SUPLET®

Technical Specification

AC/DC Converter

LAK500-220S12W

85Vac to 288Vac Input；12Vdc Output

RoHS Compliant

Features

- Compliance with RoHS10 EU Directive 2011/65/EU & 2015/863/EU
- Wide input 85Vac to 288Vac
- Efficiency up to 92%@220Vac full load
- Metal case box Type package
- Package dimension: 110.8x50.8x13.7mm(4.33”x2.00”x0.54”)
- Operating baseplate temperature range
- 4242Vdc and reinforce isolation
- Input under voltage protection
- Input over voltage protection
- Output over voltage protection
- Output over current protection
- Output short circuit protection
- Over temperature protection
- Meets IEC/EN/UL62368-1

Description

The LAK500-220S12W power supply is an AC/DC converter which provides high efficiency single output. It can operate from 85~288 Vac input voltage range, +12V output. The power supply provides input under voltage protection, input over voltage protection, output over voltage, output over current, and output short circuit, and over temperature protection.

Electrical Specifications

Input Characteristics

Parameter	Units	Specifications			Notes & conditions
		Min.	Typ.	Max.	
Input Voltage Range	Vac	85	-	288	
Peak Input Voltage	Vac	310	315	320	315Vac±5Vac for 3 minutes, unit may shut down but not broken and shall automatically restart after the AC/DC input is within specified limits
Rated Input Voltage Range	Vac	100	110/220	240	
Input Voltage Frequency Range	Hz	45	50/60	66	
Maximum Input Current	A	-	-	7.5	Vin=85Vac, 100%load
Power Factor		0.95	-	-	Vin=110Vac, 100%load
Allowable Bus Capacitance Range	uF	220	-	550	Vin=110/220Vac, 100%load
Inrush Current Limit(1)	According to ETSI EN 300132-1 V 2.0.1(2017-11) or latest version.				

Note:
(1) Electronic current limit for inrush current is based on ETSI 300 132-1.

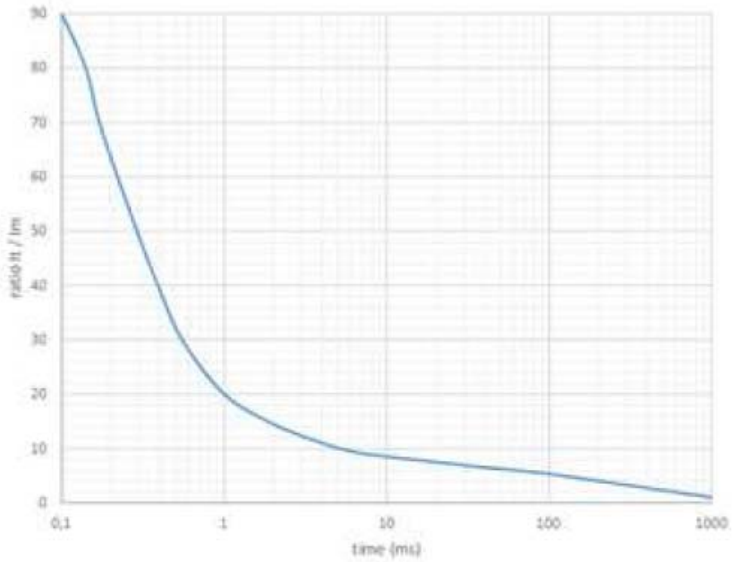


Figure 1: Maximum (absolute magnitude) inrush current characteristic Input

Output Characteristics

Parameter		Units	Specifications			Notes & conditions
			Min.	Typ.	Max.	
Output Voltage Set Point		Vdc	11.8	12.0	12.2	Vin=85-288Vac, Io=0-42A
Line Regulation		%Vo	-	-	±2	
Load Regulation		%Vo	-	-	±2	
Output Current Range		A	0	-	42	
Output Trim Range(2)		V	12	-	12.6	Trim up
Allowable Output Capacitance Range		uF	4000	-	10000	Vin=110/220Vac, Io=100%load
Overshoot of dynamic output load (3)		mV	-	300	600	Positive voltage step, 75% to 25% load dynamic , 1A/us slew rate
		mV	-	300	600	Negative voltage step, 25% to 75%load dynamic, 1A/us slew rate
Output Voltage Ripple and Noise	P-P	mV	-	100	300	Vin=110/220Vac, Io=42, peak to peak, 20MHz bandwidth
	RMS	mV	-	50	100	
Turn-on Rise Time		ms	1	-	15	
Start up Time(4)		ms	-	1500	3000	Vin=110/220Vac
Hold-up Time		ms	10	20	-	Vin=110/220Vac, Io=100%load Uout: within specified limits @Bus caps 527uF.
Overshoot of start up		%Vo	-	-	3	
PG(5)			-	Yes	-	

Note:

(2) Trim up:

Rtrimup Vo+ to Trim

For trim up, the external resistor value required to obtain a percentage output voltage change Δ% is defined as :

Rtrimup=Vo*(100+Δ)/(1.225*Δ)-100/Δ-6.11

In which,

Rtripmup, is the trim-up resistance, the unit is kohm

Δ, is the output voltage change percentage value , Δ%。

For example:

We need the output voltage trim up 5%, 12*1.05=12.6V, then we need Rtrimup is

Rtrimup=Vo*(100+Δ)/(1.225*Δ)-100/Δ-6.11=12*(100+5)/(1.225*5)-100/5-6.11=179.6k.

(3) Dynamic load response

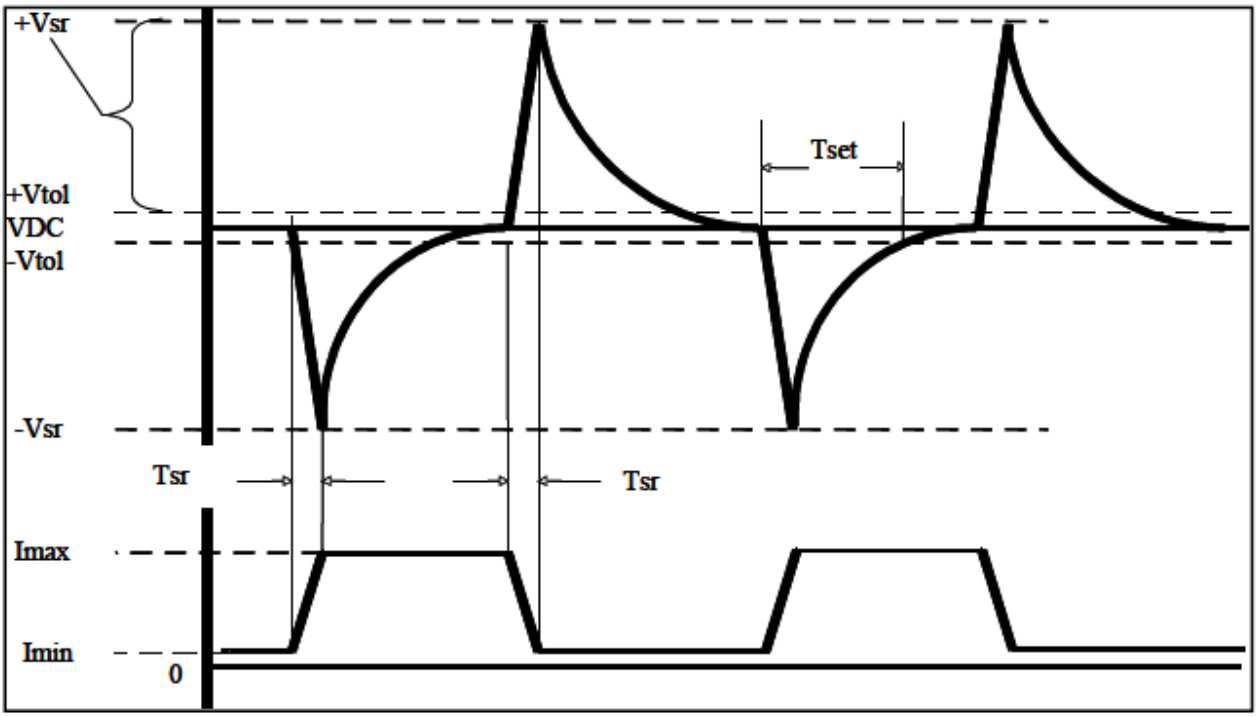


Figure 2. Dynamic load and response

Table 1 Dynamic load conditions

Parameter	Value
Frequency of load change [kHz]	0.1/1
Duty cycle [%]	50
Load rise and fall time Tsr [ms]	10
Imin [A] (25% of maximum output current)	10.5
Imax [A] (75% of maximum output current)	31.5

Table 2. Maximum step response and settling time

Parameter	Value
Step response, peak voltage Vsr [V]	±0.6
Settling time Tset [ms]	500

In cold start situation (i.e. during the heating-up from ambient temperature -40ºC to -10ºC) maximum values can be higher.

(4) Start-up

Output voltage shall rise up within 3 second from switching on the power supply. In cold start situation (i.e. during the

heating-up from ambient temperature -40ºC to -10ºC) maximum 250mVpp switching ripple is allowed.

(5) PG: power good signal PG should be set low level when fault occurs.
1. PG signal have been pulled-up by internal 3.3V in the module
2. After start up, output voltage goes to 12V, the PG output Hi-level
3. When output OVP and UVP at 12V output, PG outputs low-level, no delay.
4. When the module has other faults, such as OT, OCP, PG outputs low-level, no dely.
5. When input UVP, the PFC voltage abnormal, PG will output low level, no delay.

Protection Characteristics

Parameter		Units	Specifications			Notes & conditions
			Min.	Typ.	Max.	
Input Under Voltage Protection	Turn-on	Vac	79	82	85	Automatic recovery after input under voltage situation, hiccup mode.
	Turn-off	Vac	73	76	79	
	Hysteresis	Vac	3	-	12	
Output Over Voltage Protection		V	13	14	15	Automatic recovery after output overvoltage situation, hiccup mode.
Output Overcurrent Protection		A	44	50	56	Automatic recovery after overcurrent situation, hiccup mode.
Short Circuit Protection			-	Yes	-	Automatic recovery
Over Temperature Protection(6)			-	Yes	-	Automatic recovery after output overvoltage situation, hiccup mode.

Note:

(6) AC/DC PSU module has its own over temperature protection which protects PSU module from getting broken. AC/DC PSU module shall work in operating temperature range with suitable DC loading and external conduction cooling.

General Specifications

Parameter	Units	Specifications			Notes & conditions
		Min.	Typ.	Max.	
Efficiency	%	88	91	-	Vin=110Vac, 60%load
	%	90	93	-	Vin=220Vac, 60%load
	%	89	90	-	Vin=110Vac, 100%load
	%	90.5	92.5	-	Vin=220Vac, 100%load

MTBF[9]	Hour	-	1,000,000	-	Ta=55℃, 60%load
Product Lifetime	Year	10	-	-	
Weight	g	-	240	260	

Note:
(7) For the MTBF, the final value should meet applied unit level requirement.

Environmental Specifications

Parameter	Units	Specifications			Notes & conditions
		Min.	Typ.	Max.	
Storage Temperature	℃	-55	-	125	
Operating Temperature Range	℃	-40	-	100	Plate temperature, rated input voltage, 80%Iomax
Operating Humidity	%RH	5	-	95	
Operating Altitude	m	-	-	5000	

Isolation Specifications

Parameter		Units	Specifications			Notes & conditions
			Min.	Typ.	Max.	
Isolation Voltage	Input-Output	Vdc	-	-	4242	
	Input-Case	Vdc	-	-	2121	
	Output-Case	Vdc	-	-	707	
Isolation Resistance		MΩ	100	-	-	500Vdc test voltage

Safety

The AC/DC PSU module with a relevant assembly shall fulfill the safety requirements:

IEC 62368-1 / EN 62368-1	Safety of information technology equipment, including electrical business equipment + valid amendments
UL 62368-1	Safety of information technology equipment, including electrical business equipment

CAN/CSA-C22.2 No. 60950-1	Information Technology Equipment - Safety - Part 1: General Requirements
GR-1089-CORE	Bellcore Electromagnetic Compatibility and Electrical Safety
CCC	China Compulsory Certification

Other safety related standards that need to be fulfilled:

IEC 60950-22	Safety for information technology equipment installed outdoors
EN 60950-22	Safety for information technology equipment installed outdoors
UL 60950-22	Safety for information technology equipment installed outdoors
CAN/CSA-C22.2 No. 60950-22	Information Technology Equipment - Safety - Part 22: Equipment to be Installed Outdoors "
UL50	Safety related environmental requirements of enclosures for electrical equipment installed in non-hazardous locations

The AC/DC module must have UL certification.

Leakage

Shall meet the requirements of UL 60950, Section 5.1.The housing design shall prevent the user and installer from contacting any signal conductors during all typical installation and usage procedures therefore there is enough human protection.

Flammability

Shall meet the requirement of UL 94.Case is better than H-B rating, Power supply and printed circuit boards are better than V-0 rating.

EMC

The AC/DC PSU module should meet the EMC compliance requirement when connected with suitable applied EMI filter circuit and test board.

The EMC test specifications and test methods are listed in the table 8 as below:

Test type	Specification	Method	Requirements
Radiated Emission E-field (Enclosure port)	EN55032 Class B FCC Part 15.109 Class B	EN 55032	Class B with margin≥6dB
Conducted Emission (AC port)	ETSI EN 301 489-1 Class B	EN 55032	Class B with margin≥6dB
Harmonic Current Emission (AC port)	ETSI EN 301 489-1	IEC 61000-3-2, Input Current≤16A Per Phase	Limit for Class A Equirement
Voltage Fluctuations and Flicker (AC port)	ETSI EN 301 489-1	IEC 61000-3-3, Input Current≤16A Per Phase	1. the value of *P*st shall not be greater than 1,0 (short-term flicker indicator) 2. the value of *P*lt shall not be greater

			than 0,65 (long-term flicker indicator) 3. the relative steadystate voltage change, *d*c, shall not exceed 3.3 %; 4. the maximum relative voltage change, *d*max, shall not exceed 4 %; 5. the value of *d(t)* during a voltage change shall not exceed 3.3 % for more than 500ms. (limit in terms of relative voltage change waveform *d(t)*)
E-field Immunity (Enclosure port)	ETSI EN 301 489-1	IEC 61000-4-3	
	Test level 10V/m (80MHz-1GHz).		Criteria C (Criteria A of CISPR 35)
Power Frequency Magnetic Field Immunity (Enclosure port)	ETSI EN 301 489-1	IEC 61000-4-8	
	Test level 3 (10A/m) for continuous field Test level 3 (100A/m) for short duration 1-3 sec.		Criteria C (Criteria A of CISPR 35)
Pulse Magnetic Field Immunity (Enclosure port)	ETSI EN 301 489-1	IEC 61000-4-9	
	Test level 5 (1000A/m) pulse waveform 8/20us.		Criteria C (Criteria A of CISPR 35)
ESD Immunity (Enclosure port)	ETSI EN 301 489-1	IEC 61000-4-2	
	Air discharge ±2 kV, ±4 kV, ±8 kV, ±15 kV contact discharge ±2 kV, ±4 kV, ±8 kV to all exposed surfaces and cables of the EUT		Criteria C (Criteria A of CISPR 35)
Voltage Dips and Short Interruptions, (AC port)	ETSI EN 301 489-1	IEC 61000-4-11	
	Voltage dip: 0 % residual voltage for 0,5 cycle;		Criteria C (Criteria A of CISPR 35)
	Voltage dip: 0 % residual voltage for 1 cycle;		Criteria C (Criteria A of CISPR 35)
	Voltage dip: 70 % residual voltage for 25 cycles (at 50 Hz)		Criteria T (Criteria B of CISPR 35)
	Voltage interruption: 0% residual voltage for 250cycles (at 50 Hz).		Criteria T (Criteria B of CISPR 35)
Slow Voltage Fluctuations (AC port)	Frequency variations 45-65 Hz for unlimited time	Criteria C	Criteria C (Criteria A of CISPR 35)
	Voltage variations 85V-288V for unlimited time	Criteria C	Criteria C (Criteria A of CISPR 35)
	Voltage lower than 85V shall not cause damage to EUT	IEC 61000-4-11	Criteria R (Criteria C of CISPR 35)
Lightning Surge Immunity (AC port)	YDT 2583.13	GB/T17626.5	
	±4 kV lines to ground, pulse 1.2/50μs, *R*S =12 Ω ±2 kV line to line, pulse 1.2/50μs, *R*S=2 Ω.		Criteria C (Criteria A of CISPR 35)
	ETSI EN 301 489-1	IEC 61000-4-5	
	±2 kV lines to ground, pulse 1.2/50μs, *R*S =2 Ω ±1 kV line to line, pulse 1.2/50μs, *R*S=2 Ω.		Criteria C (Criteria A of CISPR 35)
	GR1089	IEC 61000-4-5	
	±6 kV lines to ground, pulse 1.2/50μs, *R*S =2 Ω ±6 kV line to line, pulse 1.2/50μs, *R*S =2 Ω		Criteria R (Criteria C of CISPR 35)
	IEC 62305-4 (IEC 61312-1)	IEC 61643-1, YD/T2324	
	Class II (Class C) Lines to ground(L+N--PE): ± 10 kA, pulse		Criteria R (Criteria C of CISPR 35)

	8/20μs, Line to ground(L/N--PE): ± 5 kA, pulse 8/20μs; Line to Line(L--N): ± 2.5 kA, pulse 8/20μs; 5 times in each polarity with 60s interval		
RF Common Mode (AC port)	ETSI EN 301 489-1	IEC 61000-4-6	
	Test level 2 (3Vrms) 0.15 – 80 MHz for AC power port.		Criteria C (Criteria A of CISPR 35)
Fast Transients Immunity (AC port)	ETSI EN 301 489-1	IEC 61000-4-4	
	5 kHz ± 20% at 1.0 kV for AC power port.		Criteria C (Criteria A of CISPR 35)

Performance Criteria (EN)

Performance criteria are defined in documents, ETSI EN 301 489-1

C = continuous performance criteria (Performance Criteria A of CISPR 35)

T = transient performance criteria (Performance Criteria B of CISPR 35)

R = resistibility performance criteria. (Performance Criteria C of CISPR 35)

Environment Requirement

Environment Temperature Requirements

The PSU should operate between -40°C and 85°C internally. The unit is cooled via the heat sink casting with thermal gel between the casting and the PSU. The unit will be conduction cooled and there will be zero airflow.

The external environmental maximum temp is +65°C (65°C is baseband module environment temperature). The PSU must survive for 24 hours under these conditions. There will be an internal product temperature rise of ~30°C. The PSU should output stable power and not go into over temperature shutdown. The PSU is not required to meet other specifications in this extreme condition.

The unit must be able to cold start at --40°C.

The operating ambient temperature of applied unit range shall be from -40°C to +55°C. After 30 minutes of self-heating starting at -40°C, the unit shall fulfill all the specifications all the way to +55°C ambient. The unit shall operate properly with neither mechanical nor electrical problems during the test.

Water Proof Protection Class

The AC/DC PSU module will be located inside IP 65 proof mechanics

Corrosion resistance

All materials and surface finishes of the mechanics must be selected in order to ensure corrosion-resistant product lifetime of 10 years minimum.
AC/DC PSU module is located inside IP proof mechanics.

Earthquake

The AC/DC PSU module is located inside applied unit mechanics.
The whole unit shall fulfill the following requirements with the specified testing methods:

- Bellcore GR-63-CORE, Zone 4

· ETS 300 019-1-4/A1
· ETS 300 019-2-4/A1

In-use (operational) requirements

Climatic conditions during operation indoors are according to ETSI EN 300 019-1-3 class 3.2. Tests are described in ETSI EN 300 019 2-3 V2.1.2 T3.2. Outdoor conditions are according to ETSI EN 300 019-1-4 class 4.1, and tests are described in ETSI EN 300 019 2-4 ver.2.1.2 T4.1E. Fully compliant operation is required at normal operating range.
PSU should be tested inside applied module mechanics.

Storage

The assembly shall fulfill the following requirements with the specified testing methods:
· ETS 300 019-1-1
· ETS 300 019-2-1
NOTE! The climatic conditions for storage are defined according to the ETS 300 019-1-1: class 1.3E and testing method according to the ETS 300 019-2-1: class 1.3E.

Transportation

The AC/DC PSU module shall fulfill the following requirements with the specified testing methods:
• ETS 300 019-1-2
• ETS 300 019-2-2
NOTE! The climatic conditions for transportation are defined according to the ETS 300019-1-2: class 2.3 and testing method according to the ETS 300 019-2-2: class 2.3 (table 5).

Materials

All materials and surface finishes of the mechanics must be selected in order to ensure corrosion-resistant product lifetime of 10 years minimum.
AC/DC PSU module is located inside IP proof mechanics.
Note: The AC/DC PSU module shall meet RoHS requirements.
The AC/DC PSU module shall have an identification sticker on distinct part of the module.
There shall be also a serial number sticker located on the module that shall have printed a code, version and the serial number of the assembly.

Altitude

ETSI EN 300 019-1-4 V2.1.2: up to 5000m (according Low air pressure requirement 54 kPa that represent a limit value for open air use, normally at about 5000 m)
Altitude correction factor is 1.48. Please follow below Table which from UL60950.

Table 4: Altitude correction factors

Altitude(m)	Normal barometric pressure (kPa)	Multiplication factor for clearances
2.000	80.0	1.00
3.000	70.0	1.14
4.000	62.0	1.29
5.000	54.0	1.48
6.000	47.0	1.70
7.000	41.0	1.95

8.000	35.5	2.25
9.000	30.5	2.62
10.000	26.5	3.02
15.000	12.0	6.67
20.000	5.5	14.5

Operating Humidity

It shall meet the requirements of Telcordia GR-63-CORE, Section 4.1.2. 5% to 95% RH w/ max H20 content of 0.024 gram H2O/gram of dry air. And it shall operate properly with neither mechanical nor electrical problems during the test.

Simplified Application Circuit

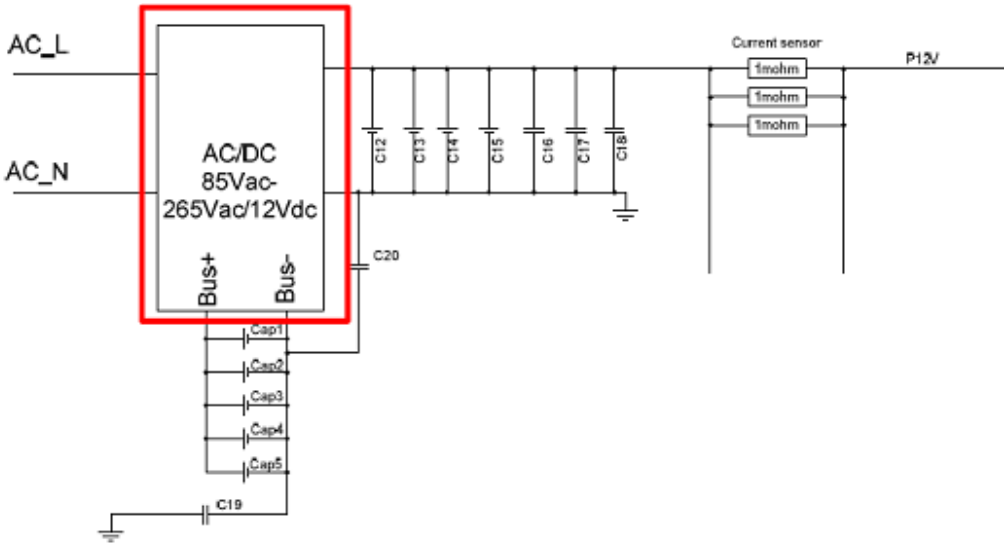


Figure 2. Application connection

Application circuit parameters

No.	Location	Description
1	Cap1,Cap2,Cap3,Cap4	CAP AL 120uF 450V 20% 105C 5000h TH 18mm
2	Cap5	CAP AL 47uF 450V 20% 105C 5000h TH 12.5mm
3	C19,C20	CAP CER X1Y1 2.2nF 500Vac 20% TH
4	C12,C13,C14,C15	CAP AL-POLY 1000uF 16V 20% 105C 12mohm THT
5	C16,C17,C18	CAP CER 22uF 25V 10% X7R 1210

Before AC_L and AC_N, there should be fuses, surge protection circuit and EMI circuit.

Outline Diagram

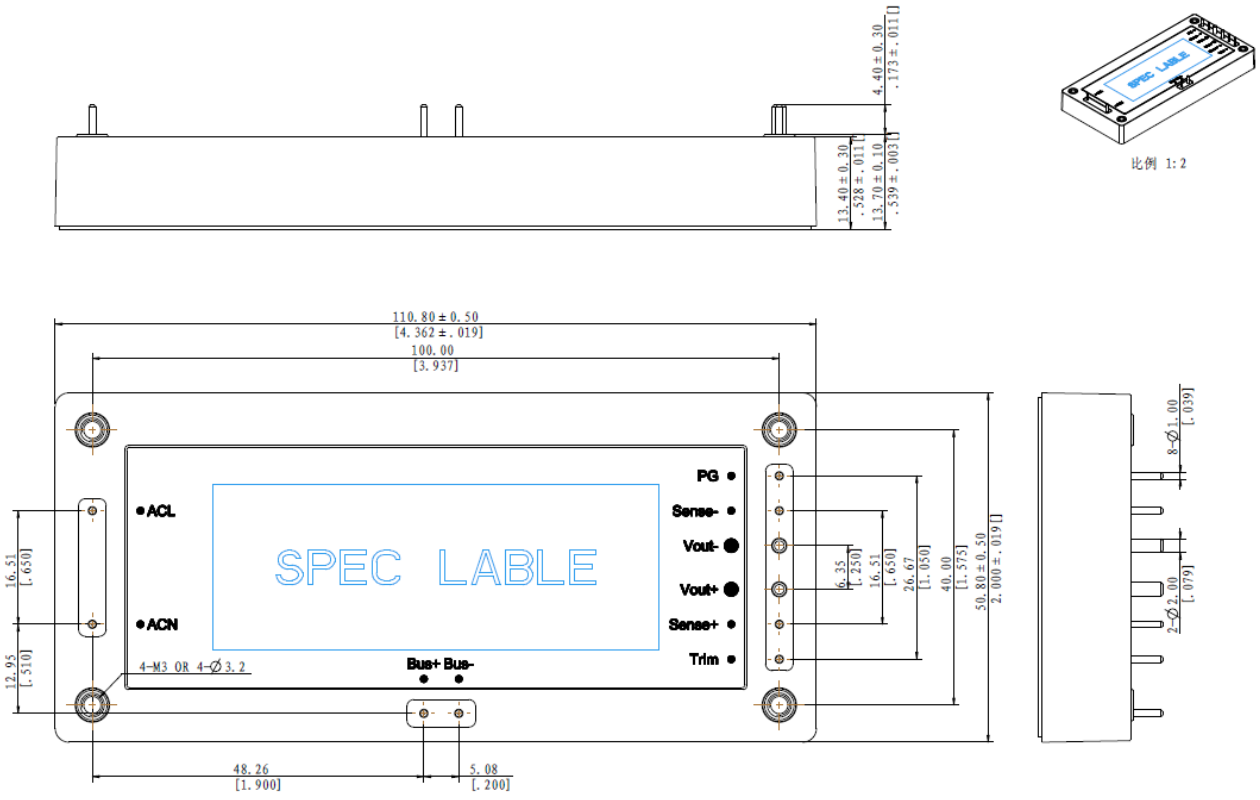
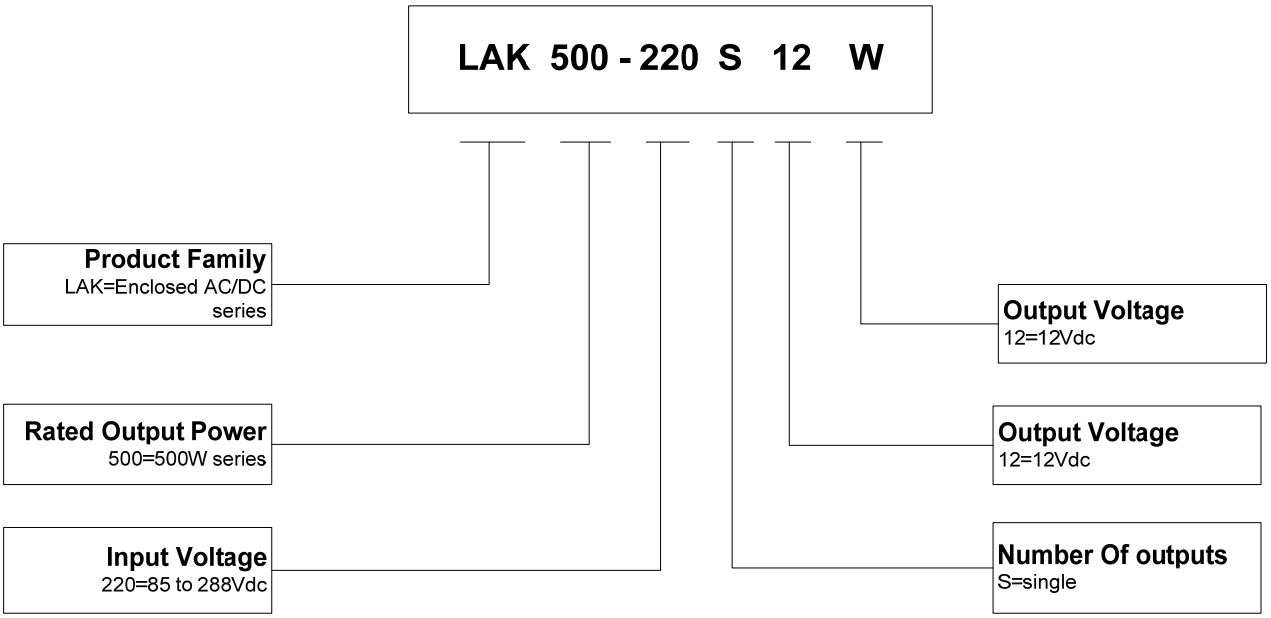


Figure 7. Outline Diagram

Dimensions are in millimeters and (inches).

Tolerances: ± 0.25mm (Unless otherwise indicated)

Naming Rules On Models



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