

Technical Information

Product Name
EF2405



Description	EF2405
	The new EF series from Wöhrlé has been specially designed for industrial use. The EF2405 switching power supply is characterized by a high-quality construction with a modern designed PCB board, which enables a high power density and a very good efficiency. The entire EF series operates in constant current mode, which is supplemented by overcurrent protection, and is also suitable for applications in DC UPS systems or charging applications. To protect the PCBAs against dust and pollutants found in harsh industrial applications, the circuit boards are conformal coated. The EF series devices offer good EMC characteristics, the electromagnetic radiation and conducted emissions of the series comply with Class B standards for emission and immunity in industry/heavy industry and comply with the environmental protection standards of the RoHS Directive.

Characteristics	
	Universal AC input voltage range
	Built-in constant current circuit for charging applications
	Full load operating temperature up to 60°C
	Cold start at -40°C
	Ultra-Slim design
	Long life electrolytic capacitor
	Built-in DC OK relay and LED indicator
	Conformal coating on PCBAs to protect against common dust and pollutants
	Compliant with 80 PLUS Gold for 115V Industrial

Overload Behavior	
Overload capacity	The EF and DF series switching power supply units have an overload capacity of 120%.

Input	
Nominal input voltage	100-240VAC
Input voltage range	90-264VAC 127-375VDC
Nominal input frequency	50-60Hz
Input frequency range	47-63Hz
DC input voltage range ¹	127-375VDC
Input current	1.2A typ. @ 115VAC, 0.6A typ. @ 230VAC

Efficiency at 100% load	93.5% typ. @ 230VAC
Average efficiency (25%, 50%, 75%, 100%)	90.5% typ. @ 115VAC
No load power consumption	0.5W max @ 115VAC & 230VAC
Max. inrush current (cold start)	40A typ. @ 230VAC
Power factor at 100% load	>0.95 @ 115VAC & >0.92 @ 230VAC
Leakage current	<0.5mA @ 240VAC

Output ²	
Rated output voltage	24VDC
Factory set point tolerance	24VDC $\pm$ 1%
Output voltage adjustment range	24-28VDC
Rated output current	5A
Output current	0-0.5A
Output power	120W max
Line regulation	$\pm$ 0.5% @ 115VAC & 230VAC
Load regulation	$\pm$ 0.5%
PARD ³ (20MHz)	<100mVpp @ 0 to +70°C <300mVpp @ -30 to 0°C
Rise time	30ms typ. @ 115VAC & 230VAC
Start-up time	300ms typ. @ 115VAC & 230VAC
Hold-up time	35ms typ. @ 115VAC & 230VAC (100% load)
Dynamic response (overshoot & undershoot O/P voltage)	$\pm$ 10% @ 115VAC & 230VAC input, 10-100% load (Slew Rate: 2.5A/ μ S, 50% duty cycle @ 5Hz & 10kHz)
Start-up with capacitive loads	10,000 μ F max
Functional	DC OK relay contact: 30V/1A The relay contact are normally "ON" (closed) when the output (Vout) is greater than 90% typ. of its rated value.

Protection	
Overvoltage	<34V, SELV Output, Latch Mode
Overload/overcurrent	105-150% of rated load current, Auto-recovery Continuous current limit Mode ⁵ (Vo >80%)
Overtemperature	Latch Mode
Short circuit	Hiccup Mode, Non-Latching (Auto-Recovery when the fault is removed)
Internal fuse	T3.15 A/250 V
Protection against shock	Class I with PE ⁶ connection

Environment	
Working temperature	-30 to +70°C (-40°C Cold Start)
Storage temperature	-40 to +85°C
Power derating	Temperature: >60°C derate power by 2.5%/°C Input Voltage: 100VAC derate power by 1%/VAC
Operating altitude	0-5,000m
Working humidity	5-90% relative humidity (non-condensing)
Vibration (operating)	IEC 60068-2-6, Sine Wave: 10-500Hz; 4G peak; 60min per axis for all X, Y, Z directions
Shock test (non-operating)	IEC 60068-2-27, Half Sine Wave: 50G for duration of 11ms; 3 times per direction
Over voltage category	II (Compliance to EN 62477-1 OVC III with 2000 meters altitude)
Pollution degree	2

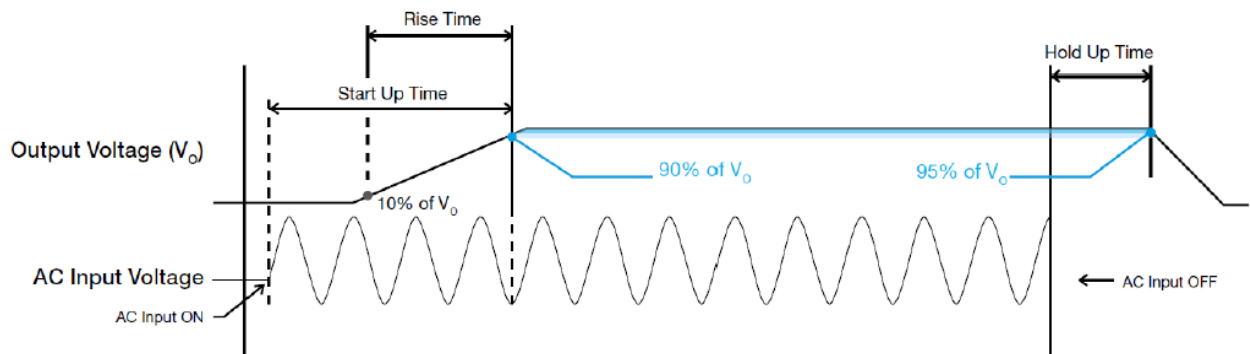
Safety/EMC ⁷		
Electrical safety	CB scheme	IEC 62368-1, IEC 60950-1, IEC 61010-1/-2-201
	TÜV-Bauart	EN/BS EN 62368-1, EN/BS EN 61010-1/-2-201
	UL/cUL	UL 62368-1, UL 61010-1/-2-201
	EAC	TP TC 004/2011
	BSMI	CNS14336-1
	CCC	GB 4943.1
CE	In conformance with EMC Directive 2014/30/EU and Low Voltage Directive 2014/35/EU	

UKCA		In conformance with Electrical Equipment (Safety) Regulations 2016 and Electromagnetic Compatibility Regulations 2016
Galvanic isolation	Input to Output	4kVAC
	Input to Ground	2kVAC
	Output to Ground	1.5kVAC
	Output to DC OK	500VAC
EMC-Emissions (CE & RE)		CISPR 32, EN/BS EN 55032, EN/BS EN 61000-6-4, AS/NZS CISPR32, EN/BS EN 61204-3, KS C 9832 Compliance to FCC Title 47, EN 61000-6-3: Class B
Component power supply for general use		EN/BS EN 61204-3
EMC-Immunity		EN/BS EN 55035, KS C 9835, EN/BS EN 61000-6-2 Compliance to EN 61000-6-1
Immunity to electrostatic discharge	IEC 61000-4-2	Level 4 Criteria A ⁸ Air Discharge: 15kV Contact Discharge: 8kV
Immunity to radiated field	IEC 61000-4-3	Criteria A ⁸ 80MHz-1GHz, 10V/M, 80% Modulation (1kHz) 1.4-2GHz, 3V/M, 80% Modulation (1kHz) 2-2.7GHz, 1V/M, 80% Modulation (1kHz)
Immunity to electrical fast transient/burst	IEC 61000-4-4	Level 3 Criteria A ⁸ 2kV
Immunity to surge	IEC 61000-4-5	Level 4 Criteria A ⁸ Common Mode ⁹ : 4kV Differential Mode ¹⁰ : 2kV
Immunity to conducted disturbances	IEC 61000-4-6	Level 3 Criteria A ⁸ 150kHz-80MHz, 10Vrms
Immunity to power frequency magnetic fields	IEC 61000-4-8	Level 4 Criteria A ⁸ 30A/m
Immunity to voltage dips and interruptions	IEC 61000-4-11	0% residual; 1 cycle, Criteria B ¹¹ 40% residual; 10 cycle, Criteria C ¹² 70% residual; 25 cycle, Criteria C ¹²
Harmonic current emission		IEC/EN/BS EN 61000-3-2, Class A & Class D
Voltage fluctuation and flicker		IEC/EN/BS EN 61000-3-3
Voltage sag immunity SEMI F47 – 0706		80% of 200VAC, 160VAC, 1000ms, Criteria A ⁸ 70% of 200VAC, 140VAC, 500ms, Criteria A ⁸ 50% of 200VAC, 100VAC, 200ms, Criteria A ⁸
MTBF – mean time between failure		Telcordia SR-332 >700,000 hrs I/P: 115VAC & 230VAC, O/P: 100% load, ambient temperature: 25°C

Functions		
Operating Status	DC OK (green LED)	DC OK relay contact
Normal Operation	ON	Closed
Overload (Hiccup Mode)	INTERMITTENT	Open
Output Short Circuit	INTERMITTENT	Open
Over Temperature	OFF	Open
No Input Power	OFF	Open

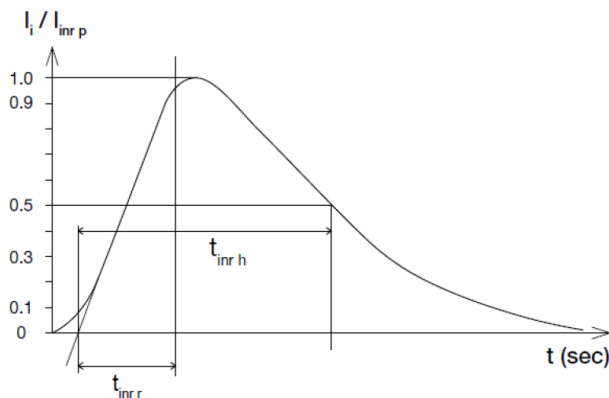
DC OK relay contacts status	Contact closes	The output voltage >90% typ. of its steady state set value.
	Contact opens	The output voltage <90% typ. of its steady state set value.
Start-up time	The time required for the output voltage to reach 90% of its final steady state set value, after the input voltage is applied.	
Rise time	The time required for the output voltage to change from 10% to 90% of its final steady state set value.	
Hold-up time	The time between the collapse of the AC input voltage, and the output falling to 95% of its steady state set value.	

Graph illustrating the start-up time, rise time, and hold-up time



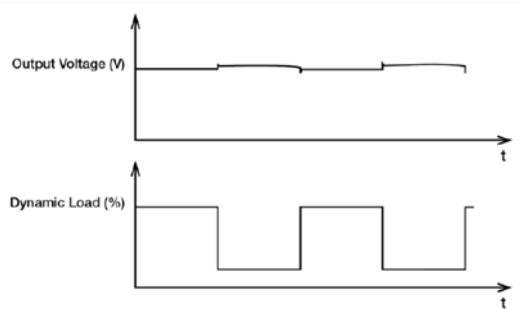
Inrush current

Inrush current is the peak, instantaneous, input current measured and, occurs when the input voltage is first applied. For AC input voltages, the maximum peak value of inrush current will occur during the first half cycle of the applied AC voltage. This peak value decreases exponentially during subsequent cycles of AC voltage.



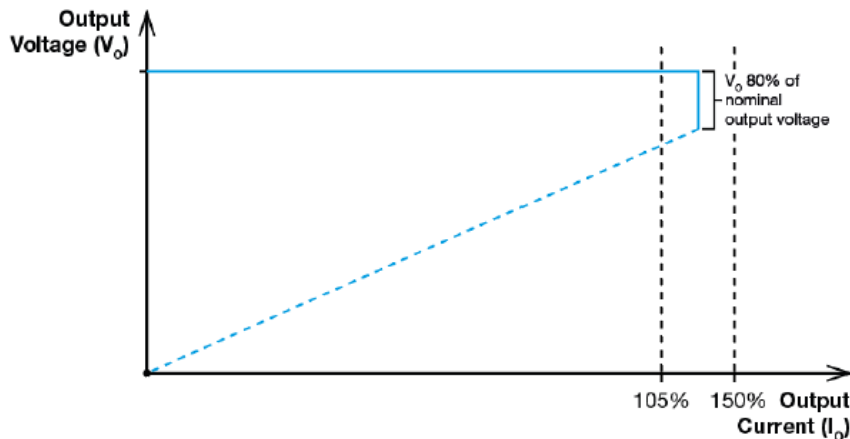
Dynamic response

The power supply output voltage will remain within $\pm 10\%$ of its steady state value, when subjected to a dynamic load from 10% to 100%.



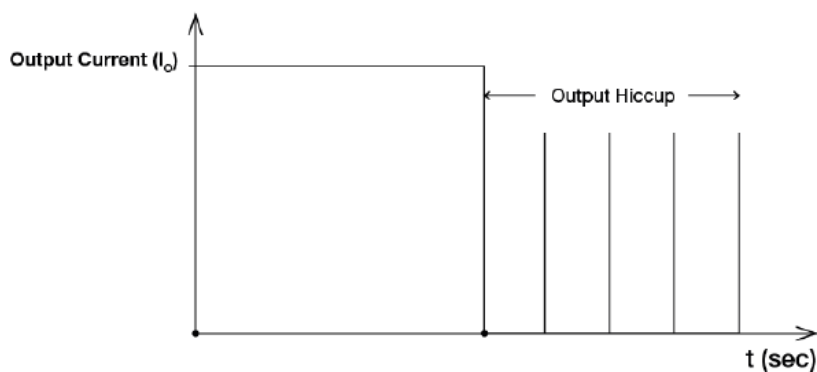
Overload & overcurrent protections (continuous current)

The power supply offers constant current limit protection for inductive and capacitive load applications when output current range is 105–150% of I_O (Max load) and output voltage large than 80%. Upon such an occurrence, the V_O (output voltage) will start to droop. Once the power supply has reached its maximum power limit, the protection will be activated; and, the power supply will operate in continuous current. The power supply will recover once the cause of OLP or OCP is removed, and I_O (output current) is back within the specified range.



Short circuit protection (auto-recovery)

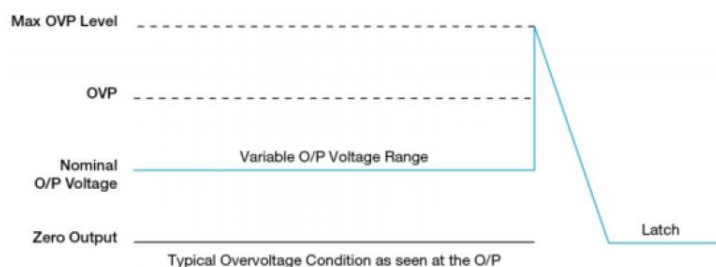
The power supply's output Short Circuit Protection function also provides protection against short circuits. When a short circuit is applied, the output current will operate in "Hiccup mode". The power supply will return to normal operation after the short circuit is removed.



Overvoltage protection (latch mode)

The power supply's overvoltage circuit will be activated when its internal feedback circuit fails. The output voltage shall not exceed its specifications defined on under "Protections". Power supply will latch and require removal/re-application of input AC voltage to restart.

The power supply should be latched and require removal /re-apply of input AC voltage to restart.

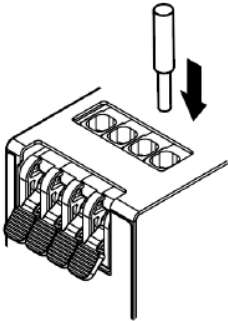
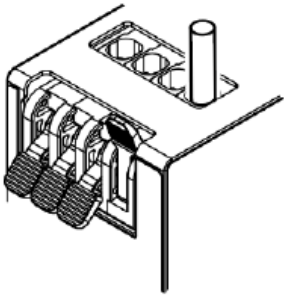


Over temperature protection (latch mode)

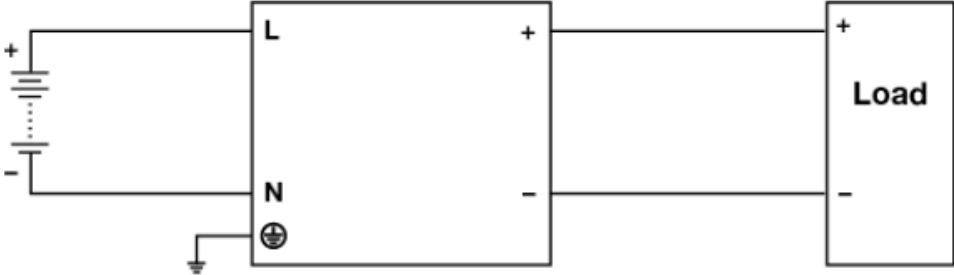
As described in load de-rating section, the power supply also has Over Temperature Protection (OTP). In the event of a higher operating temperature at 100% load; or, when the operating temperature is beyond what is recommended in the de-rating graph, the OTP circuit will be activated. When activated, power supply will latch off, until the surrounding air temperature drops to its normal operating temperature, or the load is reduced as recommended in the de-rating graph. Removal/re-application of input AC voltage will then be required to restart.

Functional and wiring diagram

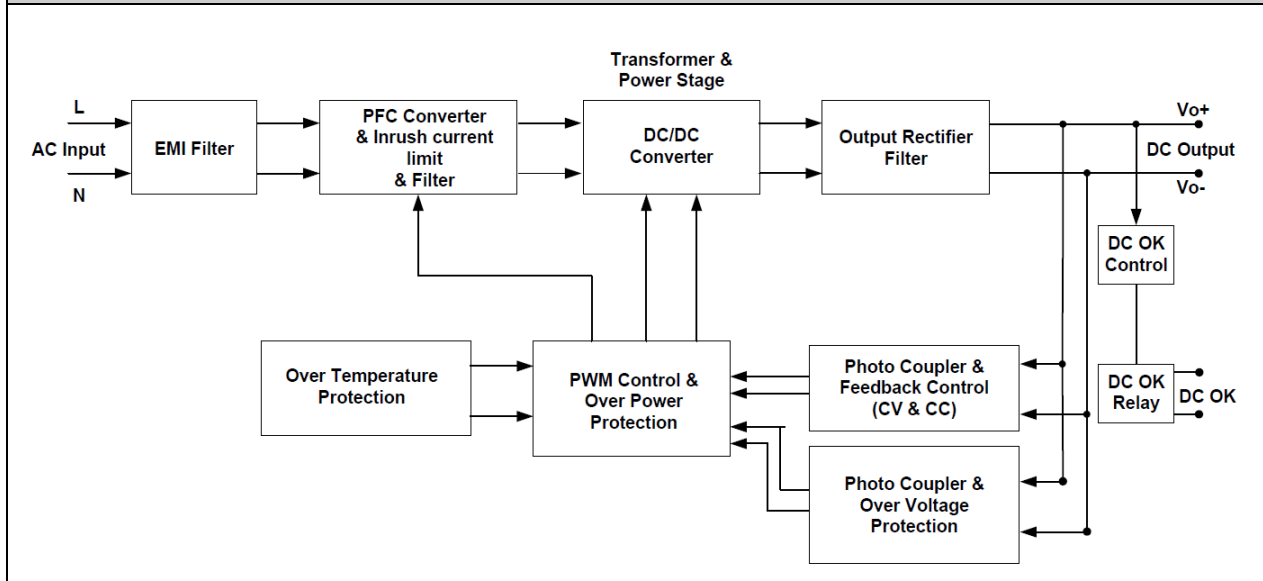
AWG wire table	Current rating for PVC wire	
	6AWG	52.5 A
	8AWG	37.5 A
	10AWG	29 A
	12AWG	22.5 A
	14AWG	16.5 A
	16AWG	12 A
	18AWG	9 A
	20AWG	6.5 A
	22AWG	5 A
	24AWG	3.5 A
	26AWG	2.5 A
	28AWG	2 A
	30AWG	1.5 A

Connecting a wire to spring clamp terminals		
		
	1. Open the lever and insert the wire.	2. Close the lever.
	To disconnect the wires, reverse the procedure. Flexible cables require ferrules.	

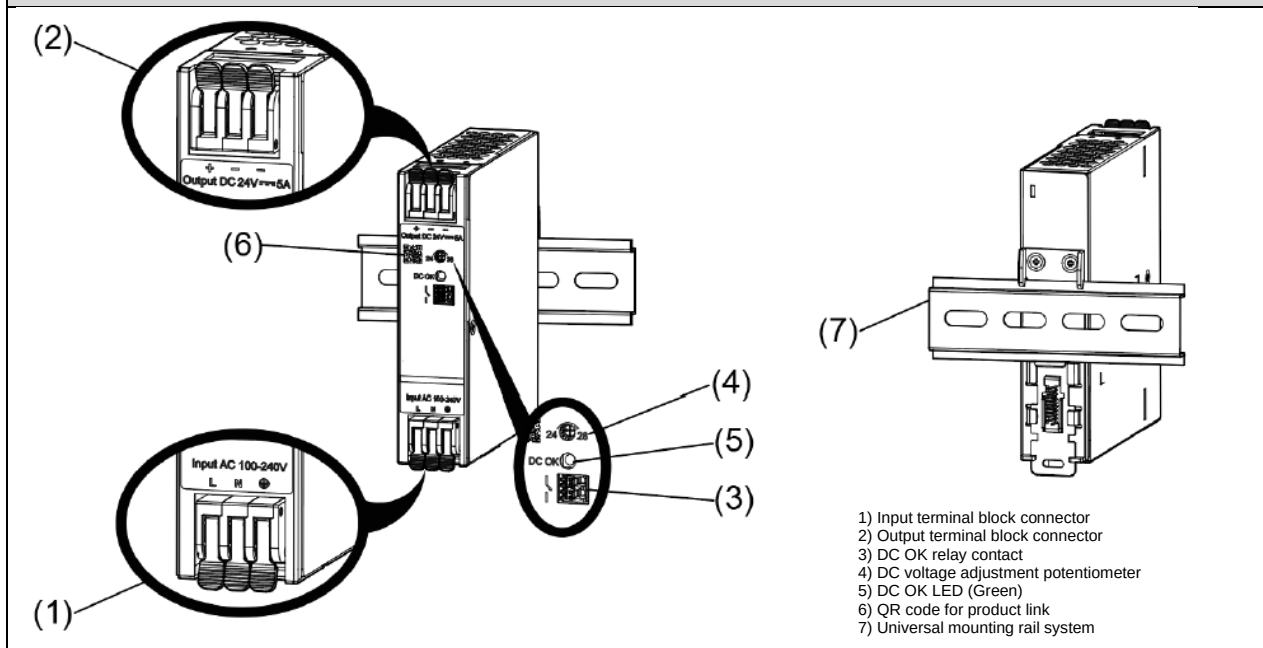
Operating Mode

	
DC Input Operation Step 1.: Use a battery or similar DC source. Step 2.: Connect +pole to L and -pole to N. Step 3.: Connect the PE terminal to an earth wire or to the machine ground.	

Block Diagram



Mechanical Data



Dimensions H x W x D in mm	123.6 x 30 x 116.8
Weight in kg	0.5
Casing	Metal
Indicator	Green LED: DC OK
Cooling	Convection
Terminal ⁴	Input: 3 Pins (rated 600V/30A) Output: 3 Pins (rated 600V/30A) DC OK: 2 Pins (rated 600V/6A)
Wire	Input: AWG 18-12 (Current rating can refer to "AWG Wire Table") Output: AWG 18-12 (Current rating can refer to "AWG Wire Table") DC OK: AWG 22-16 (Current rating can refer to "AWG Wire Table")
Mounting rail	Standard TS35 DIN Rail in accordance with EN 60715
Noise (1m from power supply)	Sound Pressure Level (SPL) <25dBA

Notes

¹ Power supply can operate at DC Input voltage, please connect +pole to L, -pole to N and PE terminal to an earth wire or to the machine ground.

² For power will be derating from 60 to 70°C, and Vin <100VAC, see Derating.

³ PARD is measured with an AC coupling mode, 5cm wires, and in parallel to end terminal with 0.1µF ceramic capacitor & 47µF electrolytic capacitor. PSU need to burn in around 5 minutes when AMB ≤0°C.

⁴ The torque at the screw terminal connector shall not exceed 5.2Kgf.cm.

⁵ Constant current limit protection for inductive and capacitive load applications

⁶ PE: Primary Earth

⁷ Power supply is considered a component in the end-user's system. Please contact our local sales to get more information about the power supply EMC test setup

⁸ Criteria A: Normal performance within the specification limits

⁹ Asymmetrical: Common mode (Line to earth)

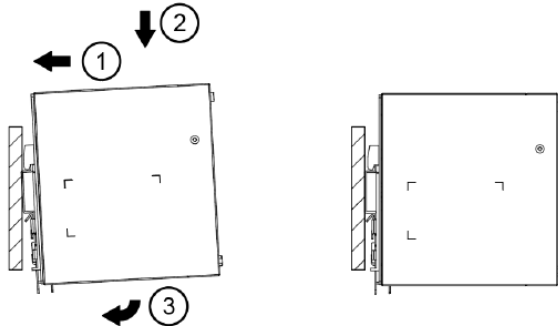
¹⁰ Symmetrical: Differential mode (Line to line)

¹¹ Criteria B: Temporary degradation or loss of function which is self-recoverable

¹² Criteria C: Output out of regulation, shuts down during test (Need to recycle AC power cord to normal operation after test)

Mounting instructions

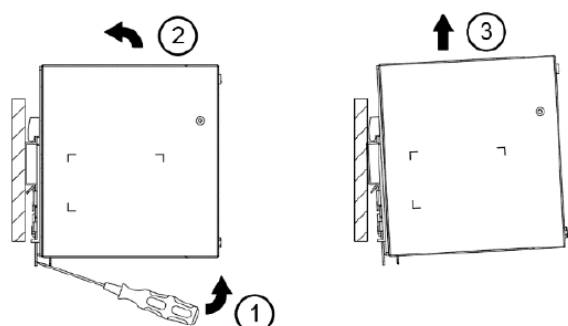
The power supply unit (PSU) can be mounted on 35 mm DIN rails in accordance with EN 60715. The device should be installed with input terminal block at the bottom. Each device is delivered ready to install.



Mounting

Snap on the DIN rail as shown above:

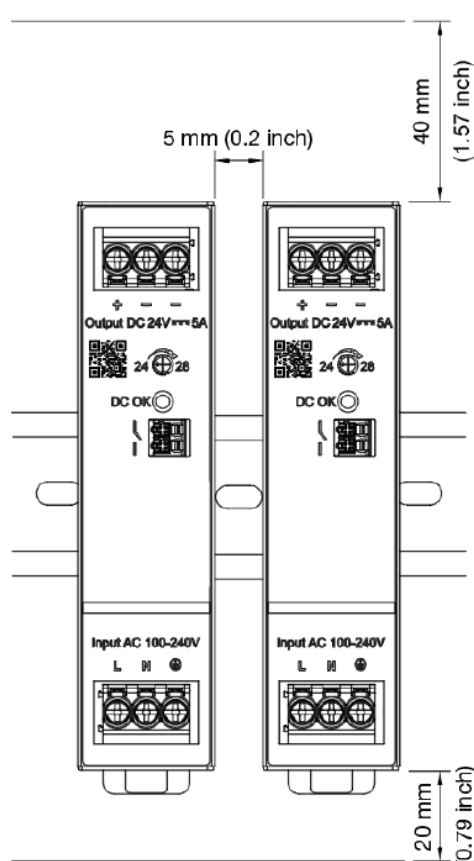
1. Tilt the unit upwards and insert it onto the DIN rail.
2. Push downwards until stopped.
3. Press against the bottom front side for locking.
4. Shake the unit slightly to ensure that it is secured.



Dismounting

To uninstall, pull or slide down the latch with screw driver as shown above. Then slide the power supply unit (PSU) in the opposite direction, release the latch and pull out the power supply unit (PSU) from the rail.

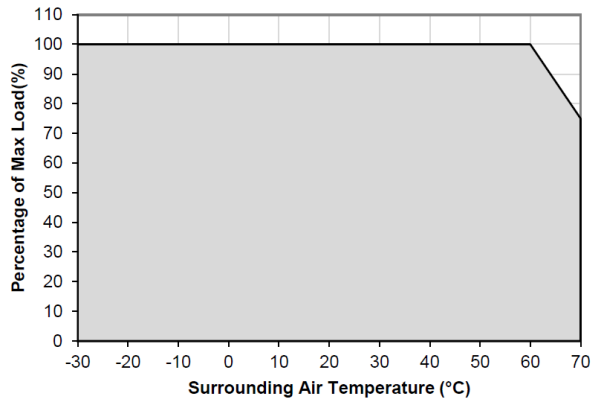
Vertical



- ALWAYS switch mains of input power OFF before connecting and disconnecting the input voltage to the unit. If mains are not turned OFF, there is risk of explosion / severe damage.
- To guarantee sufficient convection cooling, keep a distance of 40 mm (1.57 inch) above and 20 mm (0.79 inch) below the device as well as a lateral distance of 5 mm (0.2 inch) to other units and if load less than 50%, lateral distance can be 0 mm. In case the adjacent device is a heat source, the lateral distance will be 15 mm (0.6 inch).
- Note that the enclosure of the device can become very hot depending on the surrounding air temperature and load of the power supply. Risk of burns!
- The main power must be turned off before connecting or disconnecting wires to the terminals.
- DO NOT insert any objects into the unit.
- Hazardous voltages may be present for up to 5 minutes after the input mains voltage is disconnected. Do not touch the unit during this time.
- The power supplies are built in units and must be installed in a cabinet or room (condensation free environment and indoor location) that is relatively free of conductive contaminants.

Derating

Temperature/Load

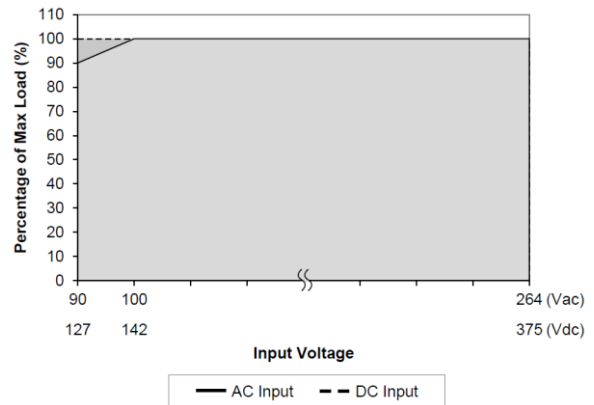


Derating for Vertical Mounting Orientation
> 60°C derate power by 2.5%/°C

Note

1. Power supply components may degrade, or be damaged, when the power supply is continuously used outside the shaded region, refer to the graph shown above.
2. The PSU will be bouncing and start up time will not exceed 5s when ambient temperature at -30°C.
3. If the output capacity is not reduced when the surrounding air temperature > 60°C, the device will run into Over Temperature Protection. When activated, power supply will latch off, until the surrounding air temperature is lowered, or the load is reduced as far as necessary to keep the device in working condition and require removal/re-application of input AC voltage to restart.
4. For the device to function in the manner intended, it is also necessary to keep a safety distance as recommended in the safety instructions while the device is in operation.
5. Depending on the surrounding air temperature and output load delivered by the power supply, the device can be very hot!
6. Need to consider power de-rating if Surrounding Air Temperature is > 60°C.

Input Voltage/Load



Derating for AC & DC Input Voltage
<100VAC derate power by 1%/VAC
No derate power for DC Input

No output power derating for the input voltage from 100-264VAC & 127-375VDC.