque per terminal block is 0.5 - 0.6 Nm / 4.5 - 5.3 lbf-in							

## General Description

The CAMTEC ESB101-series are the 2nd generation and cost-effective inrush current limiters. The limiters are made for 115/230Vac 16A networks. The line frequency range is 16½Hz – 440Hz. The ESB101-Limiter shall be located between the line-switcher/contactor and the load (p.2/Fig.1). The ESB-models are designed for capacitive loads (not for inductive loads like coils/transformers, not for AC-motors and not for DC-voltage application). In the moment of switching-on the system the inrush current of the installed load will be limited for the defined time  $T_{on}$  (p.4/Fig.5). Independent from the previous inrush level; the current limiting is always strict. After  $T_{on}$  elapses the current limiting circuit of the ESB101 will be bypassed. Then the load is directly connected to the AC. The electrical network can be stressed with current loads as normal (e.g. motors, pumps). If an AC dump overshoots the defined time  $T_{off}$ , it will be detected by the ESB101 (p.4/Fig.6). As soon as the AC recovers the inrush will be limited, again (p.2/Fig.3 & 4). The ESB101-models provide an internal temperature control. In case of a failure the device shuts down to safely prevent from overheating or fire.



(Fig.1)



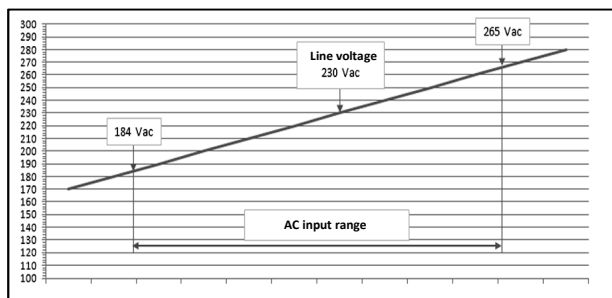
(Fig.2)

## Field Applications

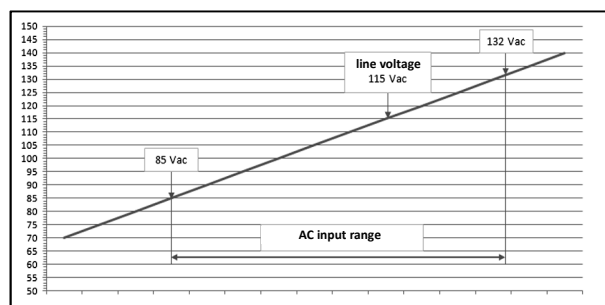
The ESB101 limiter allows connecting much more capacitive loads (e.g. LED-power supply / LED-driver) to a pre-installed circuit breaker CB (Fig.2). The ESB avoids that the MCB will be tripped. This occurs independent to the objective initial current. The result is that the number of A.C. branch lines and the pre-installed MCB can be reduced dramatically. Installation cost exhibit a sustained decline. Alternatively, the cross section of the branch lines can be reduced when using smaller and faster responding circuit breakers. The cost saving from copper is essential. Sensitive AC networks can be fused safer (e.g. Traffic Control Systems, Street-Lighting, Parking Lots and Tunnels). When the ESB101 is installed correctly, the neutral wire (N) is looped trough (Fig.1). The inrush protection circuit always acts to the line conductor. The load relates to the AC in such a way that a circuit breaker or an earth-leakage-trip works within the limits of the legal rules. This fact is also applied while the limiting circuit acts. The ESB101 is designed for capacitive loads, only. The ESB101 cannot be used together with transformers, coils, AC-motors & drives, heaters or with DC-voltage at all.

## Special Models ESB101.LED with 115Vac & 230Vac

Compared to all other ESB101-models the LED-types are the universal inrush current limiters. The concept design is made to construct optimized A.C. networks in the building automation and in the lighting sector. Tripping the installed circuit breaker will be effectively prevented. The inrush limiting time is adjusted to the values of a typical LED switch mode power supply or LED-drivers. The connectable load capacity is such as high, that even in the extremes cases it is rather impossible to exceed it in a 16A network. Installed contractors will be discharged and their lifetimes will considerable increase. To protect the installed relay in a controlled DALI-/DMX-Multiplexer we advise to use the ESB101.23 for a 16A relay or the ESB101.16 for a smaller relay. Note that the ESB101 is not designed to operate together with gas induction lamps or other conventional lighting device. The ESB101 is designed for capacitive loads, only.



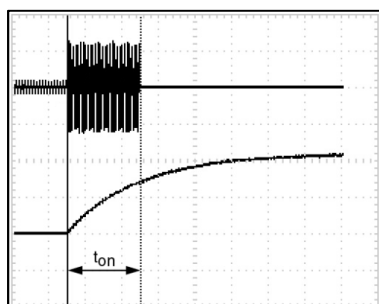
(Fig.3 operating range 230Vac)



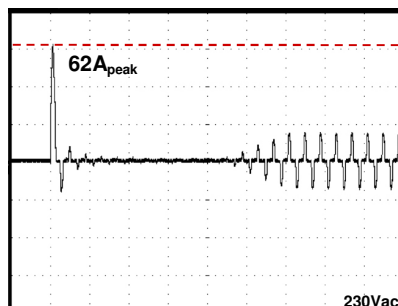
(Fig.4 operating range 115Vac)

## Design-In of the ESB101 into A/C networks

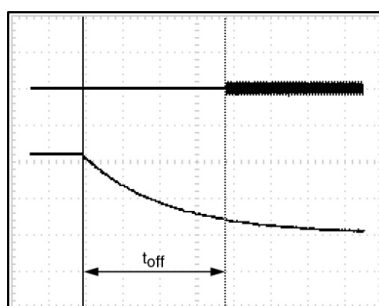
The ESB101 models are the precise inrush current limiter with an overall tolerance of  $\pm 6\%$  of the face value. For the dimension of an upstream connected circuit breaker the R.M.S is the key value of the inrush current, not the peak current. The thermal trigger point will not be met, even while using an extreme fast CB. All-dominant is the magnetic trigger current. By using the empirical formula  $I_{(peak)} \times 0,707_{(factor)} = I_{(r.m.s.)}$  the tripping current can be defined exact. Bear in mind that all the higher the inrush current is, all the faster the input capacitor of several connected switch mode power supplies will be loaded. Deduced by this fact we can say that within a 230V 16A A/C network not the ESB101.16 limiter is the right selection for a MCB B16A, but the ESB101.LED.230Vac. The technical table on page 2 shows the R.M.S value of all the ESB101 types and models.



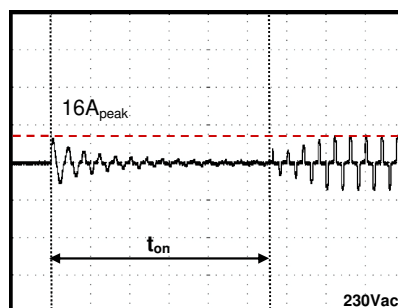
(Fig.5 limiting time  $T_{on}$ )



(Fig.7 inrush without ESB101)



(Fig.6 AC dump detection  $T_{off}$ )



(Fig.8 inrush with ESB101)

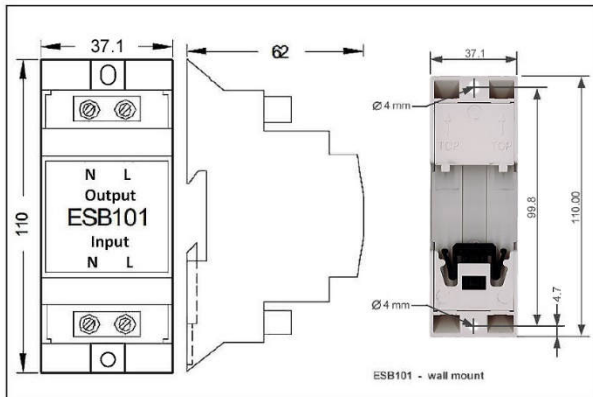
## Fig.7 and Fig.8

Fig.7 and Fig.8 show the typical start behavior of a NTC protected switch mode power supply. The used test item is a CAMTEC HSE10001.24T power supply with an output of 24V/42A (1008W) on DIN-Rail.

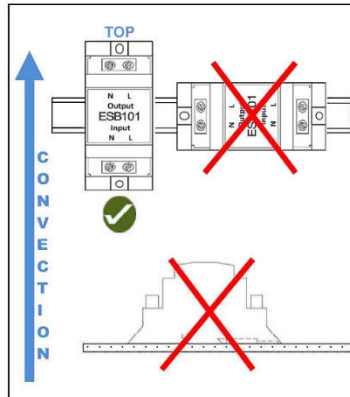
The peak current recordings show the precise limiting of the inrush from formerly  $62A_{peak}$  to  $16A_{peak}$ . The corresponding R.M.S level, that is responsible for the magnetic tripping of the MCB, is mark down by factor 0,707. After the time  $T_{on}$  elapsed it is identified that the power supply starts neatly into the continuous operation mode. Now the current is absorbed pulse-shaped from the AC. In detail the full load R.M.S. current consumption level of the HSE10001 hits 9A @ 230Vac.

## Mechanics

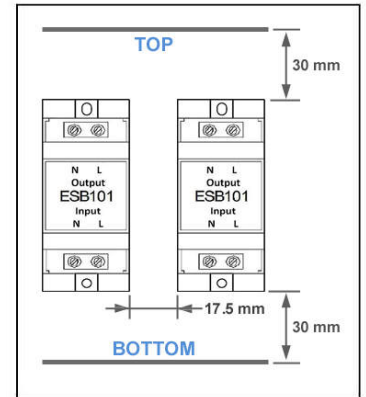
IP20 housing, UL94V-0 (E45329), ABS/NH6020 with RTI 110°C, housing for DIN/VDE0603 cutout box and wall mount. DIN 43880 with IEC standardized ventilation slots. Save fix on DIN-Rail TS35mm (7.5/15) DIN/EN60715. It is designed for building cabinets DIN/VDE0603. Easy to wall mount by multifunctional housing; remove the DIN-Rail latch and access the two mounting holes to screw the ESB101 to any old surface.



(Fig.9 mechanical drawing)



(Fig.10 mounting restriction)



(Fig.11 mounting distances)

## Mounting Instructions

Follow the above mounting restrictions to allow maximum lifetime of the product and to prevent from tripping the internal temperature protection fuse. The ESB101 is an active device. The distance between an ESB101 and the next active or temperature sensitive device shall be 17,5mm or larger. The current consumption of the device is 19mA constant at continuous operation (2,2W @ 115Vac / 4,4W @ 230Vac). Make sure that the ventilation holes below and above the unit are not blocked to allow free air convection.

Operation Temperature	Ambient Temperature	ESB101, 115Vac, AC 16A current	ANSI / UL 508	-40°C ... +55°C
			CAN / CSA C22.2	-40°C ... +55°C
			IEC 60950-1	-40°C ... +60°C
		ESB101, 230Vac, AC 10A current	ANSI / UL 508	-40°C ... +55°C
			CAN / CSA C22.2	-40°C ... +55°C
			IEC 60950-1	-40°C ... +60°C
		ESB101, 230Vac, AC 16A current	ANSI / UL 508	-40°C ... +50°C
			CAN / CSA C22.2	-40°C ... +50°C
			IEC 60950-1	-40°C ... +55°C

## Table of the standards

Model	Camtec Article No.	IEC / EN 60950-1	ANSI / UL508 listed UL-File E485106	CAN / CSA 22.2 listed UL-File E485106	GHOST EAC #0658490 RU C-DE.MO10.B.02970
ESB101.16	3041081001CA	Yes	Yes	Yes	Yes
ESB101.23S	3041081002CA	Yes	Yes	Yes	Yes
ESB101.23	3041081003CA	Yes	Yes	Yes	Yes
ESB101.33	3041081004CA	Yes	Yes	Yes	Yes
ESB101.LED.230VAC	3041081005CA	Yes	Yes	Yes	Yes
ESB101.LED.115VAC	3041081006CA	Yes	Yes	Yes	Yes
ESB101.23S.115VAC	3041081007CA	Yes	Yes	Yes	Yes
ESB101.05UPS	3041081009CA	Yes	Not listed	Not listed	Yes