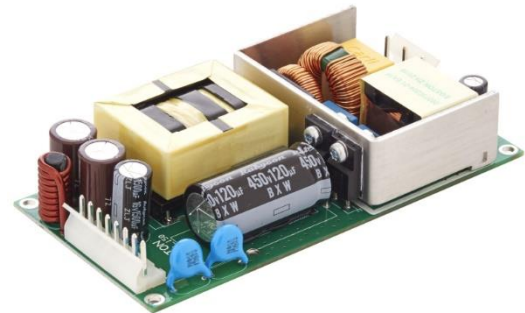


150W OPEN FRAME POWER SUPPLY

Our 150W open frame power supply module is designed for seamless integration. This robust power supply is already tested to a comprehensive range of household, medical and IT standards in order to ease the approval process of your product. Using this module provides you with a reliable and safe source of power, enabling you to focus all your design resources on what makes your product unique.



Features

- Meets Household, Medical, and IT standards
- Convection cooling
- MTBF 26 years at 50°C ambient
- High Efficiency
- Low standby losses
- Premium quality Japanese brand capacitors
- Manufacturing according to ISO 9001
- Thermal protection
- Short circuit proof
- Meets class B EMI emission requirements
- Designed in Austria

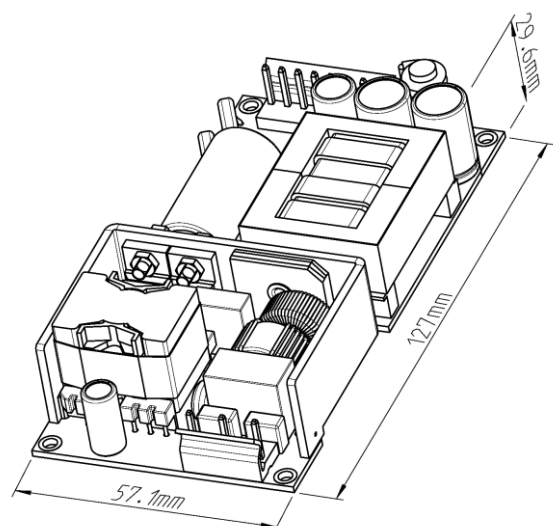
Options

- Customer specific connectors
- Customer specific output voltage

Specifications		
Output Power	150	W
Output Voltage	12 24	V
Output current	12,5 6,25	A
Universal input voltage	90 - 264	V
Operating temperature	0 - 70	°C
Efficiency	typ. 93	%
Standby Power	typ. 130	mW
Efficiency level	VI	
Means of protection	2 x MOPP	
Insulation of output	SELV	
Leakage current	max. 100	µA

Test standards	
EN 60601-1-2 EN 61000-6-2 EN 61000-6-1 EN 61000-3-2 EN 61000-3-3	General EMC standards
EN 60950-1 <i>On customer request:</i> EN 62368-1 UL 62368-1	Information technology equipment
EN 60335-1 EN 61558-2-16 EN 61558-1	Household devices
EN60601-1 <i>On customer request:</i> ES 60601-1	Medical electrical equipment

Approvals	
	  <i>On customer request:</i>



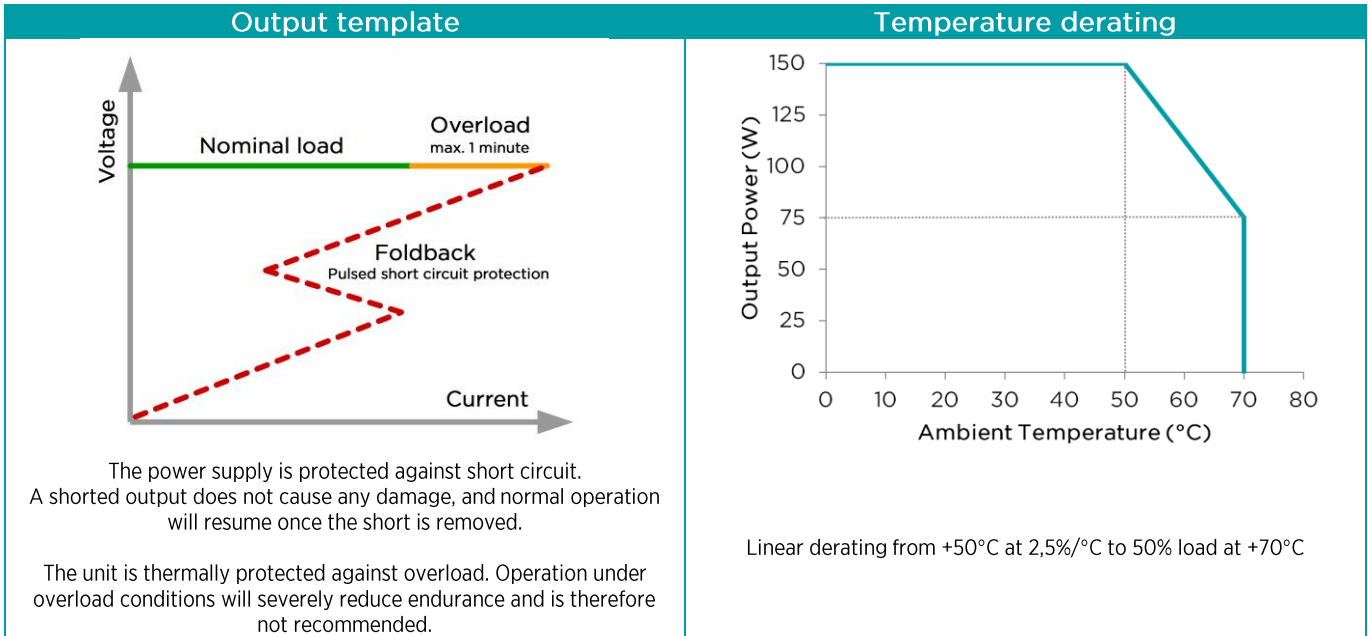
Parameter	Symbol	Min	Typ.	Max	Unit	Test Cond.
Specifications are subject to change without any notice.						
Input Voltage	U_{IN}	90		264	V_{AC}	
	Operation above the specified maximum input voltage may cause damage. Below the minimum input voltage the unit does not meet the specification.					
Input Current	I_{IN}	15		3760	mA	
Input Frequency	f_{IN}	47	50	63	Hz	
Efficiency	η		93		%	at full load
Stand-by power	P_{stb}		130		mW	without load
International efficiency mark		VI				
Output Power	P_{out}			150	W	
Output Voltage	U_{out}	11,64 23,28	12 24	12,36 24,72	V_{DC}	
Output voltage tolerance	$\Delta U_{out PCB}$			3	%	at PCB
Ripple Voltage	U_{rms}			50 100	mV_{rms}	0 - 70°C -30 - 0°C
Output Current	I_{out}			12,5 6,25	A	12V 24V
Max. Overload current	$I_{out\ overload}$		166		% of I_{out}	
	Maximum 1 minute overload duration, followed by 15 minute cooldown period.					
Isolation	Galvanic isolation with safety extra low voltage (SELV) output					
Means of protection	2 x MOPP					
Dielectric Strength	Standard	3			kV_{AC}	50Hz sinusoidal waveform
	Household	3,8				
	Medical	4,2				
Leakage current	I_{LK}			100	μA	
Internal Fuse	I_F		4		A	both inputs (L,N)
	Approved for direct connection to 16A (20A) mains circuit.					
Operating Temperature	T_{OP}	-30		70	°C	free convection derating >50°C
Thermal protection	A thermal shut down protects the power supply and the surroundings form hazardous temperatures. To reset the thermal protection unplug the unit and allow it to cool down.					
Storage Temperature	T_{ST}	-40	25	80	°C	
Humidity				95	%	non condensing
Atmospheric Pressure		70		106	kPa	
Altitude				3000	m	
Pollution degree		2				
Single component failure	A single component failure does not cause any damage to persons or ambient (fire, explosions, etc).					

Ordering information

Model	Voltage	Current	Power
E2OFxW3 150 12V	12V	12,5A	150W
E2OFxW3 150 24V	24V	6,25A	150W

Reliability

MTBF 12V	26,7 years	at 50°C ambient
MTBF 24V	26,8 years	at 50°C ambient
MTBF calculation according to standards	MIL-HDBK-217 F; - Notice 1; - Notice 2	
Maintainability	The power supply is not to be repaired	



Marking	Marking plate symbol explanation
Product name	Conformity with the relevant EU directives.
Input parameters	RoHS conform
Output parameters	The power supply has to be disposed appropriately according the local regulations for Waste Electrical and Electronic Equipment.
Date code	For indoor use only.
Safety instructions	Read instruction manual.
CE marking	
Approval marks	
QR code	

Approvals	
	Conformity with the EU low voltage directive, medical directive and EMC directive based on test reports issues from accredited test labs.
	The CB Scheme is an international program created by the International Electrotechnical Commission for Electrical Equipment (IECEE) for the acceptance of product safety test results among participating laboratories and certification organizations around the world.
	ENEC is the high quality European Mark for electrical products that demonstrates compliance with European standards (EN). CAN BE DONE ON CUSTOMER REQUEST.

Thermal considerations

The power supply is designed for cooling by natural convection. It must be installed with sufficient space around the module to allow air circulation. The enclosure must afford sufficient ventilation to dissipate the generated heat, depending on ambient temperature and load conditions.

In order to ensure safe and reliable operation of the open frame power supply in the most adverse conditions permitted in the end-use equipment, the temperature of the components listed in the table below must be not exceeded. Temperature should be monitored using thermocouples placed on the hottest part of the component (out of any direct air flow).

Temperature Measurements (Ambient temperature - max. 50°C)

Component	Max. Temperature °C
Heatsink (center)	110
Transformer T2 (winding)	115
Output Capacitor C9	100

The power supply is equipped with dual thermal overload protection. This will protect the power supply from hazardous temperatures, but operation at or near the thermal limit will severely reduce operating endurance and is therefore not recommended.

To reset the thermal shut down the mains voltage has to be switched off and (after cooling down) switched on again.

Please ensure that all surrounding components (including cables) have a proper technical specification approval with respect to the temperatures on the power supply components.

Safety distances to surroundings

For this power supply the pollution degree according the standards is 2.

To meet the safety requirements following safety distances form our power supply to the surroundings have to be ensured.

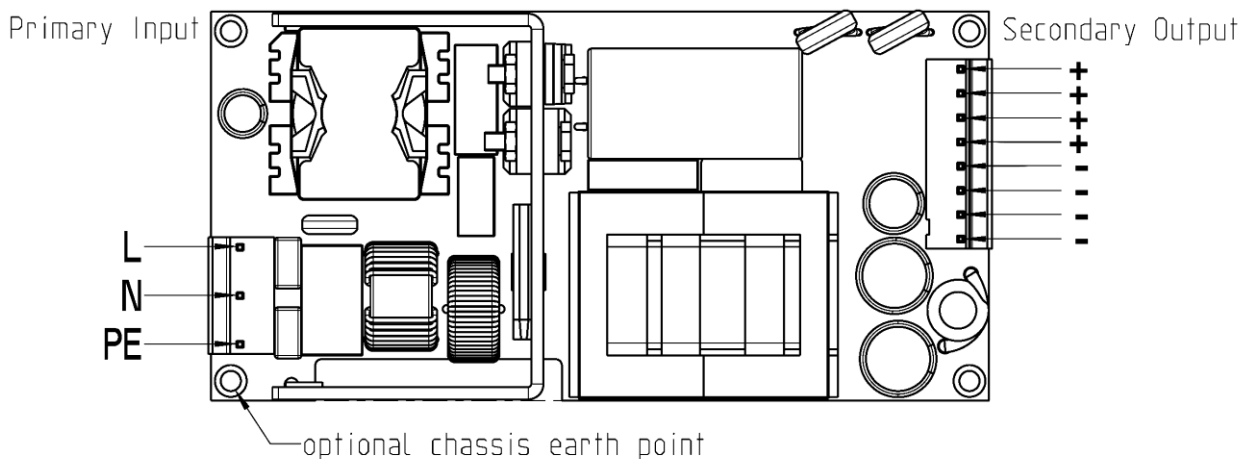
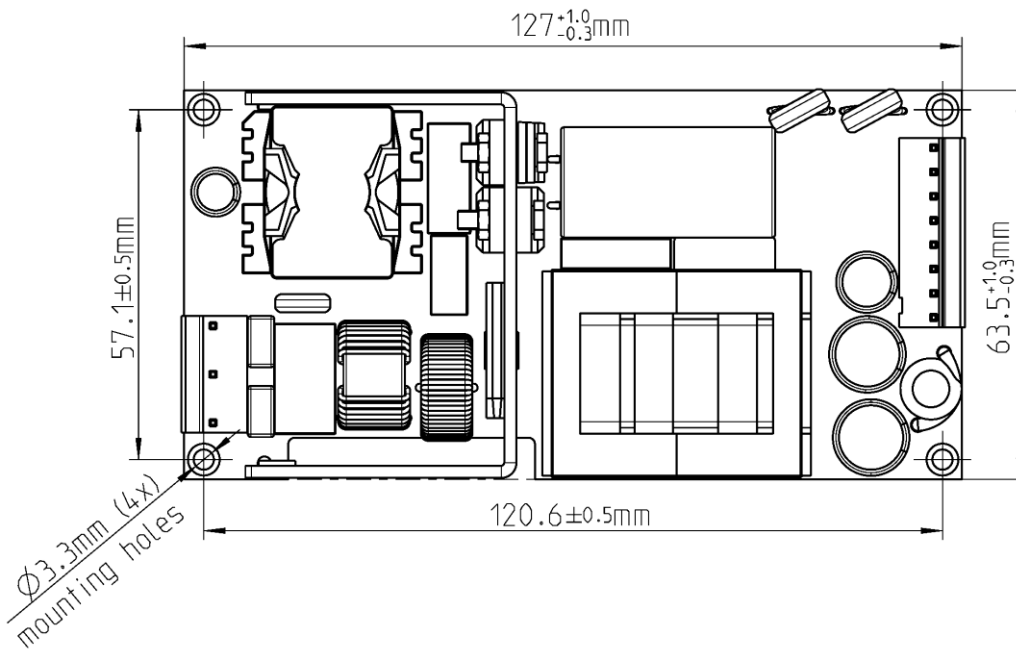
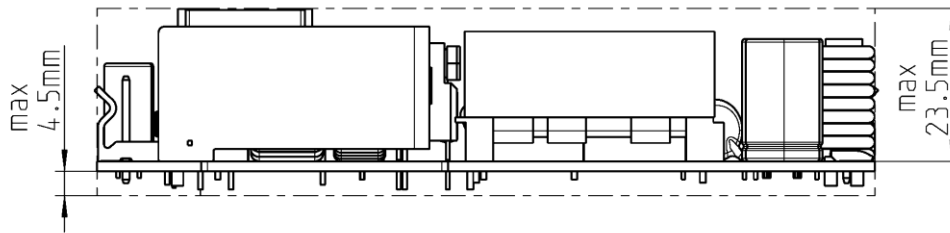
Safety distance between primary life parts of the open frame power supply and protective earth

Application	Safety standard	Means of protection	Clearance (mm)	Creepage (mm)
Medical	EN 60601-1	1x MOPP	2,5	4
Household	EN 60335-1	Basic isolation	1,5	4
IT	EN 60950-1	Basic isolation	2,3	2,5

Safety distance between primary life parts of the open frame power supply and touchable surface

Application	Safety standard	Means of protection	Clearance (mm)	Creepage (mm)
Medical	EN 60601-1	2x MOPP	7	8,3
Household	EN 60335-1	reinforced isolation	3	8
IT	EN 60950-1	reinforced isolation	4,8	5,2

Dimensions and pinout



	<p>PCBA can be mounted with screws M3 DIN 931 (max. torque 1Nm) and optional lock washers DIN 6797 which are positioned on the corners. The PCBA has to be mounted without mechanical stress to protect the PCBA from distortion.</p>
	<p>The primary side of the power supply will retain a dangerous charge for a considerable time after it has been disconnected from the mains and must be handled accordingly.</p>
	<p>ESD safe working procedures have to be observed during handling and installation of the power supply.</p>

Primary connector X1	Connector Molex 10-63-4037 Mates with Molex 5239 housing Required crimp terminal: Molex 2478 / Phosphor Bronze
Secondary connector X4	Connector Molex 09-65-2088 Mates with Molex 5239 housing Required crimp terminal: Molex 2478 / Phosphor Bronze Use all parallel pins for current carrying capability.

EMC – Special requirements according medical standard (Only for medical devices)	
Intended use and intended environment	Home healthcare and/or Professional environment
Basic safety and essential performance of the EUT	The power supply unit is not a medical end product, therefore no essential performance is defined by the manufacturer.
Basic safety regarding EMC	The power supply has to ensure proper output voltage according to its characteristics, without service within expected service life.
WARNINGS	Medical electrical equipment needs special precautions regarding EMC and needs to be installed according to EMC information.
	PE of power supply shall be connected to PE of end medical product. User shall not modify power supply.
	The switch mode power supply is designed to achieve the EMI behavior of the specified environment, it includes specific EMI filter to reduce the emissions which are specified in the IEC60601-1-2 standard.
	Please read the complete technical documentation to avoid adverse events to the patient and operator. Read also instructions for use.

EMC - Environment			
The power supply is intended for use in the electromagnetic environment specified below. The customer or the user of the power supply should assure that it is used in such an environment.			
Emissions test	Compliance	Electromagnetic environment - guidance	
RF emissions CISPR 11	Group 1	The power supply uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.	
RF emissions CISPR 11	Class B	The power supply is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.	
Harmonic emissions IEC 61000-3-2	Class A Class C Class D		
Voltage fluctuations / flicker emissions IEC 61000-3-3	Complies		
Immunity test	EN 60601-1-2:2015 test level	Achieved levels according EN 60601-1-2:2015 and achieved levels from additional standards.	Electromagnetic environment - guidance
Electrostatic discharge (ESD) IEC 61000-4-2	± 8 kV contact ±2 kV, ± 4 kV, ± 8 kV, ± 15 kVair	± 8 kV contact ±2 kV, ± 4 kV, ± 8 kV, ± 15 kVair	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst	± 2 kV 100 kHz repetition	± 2 kV (mains input), 100 kHz	Mains power quality should be that of a typical commercial or hospital environment.

IEC 610004-4	frequency	± 2 kV (DC output), 5 kHz	
Surge IEC 61000-4-5	Line-Line: $\pm 0,5$ kV, ± 1 kV Line-to-ground: $\pm 0,5$ kV, ± 1 kV, ± 2 kV	± 1 kV symmetrical – Differential mode (AC), ± 2 kV symmetrical – Common mode (AC), ± 0.5 kV symmetrical – Differential mode (DC), ± 0.5 kV symmetrical – Common mode (DC), 1.2/50 us Open Circuit Voltage	Mains power quality should be that of a typical commercial or hospital environment.
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	0 % Ut; 0,5 cycle At 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° <hr/> 0 % Ut; 1 cycle and 70 % Ut; 25/30 cycles Single phase: at 0° <hr/> 0 % Ut; 250/300 cycle	0 % Ut; 0,5 cycle At 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° <hr/> 0 % Ut; 1 cycle and 70 % Ut; 25/30 cycles Single phase: at 0° <hr/> 0 % Ut; 250/300 cycle	Mains power quality should be that of a typical commercial or hospital environment. If the user of the power supply requires continued operation during power mains interruptions, it is recommended that the power supply is powered from an uninterruptible power supply or battery.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	30 A/m	1, 3, 30 A/m	Power should be at levels characteristic of frequency magnetic fields a typical location in a typical commercial or hospital environment.
Conducted RF IEC 61000-4-6	6 Vrms 150 kHz to 80 MHz	10 Vrms	Portable and mobile RF communications equipment should not be used closer to any part of the power supply, including cables, than the recommended separation distance. Recommended separation distances see following table.
Radiated RF IEC 61000-4-3	10 V/m 80 MHz to 2.7 GHz	10 V/m	

Field strengths from fixed transmitters such as base stations for radio (cellular/cordless) telephones, land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast, cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters an electromagnetic site survey should be considered. If the measured field strength in the location in which the power supply is used, exceeds the applicable RF compliance level above, the power supply should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the power supply.

Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey should be less than the compliance level in each frequency range. Over the frequency range 150 kHz to 80 MHz, field strength should be less than 3 V/m.



Interference may occur in the vicinity of equipment marked with the following symbol:

Proximity fields from RF wireless communications equipment IEC 61000-4-3	Frequency range and Level: RF wireless communication equipment			Supplementary information: EUT powered at one of the nominal input voltages and frequencies. Dwell time minimum 1s. Actual dwell time noted in results table. Note * - As an alternative to FM modulation, 50% pulse modulation at 18Hz may be used because while it does not represent actual modulation, it would be worst case.
	Test Frequency (MHz)	Modulation	Immunity Level (V/m)	
	385	**Pulse Modulation: 18Hz	27	
	450	*FM ± 5 Hz deviation: 1kHz sine	28	
	710 745 780	**Pulse Modulation: 217Hz	9	
	810 870 930	**Pulse Modulation: 18Hz	28	
	1720	**Pulse Modulation: 217Hz	28	

	1845 1970			Note ** - The carrier shall be modulated using 50% duty cycle square wave signal.
	2450	**Pulse Modulation: 217Hz	28	
	5240 5500 5785	**Pulse Modulation: 217Hz	9	

Recommended separation distances between portable and mobile RF communications equipment and the power supply

The power supply is intended for use in the electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the power supply can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the power supply as recommended below, according to the maximum output power of the communication equipment.

Rated maximum output power of transmitter (W)	Separation distance according to frequency of transmitter (m)		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	80 MHz to 800 MHz $d = 1.2\sqrt{P}$	800 MHz to 2.5 GHz $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in metres (m) can be determined using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1 At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.

NOTE 4 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

Energy Efficiency

This power supply family fulfills Directive 2009/125/EC with Commission Regulation (EU) 2019/1782. The vales “Average active efficiency”, “Efficiency at low load” and “No-load power consumption” are typical measured values, measured at one representative sample at an input voltage of 230VAC.

Input specification		
Input Voltage	100-240	VAC
Input Frequency	50-60	Hz

Output specification			
Output voltage	12	24	VDC
Output current	12,5	5	A
Output power	150	150	W
Average active efficiency (100%/75%/50%/25%)	93,27	92,91	%
Efficiency at low load (10 %)	89,27	90,34	%
No-load power consumption	117	145	mW

Revision	Date	Author	Change
A	25.02.2016	Mauritz	First edition
B	22.04.2016	Trethan	Mounting and thermal considerations
C	26.08.2016	Mauritz	Medical EMC requirements changed
D	23.11.2016	Trethan	Minor corrections, operating temp.
E	07.08.2017	Mauritz	HV testing voltage changed
F	23.03.2018	Trethan	Update to new datasheet design
G	19.07.2018	Mauritz	MTBF added
H	06.03.2019	Mauritz	ENEC is optional
I	05.02.2020	Mauritz	Energy Efficiency added
J	25.02.2020	Mauritz	Test standards changed

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