

Technical Information

Product Name
DF2420



Description	DF2420
	The DF series DIN rail industrial power supply features high power density and high efficiency. The Series offers overcurrent protection in constant current mode, making it suitable for charging applications. Conformal coating is applied on the PCBAs to protect against dust and pollutants often found in harsh industrial environments. The series' electromagnetic radiated and conducted emissions are compliant with heavy industrial Class B Emission standard and Immunity standard and complies with environmental protection standards RoHS Directive.

Characteristics	
	Universal AC input voltage range
	Built-in constant current circuit for charging applications
	Full load operating temperature up to 55°C
	Cold start at -40°C
	Slim-Line design
	Reduced no-load power consumption
	Built-in DC OK relay and LED indicator
	Conformal coating on PCBAs to protect against common dust and pollutants

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

Input	
Nominal input voltage	3 x 380-500VAC
Input voltage range	3 x 320-575VAC (3-Phase) or 2 x 340-575VAC (2-Phase) ⁰
Nominal input frequency	50-60Hz
Input frequency range	47-63Hz
DC input voltage range ¹	450-800VDC
Input current	<0.85A @ 3 x 400VAC, <0.73A @ 3 x 500VAC
Efficiency at 100% load	94% typ. @ 3 x 400VAC & 3 x 500VAC
Average efficiency (25%, 50%, 75%, 100%)	92% typ. @ 3 x 400VAC
Max. power dissipation	0% load: <7W @ 3 x 400VAC & 3 x 500VAC 100% load: <33W @ 3 x 400VAC & 3 x 500VAC

Max. inrush current (cold start)	35A typ. @ 3 x 400VAC & 3 x 500VAC
Power factor at 100% load	>0.9 @ 3 x 400VAC, >0.88A @ 3 x 500VAC
Leakage current	<3.5mA @ 3 x 500VAC

Output ²	
Rated output voltage	24VDC
Factory set point tolerance	24VDC $\pm$ 2%
Output voltage adjustment range	24-28VDC
Rated output current	20A
Output current	0-20A
Output power	480W max
Line regulation	<40mV (@ 3 x 320-575VAC input, 100% load)
Load regulation	<200mV (@ 3 x 320-575VAC input, 0-100% load)
PARD ³ (20MHz)	<150mVpp
Rise time	100ms typ. @ nominal input (100% load)
Start-up time	1,000ms typ. @ nominal input (100% load)
Hold-up time	20ms typ. @ 3 x 400VAC & 500VAC (100% load)
Dynamic response (overshoot & undershoot O/P voltage)	$\pm$ 5% @ 3 x 320-575VAC input, 1.5-100% load (Slew Rate: 0.1A/ μ s, 50% duty cycle @ 5Hz-1kHz)
Start-up with capacitive loads	20,000 μ F max
Functional	DC OK relay contact: Rated: 30V at 1A, resistive load.

Protection	
Overvoltage	<31V, Hiccup Mode, Non-Latching (Auto-Recovery)
Overload/overcurrent	110-150% of rated load current, Auto-recovery Continuous current limit Mode ⁵ (Vo >18VDC)
Overtemperature	60 to 80°C surrounding air temperature @ 100% load, Non-Latching (Auto-Recovery)
Short circuit	Hiccup Mode, Non-Latching (Auto-Recovery when the fault is removed)
Internal fuse	T3.15A
Degree of protection	IP20
Protection against shock	Class I with PE ⁶ connection

Environment			
Working temperature	3-Phase: -25 to +70°C (-40°C Cold Start) 2-Phase: -25 to +60°C (-40°C Cold Start)		
Storage temperature	-40 to +85°C		
Power derating	Vertical mounting: >55°C derate power by 3.33%/°C Horizontal mounting: >25°C derate power by 2.5%/°C Input voltage: 2-Phase: 2 x 340-575VAC derate power to 80%		
Operating altitude and over voltage category	OVC III	0-2,500m	According to IEC/EN 62477-1 / EN 60204-1 (clearance and creepage distances) and IEC 62103 (safety part)
	OVC II	2,500-6,000m	
		0-5,000m	According to IEC/EN 62368-1, IEC/EN 61010
Working humidity	5-95% relative humidity (non-condensing)		
Vibration (operating)	IEC 60068-2-6, Sine Wave: 10-500 Hz; 3G peak; 60 min per axis for all X, Y, Z directions		
Shock test (non-operating)	IEC 60068-2-27, Half Sine Wave: 50 G for duration of 11 ms; 3 times per direction		
Pollution degree	2		

Safety/EMC ⁷		
Electrical equipment of machines	EN/BS EN 60204-1 (over voltage category III)	
Electrical equipment for use in electrical power installations	IEC/EN/BS EN 62477-1 / IEC 62103	
Safety entry low voltage	SELV (IEC 60950-1)	
	SIQ Bauart	EN 62368-1, EN 61010-1, EN 61010-2-201

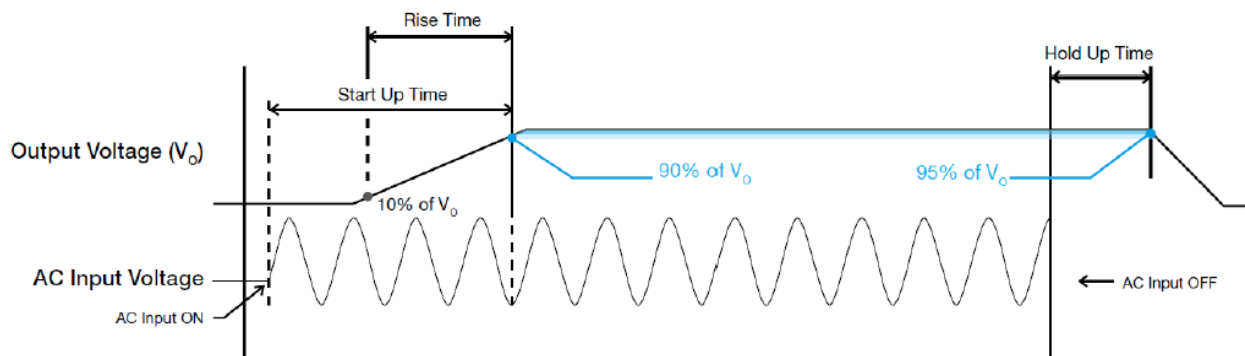
Electrical safety	UL/cUL recognized	UL 62368-1 and CSA C22.2 No. 62368-1 (File No. E307271)
	CB scheme	IEC 60950-1, IEC 62368-1, IEC 61010-1, IEC 61010-2-201
	UKCA	BS EN 62368-1, BS EN 61010-1, BS EN 61010-2-201

Electrical equipment for measurement, control, and laboratory use	UL/cUL listed	UL 61010-1, UL 61010-2-201 (File No. E236194)		
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 No. 1011 and The Electromagnetic Compatibility Regulations 2016 No. 1091		
Galvanic isolation	Input to Output	4kVAC		
	Input to Ground	2kVAC		
	Output to Ground	1.5kVAC		
	DC OK relay contact to Output	0.5kVAC		
	DC OK relay contact to Ground	1.5kVAC		
EMC-Emissions (CE & RE)		Generic Standards: EN/BS EN 61000-6-3, CISPR 32, EN/BS EN 55032, KS C 9832, FCC Title 47: Class B		
Component power supply for general use		EN/BS EN 61204-3		
EMC-Immunity		Generic Standards: EN/BS EN 55024, EN/BS EN 55035, KS C 9835, EN/BS 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	Level 3 Criteria A ⁸ 80MHz-1GHz, 10V/M, 80% Modulation (1kHz) 1.4-2GHz, 10V/M, 80% Modulation (1kHz) 2-6GHz, 10V/M, 80% Modulation (1kHz)		
Immunity to electrical fast transient/burst	IEC 61000-4-4	Level 4 Criteria A ⁸ 4kV		
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 3 Criteria A ⁸ 30A/m		
Immunity to voltage dips and interruptions	IEC 61000-4-11	0% of 3 x 380VAC	0VAC, 20ms	Criteria A ⁸
		0% of 3 x 480VAC	0VAC, 20ms	Criteria A ⁸
		40% of 2 x 380VAC	152VAC, 200ms	Criteria A ⁸
		40% of 2 x 480VAC	192VAC, 200ms	Criteria A ⁸
		70% of 2 x 380VAC	266VAC, 500ms	Criteria A ⁸
		70% of 2 x 480VAC	336VAC, 500ms	Criteria A ⁸
Immunity to low energy pulse test (ring wave)	IEC 61000-4-12	0%	0VAC, 5,000ms	Criteria B ¹¹
		Level 3 Criteria A ⁸ Common Mode ⁹ : 2kV Differential Mode ¹⁰ : 1kV		
Harmonic current emission		IEC/EN/BS EN 61000-3-2, Class A		
Voltage fluctuation and flicker		IEC/EN/BS EN 61000-3-3		
Voltage sag immunity SEMI F47 – 0706		80% of 380VAC, 304VAC, 1000ms, Criteria A ⁸ 70% of 380VAC, 266VAC, 500ms, Criteria A ⁸ 50% of 380VAC, 190VAC, 200ms, Criteria A ⁸		
MTBF – mean time between failure		Telcordia SR-332 >600,000 hrs I/P: 3 x 400VAC & 3 x 500VAC, O/P: 100% load, ambient temperature: 25°C		
Expected cap life time		10 years: I/P: 3 x 400VAC & 3 x 500VAC, O/P: 24V, 10A, ambient temperature: 40°C		

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

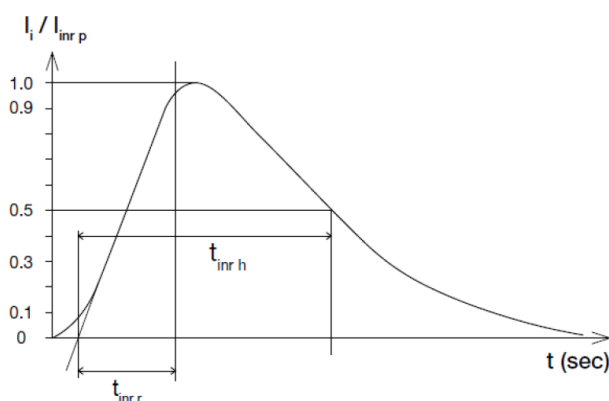
DC OK relay contacts status	Contact closes	The output voltage >90% of its steady state set value.
	Contact opens	The output voltage <90% of its steady state set value.
Start-up time	The time required for the output voltage to reach 90% of its final steady state set value, after the input voltage is applied.	
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

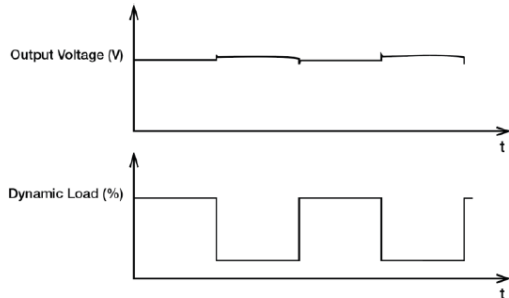
Inrush current is the peak, instantaneous, input current measured and, occurs when the input voltage is first applied. For AC input voltages, the maximum peak value of inrush current will occur during the first half cycle of the applied AC voltage. This peak value decreases exponentially during subsequent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



Dynamic response

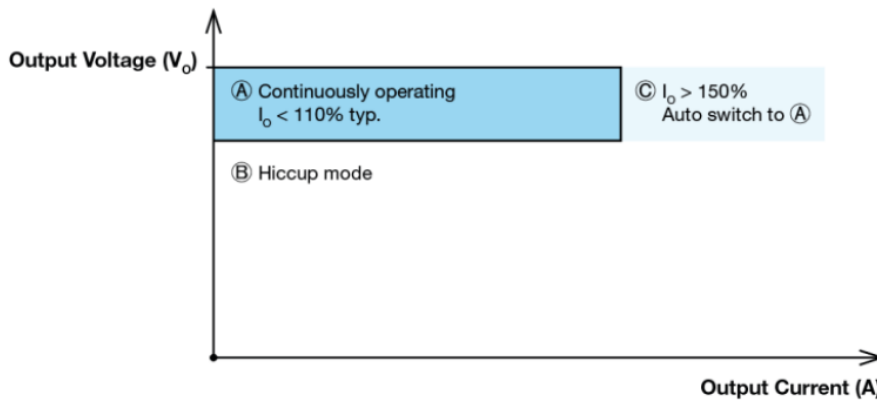
The power supply output voltage will remain within $\pm 5\%$ of its steady state value, when subjected to a dynamic load from 0% to 100%.

50% duty cycle / 5Hz to 1kHz



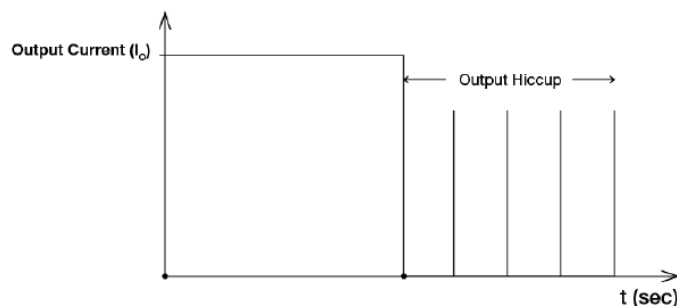
Overload & overcurrent protections (auto-recovery)

The power supply's Overload (OLP) and Overcurrent (OCP) Protections will be monitored by internal counter when output current (I_o) is 110~150% of maximum rated load ($I_o \text{ Max}$). After counter reaches the limit value (typically 5 secs), output current will be limited to 110% typ. (refer to ② below) and output voltage (V_o) will start to droop. Once V_o is below approximately 18VDC typ., the power supply will start to operate in "Hiccup mode" as described in short circuit protection. The power supply will recover once the fault condition due to OLP or OCP is removed, then I_o is back within its specified limits.



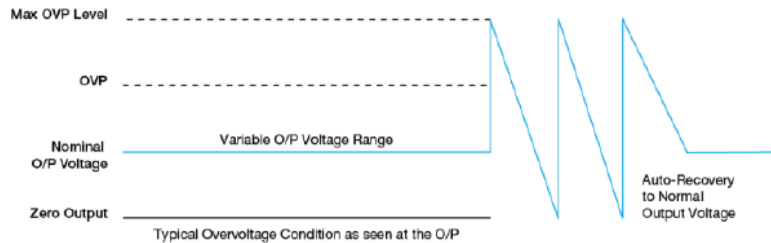
Short circuit protection (auto-recovery)

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 (auto-recovery)

The power supply's overvoltage circuit will be activated when its internal feedback circuit fails. The output voltage shall not exceed its specifications defined under "Protections".



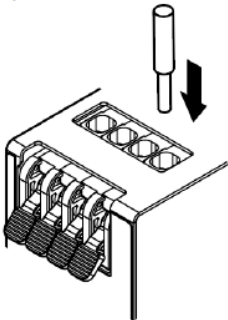
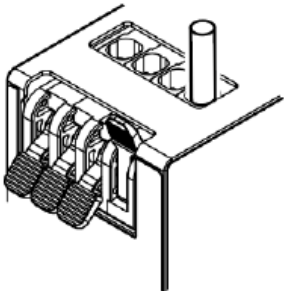
Over temperature protection (auto-recovery)

As described in load derating section, the power supply also has Over Temperature Protection (OTP). In the event of a higher operating temperature at 100% load, the power supply will run into OTP when the operating temperature is beyond what is recommended in the derating graph. When activated, the output voltage will go into bouncing mode until the temperature drops to its normal operating temperature as recommended in the derating graph.

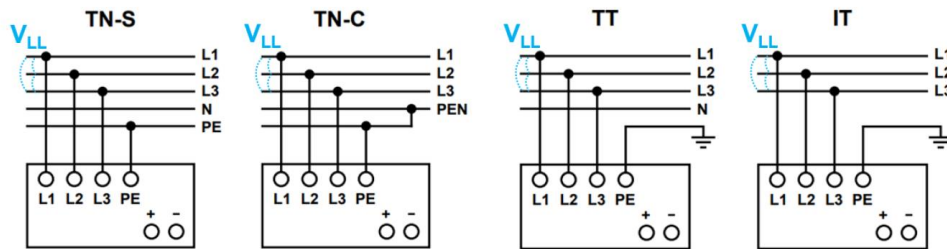
External input protection device

The unit is protected with internal fuse at L1, L2 and L3 pins, with an internal fuse that cannot be replaced. The power supply has been tested and approved on 20 A (UL) and 16 A (IEC) branch circuits without additional protection device. An external protection device is only required if the supplying branch has an ampacity greater than above. Thus, if an external protective device is necessary, or, utilized, please refer a minimum value in instruction sheet with 4 A B- or C- characteristic breaker.

Functional and wiring diagram

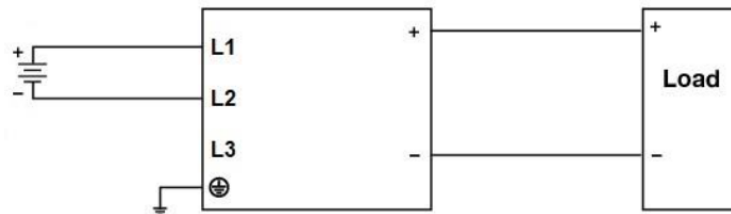
AWG wire table	Current rating for PVC wire	
	6AWG	52.5 A
	8AWG	37.5 A
	10AWG	29 A
	12AWG	22.5 A
	14AWG	16.5 A
	16AWG	12 A
	18AWG	9 A
	20AWG	6.5 A
	22AWG	5 A
	24AWG	3.5 A
	26AWG	2.5 A
	28AWG	2 A
	30AWG	1.5 A
Connecting a wire to spring clamp terminals		
	1. Open the lever and insert the wire. To disconnect the wires, reverse the procedure. Flexible cables require ferrules.	2. Close the lever.

Operating Mode



AC Input operation

The power supply is approved for Star or Wye Networks L1, L2, L3 and PE connections. The nominal input voltage is 380-500VAC phase to phase (V_{LL}), 380-500 Y 3-Phase or equivalent to 220-289VAC phase to neutral (V_{LN}) voltage system, 220-289 V 3-Phase. The neutral does not connect with input terminal actually.



DC Input operation

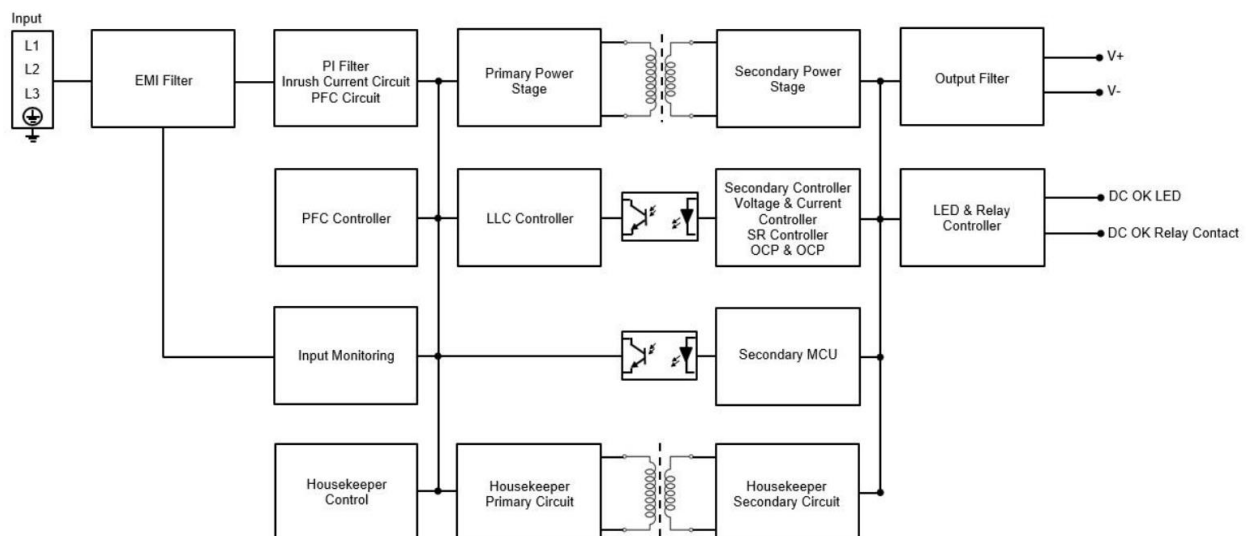
Step 1: Use a battery or similar DC source.

Step 2: Connect either connections of +pole and -pole to L1/L2/L3 as below.

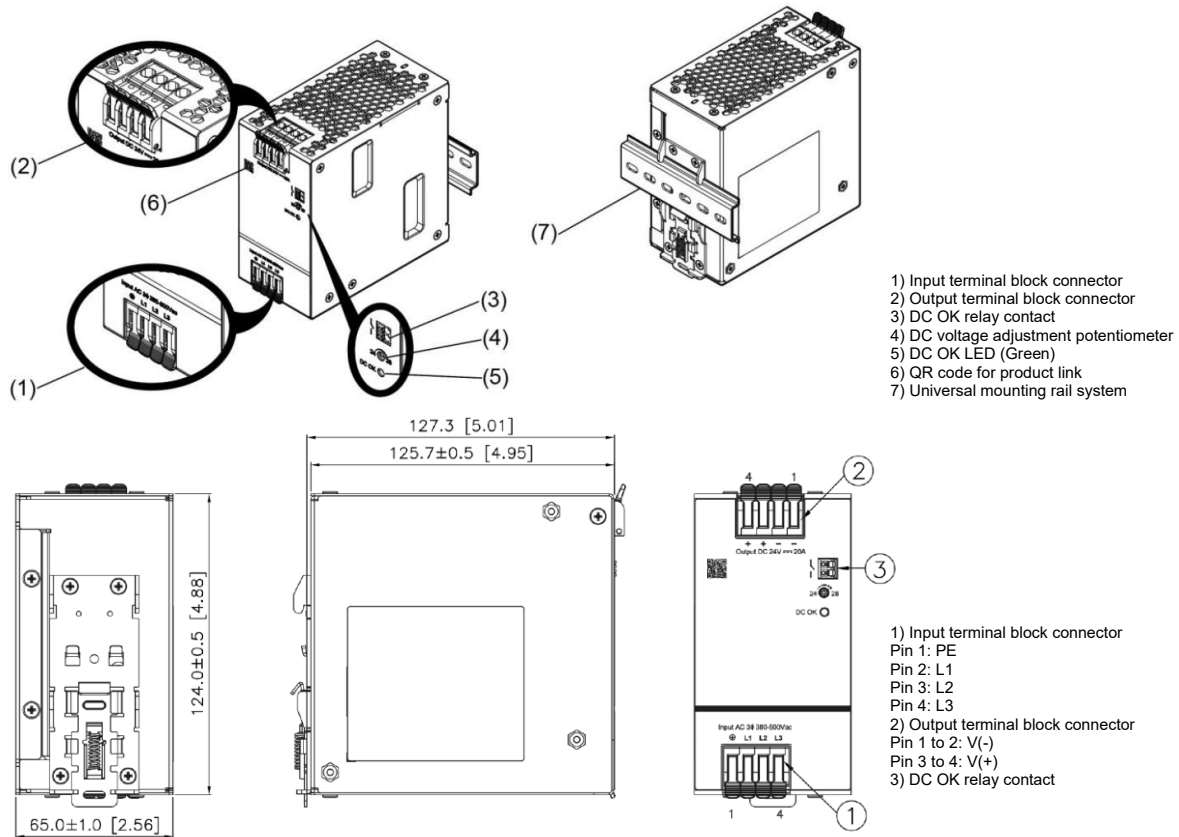
- +pole to L1 and -pole to L2
- +pole to L1 and -pole to L3
- +pole to L2 and -pole to L1
- +pole to L2 and -pole to L3
- +pole to L3 and -pole to L1
- +pole to L3 and -pole to L2

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	124 x 65 x 127.3
Weight in kg	1.2
Casing	Aluminum
Indicator	Green LED: DC OK
Cooling	Convection
Terminal ⁴	Input: 4 Pins (rated 600V/30A) Output: 4 Pins (rated 600V/30A) Signal: 2 Pins (rated 300V/12A)
Wire	Input: AWG 18-10 Output: AWG 12-10 Signal: AWG 20-16
Mounting rail	Standard TS35 DIN Rail in accordance with EN 60715
Noise (1m from power supply)	Sound Pressure Level (SPL) <25dBA

Notes

⁰ For 2-phase input, see power de-rating.

¹ Power supply can operate at DC Input.

² For power will be derating from 55 to 70°C, see power 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 5.4Kgf.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)

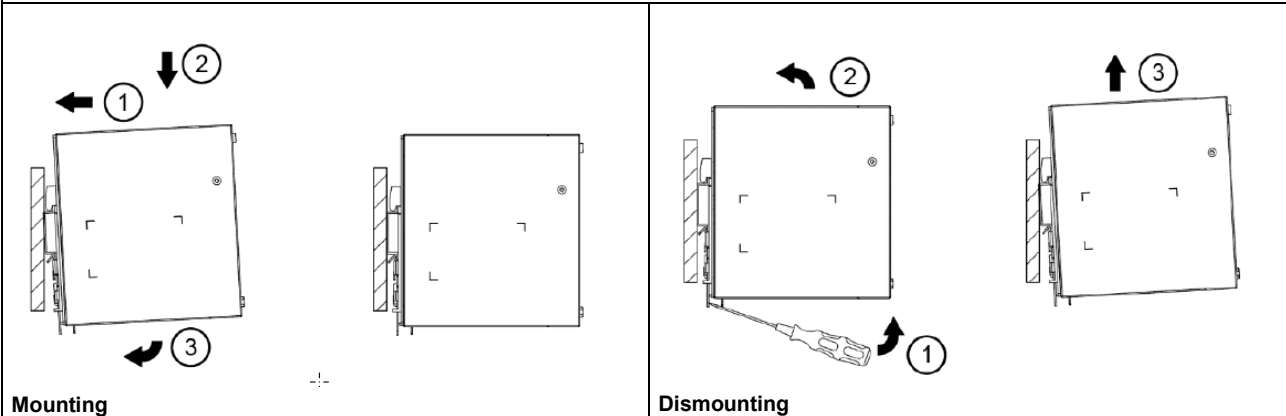
¹⁰ Symmetrical: Differential mode (Line to line)

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

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.

1. Tilt the unit upwards and insert it onto the DIN rail. Snap on the DIN rail as shown below.
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.
5. To uninstall, pull or slide down the latch with screw driver as shown below. 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.



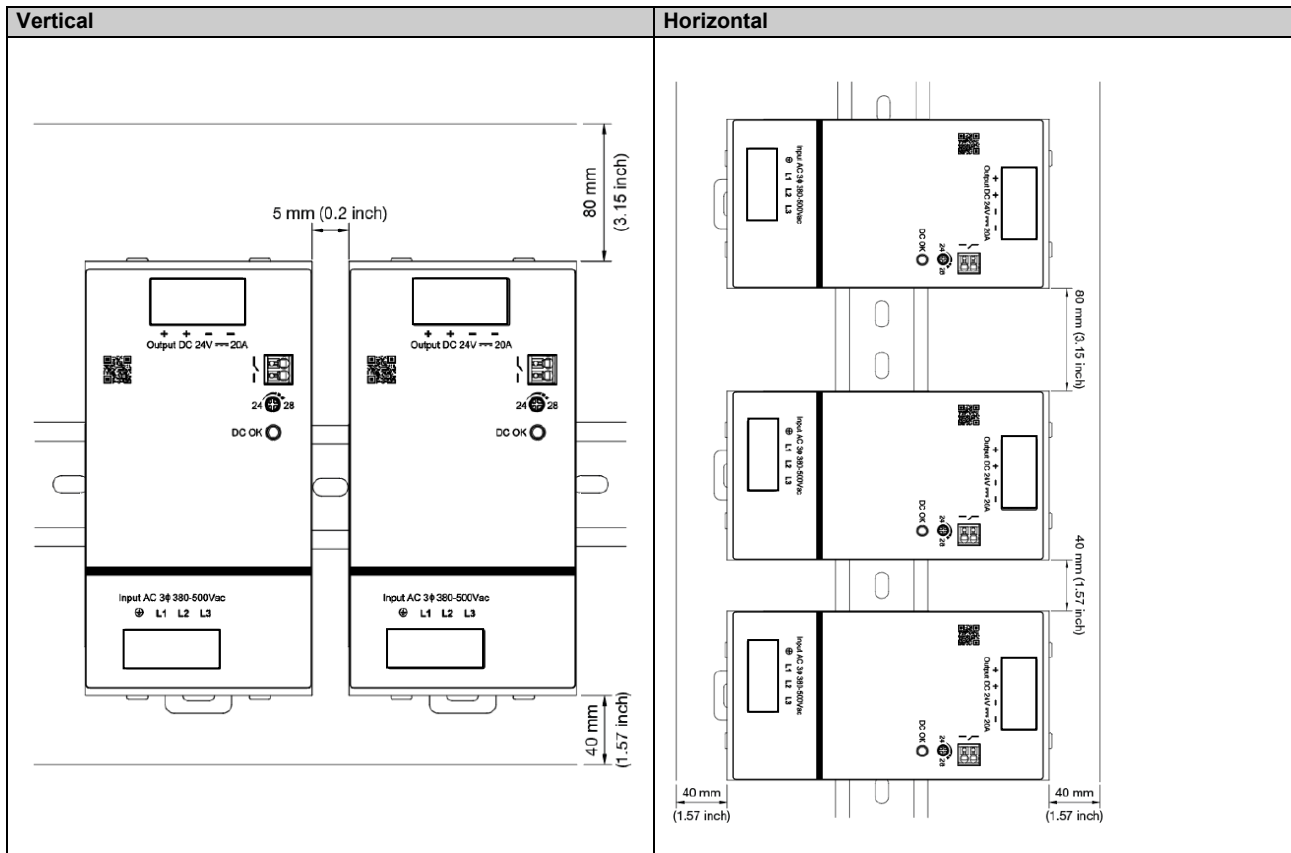
Mounting

Dismounting

In accordance to IEC/EN/UL/CSA 62368-1 and IEC/EN/UL/CSA 61010-2-201, flexible cables require ferrules.

Use appropriate copper cables designed to sustain operating temperature of:

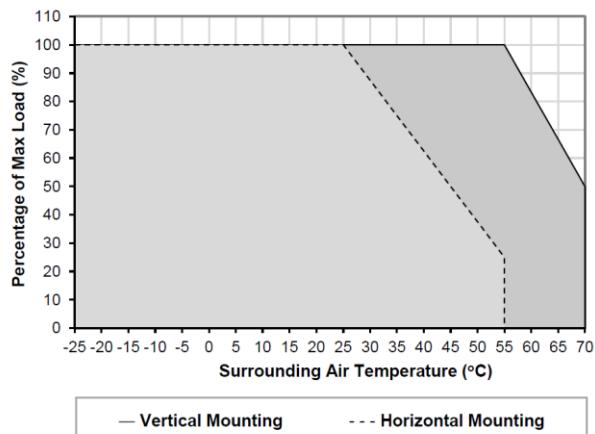
- At least 75°C for ambient <25°C
- At least 90°C for ambient <70°C.



- 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, please refer to the following instructions to ensure sufficient clearance around the device.
Vertical Mounting: 80 mm (3.15 inch) above and 40 mm (1.57 inch) below the device as well as a lateral distance of 5 mm (0.20 inch) to other units. In case the adjacent device is a heat source (50% load of 480 W), the lateral distance will be 25 mm (0.98 inch).
Horizontal Mounting: 80 mm (3.15 inch) above and 40 mm (1.57 inch) below the device as well as a lateral distance of 40 mm (1.57 inch) to other units.
- The external enclosure where the unit will be installed shall meet the requirements for mechanical, electrical and fire enclosure.
- 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.
- The power supply is approved for the connection to 3-phase TN, TT and IT power grids (star networks) with a maximum phase-to-phase voltage of 500 Vac.

Derating

Temperature/Load



Derating for Vertical Mounting Orientation

>55°C (3.33%/°C) in Vertical

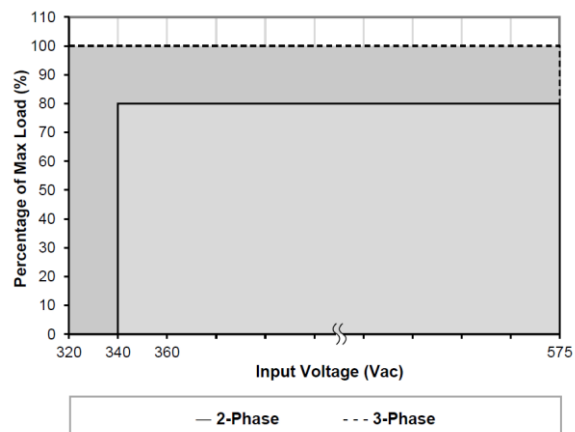
Derating for Horizontal Mounting Orientation

>40°C (2.5%/°C) in Horizontal

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 above.
2. If the output capacity is not reduced when the surrounding air temperature exceeds its specification as defined under "Environment", the device will run into Over Temperature Protection. When activated, the output voltage will go into bouncing mode and will recover when the surrounding air temperature is lowered or the load is reduced as far as necessary to keep the device in working condition.
3. In order 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.
4. Depending on the surrounding air temperature and output load delivered by the power supply, the device can be very hot!

Input Voltage/Load



Derating for AC Input Voltage

2 x 340-575VAC derate power to 80%

No output power de-rating across the entire 3-phase input voltage range.

Output power de-rating to 80% across the entire 2-phase input voltage range.