

KEPCO MISSION-CRITICAL POWER SUPPLIES FOR EXTREME ENVIRONMENTS AC - DC, DC - DC, VEHICULAR POWER



Two KHX modules with Distribution Box
Fault Tolerant, N+1 Redundant

SERIES KHX

Kepeco's sealed KHX power supply modules are ideal for railroad /mass transit applications as well as harsh or unusual environments such as may be encountered in military, marine, mining and industrial applications. KHX's fault-tolerant design improves availability, eliminating single-points of failure. They are well suited to meet the frequent wash-down and sanitizing requirements of the food and beverage industry. Modular design permits KHX to mesh with other Kepeco models as part of an N+1 redundant system. Optional enhancements include distribution boxes, battery backup, status monitoring and MIL-STD-461 (all application classes). KHX are designed to provide high availability DC power for applications where safety and reliability are a must. Optional 28V DC vehicle power input meets MIL-STD-1275.

Kepeco power supplies run the signaling systems on America's largest mass transit systems and power military vehicles and airborne equipment. Kepeco's railroad battery chargers provide battery backup to operate rail crossings, signalling and telecommunication systems. These fault tolerant power systems are ideal for control rooms, access control, fare collection and WiFi hot spot applications as well as many other applications in industries where environmental concerns must be addressed.

KHX FEATURES

- Perfect for extreme wet and hot environments.
- Outdoor rated enclosure NEMA type 3; 3R; 4; 6P or IEC IP65/66/67/68/69/69K.
- Submersible for flood prone tunnels IP68 and NEMA6P.
- Withstand high temperature (steam)/high pressure water-jets.
- Hot-swappable: no system downtime for maintenance.
- Undercarriage mount of railway cars; trucks or EV subject to frequent wash-downs per IP69K, water splash or flooding.
- Wineries; food and beverage facilities, subject to daily or constant cleaning per IP69 or IP69K.
- Can be used as Sensor power supply in underground application or submersible application.
- Designed to meet ABS (American Bureau of Shipping) requirement.
- Seismic-proof design complies with International and California/Alaska Building Codes. Ideal for wave reflection geophysics/geological exploration.
- Sealed design allows use in explosion-proof applications; e.g., power to LED lighting or any equipment in zone 1 class 2 for chemical/industrial/agricultural applications.
- -28 Option - Military powered/Vehicle powered 28V DC input
- EMI option meets EMC per EN 61000 and MIL-STD-461G (ground, Army).
- Low brownout/AC/DC with Surge/EMI protection for power line input-sensitive or generator-run equipment, or input line redundancy for lighting applications, e.g., replacing fluorescent designs with LED designs.
- All the electrical features/characteristics of Kepeco's popular **HSP/HSM**
- Optional Ethernet Control, USB, I²C,; wall mount, DIN rail, pole mount.

TYPICAL APPLICATIONS

- Railroad Signaling systems
- Redundant Power for industrial control loops
- Meet frequent wash-down and sanitizing requirements
- Battery charger backup to operate rail crossings and telecommunication system
- LED Signs and Monitors
- Battery Charging
- Wireless Base Stations
- Margin Testing
- Oil and Gas Exploration/Refineries
- Off-grid Power Systems
- Optional -28V DC Vehicle powered

INDUSTRIES

- Railroad, mass transit
- Military
- Marine Environments
- Mining
- Industrial
- Food and beverage



www.kepecopower.com/khx.htm

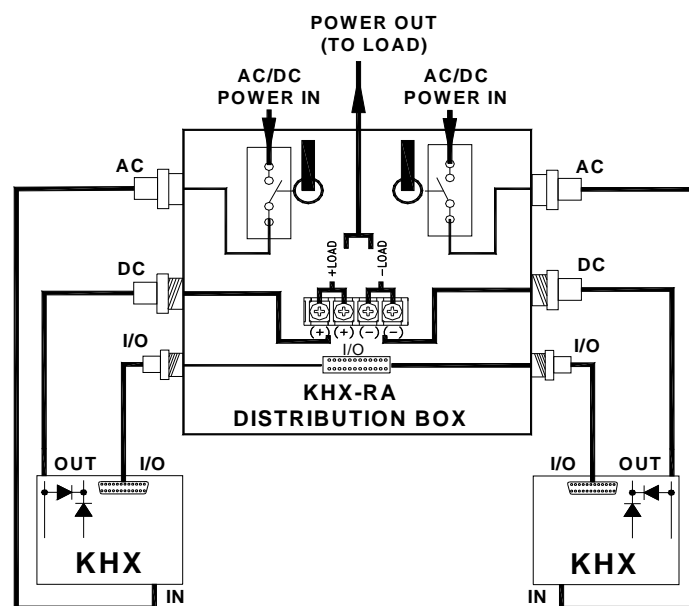


Standard configuration uses hermetic sealed connectors per MIL-C-5015; MIL-DTL-12520; MIL-DTL-22992; MIL-DTL-38999. Various connector interfaces, military or commercial/industrial: Pin-sleeve/IEC 60309 style for AC, multi-pin/circular style for DC and I/O. Flywire/cables with any terminations are also available as standard features.

KHX's support critical infrastructure applications that require the power supply to be installed remotely (over 600 feet) from the devices to be powered.

The KHX units allow many possible combinations to increase the reliability and capabilities beyond that of a single unit. Dedicated distribution boxes are required only for hot swap capability, but are recommended for all other configurations to simplify connection and maintain IP ratings.

- **Hot Swap** - Allows zero system downtime. When combined with N+1 redundancy to increase reliability, hot swap allows maintenance to be performed on a live system.
- **N+1 redundant (no current share)** - This means at least two units are paralleled to attain a current reserve higher than the maximum load. This allows the system to operate properly in the event of a component failure, thus greatly improving system reliability. OR-ing diodes (required) are built-in to KHX. However, this solution puts the burden on one supply which works almost to full load while the other is idle until a failure occurs. KHX N+1 with current share is a better solution (see below).
- **N+1 redundant (with current share)** - This means at least two units are paralleled to attain a current reserve higher than the maximum load, however current share means that current is supplied to the load from both units equally. OR-ing diodes (required) are built-in to KHX. If one unit fails, the other automatically supplies full load current. The built-in current share bus of KHX means that both units operate at 50% of their ratings most of the time, resulting in an increase in unit MTBF as well as system reliability due to redundancy, making this the recommended solution.
- **Power supply combinations** - Allow voltage and current ratings to exceed those of a single unit.
 - Units in parallel increase the current output of one unit x N (N = number of units in parallel). OR-ing diodes (required) are built-in to KHX.
 - Units in series increase the voltage output of one unit x N (N = number of units in series). Back-biased diodes (required) are built-in to KHX.



KHX MODEL TABLE								
MODEL	OUTPUT VOLTAGE (Volts)		OVP SETTING (Volts)	OUTPUT CURRENT (Amps)	RIPPLE (mV p-p)		NOISE (mV p-p)	EFFICIENCY (Percent) (See Note 1.)
	Nominal (Factory Set)	Adjustment Range	Factory Setpoint	50 ° C	Source max	Switching max	(Spike) 20MHz	100% Load 115V a-c
1000 WATT MODELS								
KHX 3.3-230	3.3	0.7-3.6	4.29	230	20	30	100	71
KHX 5-200	5	1.0-5.5	6.5	200	20	30	100	72
KHX 12-84	12	2.4-13.2	15.6	84	20	40	120	73
KHX 15-66	15	3.0-16.5	19.5	66	20	40	150	76
KHX 24-42	24	4.8-26.4	31.2	42	20	60	240	77
KHX 28-36	28	5.6-30.8	36.4	36	20	60	280	78
KHX 48-21	48	9.6-59.2	62.4	21	20	60	480	80
KHX 125-8	125	19.2-140	132	8	20	60	480	80
1500 WATT MODELS								
KHX 24-60	24	4.8-26.4	31.2	60	20	60	120	77
KHX 28-53	28	5.6-30.8	36.4	53	20	60	140	78
KHX 48-30	48	9.6-59.2	62.4	30	20	60	240	80
KHX 125-12	125	19.2-140	132	12	20	60	240	80
3000 WATT MODELS								
KHX 24-125	24	4.8-26.4	31.2	125	30	80	280	77
KHX 28-112	28	5.6-30.8	36.4	112	30	80	280	78
KHX 48-63	48	9.6-59.2	62.4	63	30	80	280	80
KHX 125-24	125	19.2-140	132	24	30	80	280	80

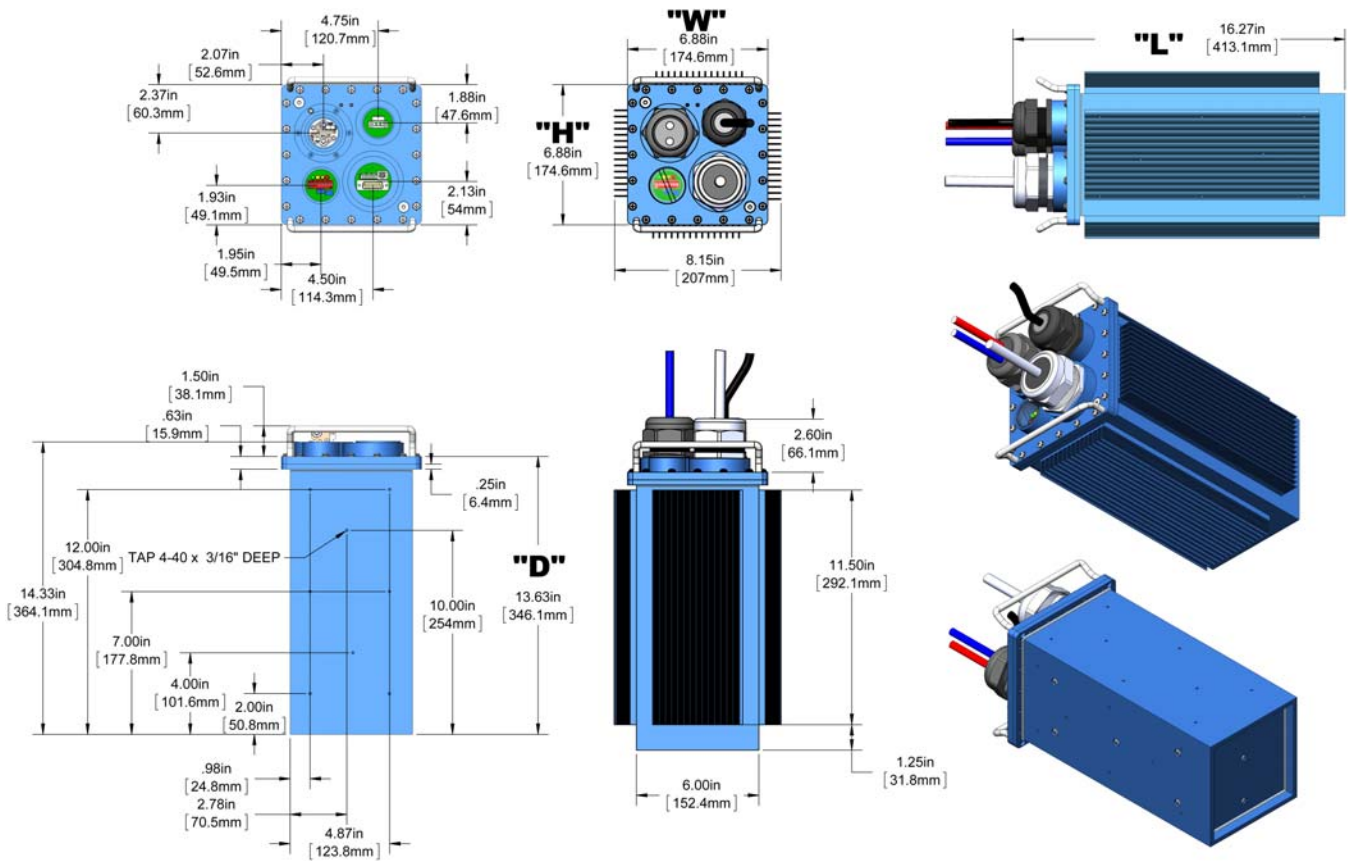
(1) Storage temperature -40°C to +85°C. Operating temperature -20°C to +75°C with 100LFM air cooling; derate 25% for still air -20°C to +32°C, derate 40% for +32°C to +52°C.

KHX Options (add suffix to model number)

-EMI: EMC Compliant with MIL-STD-461

-28: 28-Volt DC input per MIL-STD-1275





Outline Dimensions	H	W	L	D
KHX 1000/1500 W	6.9" [176mm]	6.9" [176mm]	16.2" [412mm]	13.7" [348mm]
KHX 3000 W	14" [356mm]	14" [356mm]	26" [660mm]	24" [610mm]
Addition of Cooling Fins	1.2" [31mm]	1.2" [31mm]	None	None

NOTE: for -28 and -EMI options, add 4" to L and D dimensions.

KHX PHYSICAL CHARACTERISTICS			
SPECIFICATION		RATING/DESCRIPTION	CONDITION
Dimensions	English	7" x 7" x 15"	
	Metric	177.8 x 177.8 x 381mm	
Weight 1000W/1500W	Four heatsinks	32 lbs [14.5 Kg]	
	No heatsinks	23.2 lbs [10.5 Kg]	
Weight 3000W	Four heatsinks	68 lbs [30.8 Kg]	
	No heatsinks	55 lbs [24.9 Kg]	
Source connection	a-c, >100Vd-c	3 pin Euro Block Plug-header	
	28V d-c	Threaded rod1/4-20	
Load connection		Two bus bars plus 1/4-20 stud	
Signal connection		26 pin D-subminiature HD connector	



KHx INPUT CHARACTERISTICS			
SPECIFICATION		RATING/DESCRIPTION	CONDITION
a-c voltage 1000W models	Nominal	100-250 Va-c	Single phase
	Range	90-277 Va-c	Wide Range
a-c voltage 1500W models	Nominal	200-250 Va-c	Single phase
	Range	180-277 Va-c	Wide Range
a-c voltage 3000W models	Nominal	200-250 Va-c	Single phase
	Range	180-277 Va-c	Wide Range
d-c voltage	1000W	125-420 Vd-c	Polarity insensitive
	1500W/3000W	250-420 Vd-c	Polarity insensitive
	1000W/1500W/ 3000W	20-33Vd-c	-28 Option, Polarity Sensitive
Brownout voltage	1000W	75 Va-c	
	1500W	150 Va-c	
Source Frequency		47-440Hz	>63Hz, input leakage current exceeds tabulated value.
Source Current	120V a-c:	1000W; 11.0A rms	Typical
	240V a-c:	1000W: 5.5A rms 1500W: 8.5A rms	
Power Factor (a-c input)	Typical	0.99	
	Minimum	0.96	Any source, 25% to 100% load

KHx CONTROL CHARACTERISTICS			
SPECIFICATION		RATING/DESCRIPTION	CONDITION
Voltage set programming (mode selected by internal switches) (isolated)	Internal	Multiturn potentiometer	The DC OK/DC FAIL fault detect window tracks the programmed output voltage; OVP trip unaffected
	External 1	Resistance, 0 - 10K = 100 - 50%	
	External 2	Voltage, 0 - 10V = 0 - 100% of rated output voltage	
Current limit programming (mode selected by internal switches)	Internal	Multiturn potentiometer	
	External	Voltage, 0 - 10V = 0 - 110% of rated output current	
Remote ON/OFF	Normal H	TTL level	Isolated 5V, 100mA, internal pull up supply
	Normal L	TTL level	
Current Share/Forced Load share Bus		Single wire connection between modules	0 - 5V signal indicates each modules current



KHx OUTPUT CHARACTERISTICS

SPECIFICATION	RATING/DESCRIPTION	CONDITION	
Output Setting Range	all except 48V	-80% to +10% ⁽¹⁾	Of nominal output
	48V model:	-80% to +25% ⁽¹⁾	Wide Range
Source Effect	typ.	0.05%	Nominal ±15%
	max.	0.1%	
Load Effect	typ.	0.05%	5% - 100% load, operation between 0 and 5% load results in increased ripple and degraded transient response.
	max.	0.1%	
Temperature Effect	typ.	0.01%	Per degree C (0 to 50°C)
	max.	0.02%	
Combined Effect (source, load, temperature & time)	typ.	0.15%	
	max.	0.3%	
Time Effect (drift)	typ.	0.05%	0.5 - 8.5 hours
	max.	0.1%	
Startup Time	max.	1 second	Any source/load
Recovery characteristics	Excursion	<3% of normal output	50 - 100% load
	Recovery	1000W: 100µsec 1500W: 300µsec	Return to 1% of setting
Ride through	min.	21.5 Milliseconds	From loss of source to flag signal
Hold up Time	min.	5 Milliseconds	After signal flag
Overshoot	turn on	+3% max	Any source, 5% - 100% load
	turn off	none	
Error Sense	3.3V & 5V	0.25V	Voltage allowance per wire
	all others	0.4V	
Series connection (output floats)		500V	Maximum voltage off ground
Parallel connection (for redundancy)		Current shares within 5% of rated load	5% - 100% load
Selective overvoltage shutdown		Adjustable 100% - 140% of nominal, factory set to 130%	Latched, reset by cycling source power off
Current limiting		Constant Current mode Factory set 110% of IO max	Optional shutdown mode with 20 second delay
Remote on/off	RC-1	Normally high	Isolated form C or TTL
	RC-2:	Normally low	
Overtemperature		Thermostat, auto restart	With hysteresis

(1) External voltage programming only, otherwise -30% to +10%. -30% to +25% for 48V models



KHX GENERAL SPECIFICATIONS

SPECIFICATION		RATING/DESCRIPTION	CONDITION
Temperature	Operating	20°C to +75°C	50°C to 60°C: 85% of power rating (see below) 60°C to 70°C: 60% of power rating (see below) 70°C to 75°C: 35% of rated power
	Storage	40°C to +85°C	
Power Rating: 1000W Models	Continuous	1000W	100 LFM air cooling, temperature -20°C to 50°C
		750W	Still air, temperature -20°C to 32°C
		600W	Still air, temperature 32°C to 50°C
	Peak	1000W peaks of < 1 hour	Still air, temperature -20°C to 50°C
Power Rating: 1500W Models	Continuous	1500W	100 LFM air cooling, temperature -20°C to 50°C
		1000W	Still air, temperature -20°C to 32°C
		800W	Still air, temperature 32°C to 50°C
	Peak	1500W peaks of < 1 hour	Still air, temperature -20°C to 50°C
Humidity		0 to 95% RH	Non-condensing, operating and storage
Shock		20g, 11msec ±50% half sine	Non-operating, 3 axes 3 shocks each axis
Vibration		5-10Hz 10mm double amplitude	Non-operating, 1 hour each axis
		10-55Hz 2g	
Altitude	Operating	Sea level to 10,000 ft.	
	Storage	Sea level to 160,000 ft.	
Isolation	Output-case	500V d-c	25°C, 65% RH
Withstand Voltage	Input-output:	3,000V a-c rms	25°C, 65% RH
	Input-case	1,500V a-c rms	
Safety ⁽¹⁾		UL 1950. EN 60950 CSA 22.2 No. 234-M90 level 5	Information Technology Equipment
Weight	Four heatsinks	32 lbs [14.5 Kg]	
	No heatsinks	23.2 lbs [10.5 Kg]	
Environmental ⁽¹⁾		NEMA250, UL50E, TYPE 3R, 4, 6 IEC 60529, IP65, IP66, IP67, IP69, IP69K ISO 20653	Cable glands installed or fly-wire termination.
		MIL-STD-810G: Altitude, fungus Resistance, Random Vibration, Shock, High/Low Temperature and Humidity	

(1) Designed to meet.

(2) Max allowable surface temperature of case limited to <70°C.
Max allowable inner ambient temperature of components limited to <75°C.



KHX CURRENT HARMONICS, SOURCE TRANSIENTS AND EMI SPECIFICATIONS

SPECIFICATION	RATING/DESCRIPTION	CONDITION
IMMUNITY (1)	EN 61000/MIL-STD-461	
Radiated RF (Ampl. Mod.)	EN 61000-4-3/RS103 (2)	10V/m, 80 - 1000MHz
Radiated RF (Pulse Mod.)	EN 61000-4-3/RS103 (2)	10V/m, 900MHz
Magnetic Field	EN 61000-4-8/RS101 (2)	30A/m, 50Hz
Electrostatic Discharge (2)	EN 61000-4-2 (2)	4KV (contact) 8KV (air)
Conducted RFI	EN 61000-4-6/CS114 (2)	10Vrms, 0.15 - 80MHz
Electrical Fast Transient	EN 61000-4-4/CS115 (2)	2KV, Tr/Th = 5/50ns
Surge (CM, DM)	EN 61000-4-5 (2)	2KV (CM) Tr/Th = 8/20 μ s 2KV (DM) Tr/Th = 8/20 μ s
EMISSIONS		
Conducted RF	FCC, Class A (2) CISPR 22, Class A (2)	2KV, Tr/Th = 5/50ns
Current Harmonics	EN 60555-2 and EN 61000-3-2 (2)	0 - 2KHz

(1) All immunity levels designed to meet the requirements for heavy industrial applications per EN 50082-2 using Criteria A (no operational effect).

(2) Designed to meet.

KHX SIGNALS AND FLAGS

SPECIFICATION	RATING/DESCRIPTION	CONDITION	
Status Flags (Form C dry relay contacts)	POWER	Indicates low source voltage; signal asserted 5msec prior to loss of output voltage.	
	OUTPUT	Indicates normal operation	
	OVER TEMP	Over temperature shutdown	
	FAN FAIL	Failure of internal fan	
Status Indicators Front panel LEDs (1)	POWER	Green	Lit when a-c is sufficient
	DC FAIL	Red	Lit when output failure is detected
	OVER TEMP	Yellow	Lit when thermostat activates
	FAN FAIL	Red	Lit when fan failure is detected
Test Points	Monitor setpoint voltage	0.1 x E _{OUT}	
	Monitor setpoint current	0 - 5V full scale	
Auxiliary Voltage (isolated)	4-5 - 5.5V d-c isolated 0 - 100 milliamperes	Present whenever house-keeping supply is operating	

(1) Status indicators and Status flags are isolated and operate independently although driven by the same detector circuit.

