VCCS300 Series

USER MANUAL

300W | 600W | 900W

Scalable

2" x 4" x 1.61"

Small

Fan-less

Silent

Cool it your way: Conduction | Convection | Forced Air

The VCCS300 series user manual has been prepared by our design team to assist qualified engineers in correctly designing in the VCCS300 product into their application to achieve the best reliability and performance possible.

VCCS300 Series Overview

The VCCS300 series of conduction cooled power supplies deliver a silent 300 Watts of power in a miniature 2x4x1.61 Inch package and is the ultimate power solution for industrial or medical applications where a high efficiency, ruggedized, noiseless and BF rated power solution with Class I or II installation capability is required. The product series offers power densities exceeding 23W per cubic inch with efficiencies up to 95% in a scalable power architecture. The VCCS300 conduction cooled power solution can be scaled up to 600 watts, 900 watts and beyond by utilising the onboard current sharing feature. The VCCS300S is approved to the latest industrial safety standards (IEC/UL62368-1 2nd Edition) while the VCCS300M is approved to the latest medical safety standards (IEC/UL60601-1 3RD Edition & IEC/UL60601-1-2 4TH Edition). Both versions are approved to the latest EMC standards and feature market leading specifications and design-in application support.

Contents

Part Numbers and Ordering Information

SUMMARY SPECIFICATION							
Model	Nominal voltage	Rated current	Rated Power	Ripple	Load regulation	Line regulation	OVP
VCCS300X-12 [1]	12V	25A	300W [2]	180mV	±50mV	±0.1%V_{NOM}	15V
VCCS300X-24 [1]	24V	12.5A	300W [2]	240mV	±50mV	±0.1% V_{NOM}	30V
VCCS300X-48 [1]	48V	6.25A	300W [2]	480mV	±50mV	±0.1% V_{NOM}	60V

1. X = S for ITE, M for Medical
2. Subject to appropriate deratings.

PART NUMBERING SYSTEM

SERIES	VCCS300	S	-	12	-	0	0	0	Factory use

Product Family	Output Voltage
S – Industrial M - Medical	Standard 12/24/48

Industrial unit has ITE approvals (IEC62368), Medical unit has medical approvals (IEC60601)

Contact your Distributor or Vox Power representative for information regarding non-standard output voltage requirements

Important installation information

The VCCS300 series of open frame power supplies are intended for use within end customer applications which restrict access to un-authorized personnel. The instructions in this manual and all warning labels on the product must be adhered to carefully.

SAFETY

The VCCS300S and VCCS300M series are designed in accordance with the relevant safety requirements of IEC/EN/UL/CSA 62368-1, IEC/EN/UL/CSA 60601-1, Low voltage Directive LVD 2014/35/EU and EMC directive EMC 2014/30/EU.
All VCCS300 series power supplies must be installed correctly in a controlled environment which restricts access to any un-authorised personnel. Equipment and system manufacturers must protect service personnel against unintentional contact with the output terminals.

HAZZARDS

Dangerous voltages are present within the power supply. It should only be handled by qualified personnel when the power supply has been disconnected from the mains supply voltage for more than 3 minutes.
External surfaces of the power supply may become extremely hot during and after operation. Appropriate care should be taken.
If series and/or parallel combinations of outputs exceed safe voltage and/or energy levels, the final equipment manufacturer must provide the appropriate protection for both users and service personnel.

DE-RATINGS

Mains Voltage	The output power must be de-rated by 2.5W/V_{RMS} below 120 V_{RMS} to 85V_{RMS} minimum. (300W @ 120 V_{RMS}, 225W @ 90 V_{RMS})
Thermal	The output power must be de-rated as outlined in the "Power Ratings" section of the user manual.

Remember to take the appropriate de-rating into consideration before specifying any VCCS300 power supply for an application. If in any doubt, please contact Vox Power directly or your local Vox Power representative.

HEALTH AND SAFETY

To comply with section 6 of the health and safety at work act, a label that is clearly visible to service personnel must be placed on the final equipment. These labels warn that surfaces of the power supply may be hot and should not be touched when the product is operating.

FUSING

The power supply has internal dual pole fusing. One fuse in each line.
Fuses are not replaceable. Damaged units should be returned to Vox Power for analysis and repair.
DC operation is not covered by safety approvals. Contact Vox Power for details.

SERVICING

The power supply contains no user serviceable parts. Repairs must be carried out by authorised personnel only. Contact Vox Power for further information.

COOLING

For proper operation of the power supply, the user must ensure all component temperatures are within specifications. A thorough review of the user manual should be carried out for details of thermal performance.

EARTH TERMINAL MARKING (Class I installations only)

To comply with the requirements of IEC/EN/UL/CSA 62368-1, & IEC/EN/UL/CSA 60601-1, where the incoming wiring earth is intended for connection as the main protective earth conductor and where the terminals for such a connection is not supplied on a component or subassembly, the user shall add an appropriate label displaying a protective earth symbol in accordance with IEC60417-5019 (2006-08) directly adjacent to the terminal. The label should be durable and legible and should comply with IEC62368-1 clause F.3.10 Test for durability of Markings and IEC60601-1 clause 7.1.3 Durability of Markings.

CLASS II INSTALLATIONS

To ensure end equipment complies with safety certifciations, the user should carry out a thorough review of the VCCS300 safety certification reports and any engineering conditions of acceptability contained therein.
A review of the "*Installing your VCCS300 product"* section in the user manual should also be carried out.

WARRANTY

Contact your sales agent or Vox Power for product repairs. See Vox Power standard terms and conditions for warranty conditions.

PRODUCT LABELS

The external product label contains information relevant to the power system. The label contains input voltage, maximum input current, input frequency, maximum output power, fuse rating and type, serial number, approvals and product part number in form VCCS300X-YYYY-ZZZ.

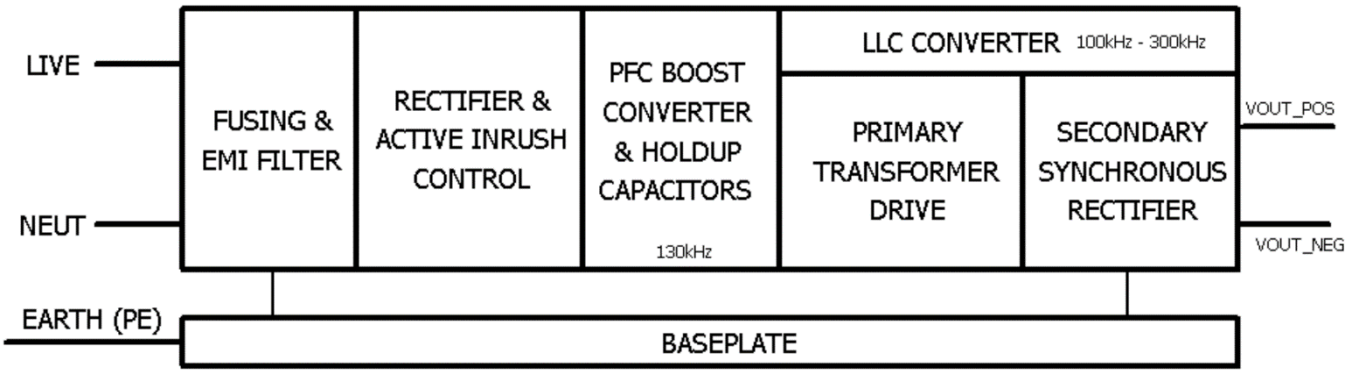
OTHER

- A label warning that external surfaces are hot during operation and that the unit should be allowed to cool down properly should be placed on the unit where such a label is clearly visible.
- The VCCS300 series is designed to comply with EMC standards but it does not imply that the end system will be compliant.
- To prolong the life of the unit, use in a dust free environment.
- Units can sometimes be damaged during transit. In the event of transit damage, DO NOT connect power to the unit. Contact your sales agent or Vox Power.
- Always use adequately sized cables and ensure good crimp connections. Use cable supports to minimise stress on connectors.
- Avoid excessive shock or vibration.
- Ensure to adhere to maximum pentration depth for mounting screws. See the *Mechanical Dimensions and Mounting* section in the user manual.
- Ensure to adhere to minimum installation clearances. See the *Installing your VCCS300 product* section in the user manual.

Product Operation

System overview

The diagram below outlines the topology and major internal components of a VCCS300 power supply.



The AC mains is fused, filtered, and rectified before being boosted to an appropriate DC voltage. Protection is provided from AC line disturbances and excessive EMI emissions. The integrated EMI filter attenuates high frequency current emissions to levels below EN55022 class B. It also provides dual pole fusing, one fuse in each conductor and protection from line disturbances as outlined in EN61000.

Inrush current is controlled by a resistive element upon initial connection to the AC line. Once the internal capacitances have been charged, the resistive element is bypassed to reduce losses. Note that the inrush specification in the datasheet is given at 25°C, cold start. Inrush current will increase for temperatures above 25°C and re-application of AC mains.

Active Power Factor Correction (PFC) is used to ensure an accurate input current waveform with extremely low harmonic content, exceeding the requirements of EN61000-3-2. This stage also provides active input current limiting which prevents overloading of the input stage while maintaining high power factor.

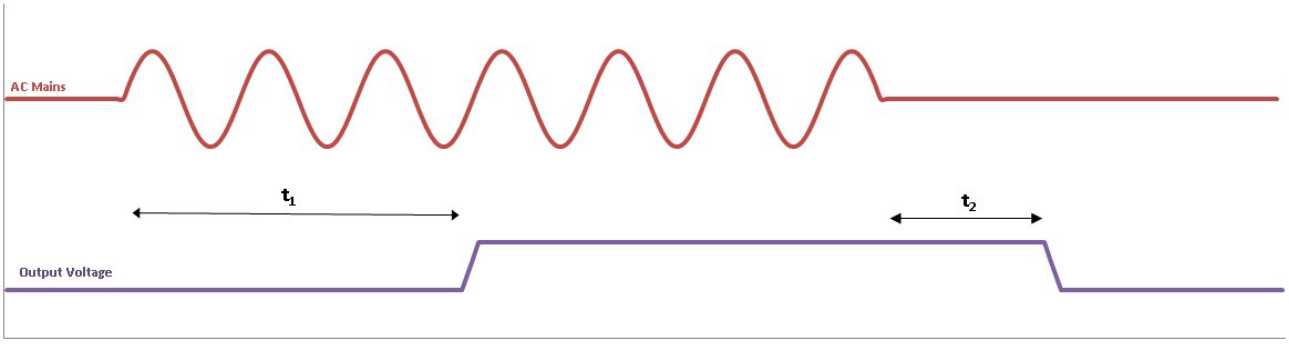
The output of the PFC stage charges the hold-up electrolytic capacitors which store enough energy to allow the VCCS300 product to continue operating during minor line disturbances. Long lifetime and high temperature capacitors are used which ensures extended lifetime and product reliability.

A highly efficient zero voltage switching circuit is used to drive the LLC transformer from the hold-up capacitors. The output synchronous rectifiers connect to the transformer secondary and provide safe isolated power. This power converter is controlled using the latest analog control technology to produce superior output performance in a miniature size.

Startup & Shut Down Timing

The VCCS300 operates from a universal input voltage range and starts automatically upon application of adequate AC mains voltage (>50V_{RMS}). After a short delay the output voltage starts and delivers power to the application loads.

The diagram below shows the normal start up/shut down sequence and gives typical timings.



Typical timing values at 120Vac 300W 25°C: t_1φ ≈ 600 ms, t_2φ ≥16ms (minimum)

When the AC mains voltage is removed, the internal hold-up capacitors will supply power to the load for typically 16ms (t_2) at maximum power.

Hold-up

For short line distubances (<16ms), the unit can deliver full output power without disturbances on the output voltage.

No Load Power Consumption

The VCCS300 series has an extremely low no-load power consumption of <1W. To achieve this the unit enters burst mode when the output power is below 6W. When in burst mode the ripple frequency will reduce significantly. The unit returns to normal operation when the output load goes above 12W.

Input Over Current Protection (OCP)

The input circuitry is protected from excessive input current by means of an over current protection circuit which limits the input current to approximately 5Arms. If the OCP threshold is exceeded the unit may shut down and attempt to automatically restart.

Input Under Voltage Protection (UVP)

The input circuitry will not operate until the applied mains voltage exceeds 50V_{RMS}. Once the unit is active it can operate down to approximately 10V_{RMS} under no load conditions. When operating below the minimum specified mains voltage (85V_{RMS}) the input circuitry is protected by the input over current protection (OCP).

Over Temperature Protection (OTP)

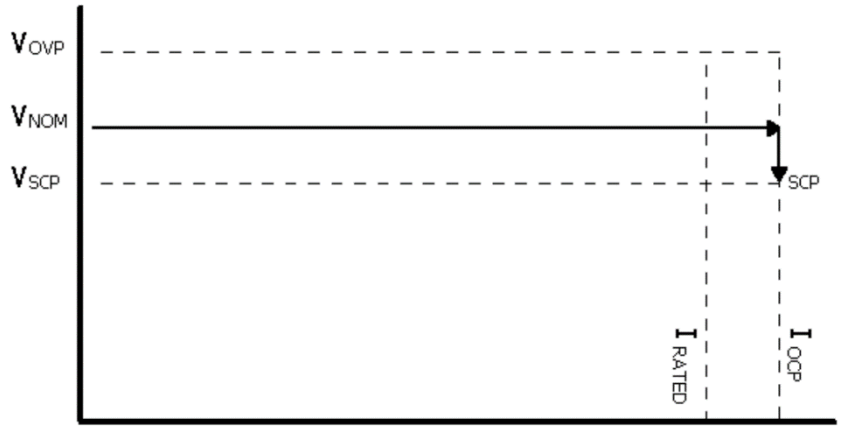
The unit is protected from excessive temperatures by means of various internal temperature sensors. If temperature thresholds are exceeded the unit may turn off. The unit will automatically recover once it has cooled sufficiently.

Output Performance (12V, 24V & 48V Models)

Power Profile

The power profile diagram below is a voltage/current plot that together with the associated table provides details of the main features of the standard output voltages. Alternative output voltage constructions are available to order, consult your Vox Power Distributer or Vox Power representative for further details.

POWER PROFILE



Model	V_{NOM} (V)	I_{RATED} (A)	V_{OVP} (V)	V_{SCP} (V)	I_{OCP} (A)
VCCS300(X)-12	12	25A	15	9.6	28.75
VCCS300(X)-24	24	12.5A	30	19.2	14.37
VCCS300(X)-48	48	6.25A	60	38.4	7.18

Over Voltage Protection (OVP)

In the event of an output fault, the unit is protected against excessive output voltages. If the output voltage exceeds the V_{OVP} threshold, the output will be disabled, and the unit will attempt to restart at a minimum of 1 second intervals.

Over Current & Short Circuit Protection (OCP & SCP)

The over current threshold is typically set at 115% of the rated current and has a constant current, straight line characteristic that reduces the output voltage as the load resistance decreases. If the output voltages falls below the short circuit voltage threshold (V_{SCP}) the unit enters short circuit protection mode. In SCP mode, the output shuts down completely for a minimum of 1 second then attemps to restart. This process repeats until the overload condition is removed, at which point normal operation resumes.

Reverse Current Protection (RCP)

The output rectifier uses synchronous rectification to achieve high efficiency. Typically synchronously rectified outputs can both source and sink current. The VCCS300 series outputs have internal protection to prevent any reverse current flowing into the unit.

Start-up

The outputs are designed to have a controlled start-up with a rise time of approximately 2ms (0% to 67%) under full load. Start-up into pre-biased loads will not discharge any external capacitance or cause any damage to the unit.

External capacitance

The outputs can support a large external capacitance as detailed in the table shown.
The capacitances specified ensure reliable start-up with rated load applied.
Larger capacitances can be applied for reduced load currents.

V_{OUT}	C_{EXT_MAX}
12	3mF
24	1.5mF
48	0.6mF

Start up into Pre-biased loads

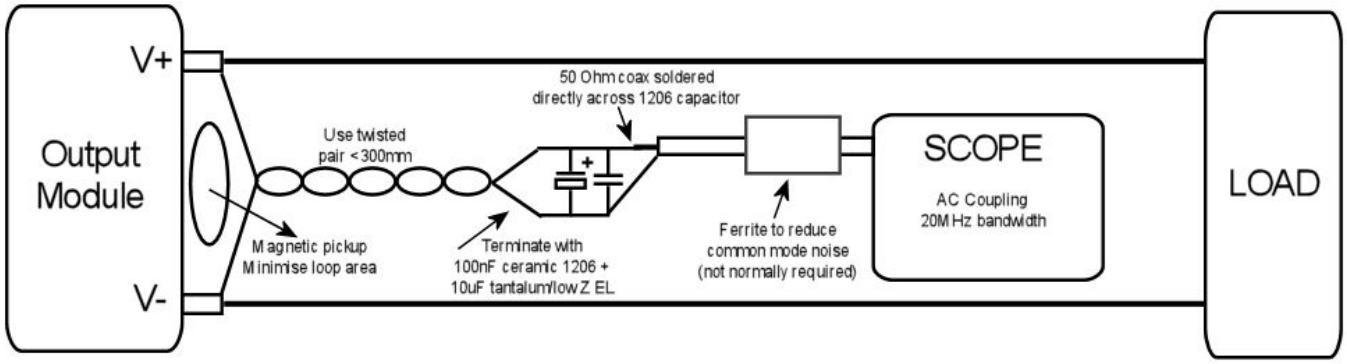
A pre-biased load is a load that already has a voltage present when the power supply is turned on. This can occur if the output capacitors are not loaded and the unit is turned off and then on again before the capacitors have had a chance to discharge.
In such circumstances there may be a small voltage overshoot of approximately 10% at start up. However, this can be eliminated by adding sufficient external capacitance.

Shut Down

At shutdown, the outputs enter a high impedance state. Where no external load is present it may take some time for the voltage to decay. When driving inductive loads, care must be taken to limit the voltage at the output terminals to prevent damage to the unit.

Ripple and Noise

The ripple and noise figures stated in the datasheet are defined based on a standard measuring method. To obtain the same results the same test setup must be used, and care must be taken to eliminate any parasitic noise pickup. The diagram below shows details of the setup and sources of noise pickup.



The output ripple frequency can vary from 100kHz to 300kHz but is typically 180kHz. Under light load conditions (<6W) the unit may enter burst mode and the ripple frequency will reduce significantly but will remain within specification.

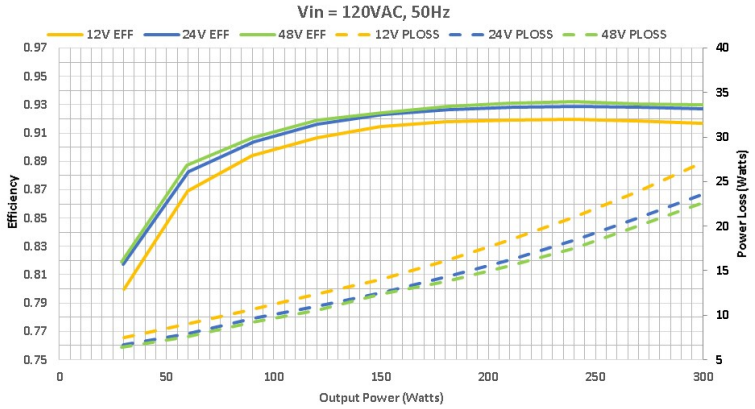
Transient Response

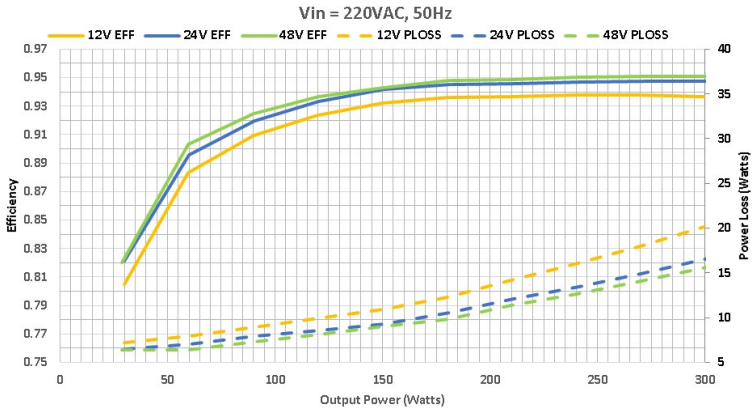
The VCCS300 series uses the latest current mode control algorithms to achieve a fast (<500uS) and stable response to dynamic loading. Where large dynamic loading and tight voltage deviation specification are required, additional low impedance external capacitance should be placed at the load.

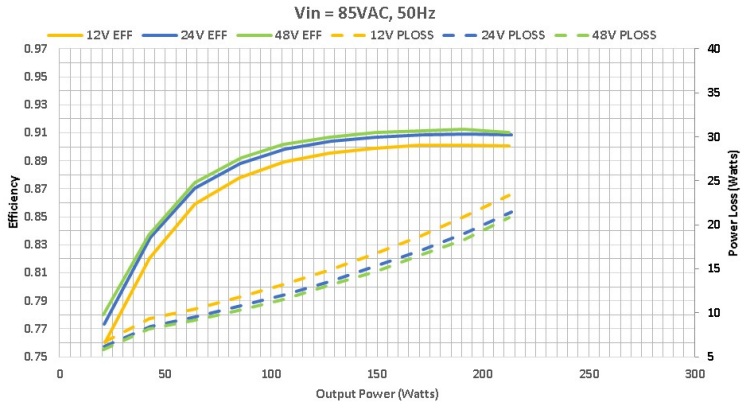
Efficiency Performance

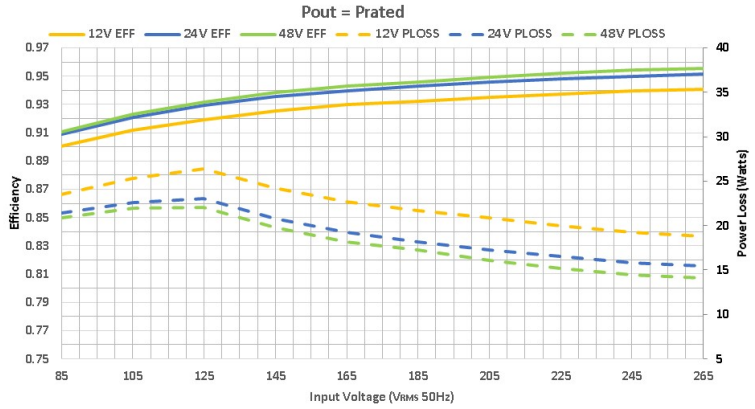
The efficiency of the VCCS300 product is dependent on parameters such as mains voltage, output power and on the model. The plots below show typical efficiencies of a VCCS300 product for the standard output voltages. The plots cover the full load and line voltage range.

TYPICAL EFFICIENCIES









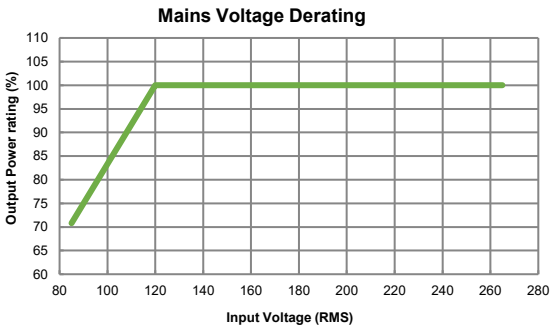
Power Ratings

VCCS300 series products must always be operated within stated operating limits. Equipment manufacturers and other users must take the appropriate derating into account when specifying a unit for the intended application. If in doubt, contact your sales representative or Vox Power for assistance.

The relevant deratings for the VCCS300 series power supplies are detailed below,

Mains Voltage Derating [4]

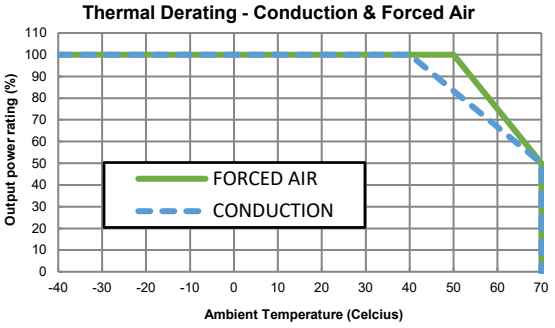
Mains Voltage Derating Table		
Mains Voltage (V_{RMS})	**Output Power**	**(%)**
120	300	100%
110	275	91.7%
100	250	83.3%
90	225	75.0%
85	212.5	70.8%
The output power must be de-rated by 2.5% for every 3 volts below 120V_{RMS}, down to a minimum of 85V_{RMS}.		



Thermal Derating - Conduction & Forced Air Cooled [3,4]

Thermal Derating Table – Conduction & Forced Air		
$T_{AMBIENT}$ (°C)	**Conduction (%)**	**Forced Air (%)**
-40	100%	100%
40	100%	100%
50	83.3%	100%
70	50.0%	50%

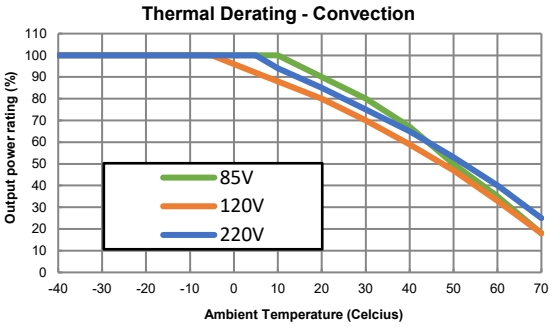
1. The conduction cooled rating for all models applies under the following conditions. Baseplate temperature [2] ≤ $T_{AMBIENT}$ + 15°C
2. The forced air rating for all models applies for 1MS^{-1} (200LFM). See *Mechanical Dimensions and Mounting* section for Airflow direction.
3. Mounted with baseplate at the bottom, 40mm above surface.



Thermal Derating - Convection Cooled [3,4]

Thermal Derating Table – Convection			
Ambient Temperature	**85V_{RMS} [2] (%)**	**120V_{RMS} (%)**	**220V_{RMS} (%)**
-40	100%	100%	100%
-5	100%	100%	100%
5	100%	92%	100%
10	100%	88%	94%
20	90%	80%	85%
30	80%	70%	75%
40	67%	59%	65%
50	50%	47%	53%
60	25%	33%	40%
70	18%	18%	25%

- The convection cooled rating applies under the following conditions, No forced airflow or conduction cooling. The VCCS300 is mounted horizontally.
- Mains voltage deratings apply at 85V_{RMS}.



Notes:

1. Ambient air temperature is the air temperature immediately surrounding the PSU. If the PSU is mounted within an enclosure, the internal enclosure ambient temperature should be used.
2. Baseplate temperature is measured at baseplate temperature sensing location TP1. See *Mechanical Dimensions and Mounting* section for Airflow direction.
3. Thermal deratings are derived from maximum component temperatures under controlled conditions. Component temperatures must be verified in the end application as described in the "Component Temperatures" section of the user manual.
4. **Mains Voltage deratings are cumulative with thermal deratings.**

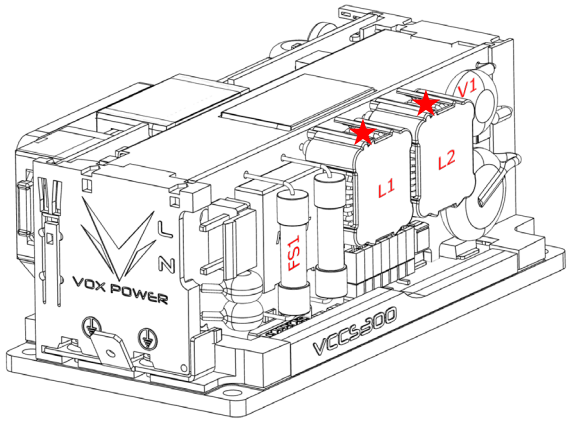
Component Temperatures

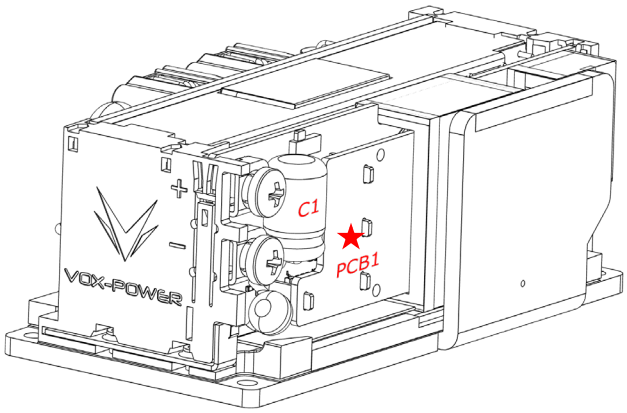
Evaluating the VCCS300 product in the end application

To ensure the product is operating within its ratings in the end application the following procedure should be performed during the design stage.

1. Setup the application in worst case conditions, considering mains voltage, output power, ambient temperature, mounting orientation, airflow, and cooling restrictions.
2. Install thermocouples in the positions listed below using glue to hold the thermocouples in place.
3. Power the system and monitor the temperatures until they reach steady state.
4. Ensure that all temperatures remain below recommended temperatures under normal conditions and do not exceed maximum temperatures under worst case conditions. It is good practice to leave some margin in the design.

Description	Reference	Measurement Position	Recommended temperature	Maximum allowed temperature
Fuse	FS1	Body Centre	100°C	125°C
Filter Inductors	L1 & L2	Winding Top (Starred)	110°C	130°C
Varistor	V1	Body Centre	80°C	85°C
Electrolytic capacitor	C1	Body Centre	90°C	105°C
Transformer	PCB1	Centre (Starred)	115°C	130°C

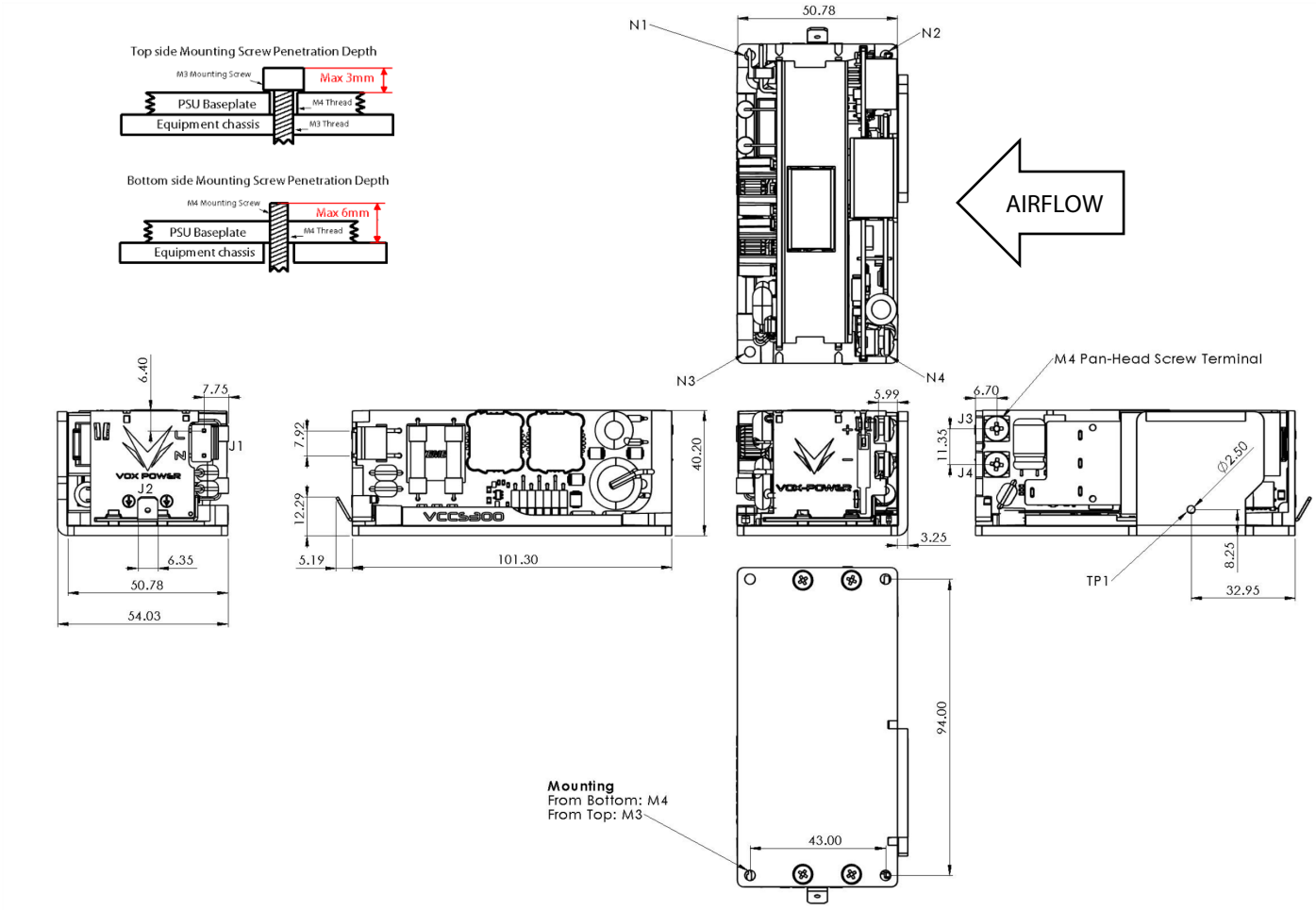




Operation of components above the recommended temperatures will result in reduced lifetime of the unit and invalidate the warranty.

Mechanical Dimensions and Mounting

MECHANICAL DIMENSIONS AND MOUNTING			
SCREWS			
Location	Details	Penetration	Tightening
Baseplate Mount (Screw from top side): N1 – N4 (1)	M3 Hex Socket Head Cap Screw	**3mm Head height**	0.50NM
Baseplate Mount (Screw from bottom side): N1 – N4	M4 - Customer Preference	**6mm from bottom of Baseplate**	0.55NM
Output Terminal	M4 SEM POZI	M4 SEM screw, 8mm max length	0.55NM

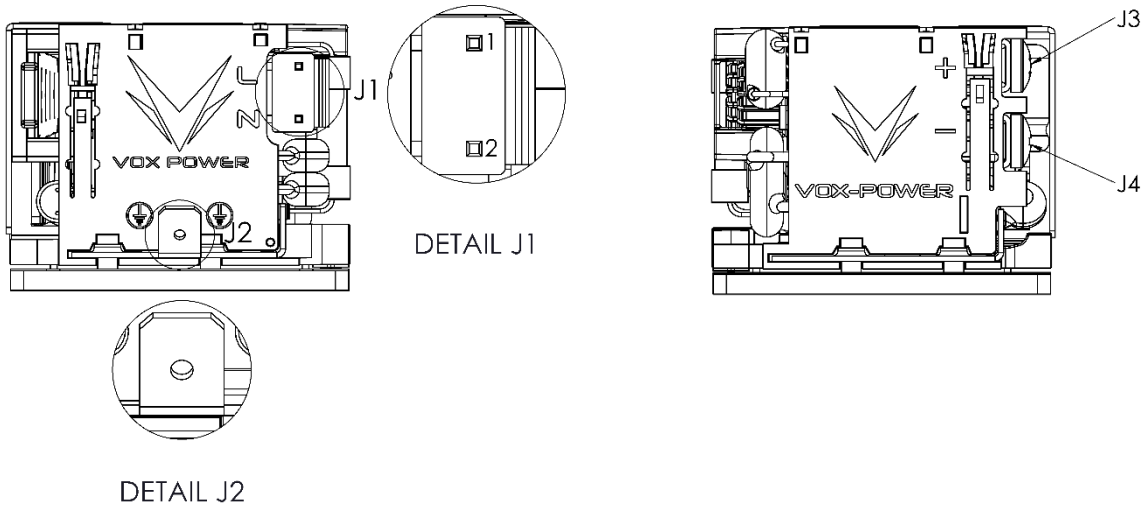


Notes

1. Top Side mounting screws are obstructed by components in some areas. M3 Hex socket screws should be used to allow angled access for tightening with a 2.5mm hex ball screwdriver. Care should be taken to ensure components are not damaged while tightening.

Connector details

CONNECTOR DETAILS



MATING CONNECTORS				
Ref.	Details	Manufacturer	Housing	Terminal
J1 - Mains Input 1 – Live 2 - Neutral	2 Pin, 7A, 250V_{AC}, 7.92mm Locking (1)	JST	VAR-2	SVA-41T-P1.1
J2 - Protective Earth	FASTON, PIDG series, Positive lock 0.25EX	TE Connectivity	-	165536-1
J3 - Positive Output Power J4 - Negative Output Power	M4 terminal, 0.55Nm	KST	-	SNBS5-4

Notes
1. Cable 18-20AWG, 300V, >7A, 105°C.
2. Direct equivalents may be used for any connector parts.
3. All cables must be rated 105°C min, equivalent to UL1015

Safety

The VCCS300 unit has been designed to comply with the Low Voltage Directive DIR 2014/35/EU (LVD), the EMC Directive DIR 2014/30/EU and DIR 2011/65/EU regarding the restriction of certain hazardous substances and is CE marked to show its compliance.
When correctly installed (per the installation instructions in this manual) in a limited access environment the VCCS300S & M comply with the requirements of IEC/EN/UL/CSA 62368-1 2nd Edition and IEC/EN/UL/CSA 60601 3rd Edition, respectively.

- The power supply should not be operated close to combustible materials or atmosphere.
- Care should be taken to ensure liquid or metal shavings do not enter the power supply as this can cause a fire hazard.
- The power supply does not contain any user serviceable parts and should be returned to Vox Power for repair.

WARNING!

- Series connected units with combined voltages exceeding 60 volts are not considered SELV. Paralleled and/or series units with combined energy ratings greater than 240 VA may cause energy hazards. The equipment manufacturer must provide additional and adequate protection to service and technical personnel.
- Always remove the power before handling the unit. During operation, the external surface of the unit can become hot. Leave to stand for 10 minutes to allow the unit to cool down before handling the unit.
- Dangerous voltages are present within the power supply even when the supply voltage has been removed.

SAFETY SPECIFICATIONS				
Parameter	Details	Max	Units	Notes
Isolation Voltages	Input to Output (2 MOPP) [1] Input to Chassis (1 MOPP) Output to Chassis (1 MOPP)	4000 2000 1500	V_{AC} V_{AC} V_{ac}	
Earth Leakage Current	NC/SFC (Class I), 264Vac, 63Hz, 25°C	<200/<400	µA	
Touch (Enclosure) Leakage Current	NC (Class I/Class II), 264Vac, 63Hz, 25°C SFC (Class I/Class II), 264Vac, 63Hz, 25°C	0/<200 <200/<500	µA	
Patient Leakage Current	NC (Class I/Class II), 264Vac, 63Hz, 25°C SFC (Class I/Class II), 264Vac, 63Hz, 25°C	<100/<100 <100/<200	µA	

Notes
1. Use DC equivalent voltage to test assembled unit.
2. NC = Normal Condition, SFC = Single Fault condition
3. Leakage currents will sum for paralleled units. N units will have N times the leakage current.

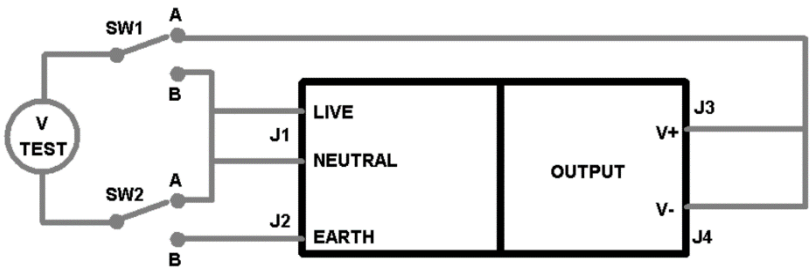
INSTALLATION SPECIFICATIONS			
Parameter	Details	Parameter	Details
Equipment class	I or II [1]	Flammability Rating	94V-2
Overvoltage category	II	Ingress protection rating	IP10
Material Group	IIIb (indoor use only)	Intended usage environment	Home Healthcare (M)/ Industrial (S)
Pollution degree	2		

1. Conditions of acceptability may apply. See UL report.

Withstand Voltage Test

The VCCS300 units are designed to withstand the test voltages listed below using the test circuit shown.

Test Circuit



Voltage	Ramp	Dwell	I_{MIN}	I_{MAX}	Test Type	SW1	SW2
6000VDC	10s	60s	0	5mA	Input to Output.	A	A
3000VDC	10s	60s	0	5mA	Input to Chassis.	B	B
2500VDC	10s	60s	0	5mA	Output to Chassis.	A	B

EMC Compliance

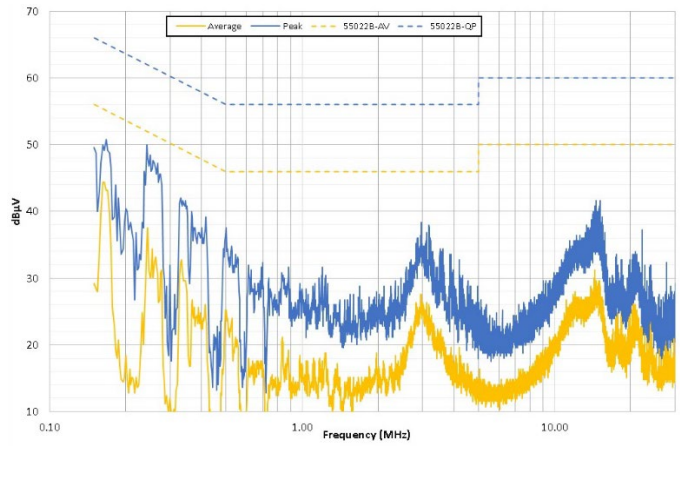
To support compliance of the final system design with the EMC directive 2014/30/EU, the VCCS300 PSU has been designed and tested to the following standards.

ELECTROMAGNETIC COMPLIANCE – EMISSIONS		
Phenomenon	Basic EMC Standard	Test Details
Radiated emissions, electric field	EN55011/22	Class B compliant
Conducted emissions	EN55011/22, FCC part 15, CISPR 22/11	Class B compliant
Harmonic Distortion	IEC61000-3-2	Compliant
Flicker & Fluctuation	IEC61000-3-3	Compliant
Radiated emissions, electric field, 30Hz-18GHz.	MIL-STD-461F: RE102 (Ground, Fixed)	Compliant (When mounted in enclosure)
Conducted emissions, power leads, 10kHz-10Mhz.	MIL-STD-461F: CE102	Compliant

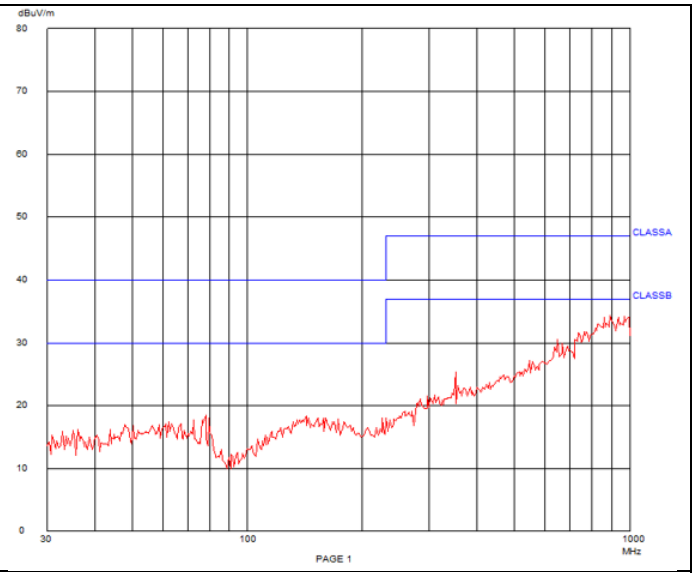
ELECTROMAGNETIC COMPLIANCE – IMMUNITY		
Phenomenon	Basic EMC Standard	Test Details
Electrostatic discharge	IEC61000-4-2	Test level 4: 15kV air, 8kV contact
Radiated RF EM fields	IEC61000-4-3	Test Level 3: (10V/m, 80MHz-2.7GHz) sine wave AM 80% 1kHz
Proximity fields from RF wireless communications equipment	IEC61000-4-3	Test levels as per IEC60601-1-2:2014 Table 9
Electrical Fast Transients/bursts	IEC61000-4-4	Test Level 3: (2kV Power, 1kV I/O) 5kHz(ed3) & 100kHz(ed4)
Surges	IEC61000-4-5	Test Level 3: 1kV L-N, 2kV L-E
Conducted disturbances induced by RF fields	IEC61000-4-6	Test Level 3: 10V, 0.15 to 80MHz sine wave AM 80% 1kHz
Power Frequency Magnetic Fields	IEC61000-4-8	Test level 4: 30A/m 50Hz
Voltage Dips	IEC61000-4-11 [2]	0% 10ms (Criterion A) 0% 20ms (Criterion B [3]) 70% 0.5s, 40% 0.2s (Criterion A at 240V and Criterion B at 100V)
Voltage interruptions	IEC61000-4-11	0% 250/300 cycle as per IEC60601-1-2:2014 (Criterion B)
Voltage Sag Immunity	SEMI-F47-0706 [2]	0% 20mS (Criterion B [3]) 80% 1s,80% 10s,90% continuous (Criterion A) 70% 0.5s, 50% 0.2s (Criterion A at 240V and Criterion B at 100V [4])
Shipboard Electric Power. Voltage Spike Test	MIL-STD-1399, SECTION 300A	Type 1, 115V 60Hz single phase
Conducted susceptibility, power leads	MIL-STD-461F: CS101	30Hz-150kHz
Conducted susceptibility, Bulk cable injection	MIL-STD-461F: CS114	10kHz-200MHz
Conducted susceptibility, Bulk cable injection, impulse excitation	MIL-STD-461F: CS115	
Conducted susceptibility, damped sinusoidal transients, cables and power leads	MIL-STD-461F: CS116	10kHz-100MHz
Radiated susceptibility, Magnetic field	MIL-STD-461F: RS101	30Hz-100kHz
Radiated susceptibility, electric field	MIL-STD-461F: RS103	2 MHz to 40 GHz, 20V
Aircraft Electric Power Characteristic	MIL-STD-704F	SAC102,104,105,109,110 (MIL-HDBK-704-2) & SXF102,104,105,109,110 (MIL-HDBK-704-6)

Notes:

1. Criterion A = No degradation of performance or loss of function.
   Criterion B = Temporary degradation of performance or loss of function is allowed, provided the function is self-recoverable.
   Criterion C = Temporary loss of function is allowed but requires operator intervention to recover.
2. Tested at nominal range (100V to 240V). Line deratings applied where appropriate.
3. Criterion A is achieved for all input voltages when Pout <= 280W
4. Criterion A is achieved for full power when Vin >=160V or at all input voltages when Pout <= 200W



Typical Conducted emissions



Typical Radiated emissions

For radiated and conducted emissions, compliance of the final system relies on proper installation of the PSU component. The installation guidelines detailed below should be followed.

Installation Guidelines for optimum EMC performance

- VCCS300 units should be mounted within a metal enclosure using the mounting fixtures provided.
  (See "Mechanical Dimensions & Mounting" section)
- If the application enclosure is not metal, then a metal ground plate should be used to mount both the power supply and the load.
- Both input and output cables should be fixed as close as possible to the ground plate or metal enclosure.
- Input and output cables should be separated as much as possible from each other or a shield/screen used to isolate RF currents
- All cables lengths and loop areas should be minimised.
- Where cables must enter or exit the enclosure, good high frequency 100nF decoupling capacitors of sufficient voltage rating should be connected to the cables as close to the entry/exit point as possible.

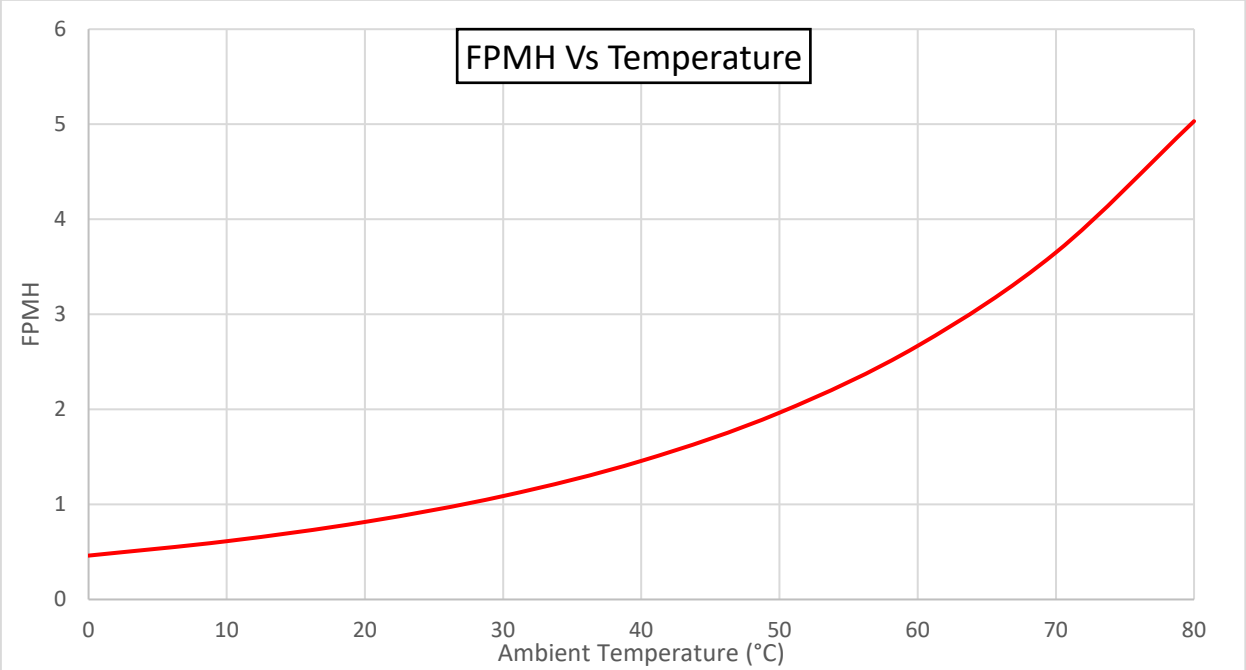
For further details or assistance contact Vox Power.

Reliability

The VCCS300 series has undergone extensive testing, including HALT and Environmental testing. Reliability data is collected on an ongoing basis. Please contact Vox Power or your distributor for the most up to date reliability data.

The reliability data quoted in the datasheets are the calculated *failures per million hours* (FPMH) using the Telcordia SR-332, issue 2 standard. The procedure defined in SR-332 allows several different techniques to be used for calculating MTBF and when evaluating competing MTBF figures it is important that only the same techniques are compared.
The quoted VCCS300 reliability figures use Method I Case 3, Ground, Fixed, controlled which specifies an ambient temperature of 30°C and an upper confidence level of 90%. It is also assumed that the product is operated at 100% duty cycle, has an input voltage of $120V_{RMS}$, an output power of 300W and that the baseplate temperature is the same as the ambient temperature.

The variation in FPMH is shown in the graph and table below.



Ambient Temperature	0	10	20	30	40	50	60	70	80
Failure Rate (FPMH)	0.46144630	0.613015302	0.815511105	1.0879098	1.45771725	1.96498947	2.66813507	3.65047088	5.0317409
MTBF (Hrs)	2167099.35	1631280.64	1226224.87	919193.78	686004.089	508908.57	374793.61	273937.26	198738.37

Installing your VCCS300 Product

The VCCS300 power supply is designed to be used as part of an end-system in a restricted environment and therefore should only be accessible to qualified and trained personnel. Persons attempting to install a unit must have the necessary knowledge and training before doing so. Incorrect installation may cause damage to the power supply and may affect the warranty.

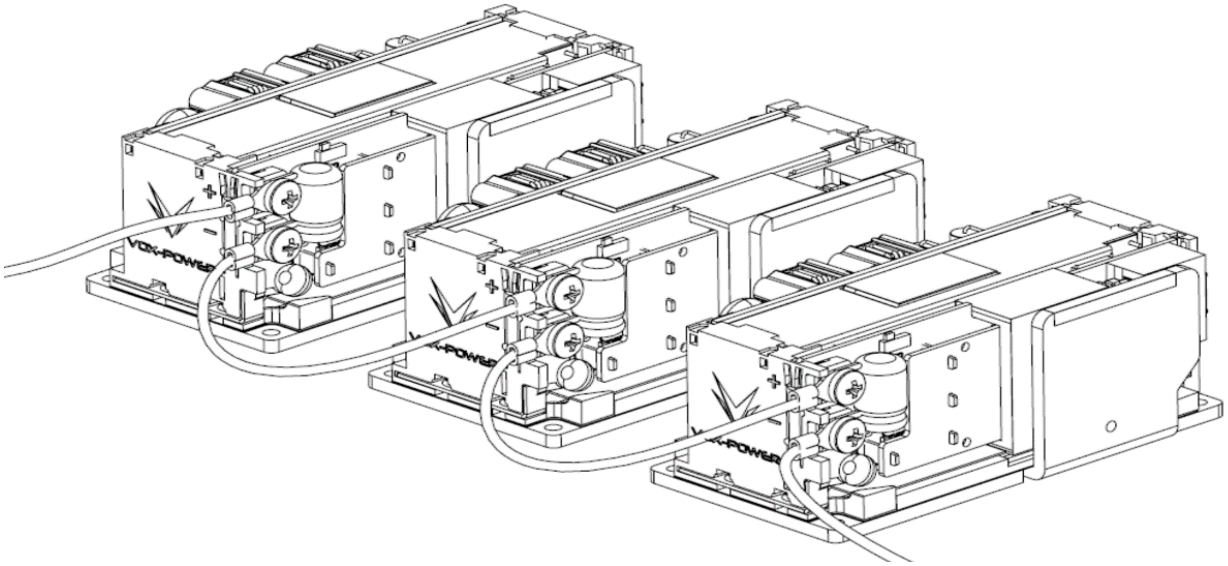
DO NOT use parts if any part of the product exhibits any kind of physical damage.
DO NOT connect any mains power before the installation is complete.

Once installation has been completed, operation of the unit should be verified.

Please contact Vox Power or your distributor for assistance in installing your power supply. Never assume, always ask.

Connecting units in series

VCCS300 units of the same type can be series connected to achieve higher output voltages. Below is an illustration of how-to series connect three units to give 900W of output power.
When mounting multiple units ensure to maintain sufficient safety clearances between units. See installation clearances section for more details.



WARNING!

- Energy and voltage hazards may arise when individual units are series connected. When safe energy and voltage levels are exceeded ensure that an appropriate warning label is affixed to the power supply in a manner that service personnel will always notice it. See the Safety section for more details.
- Leakage currents will increase when multiple units are installed in an end-system.

Isolation to Ground
Care must be taken not to exceed the output isolation to chassis ground when series connecting units. Each output is rated for 2200 Volts maximum between each output terminal and chassis ground. Exceeding this voltage may damage the unit.

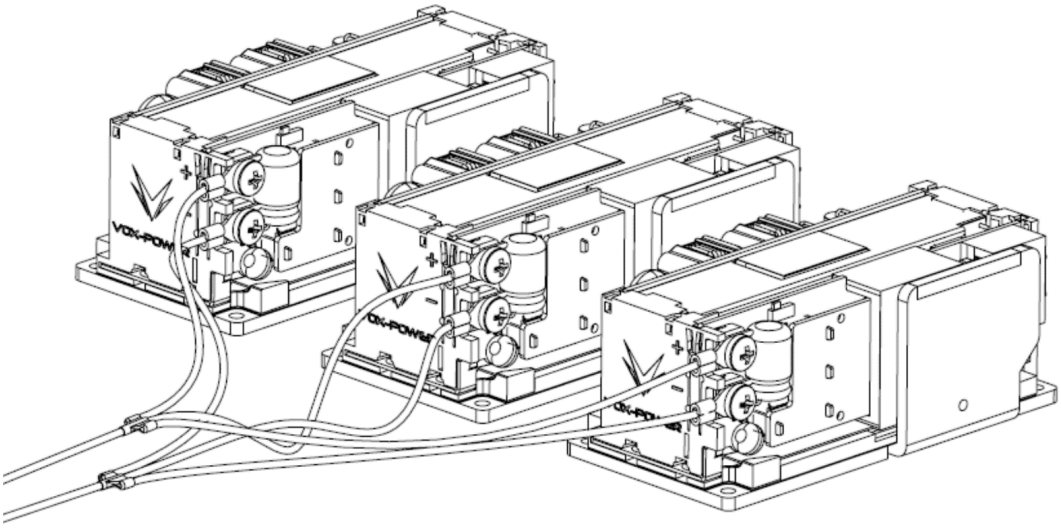
SELV Precautions
Where series combinations of units exceed 60V, the output can no longer be considered SELV (Safety Extra Low Voltage) and hence the final equipment manufacturer must provide suitable protection for both users and service personnel.

Ripple
When outputs are series connected, the output ripple will increase and may contain frequencies in the audio spectrum.

Connecting units in parallel

VCCS300 units of the same type can be paralleled in any number to achieve higher output currents. To parallel the outputs simply connect all the positive power cables together and all the negative power cables together. No other external circuitry is necessary.
For best performance and increased reliability, it is recommended to enable share mode on each unit (See "Share Mode (Droop)" section below for details).
The accuracy of current sharing is highly dependent on external cable resistance. To minimise errors, it is important to have equal cable lengths from each output terminal to the common connection point for both positive and negative cables.

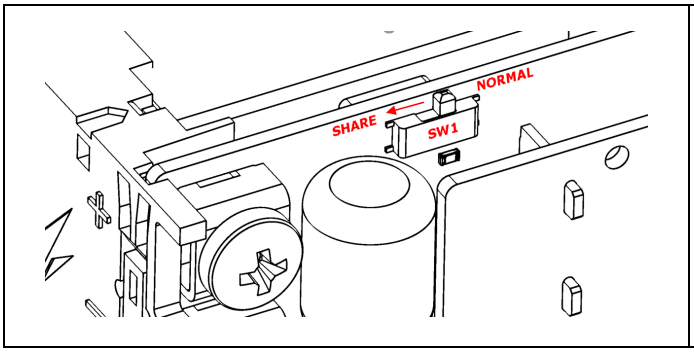
Below is an illustration of optimised parallel connection of three units to give 900W of output power.

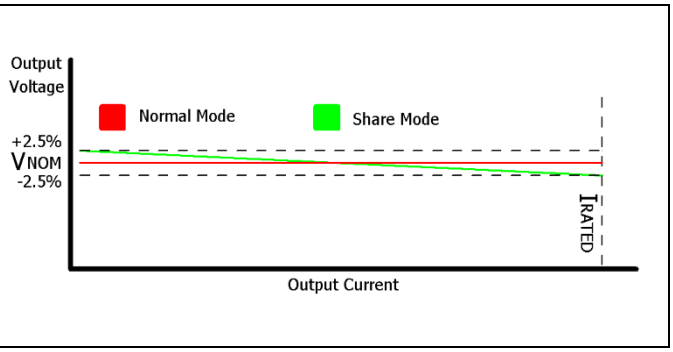


WARNING!

- Energy and voltage hazards may arise when individual units are paralleled. When safe energy and voltage levels are exceeded ensure that an appropriate warning label is affixed to the power supply in a manner that service personnel will always notice it. See the Safety section for more details.
- Leakage currents will increase when multiple units are installed in an end-system.

Share Mode (Droop)
When paralleling multiple units, share mode should be enabled by sliding SW1 to the share position as shown below.
This will introduce a +/-2.5% slope to the load regulation that enables the paralleled units to share load current equally between them and increase system reliability.





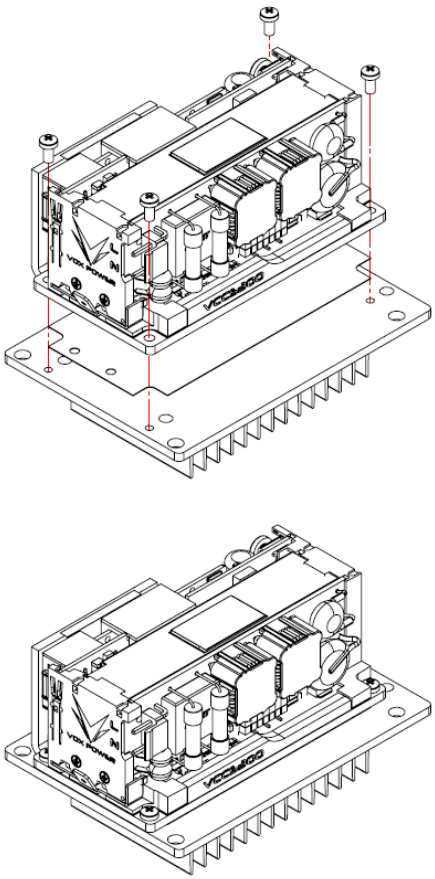
In share mode, the output voltage of each unit has an artificial voltage drop added that reduces the output voltage as the current increases. At 0% load the voltage is typically V_{NOM}+2.5%, at 50% load it is V_{NOM} and at 100% load it is V_{NOM}-2.5%.

Normal Mode
For normal parallel mode, SW1 should be set to normal position. In this mode, the highest set output will supply all the load current until its current limit is reached. If the load demand exceeds this level the output voltage will drop to the level of the next highest set output and that output will begin to supply the load current while the first output continues delivering full current. This process repeats for the total number of paralleled outputs. Typically, system reliability is reduced in this mode of operation as the higher set outputs will do most of the work with the lower set outputs only delivering current during peak load demand.

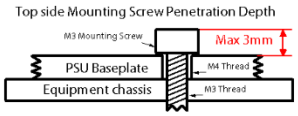
Ripple
When outputs are paralleled, the output ripple may contain frequencies in the audio spectrum.

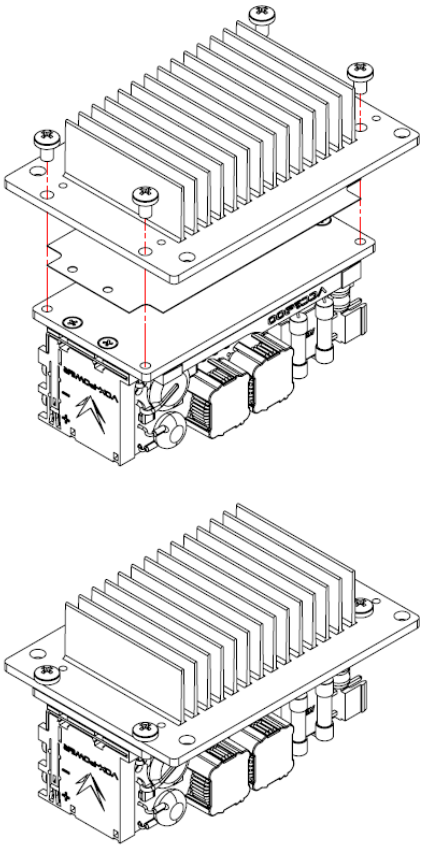
Attaching a heatsink or cooling plate

For improved performance & reliability, the baseplate of the VCCS300 unit can be attached to a heatsink, cooling plate or equipment enclosure. It is recommended to use a thermal interface material (such as SILPAD400) between the baseplate and mounting surface to ensure efficient cooling. The baseplate has four M4 threaded mounting holes which allow the unit to be mounted from the top side with 4x M3 Hex Socket Head Cap Screws or from the bottom side with 4x M4 screws.
The diagrams below show a VCCS300 unit attachment to a heatsink from top side and bottom side. Before assembly ensure both the baseplate and heatsink surfaces are clean and free from debris.

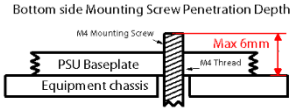


TOP SIDE MOUNTING





BOTTOM SIDE MOUNTING

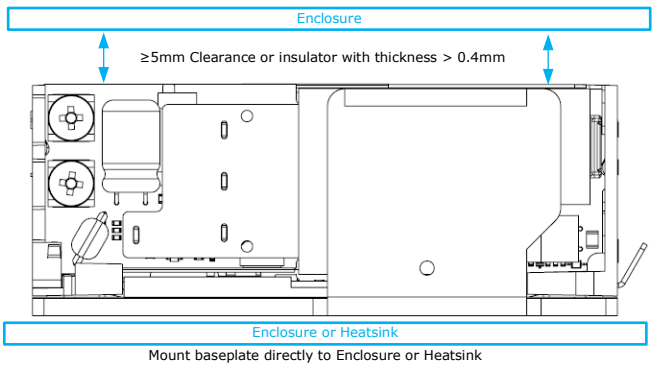


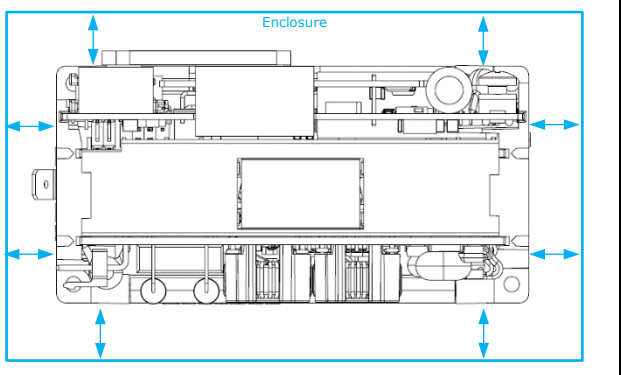
Top Side mounting screws are obstructed by components in some areas. M3 Hex socket screws should be used to allow angled access for tightening with a 2.5mm hex ball screwdriver. Care should be taken to ensure components are not damaged while tightening.

It is recommended to tighten the baseplate mounting screws to 0.5NM. In high vibration environments, an appropriate thread lock should be used.
All recommended screw tightening torques are nominal values and should be verified in the application where appropriate.

Installation Clearances

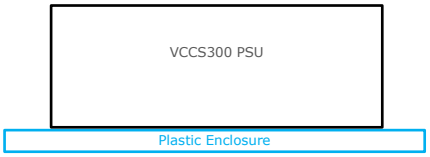
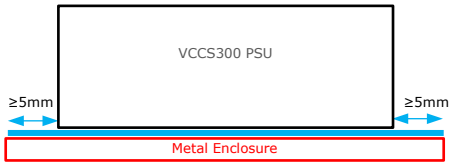
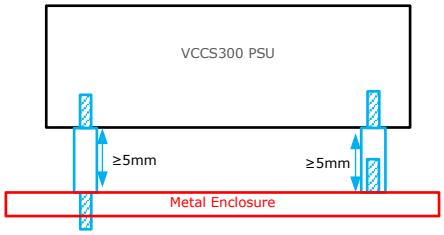
The diagram below shows the minimum recommended clearances to meet safety isolation requirements.



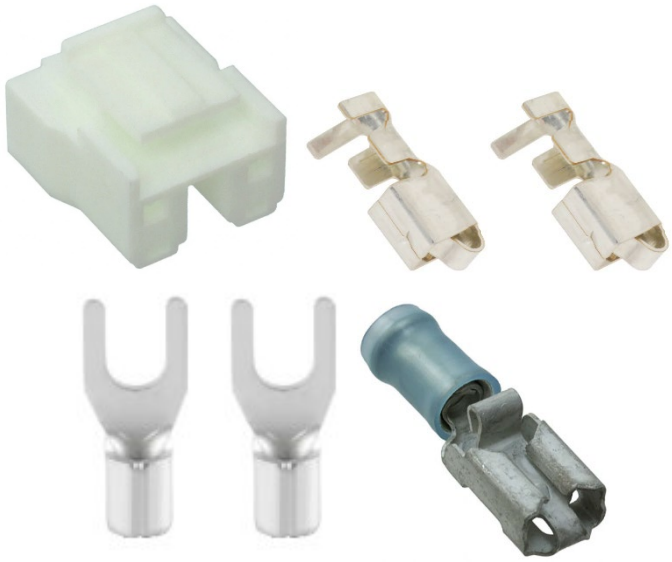
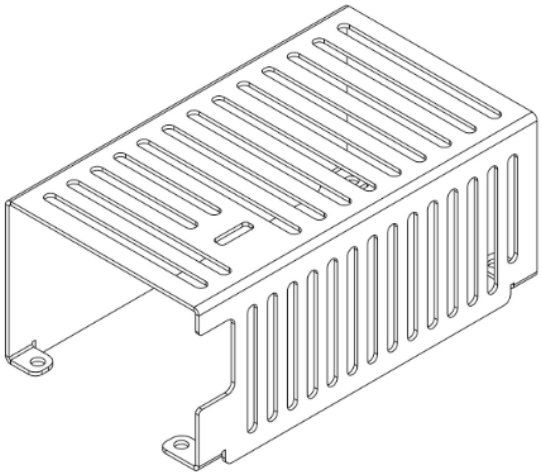


Class II equipment

For Class II equipment, the end equipment must also provide a supplementary insulation barrier to the baseplate. This can be achieved in a variety of ways such as a plastic enclosure, insulating sheet or insulating mounting pillars.

Plastic enclosure	Insulator	Insulating Spacers
Must meet safety agency requirements. No accessible conductive parts.	Must meet safety agency requirements. Recommend 5mm creepage from all edges.	M4 thread, Male-Male or Male-Female, Nylon 6/6
		

Accessories

Description	Photo/Drawing	Order code
VCCS300 Cable Set 1x Input connector housing 2x Input crimp connectors 1x Earth crimp connector 2x Output crimp connector		CAB-V3
VCCS300 Cover Kit		CKIT-V3