

# CCH400 & CCH600 Series



- 400 W & 600 W – Baseplate Cooled
- Compact 8.4" (214 mm) x 4" (102 mm) x 1.69" (43 mm) Package
- High Efficiency up to 90%
- -40 °C to +85 °C Baseplate Operating Temperature
- No Fan, Quiet Operation
- MIL-STD-461 EMC
- MIL-STD-810F Shock & Vibration
- Remote Sense
- 5 V Standby Output
- Remote On/Off & AC OK Signal
- Current Share for Parallel Operation
- Overtemperature Warning/Shutdown
- 3 Year Warranty

The CCH series has been designed for use in electronic systems which need to operate in the harshest of environments.

These electronic systems are typically sealed to protect them from the elements, thus making thermal management very challenging. The CCH power supplies are designed with the heat generating components directly attached to a baseplate which allows conducted heat to be easily passed from the equipment through a heatsink to the outside environment.

This AC-DC single output product family, fitted with a 5 V standby rail and interface signals also features efficiencies in excess of 90%. The discrete design of the CCH allows for all heat dissipating components to be connected to the baseplate, optimising efficiency and resulting in a very compact 8.4" (214 mm) x 4" (102 mm) x 1.69" (43 mm) package and smaller heatsinking requirements.

The addition of MIL-STD-461 EMC and MIL-STD-810 shock and vibration requirements mean that the product is suitable not only for a wide range of Industrial equipment but can also be used in Military COTS applications.

## Models and Ratings

| Output Voltage V1 | Output Current V1 | Standby Supply V2 | Output Power | Model Number |
|-------------------|-------------------|-------------------|--------------|--------------|
| 12.0VDC           | 34.0 A            | 5.0 V/0.5 A       | 411 W        | CCH400PS12   |
| 24.0VDC           | 17.0 A            | 5.0 V/0.5 A       | 411 W        | CCH400PS24   |
| 28.0VDC           | 14.5 A            | 5.0 V/0.5 A       | 409 W        | CCH400PS28   |
| 48.0VDC           | 8.5 A             | 5.0 V/0.5 A       | 411 W        | CCH400PS48   |
| 12.0VDC           | 50.0 A            | 5.0 V/0.5 A       | 603 W        | CCH600PS12   |
| 24.0VDC           | 25.0 A            | 5.0 V/0.5 A       | 603 W        | CCH600PS24   |
| 28.0VDC           | 21.5 A            | 5.0 V/0.5 A       | 605 W        | CCH600PS28   |
| 48.0VDC           | 12.5 A            | 5.0 V/0.5 A       | 603 W        | CCH600PS48   |

## Input Characteristics

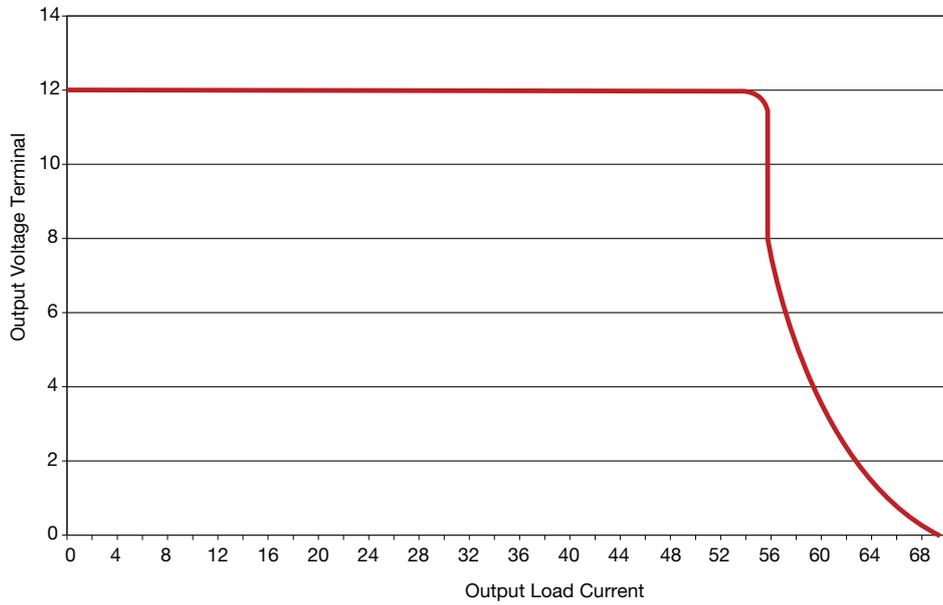
| Characteristic            | Minimum                   | Typical  | Maximum | Units | Notes & Conditions                                  |
|---------------------------|---------------------------|----------|---------|-------|---|
| Input Voltage - Operating | 90                        | 115/230  | 264     | VAC   |   |
| Input Frequency           | 47                        | 50/60    | 400     | Hz    | Agency approval 47-63 Hz                            |
| Power Factor              |                           | >0.9     |         |       | 230 VAC, 100% load<br>EN61000-3-2 class A compliant |
| Input Current - No Load   |                           | 0.4      |         | A     |   |
| Input Current - Full Load |                           | 4.3/2.1  |         | A     | 115/230 VAC CCH400                                  |
|                           |                           | 6.3/3.1  |         |       | 115/230 VAC CCH600                                  |
| Inrush Current            |                           |          | 60      | A     | 230 VAC   |
| Earth Leakage Current     |                           | 0.7/1.1  | 1.8     | mA    | 115/230 VAC/50 Hz (Typ.), 264 VAC/60 Hz (Max.)      |
|                           |                           | 7.5/15.0 |         | mA    | 115/230 VAC/400 Hz                                  |
| Input Protection          | F10 A/250 V internal fuse |          |         |       |   |

## Output Characteristics

| Characteristic             | Minimum  | Typical | Maximum                         | Units   | Notes & Conditions  |
|----------------------------|----------|---------|---------------------------------|---------|---|
| Output Voltage - V1        | 12       |         | 48                              | VDC     | See Models and Ratings table  |
| Initial Set Accuracy       |          |         | $\pm 1^{(V1)}$ & $\pm 3^{(V2)}$ | %       | 50% load, 115/230 VAC   |
| Output Voltage Adjustment  | $\pm 10$ |         |                                 | %       | V1 only via potentiometer. See mech. details (p.7).                           |
| Minimum Load               | 0        |         |                                 | A       |   |
| Start Up Delay             |          | 1.0     |                                 | s       | 230 VAC full load (see fig.X)*  |
| Hold Up Time               | 20       |         |                                 | ms      |   |
| Drift                      |          |         | $\pm 0.2$                       | %       | After 20 min warm up  |
| Line Regulation            |          |         | $\pm 0.5$                       | %       | 90-264 VAC  |
| Load Regulation            |          |         | $\pm 1^{(V1)}$ , $\pm 5^{(V2)}$ | %       | 0-100% load   |
| Transient Response - V1    |          |         | 4                               | %       | Recovery within 1% in less than 500 $\mu$ s for a 50-75% and 75-50% load step |
| Over/Undershoot - V1       |          | 1       |                                 | %       |   |
| Ripple & Noise             |          | 1       |                                 | % pk-pk | 20 MHz bandwidth  |
| Overvoltage Protection     | 110      |         | 140                             | %       | Vnom DC. Output 1, recycle input to reset                                     |
| Overload Protection        | 105      |         | 140                             | % I nom | Output 1, auto reset (see fig.1)  |
| Short Circuit Protection   |          |         |                                 |         | Continuous, approx. constant current (see fig.1)                              |
| Temperature Coefficient    |          |         | 0.05                            | %/°C    |   |
| Overtemperature Protection |          | 90      |                                 | °C      | Fitted to Baseplate   |

## Output Overload Characteristic

Figure 1  
Typical V1 Overload  
Characteristic  
(CCH600PS12)



## General Specifications

| Characteristic  | Minimum | Typical             | Maximum   | Units             | Notes & Conditions                   |
|---|---------|---------------------|-----------|-------------------|--------------------------------------|
| Efficiency  |         | 89                  |           | %                 | Full load (see fig.2-5)              |
| Isolation: Input to Output<br>Input to Ground<br>Output to Ground | 3000    |                     |           | VAC               |                                      |
|   | 1500    |                     |           | VAC               |                                      |
|   | 500     |                     |           | VDC               |                                      |
| Switching Frequency   |         | 30-333 / 51.1 / 138 |           | kHz               | PFC / Main / Standby Converters      |
| Power Density   |         |                     | 10.5      | W/in <sup>3</sup> |                                      |
| Mean Time Between Failure   |         | 300                 |           | kHrs              | MIL-HDBK-217F, Notice 2<br>+25 °C GB |
| Weight  |         |                     | 3.3 (1.5) | lb (kg)           |                                      |

## Efficiency Versus Load

Figure 2 - CCH400PS12

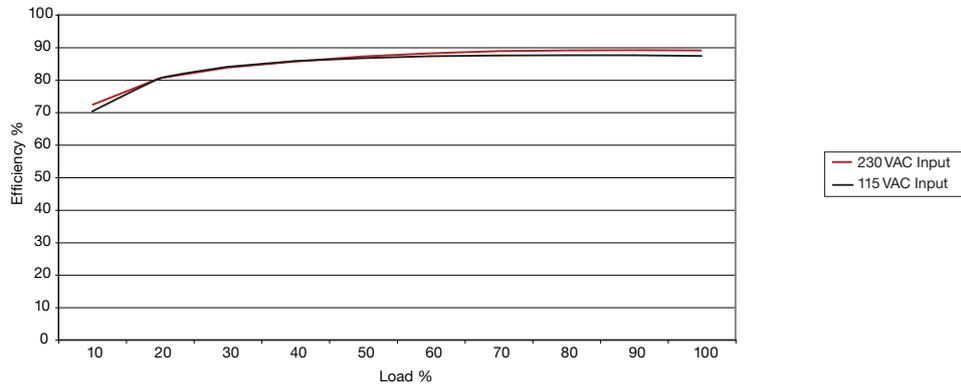


Figure 3 - CCH400PS48

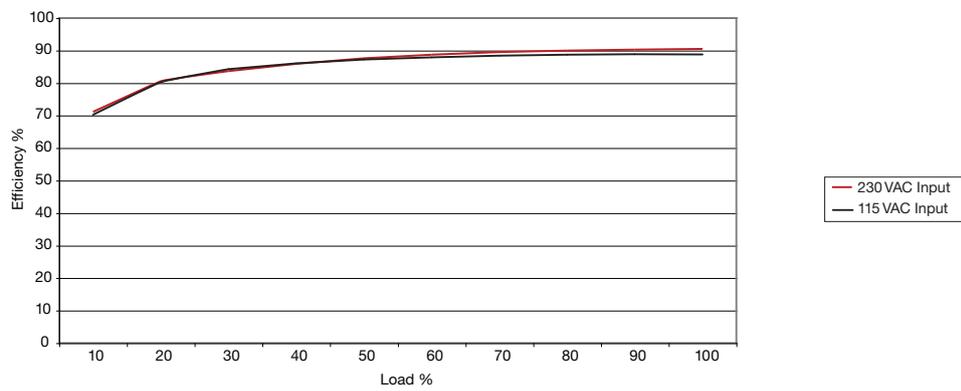


Figure 4 - CCH600PS12

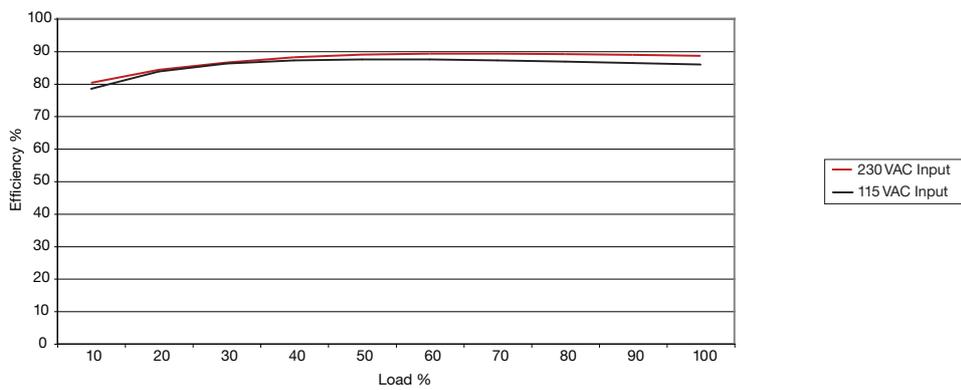
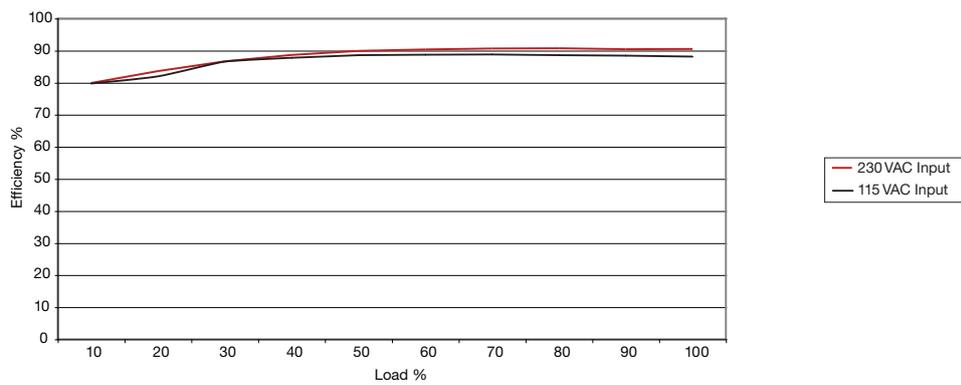


Figure 5 - CCH600PS48

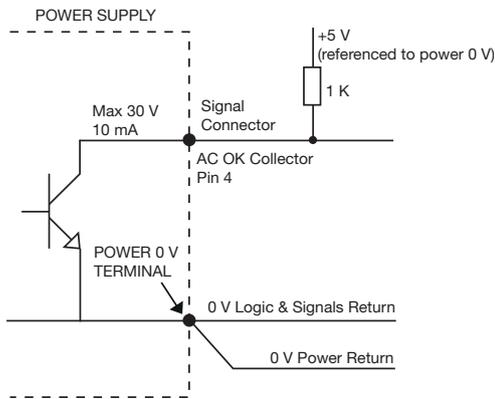


## Efficiency Versus Load

| Characteristic               | Notes & Conditions   |
|------------------------------|--|
| <b>Signals &amp; Control</b> |  |
| Remote Sense                 | Compensates for 0.5V total voltage drop.   |
| AC OK/Power Fail             | Open collector referenced to output 0V, transistor on when AC is good (see fig.6)<br>AC OK: Provides $\geq 2$ ms warning of loss of output from AC failure. Transistor on ( $<0.8V$ ) = AC OK. Transistor off ( $>4.5V$ ) = AC NOT OK. |
| Remote On/Off                | The inhibit pin should be pulled below 0.4V to switch V1 off. Open circuit or $>4V$ to switch output on.   |
| Current Share                | Connecting pin 1 of like voltage units will force the current to share between the outputs. Units share current within 10% of each other at full load. See fig 9.  |
| Overtemperature Warning      | Open collector referenced to output 0V, transistor normally off when temperature is within safe limits.  |
| Standby Supply               | 5V/0.5 A supply, always present when AC supplied. Isolated from the AC input, power output and auxiliary signals/controls.   |

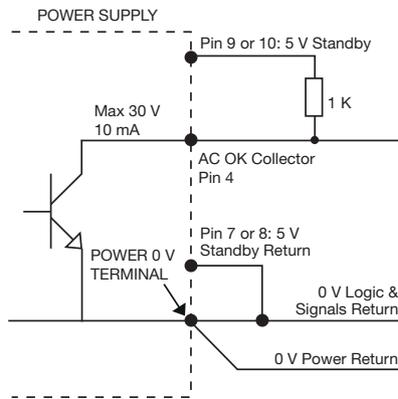
## Signals

Figure 6 - AC OK/Power Fail Function



Ensure that the logic & signals return is run as a separate route and connected as close as possible to the PSU power 0V terminal to avoid a voltage drop along the signal path

Figure 7 - 5 V Standby to pull up open collector signals



The 5V standby supply is a floating output. If required to 'pull-up' signal lines, the standby 0V return must be connected to the 0V power return.

Figure 8 - Inhibit Function

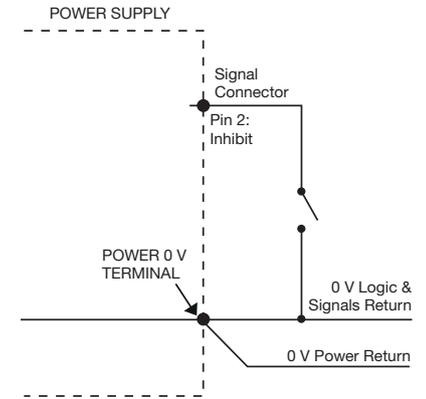
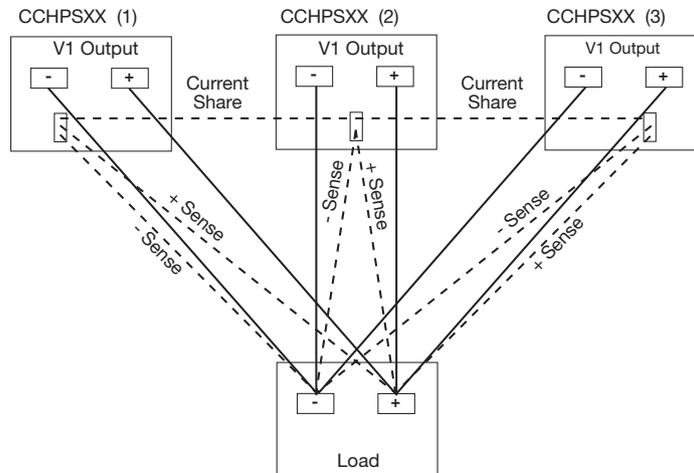


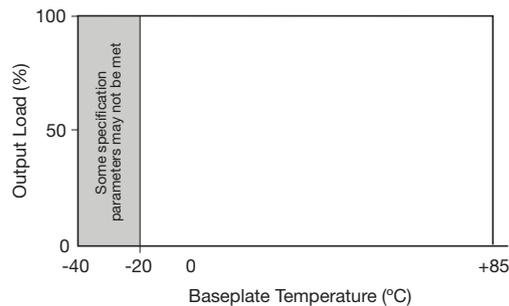
Figure 9 - Parallel & Current Share



## Environmental

| Characteristic        | Minimum | Typical | Maximum | Units | Notes & Conditions   |
|-----------------------|---------|---------|---------|-------|--|
| Operating Temperature | -40     |         | +85     | °C    | Baseplate temperature. See thermal considerations & performance, curve Fig 7 |
| Storage Temperature   | -40     |         | +85     | °C    |  |
| Cooling               |         |         |         |       | Baseplate cooled   |
| Humidity              | 5       |         | 95      | %RH   | Non-condensing   |
| Operating Altitude    |         |         | 3000    | m     |  |
| Shock                 |         |         |         |       | MIL-STD 810F clause 516.5 Proc 1. 40 g, 11 ms in 6 axis                      |
| Vibration             |         |         |         |       | MIL-STD 810F figure 514.5C-17  |

Figure 7 - Thermal performance Curve



## Electromagnetic Compatibility - Emissions

| Phenomenon           | Standard           | Test Level    | Criteria | Notes & Conditions |
|----------------------|--------------------|---------------|----------|--------------------|
| Conducted            | EN55022            | Class B       |          |                    |
|                      | MIL-STD-461E CE102 | 10 KHz-10 MHz |          |                    |
| Radiated             | EN55022            | Class A       |          |                    |
| Voltage Fluctuations | EN61000-3-3        |               |          |                    |

## Electromagnetic Compatibility - Immunity

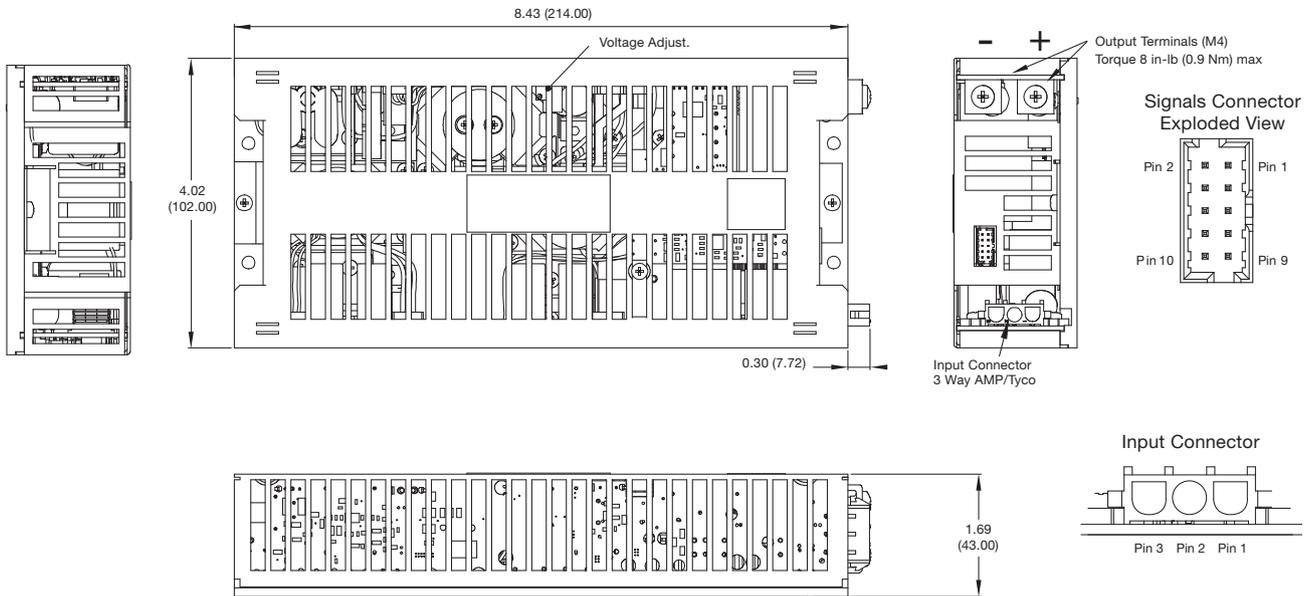
| Phenomenon             | Standard           | Test Level               | Criteria | Notes & Conditions |
|------------------------|--------------------|--------------------------|----------|--------------------|
| Low Voltage PSU EMC    | EN61204-3          | High severity level      | as below |                    |
| Harmonic Current       | EN61000-3-2        | Class A                  |          |                    |
| Radiated               | EN61000-4-3        | 3                        | A        |                    |
| EFT                    | EN61000-4-4        | 3                        | A        |                    |
| Surges                 | EN61000-4-5        | Installation class 3     | A        |                    |
| Conducted              | EN61000-4-6        | 3                        | A        |                    |
|                        | MIL-STD-461E CS114 | Curve 3 10 KHz - 200 MHz |          |                    |
| Dips and Interruptions | EN61000-4-11       | Dip: 30% 10 ms           | A        |                    |
|                        |                    | Dip: 60% 100 ms          | B        |                    |
|                        |                    | Dip: 100% 5000 ms        | B        |                    |

## Safety Agency Approvals

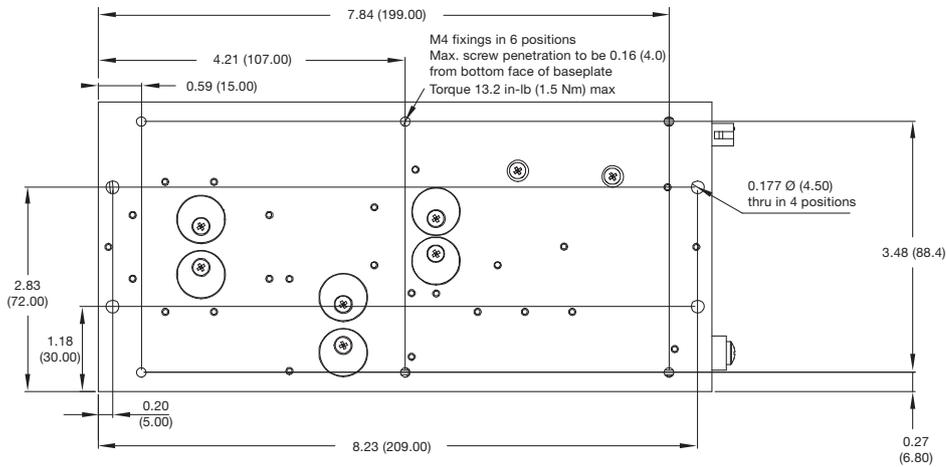
| Safety Agency | Safety Standard   | Category               |
|---------------|---|------------------------|
| CB Report     | IEC60950-1 (2005) 2nd Ed, IEC62368-1:2014                                       | Information Technology |
| UL            | UL60950-1, 2nd Edition, 2007-03-27, CSA C22.2 No 60950-1-07 2nd Edition 2007-03 | Information Technology |
| TUV           | EN60950-1/A11:2009, EN62368-1:2014/A11:2017                                     | Information Technology |
| CE            | LVD   |                        |

| Equipment Protection Class | Safety Standard                       | Notes & Conditions  |
|----------------------------|---------------------------------------|---|
| Class I                    | IEC60950-1:2005 Ed 2, IEC62368-1:2014 | See safety agency conditions of acceptability for details |

## Mechanical Details



## Mounting Holes



| Input Connector |          |
|-----------------|----------|
| Pin             | Function |
| 1               | Earth    |
| 2               | Neutral  |
| 3               | Line     |

Connector: 3 way AMP/Tyco  
type MATE-N-LOK 1-350943-0

Mates with MATE-N-LOK 350766-1

| Signal Connector |                   |
|------------------|-------------------|
| Pin              | Function          |
| 1                | Current Share     |
| 2                | Inhibit           |
| 3                | Overtemp. Warning |
| 4                | AC OK/Power Fail  |
| 5                | +Sense            |
| 6                | -Sense            |
| 7                | -Standby          |
| 8                | -Standby          |
| 9                | +Standby          |
| 10               | +Standby          |

Connector: 10 WAY 2mm pitch p/n MOLEX 87833-1031

Mating half: p/n MOLEX 51110-1056

Contact: p/n MOLEX 50394-8100

## Notes

1. All dimensions in inches (mm).
2. Tolerance .xx = ±0.02 (0.50); .xxx = ±0.01 (0.25)

3. Weight 3.3 lbs (1.5 kg)
4. Connector kit available, order part no. 'CCH CONKIT'

## Thermal Considerations - Baseplate Cooling

The use of power supplies in harsh or remote environments brings with it many fundamental design issues that must be fully understood if long-term reliability is to be attained.

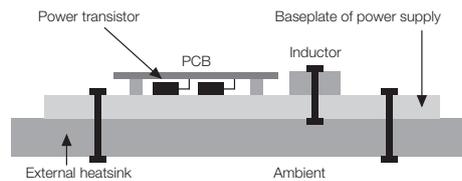
Under these conditions, it is generally accepted that electronic systems have to be sealed against the elements. This makes the removal of unwanted heat particularly difficult. The use of forced-air cooling is undesirable as it increases system size, adds the maintenance issues of cleaning or replacing filters, and the fan being prone to wear out, particularly in tough environments.

The extremes of ambient temperature encountered in remote sites can range from  $-40\text{ }^{\circ}\text{C}$  to over  $+40\text{ }^{\circ}\text{C}$ . It is common for the temperature within the enclosure to rise some  $15$  to  $20\text{ }^{\circ}\text{C}$  above the external temperature. The positioning of the power supply within the enclosure can help minimize the ambient temperature in which it operates and this can have a dramatic effect on system reliability.

System enclosures are typically sealed to IP65, IP66 or NEMA 4 standards to prevent ingress of dust or water. Removal of heat from other electronic equipment and power supplies in a situation with negligible airflow is the challenge. From the power system perspective, the most effective solution is to remove the heat using a heatsink that is external to the enclosure. However, most standard power supplies cannot provide an adequate thermal path between the heat-dissipating components within the unit and the external environment.

Fundamentally, the successful design of a power supply for use within sealed enclosures relies on creating a path with low thermal resistance through which conducted heat can be passed from heat-generating components to the outside world.

The components that generate the most heat in a power supply are distributed throughout the design, from input to output. They include the power FET used in an active PFC circuit, the PFC inductor, power transformers, rectifiers, and power switches. Heat can be removed from these components by thermally connecting them to the base-plate that in turn can be affixed to a heatsink. As mentioned earlier, the heatsink is then located outside of the enclosure.



**Basic construction of baseplate cooled PSU with all of the major heat-generating components thermally connected to the baseplate**

### Dissipating the Heat: Heatsink Calculations

Three basic mechanisms contribute to heat dissipation: conduction, radiation and convection. All mechanisms are active to some degree but once heat is transferred from the baseplate to the heatsink by conduction, free convection is the dominant one.

Effective conduction between the baseplate and heatsink demands flat surfaces in order to achieve low thermal resistance. Heat transfer can be maximized by the use of a thermal compound that fills any irregularities on the surfaces. System designers should aim to keep thermal resistance between baseplate and heatsink to below  $0.1\text{ }^{\circ}\text{C}/\text{W}$ . This is the performance offered by most commonly used thermal compounds when applied in accordance with manufacturers' instructions.

Radiation accounts for less than 10% of heat dissipation and precise calculations are complex. In any case, it is good practice to consider this 10% to be a safety margin.

The following example shows how to calculate the heatsink required for an CCH600PS48 with 230 VAC input and an output load of 500 W operating in a 40 °C outside ambient temperature.

1. Calculate the power dissipated as waste heat from the power supply. The efficiency (see fig. 9 & 10) and worst case load figures are used to determine this using the formula:

$$\text{Waste heat} = \left\{ \frac{1 - \text{Eff}\%}{\text{Eff}\%} \right\} \times P_{\text{out}} = \left\{ \frac{1 - 0.91}{0.91} \right\} \times 500 \text{ W} = 49.5 \text{ W}$$

2. Estimate the impedance of the thermal interface between the power supply baseplate and the heatsink. This is typically 0.1°C/W when using a thermal compound.

3. Calculate the maximum allowable temperature rise on the baseplate. The allowable temperature rise is simply:

$T_B - T_A$  where  $T_A$  is the maximum ambient temperature outside of the cabinet  
and  $T_B$  is the maximum allowable baseplate temperature.

4. The required heatsink is defined by its thermal impedance using the formula:

$$\theta H = \frac{T_B - T_A}{\text{Waste Power}} \times 0.1 = \frac{85 \text{ °C} - 40 \text{ °C}}{49.5 \text{ W}} \times 0.1 = 0.81 \text{ °C/W}$$

5. The final choice is then based on the best physical design of heatsink for the application that can deliver the required thermal impedance. The system's construction will determine the maximum available area for contact with the baseplate of the power supply and the available space outside of the enclosure will then determine the size, number and arrangement of cooling fins on the heatsink to meet the dissipation requirement.