Switching Power Supplies
3-Phase RACPRO1 Series

Overview

The slim RACPRO1 series is a high-reliability, three-phase AC input, DIN rail mount power supply. It is specially designed for demanding applications in the harsh industrial automation field. The unique and innovative modern design with 25-degree push-in connectors allows easy tool-less installation or replacement.

Features

- Slim design with 25-degree push-in connectors
- Fast tool-less mounting and demounting
- Active inrush current limitation
- Thermal power bonus 120%/45°C
- 3-year warranty

RACPRO1-T240/24

3-Phase Switching Power Supplies

Part Number	Price	Output Voltage Range	Input Voltage Range	Output (Adjustable)	Efficiency	Dimensions H x W x D mm [in]	Weight gram [lb]	Drawing Link
RACPRO1-T240/24	$140.00	24-28 VDC	320-575 VAC 450-815 VDC	24 VDC @ 10A/240W	94.1% @ 480 VAC	135 x 43 x 140.4 [5.3 x 1.7 x 5.5]	531 [1.17]	PDF
RACPRO1-T480/24	$190.00	24-28 VDC		24 VDC @ 20 A/480W	95% @ 480 VAC	135 x 52 x 155.7 [5.3 x 2.0 x 6.1]	768 [1.69]	PDF
RACPRO1-T480/48	$190.00	48-56 VDC		48 VDC @ 10A/480W	94% @ 480 VAC			PDF
RACPRO1-T960/24	$275.00	24-28 VDC		24 VDC @ 40A/960W	96% @ 480 VAC	135 x 80 x 155.7 [5.3 x 3.15 x 6.1]	1140 [2.51]	PDF
RACPRO1-T960/48	$275.00	48-56 VDC		48 VDC @ 20A/960W	97% @ 480 VAC			PDF

3-Phase Switching Power Supplies

Part Number	Input/Output Cage Clamp								Push-in Signal Terminal *			
	Function	AWG	mm^2	Wire Stripping Length	Function	AWG	mm^2	Wire Stripping Length	Function	AWG	mm^2	Wire Stripping Length
RACPRO1-T240/24	L1, L2, L3	24-8	0.25-6	12-13mm	+1, +2 (Vout)	24-8	0.25-6	12-13mm	Signal	24-16	0.25-1.5	8-9mm
	PE				-1, -2 (Vout)							
RACPRO1-T480/24	L1, L2, L3				+1, +2 (Vout)							
	PE				-1, -2 (Vout)							
RACPRO1-T480/48	L1, L2, L3				+1, +2 (Vout)							
	PE				-1, -2 (Vout)							
RACPRO1-T960/24	L1, L2, L3				+1, +2 (Vout)	18-4	0.75-25	18-20mm	Signal (13, 14)			
	PE				-1, -2 (Vout)							
RACPRO1-T960/48	L1, L2, L3				+1, +2 (Vout)							
	PE				-1, -2 (Vout)							

*** Do not connect to hazardous voltages.**
Ferrules are required for stranded wire.

Switching Power Supplies 3-Phase T960 Model RACPRO1 Series

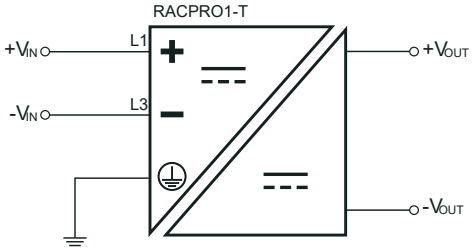
Specifications		
Models		***T960***
Nominal Input Voltage		400 to 480 VAC at 50/60 Hz
Operating Range [1]	***3-Phase***	320 to 575 VAC [2]
	2-Phase	350 to 480 VAC (max. P_{OUT} - 60W)
	DC Operation (Refer to Connections for DC Operation Diagram)	Continuous 450 to 815 VDC 10s max. 850 VDC
Turn-on Voltage	***AC Operation***	Minimum 300 VAC (prevents switching on 1AC operation)
	DC Operation	Minimum 424 VDC
Turn-off Voltage	***AC Operation***	Minimum 290 VAC
	DC Operation	Minimum 410 VDC
Input Current	***AC Operation 400 VAC***	Maximum 3x 1.6A
	AC Operation 480 VAC	Maximum 3x 1.4A
	DC Operation 500 VDC	Maximum 2.1A
Inrush Current	***3AC 400 VAC, cold start***	Maximum 10A
No Load Power Consumption	***3AC 400 VAC***	RACPRO1-T960/24 2.2W typical 3W maximum
		RACPRO1-T960/48 2.1W typical 3W maximum
	3AC 480 VAC	RACPRO1-T960/24 2.5W typical 3W maximum
		RACPRO1-T480/48 2.7W typical 3W maximum
Input Frequency Range		47 to 63 Hz
Nominal Output Voltage (factory set)		RACPRO1-T960/24RACPRO1-T960/24 typical 24 VDC RACPRO1-T960/48 typical 48 VDC
Minimum Load		0%
Power Factor (full load)		Typical 0.94
Start-up Time	***(2- & 3-phase operation, 400 VAC)***	Typical 695ms maximum 810ms
Rise Time		Typical 5ms maximum 10ms
Hold-up Time		RACPRO1-T960/24 typical 23ms
		RACPRO1-T960/48 typical 21ms
Internal Operating Frequency		Typical 83 kHz
Ripple and Noise		Maximum 1% of nom V_{out} (20MHz bandwidth)
Housing Material		Polycarbonate/aluminum
Agency Approvals		cULus File NMTR.E470721, CE

[1] The products were submitted for safety files at AC and DC-Input operation. (350V-575 VAC and 450-600 VDC) If input voltage is >500 VDC consider an external fuse according to applicable standards. 2-phase operation is not included in the safety approvals. Additional tests might be necessary when the complete application has to be approved according to UL 62368-1, 61010-1 and UL 61010-2-201

[2] Output power derating for Line-input of less than 3AC 350 VAC (derate linearly from 100% at 350 VAC to 90% at 3AC 320 VAC)

Measured @ T_{AMB}= 25°C, 3AC 400 VAC full load and after warm-up unless otherwise stated.

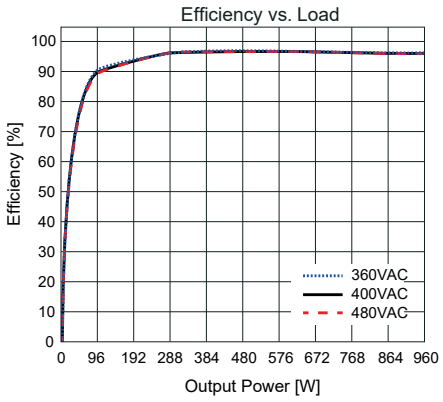
Connections for DC Operation

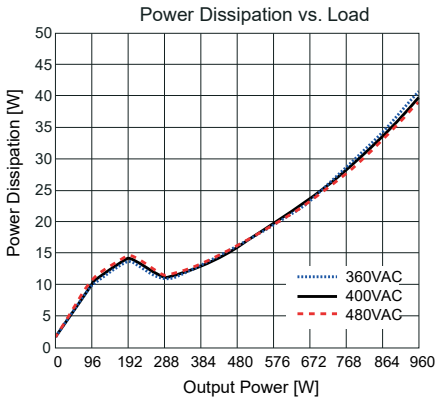


Switching Power Supplies 3-Phase T960 Model RACPRO1 Series

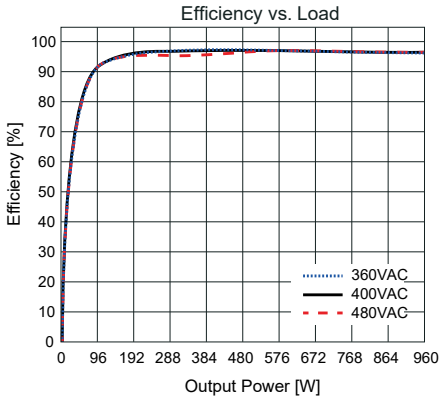
Characteristic Curves

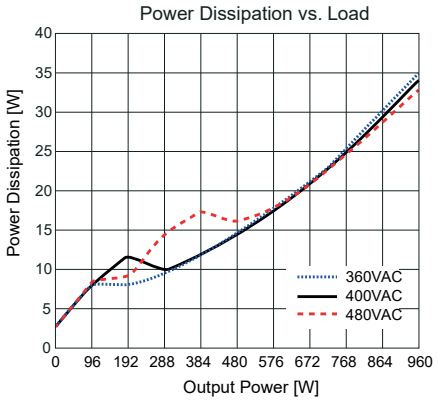
RACPRO1-T960/24





RACPRO1-T960/48





Additional Features			
Parameter	***Condition***		***Value***
Output Voltage Adjustability (1)	On-board potentiometer	RACPRO1-T960/24	24-28 VDC
		RACPRO1-T960/48	48-56 VDC
Parallel Load Share Mode	—		Refer to DIP-Switch Settings
Boost Power	Refer to Boost Power		150% for 7.5s
			250% for 20ms
Charging Mode	DIP-Switch 2 "ON"; limited to T_{AMB} max. 60°C, to maintain reliability Refer to CC/CV Mode (Charging Mode)		Typical 100% $I_{OUTLIMIT}$ continuous
Load Indication LED	LED green, refer to Load Indication LED		Normal Mode
	LED off		Abnormal mode, no operation or failure
DC-OK LED	LED Green		Output voltage OK, normal mode
	LED off		Abnormal mode, no operation or failure
Signal Contact	Closed		Normal mode
	Open		Abnormal mode, no operation or failure
Signal Contact Rating	Do not connect signaling contact to hazardous voltages	RACPRO1-T960/24	30 VDC / 0.1A
		RACPRO1-T960/48	60 VDC / 0.1A

(1) When input voltage is below 350 VAC, the output voltage is limited to 24/48 VDC.
Make sure that the maximum rated output power will not be exceeded when trimming up.

Switching Power Supplies 3-Phase T960 Model RACPRO1 Series

DIP-Switch Settings

Single Mode (Factory set) *
Power Boost Mode available, refer to Boost Power

Parallel Load Share Mode ***
Angled output characteristic (droop mode) for load sharing. Voltage drop from 0 to nom. I_{OUT}: 1.2V

Charging Mode
Current Limitation strictly at nominal current. Refer to CC/CV Mode (Charging Mode)

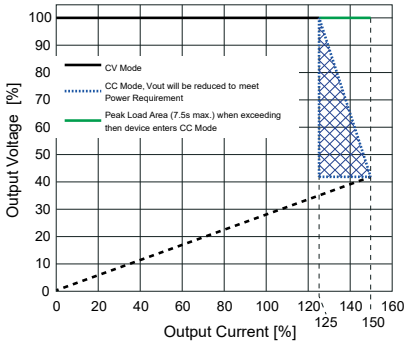
Not allowed!
This would result in an output characteristic with passive load sharing and nominal output current only. This won't necessarily damage the PSU, but it will prevent the 150% boost power mode from activating. We advise against using these PSUs in this mode out of an abundance of caution.

DIP1	DIP2	
OFF	OFF	
ON	OFF	
OFF	ON	
ON	ON	

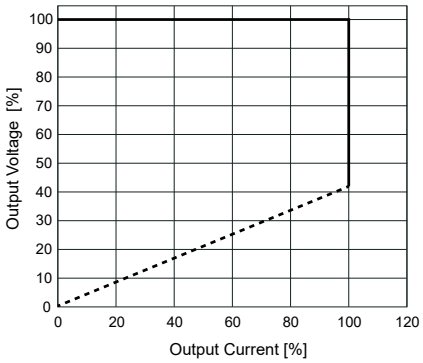
** Series operation is allowed. A setup was successfully tested without issue using three RACPRO1-T480/48 units in series for an output of 150V. If a series configuration is to be used, it is critical that proper wiring, connections, and safety measures are in place ahead of time to prevent any converters being disproportionately loaded.*
For series operation, best practice it to put the PSUs in Single Mode, as this would provide full power with the 150% power boost.

*** This mode enables automatic current sharing between paralleled units by slightly decreasing the output voltage as output current increases. When 2+ supplies are operated in parallel, if one unit starts taking more load, its voltage drops a bit more, and the other unit(s) begins to supply more current in response to this voltage drop.*

U/I Factory Setting (Single Mode)



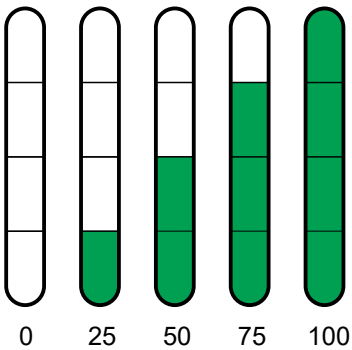
CC/CV Mode (Charging Mode)



Constant Current / Constant Voltage mode. It's useful for the battery charging mode to have the output stay at the 100% rated output current. This is applicable for just the T480 and T960.

Load Indication LED

4 LEDs displaying actual and target current of rated output current.



Regulations		
Parameter	***Condition***	***Value***
Output Accuracy	—	±1.0% maximum
Line Regulation	Low line to high line, full load	±0.1% typical
Load Regulation	0 to 100% load	±0.3% typical
Max. Capacitive Load (start-up)	RACPRO1-T960/24	40mF
	RACPRO1-T960/48	20mF
Transient Response	10 to 100% load	±3.0% typical
	Recovery time	100ms typical

Measured @ T_{AMB}= 25°C, 3AC 400 VAC full load and after warm-up unless otherwise stated.

Switching Power Supplies 3-Phase T960 Model RACPRO1 Series

Protections			
Parameter	***Type***		***Value***
Internal Input Fuse	DC compliant		2 x 5A, slow-blow
Easy Fuse Tripping	—		250% / 20ms
External Input Protection	—		16A C-characteristic circuit breaker
Short Circuit Protection (SCP)			Hiccup mode, auto recovery
Over Voltage Protection (OVP)	SELV output	RACPRO1-T960/24	35 VDC, latch off
		RACPRO1-T960/48	59.8 VDC, latch off
Return Voltage Immunity	Continuous	RACPRO1-T960/24	35 VDC maximum
		RACPRO1-T960/48	63 VDC maximum
	<5 min	RACPRO1-T960/24	38 VDC maximum
		RACPRO1-T960/48	68 VDC maximum
Absorbing Energy	RACPRO1-T960/24		2J
	RACPRO1-T960/48		1.5 J
Over Voltage Category (OVC)	—		OVCII
Over Current Protection (OCP)	< 6 sec		> 150% of rated load current, hiccup mode, auto recovery
	< 20ms (1)		> 250% of rated load current, hiccup mode, auto recovery
Class of Equipment	—		Class I with PE connection
Isolation Voltage (safety certified) (2)	I/P to O/P (tested for 1 minute)		3.5 kVAC / 5 kVDC
	I/P to PE (tested for 1 minute)		1.6 kVAC / 2.5 kVDC
	O/P to PE (tested for 1 minute)		500 VAC / 700 VDC
Isolation Resistance	I/P to O/P		4.5 MΩ minimum
Insulation Grade	—		Reinforced
Earth Leakage Current	480 VAC / 60 Hz		3.5 mA maximum

Measured @ T_{AMB}= 25°C, 3AC 400 VAC full load and after warm-up unless otherwise stated.
(1) V_{OUT} = 19 VDC minimum.
(2) For repeat Hi-Pot testing, reduce the time and or the test voltage

Switching Power Supplies 3-Phase T960 Model RACPRO1 Series

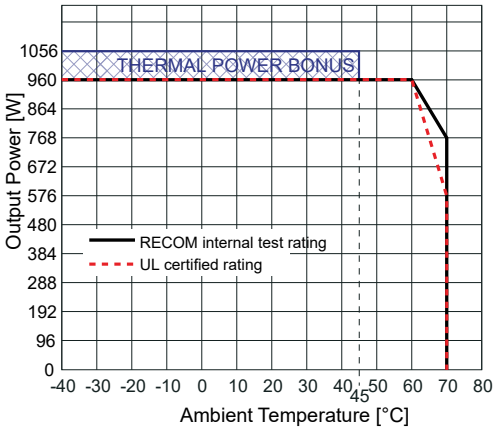
Environmental		
Parameter	***Condition***	***Value***
Operating Ambient Temperature Range	At natural convection (0.1m/s)	-40 to 70°C [-40 to 158°F] with derating Refer to Derating Graph for without derating
Operating Altitude	—	Recognized by safety agency for sate operation up to 5000m. High altitude operation maybe impact the performance and lifetime.
Operating Humidity	Non-condensing	95% RH maximum
Pollution Degree	—	2
IP Rating	—	IP20
Shock	According to IEC 60068-2-27 Fa (non-operating)	15G/11ms, 3 times (positive/negative) in all axis
Vibration	According to IEC 60068-2-6 Fc (non-operating)	5 - 8.4 Hz @ 3.5mm deflection 8.4 -150Hz @ 2G, 10 cycles /axis (min-max-min); 1 octave/min
MTBF	According to EN/IEC 61709 (SN29500)	680 x 10^3 hours
Design Lifetime	T_{AMB}= 40°C @ 100% Load	80 x 10^3 hours

Measured @ T_{AMB}= 25°C, 3AC 400 VAC full load and after warm-up, unless otherwise stated.

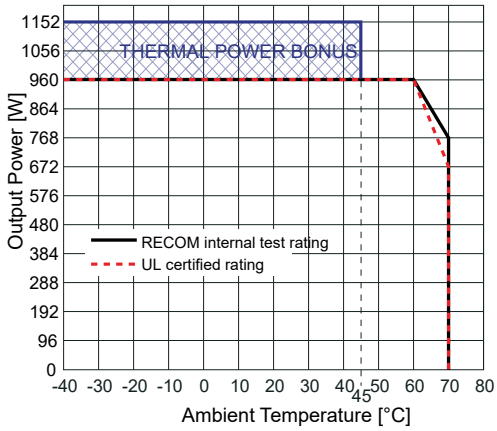
Derating Graph

(@ Chamber and natural convection 0.1m/s)

RACPRO1-T960/24

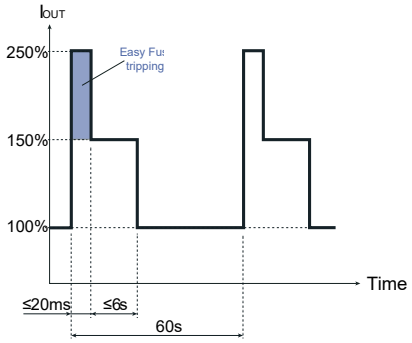


RACPRO1-T960/48



Boost Power

(400-480 VAC or 500 VDC; -40°C to +60°C max.)

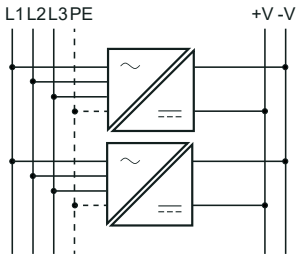


Easy fuse tripping is designed to trip a fuse in the event of a short circuit. Once the fuse has tripped, the current returns to its normal operation value. The impulse that causes easy fusing tripping happens independently of the power boost.

Switching Power Supplies 3-Phase T960 Model RACPRO1 Series

Phase Redundancy

If on phase fails, operation is still guaranteed. (2-phase operation)



Parallel Operation

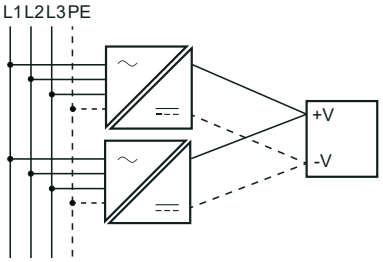
1) Make sure that the DIP-Switch 1 is “ON” to get into the Parallel Load sharing mode.

2) Adjust each power supply to the exact same output voltage with the same load and cooling conditions.

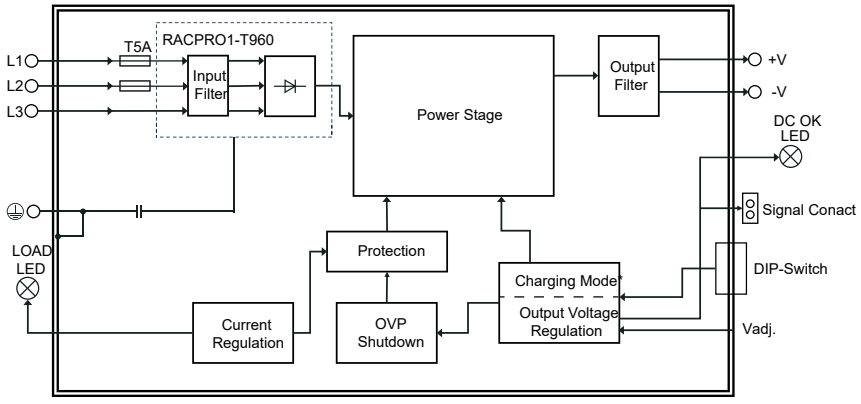
3) Use the same wire length and cable cross-section for each power supply (star connection) and energize all units at the same time to avoid triggering overload protection.

4) Do not use power supplies in parallel with mounting orientations other than the standard mounting orientation (input terminals at the bottom of the unit) or in any other condition where a derating of the output current is required (e.g. above 60°C).

5) Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple power supplies.



Block Diagram



Switching Power Supplies 3-Phase RACPRO1 Series

Safety & Certifications RACPRO1 Series		
Certificate Type (Safety)	***Report Number***	***Standard***
Audio/Video, information and communication technology equipment - Part 1: Safety requirements (CB)	24TH0201_62368-1_0	IEC62368-1:2018 3rd Edition
Audio/Video, information and communication technology equipment - Part 1: Safety requirements		EN IEC 62368-1:2020+A11:2020
Audio/Video, information and communication technology equipment - Part 1: Safety requirements	Pending	UL62368-1:2019 3rd Edition CAN/CSA-C22.2 No. 62368-1-19 3rd Edition
Electrical Equipment For Measurement, Control, and Laboratory Use; Part 1: General Requirements (CB)	4TH0201_61010-1_0	IEC61010-1:2010+A1:2016 3rd Edition
Electrical Equipment For Measurement, Control, and Laboratory Use; Part 1: General Requirements		EN61010-1:2010+A1:2019
Electrical Equipment For Measurement, Control, and Laboratory Use; Part 1: General Requirements	Pending	UL61010-1:2012 3rd Edition CAN/CSA-C22.2 No. 61010-1-12 3rd Edition
Electrical Equipment For Measurement, Control, and Laboratory Use; Part 2-201: Particular requirements for control equipment (CB)	24TH0201_61010-2-201_0	IEC61010-2-201:2017 2nd Edition
Electrical Equipment For Measurement, Control, and Laboratory Use; Part 2-201: Particular requirements for control equipment		EN IEC 61010-2-201:2018
Electrical Equipment For Measurement, Control, and Laboratory Use; Part 2-201: Particular requirements for control equipment	Pending	UL61010--2-201:2018 2nd Edition CAN/CSA-C22.2 No. 61010-2-201: 2018-02-01-12
RoHS2	—	RoHS 2011/65/EU + AM2015/863

EMC Compliance according to IEC/EN61000-6-4/6-2 RACPRO1 Series		
EMC Compliance according to IEC/EN61000-6-4/6-2	***Condition***	***Standard / Criterion***
Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments	—	IEC/EN61000-6-2:2019
Electromagnetic compatibility (EMC) - Part 6-3: Generic standards - Emission standard for residential area	—	IEC/EN 61000-6-3:2021
ESD Electrostatic discharge immunity test	Air: ±8kV; Contact: ±6kV	IEC61000-4-2:2008, Criteria A EN61000-4-2:2009, Criteria A
Radiated, radio-frequency, electromagnetic field immunity test	10V/m (80-6000MHz)	IEC/EN61000-4-3:2006+A2:2010, Criteria A
Fast Transient and Burst Immunity	AC Power Port ±4kV DC Output Port: ±2kV	IEC/EN61000-4-4:2012 Criteria A
Surge Immunity	AC-Power Port L1-L2-L3-L2-L3 ±2.5kV L1-PE,L2-PE, L3-PE: ± 6kV DC-/Output Port: Vout(+) - Vout(-), DC-OK(13-14): ±1kV Vout(+)-PE, Vout(-)-PE: ±2kV	IEC/EN61000-4-5:2014+A1:2017, Criteria A
Immunity to conducted disturbances, induced by radio-frequency fields	10Vrms (0.15-80 MHz)	IEC61000-4-6:2013, Criteria A EN61000-4-6:2014, Criteria A
Power Magnetic Field Immunity	30A/m, 50/60 Hz	EN6100-4-8:2010 Criteria A
Voltage Dips (400 VAC, 50Hz)	100% 5 cycles 70% 10 cycles 40% 25 cycles 30% 25 cycles	IEC61000-4-11:2004+A1:2017, Criteria B
Voltage Interruptions (400 VAC, 50Hz)	100% 250 cycles	IEC61000-4-11:2004+A1:2017, Criteria B
Limits of Harmonic Current Emissions	—	EN IEC 61000-3-2:2019
Limits of Voltage Fluctuations & Flicker	—	IEC61000-3-3:2013+A1:2017