



## TDK-Lambda Convection and Conduction Cooled AC/DC Power Supplies



# Innovating Reliable Power

TDK-Lambda's broad selection of convection and conduction cooled power supplies are ideally suited for applications that do not rely on fans for cooling. Eliminating fans reduces audible noise, required maintenance, and also increases system reliability.

## Convection Cooled



Series	Power	Outputs	Voltage	Current	Features	Cooling
CSS	40-360W	1	5-57V	up to 30A	Medical and ITE Power Supply	Convection
CSW	40-65W	1	5-54V	up to 8A	Convection Cooled ITE	Convection
CFE	300W/400W	1	12-48V	up to 33.3A	Medical and ITE Power Supply	Convection
CM	425-600W	4	1.5-232V	up to 100A	Medical and ITE Modular	Convection
CUS-LD	79-252W	1	3.3-48V	up to 50A	Convection Cooled ITE	Convection
CUS-M	30-350W	1	5-48V	up to 29A	Convection Cooled Medical & ITE	Convection
CUT75	35-75W	2 to 3	5-24V	up to 8A	No Min Load	Convection
DRB	15-480W	1	5-48V	up to 20A	DIN Rail Mount - High Efficiency	Convection
DRF	120-480W	1	24V	up to 20A	DIN Rail Mount - High Efficiency	Convection
DRL	10-100W	1	12-24V	up to 4.5A	DIN Rail Mount, Low Profile	Convection
DT	40-300W	1	12-54V	up to 25A	Medical & ITE Adaptor, CEC, ErP	Convection
EVS300	300W	1	12-18V	up to 16.7A	Constant Current	Convection
GWS	250W	1	12-48V	up to 21A	High Efficiency - Enclosed	Convection
HWS-A	15-150W	1	3.3-48V	up to 30A	Limited Lifetime Warranty	Convection
KM	15-60W	1 to 3	3.3-24V	up to 10A	Medical PCB-Mount - Encapsulated	Convection
KPS-A	5-15W	1	3.3-24V	up to 3A	PCB Mount - Open Frame	Convection
KAS	2-4W	1	3.3-24V	up to 1.2A	PCB Mount - Encapsulated	Convection
KWS-A	5-25W	1	5-24V	up to 5A	PCB Mount - Encapsulated	Convection
LS	25-150W	1	3.3-48V	up to 40A	Low Cost - Enclosed	Convection
LWT	15-50W	3	5-24V	up to 8A	Low Profile Power Supply	Convection
RWS-B	50-150W	1	5-48V	up to 21A	Enclosed Power Supplies	Convection
ZPSA	20W-100W	1	3.3-48V	up to 8A	Open Frame 2"x4"	Convection
ZW	10-440	1 to 4	3-52V	up to 30A	Open Frame Power Supply	Convection
ZWX	90-300W	5	3.3-12V	up to 10A	ATX Convection Cooled	Convection

## Conduction Cooled



Series	Power	Outputs	Voltage	Current	Features	Cooling
CPFE	1000W	1	12-48V	up to 60A	Conduction Cooled Power Supply (MIL STD 461/462D CE102 EMC)	Conduction
CPFE1000FI	720-1000	1	12-48V	up to 60A	Conduction Cooled Power Supply	Conduction
PFE-SA, -F & -FA	300-1000W	1	12-48V	up to 60A	Harsh Environment Power Module	Conduction
CM	425-600W	4	1.5-232V	up to 100A	Medical and ITE Modular	Conduction
PFH500	500W	1	28V	up to 18A	Harsh Environment Power Module	Conduction



## Convection Cooled



Convection

### Applications

- ◆ Industrial
- ◆ Medical
- ◆ COTS
- ◆ Test
- ◆ Communication
- ◆ LED
- ◆ Broadcast

### Features

- ◆ Universal AC Input
- ◆ High Efficiency
- ◆ High Convection Ratings
- ◆ Medical & ITE Safety Approvals

### Product Types

- ◆ Open Frame, Chassis Mount, PCB Mount & DIN Rail
- ◆ PCB Mount and External Desktop



### CFE Series



#### 300W/400W Medical & ITE

- ◆ BF Rated
- ◆ 94% Efficient, 0.5W Standby Power
- ◆ 450W Peak Loading (10s)
- ◆ Suitable for 1U applications
- ◆ Five Year Warranty



### CSS Series



#### 40 to 500W Medical & ITE

- ◆ Wide Range AC Input
- ◆ Low profile, Industry Standard Footprints
- ◆ Global Safety Agency Compliance
- ◆ Three year warranty



### CUS-LD Series



#### 70 to 250W Single Output

- ◆ High Efficiency, up to 90%
- ◆ Low profile
- ◆ Wide Range AC Input
- ◆ Convection Cooled
- ◆ Coated PCB as standard on CUS250LD
- ◆ Three year warranty



### CUS350M Series



#### 200 to 350W/420W Medical & ITE

- ◆ High Efficiency, up to 94%
- ◆ Low profile
- ◆ Convection Cooled, and Forced Air Ratings
- ◆ 5V Standby & 12V Fan Output (CUS350M)
- ◆ Three year warranty



### CUT Series



#### 35-75W Triple Output

- ◆ 1.06" high
- ◆ No minimum loads
- ◆ 5V isolated from outputs 2 & 3
- ◆ Convection Cooled
- ◆ Optional cover and terminal type
- ◆ Three year warranty



### KPSA Series



#### 5 to 15W Board Mount

- ◆ Low profile
- ◆ Smaller footprint
- ◆ PC board Mountable
- ◆ Low Cost
- ◆ UL Class II Approved
- ◆ One year warranty



### LWT Series



#### 17-50W Triple Output

- ◆ 26mm height
- ◆ Outputs 2 and 3 isolated from output 1
- ◆ Universal Input (85 - 265VAC)
- ◆ Low Profile Wattbox design on LWT
- ◆ 1 year warranty



### CUS 30/60/100/150/200M Series



#### 30-250W Medical & ITE

- ◆ 2 x 3", 2 x 4" & 3 x 5" Footprints
- ◆ Low profile
- ◆ Class I & II for some models
- ◆ BF Rated
- ◆ 3 to 5 year warranties



### ZPSA Series

#### 20W to 100W Single Output

- ◆ 2 x 3.5", 2 x 4" & 3 x 5" Footprints
- ◆ Wide Range AC Input
- ◆ Low Profile
- ◆ Global Safety Agency Compliance
- ◆ EN61000-4 Immunity
- ◆ 2 year warranty



### ZW Series



#### 10-440W Single & Multiple Output

- ◆ 85-265 universal input
- ◆ Open frame
- ◆ ZWQ 1U quad output models from 80-170W
- ◆ ZWD Dual 5V to 24V output models from 120-225W
- ◆ ZWX 1U ATX quad output +5V standby output
- ◆ 3 to 5 year warranty



### CM Series

#### 425 to 600W Modular Power Supply

- ◆ Medical & ITE convection/conduction cooled
- ◆ 1U high
- ◆ Wide output adjustment
- ◆ Up to 4 outputs
- ◆ No minimum loading required
- ◆ 5 year warranty



### CSW Series



#### 80-65W Wide AC-DC Input

- ◆ 90 - 305VAC Input
- ◆ U Channel or Enclosed
- ◆ DIN Rail Mount
- ◆ 3 year warranty



### DRF Series



#### 120W to 480W High Efficiency DIN Rail Mount

- ◆ Excellent efficiency – up to 94%
- ◆ Extremely narrow case
- ◆ Market leading no load power consumption
- ◆ ErP compliant, Remote On/Off, 24VDC output
- ◆ Droop Mode Current Share, 150% peak power for 4s
- ◆ 5 year warranty

### DRB Series



#### 15W to 480W High Efficiency DIN Rail Mount

- ◆ Excellent efficiency – up to 93%
- ◆ ErP compliant, very low no load power consumption
- ◆ Market leading case width
- ◆ Output voltages 5, 12-15, 24, 48VDC
- ◆ 15W, 30W, 50W, 100W and 480W models
- ◆ 3 year warranty



### DRL Series

#### 10-100W Low Profile DIN Rail Mount

- ◆ Low profile for building automation
- ◆ Class II double insulation
- ◆ ErP compliant, very low no load power consumption
- ◆ 10W, 30W, 60W & 100W models
- ◆ 3 year warranty

### KWSA Series



#### 5-25W Industrial AC-DC PCB-Mount

- ◆ Small size and lightweight
- ◆ PC Board Mountable
- ◆ Wide Range Input
- ◆ Wide operating temperature range -40 to +85°C
- ◆ Class II (No ground needed)
- ◆ 3 year warranty



### KMS & KMS-A Series

#### 15-60W Medical AC-DC PCB-Mount

- ◆ Small size and lightweight
- ◆ PC Board Mountable
- ◆ Wide Range Input
- ◆ Medical Safety Certifications (4kVAC Input - Output)
- ◆ Class II (No ground needed)



### KAS Series

#### 2-4W Wide AC-DC Input PCB-Mount

- ◆ 90-305VAC input
- ◆ Class II (no ground needed)
- ◆ Wide temperature range -40 to +80°C
- ◆ Low off-load power consumption
- ◆ 3 year warranty



### GWS Series



#### 250W, 500W Single Output

- ◆ High Efficiency, up to 93%
- ◆ 1.6" high (For 1U racking)
- ◆ Wide Range AC Input
- ◆ 250W Convection Cooled
- ◆ 5 year warranty

### HWS-A Series



#### 15-150W High Quality Industrial & Medical Power

- ◆ Long Field Life
- ◆ SemiF47 Compliant (230VAC)
- ◆ Medical Certification (HWS/ME)
- ◆ Conformal Coating, -40°C Startup (HWS/HD)
- ◆ Limited Lifetime Warranty (click for terms and conditions)



### LS Series



#### 25-200W, 3.3-48V, up to 40A, Low Cost

- ◆ Very low cost
- ◆ Small size
- ◆ 115VAC or 230VAC input
- ◆ Withstands 300VAC surges (5s)
- ◆ 3 year warranty

### RWSB Series



#### 50W to 600W Single Output Low Cost

- ◆ Cost Effective
- ◆ Wide Range AC Input
- ◆ Compact Size
- ◆ Enclosed
- ◆ 5 year warranty



### Desktop DT Series



#### 40W to 300W Adaptor / External power

- ◆ EISA and CEC Compliant (most models)
- ◆ Compact package size
- ◆ Single Outputs up to 54V
- ◆ Medical or Industrial Certifications
- ◆ Energy Efficiency Level V & VI models
- ◆ 1 to 3 year warranties



### EVS300 Series



#### 300W Constant Current

- ◆ Suitable for battery charging
- ◆ 12-18V compliant voltage
- ◆ Adjustable current settings
- ◆ 5 year warranty

# Understanding Convection Cooled Power Supplies

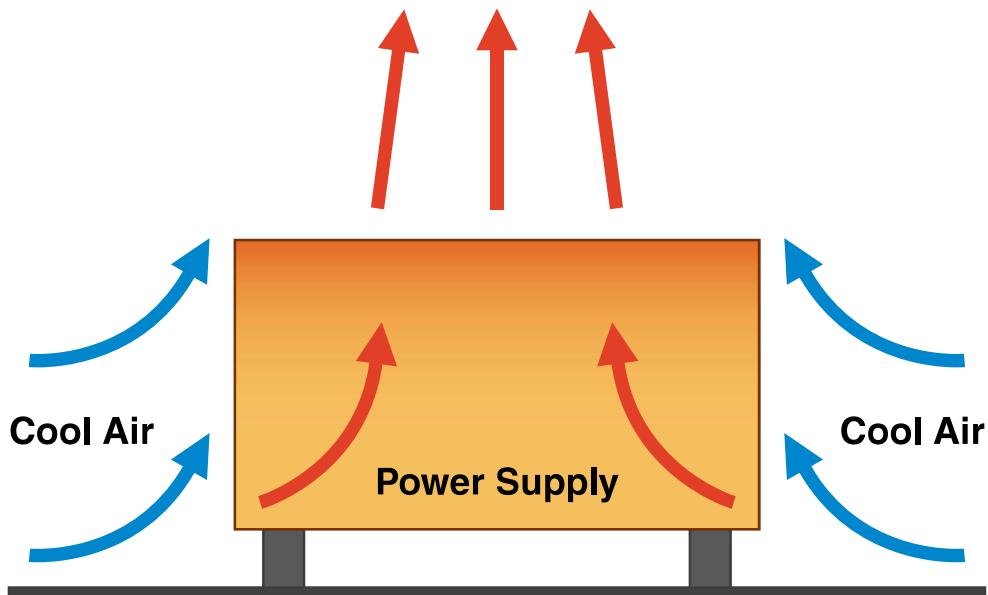
There are a number of commonly used terms to describe cooling methods in the power supply industry:

<b>Fan cooled</b>	Unit has an internal fan
<b>Convection cooled</b>	Unit requires no fan cooling
<b>Forced air cooled</b>	Unit requires external airflow
<b>Conduction cooled</b>	Unit relies on a cold plate to remove the waste heat

The most misunderstood and hence most misapplied is probably convection cooled. Many Engineers assume that a convection cooled power supply is one that does not need any airflow to operate.

One definition of convection is “The transfer of heat by the circulation or movement of the heated parts of a liquid or gas”. In our case – the circulation or movement of hot air.

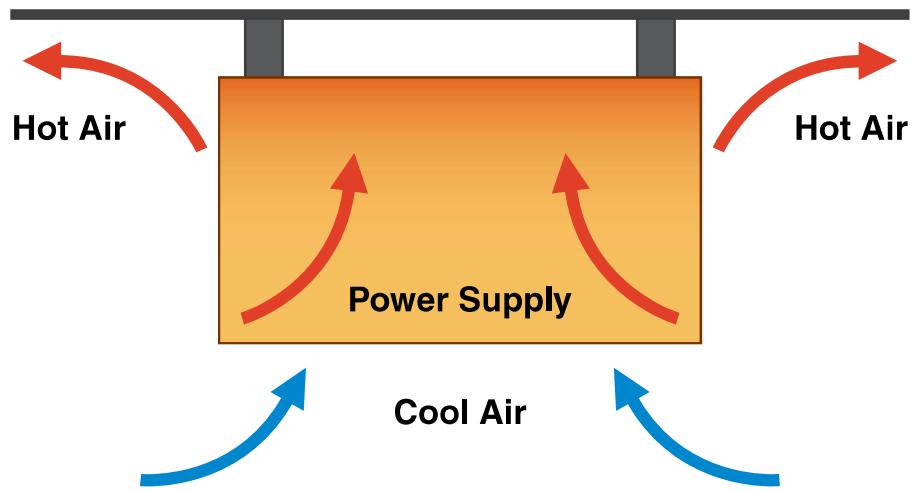
Open frame power supplies, for example, are typically mounted on a flat surface upon standoffs, and below we can see how the air behaves.



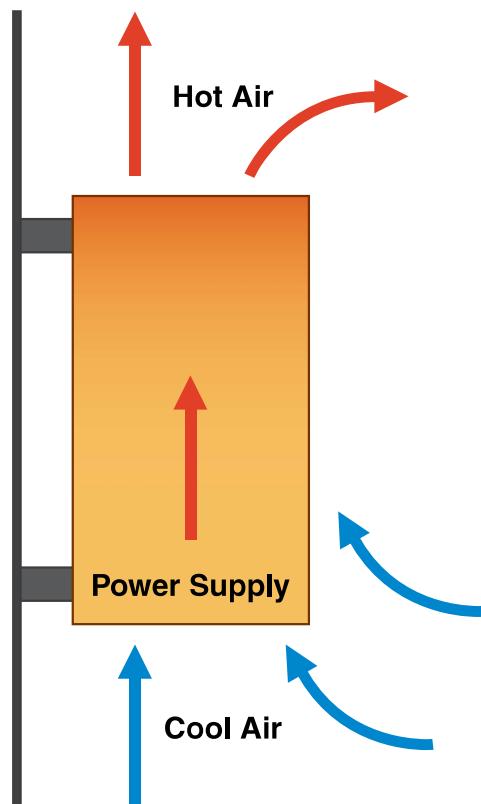
As the hot air rises, cooler air is drawn in from the sides. Although the airspeed is quite low, just 0.3m/s, it is sufficient to reduce internal temperatures. When the power supply goes through safety certification, this is taken into account during thermal testing.

It is very important to ensure that there is adequate space for the air to be drawn in from the sides and allowed to exit above the power supply. A distance of 50mm is considered safe.

Orientation of the product is also very important. Most manufacturers will state a recommended mounting orientation and any derating associated if that is not followed. Mounting the product upside down for example can severely reduce field life unless heavy derating is applied, and is often forbidden.



The ramifications of mounting the power supply vertically should be studied. Ideally the output electrolytic capacitors should be located at the bottom, where the temperature will be the coolest.



If in doubt, consult the manufacturer's installation manual. For high density products, recommended maximum component temperatures will be advised for critical parts.



# Conduction Cooled



Conduction

## Applications

- ◆ Industrial
- ◆ COTS
- ◆ Test & Measurement
- ◆ Communication
- ◆ LED
- ◆ Broadcast

## Features

- ◆ High Efficiency
- ◆ High Baseplate Operating Temperature
- ◆ i<sup>2</sup>C Interface (some models)
- ◆ Protective PCB Coating (some models)
- ◆ Parallel Operation



## CPFE1000FI Series (Industrial use)



## 720-1000W Single Output Conduction Cooled

- ◆ Universal Input
- ◆ Smaller size than CPFE1000F
- ◆ Baseplate cooled, no fan required
- ◆ I2C Interface
- ◆ High Efficiency
- ◆ PCB assembly option
- ◆ Protective PCB coating option
- ◆ Parallel up to 6 units
- ◆ Radiated & Conducted Emissions: Class B conducted, Class A Radiated, EN55022/EN55011



## CPFE Series (MIL-COTS)



## 1000W Single Output Conduction Cooled

- ◆ Universal Input
- ◆ MIL STD 461/462D CE102 EMC
- ◆ Baseplate cooled, no fan required
- ◆ I2C Interface
- ◆ High Efficiency
- ◆ Parallel up to 6 units
- ◆ Radiated & Conducted Emissions: Class B and MIL STD 461/462D CE102



## PFE-SA &amp; -FA Series (Building block)



## 300-1000W Full Brick AC-DC

- ◆ Low profile, small size
- ◆ 100°C baseplate temperature
- ◆ High power density, High Efficiency
- ◆ Parallel capabilities on 500-1000W
- ◆ Peripheral components required to make operational (reference design available)
- ◆ We offer value added services "brick on board," example below



## PFH Series (Building Block)



## 500W Ac-DC Power Module

- ◆ 4" x 2.4" Brick Foot-print
- ◆ 100°C Baseplate temperature
- ◆ PMBus™ option
- ◆ Peripheral components required to make operational (reference design available)
- ◆ 3 year warranty



## CM Series



## 425 to 600W Modular Power Supply

- ◆ Medical & ITE convection/conduction cooled
- ◆ 1U high
- ◆ Wide output adjustment
- ◆ Up to 4 outputs
- ◆ No minimum loading required
- ◆ 5 year warranty

## Power + Value Added Services



- ◆ PFE "Brick on Board" example

## Advantages of Conduction Cooled Power Supplies



Most mid- to high-power supplies use fans to help dissipate the internal heat that is generated as a result of imperfect AC to DC conversion efficiencies. Since fans are electromechanical devices, they reduce the system's MTBF and add to the required maintenance expenses.

The photo above is a power supply that operated for many years at a postal depot where mail is handled and sorted automatically. As can be seen (after the fan was removed) paper fragments and airborne dust contaminants were pulled into the supply by the fan and eventually caused a blown fuse.

As might be expected, the proper maintenance program for any fan-cooled power supply calls for the periodic inspections of the supply, with the fan removed, and the replacement of the fan with a new one.

A new breed of conduction-cooled power supplies has been developed that do not depend on fans for cooling. Instead, the required cooling is accomplished by conducting the internal heat loads to an external metal structure or enclosure, which act as a large heat sink surface.

## Advantages of Conduction Cooled Power Supplies



The photo above shows TDK-Lambda's new CPFE1000FI series, which are conduction-cooled, 1,000 watt AC-DC power supplies. (A 500 watt version is also available.) All heat is conducted to the supply's aluminum plate, which is designed to easily mount to a metal enclosure or cold plate for cooling. More details and specifications for these power supplies are at this web link: <http://us.tdk-lambda.com/lp/products/cpfe1000fi-series.htm>.

In some applications, these conduction-cooled devices are mounted to liquid cooled cold plates that are made of metal with internal serpentine channels through which a liquid circulates while removing the unwanted heat. The net result is that the system operates with a substantial reduction in audible noise, reduced maintenance costs (no dust build-up and fan wear-out), and an enhanced MTBF.

A good example is a visit to a Television Broadcasting Station that consumes about 100 kilowatts of power. At this location, in separate areas, is a traditional fan-cooled system as well as the latest generation system, which uses conduction-cooled power supplies and RF amplifiers that are cooled via liquid flow cold plates. During the operation of the traditional system with fan cooling, the audible noise is so loud that personnel within 100 feet of the system have to wear hearing protection devices. By comparison, in the other area where the new system with liquid cooling is operating, the noise level is so low (similar to an office environment) that no hearing protection is required.