

## Overview

The purpose of this document is to inform customers of the performance characteristics of the VCCM600 series power supplies when used at 400Hz input voltage frequency.

The VCCM600 power supply characteristics are measured under various line and load conditions for both 50Hz and 400Hz.

Efficiency, Power Factor and input current waveforms will be measured over the load range for input voltages of 85V<sub>RMS</sub>, 120V<sub>RMS</sub> and 220V<sub>RMS</sub>.

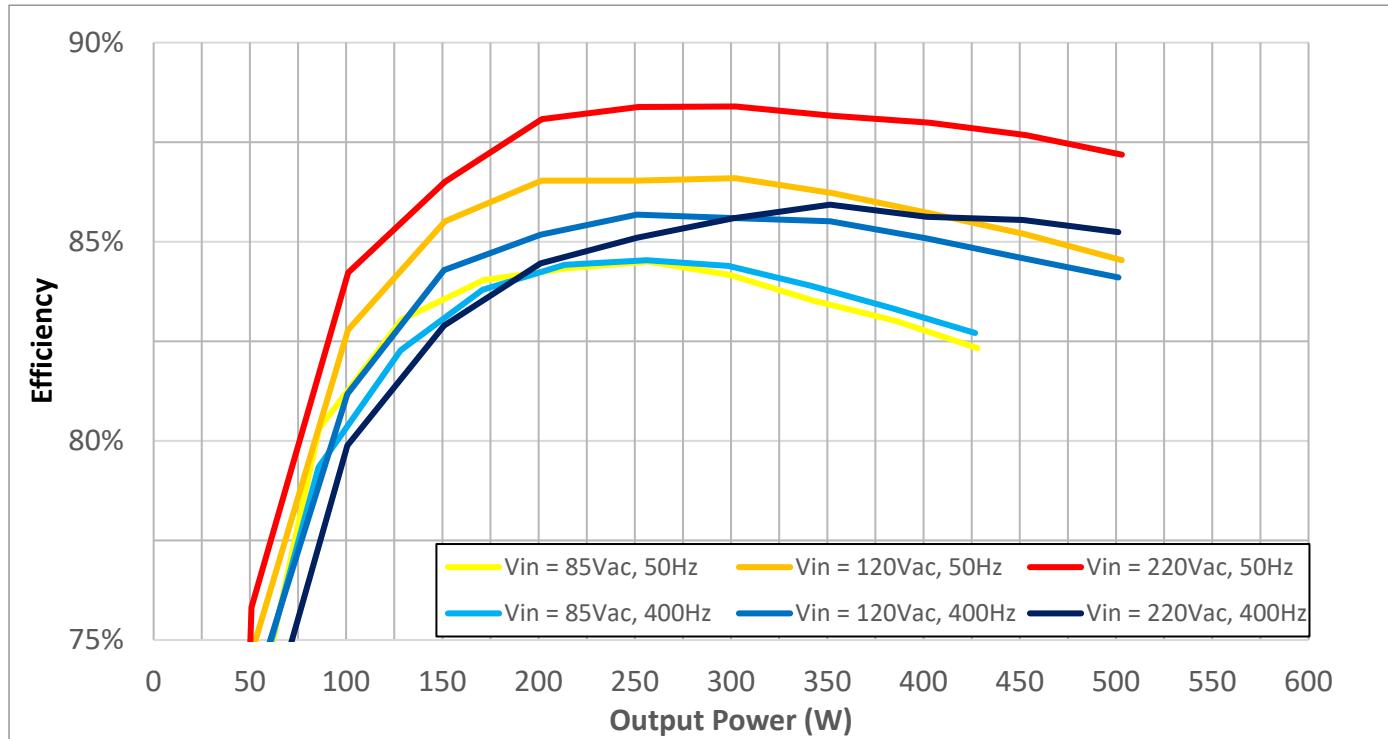
## Efficiency

The plots below compare typical efficiencies and power loss for 50Hz and 400Hz input voltages. The plots cover VCCM600 series power supplies configured for their maximum output power configurations and derated output power configurations. They include the full load range for 85V<sub>RMS</sub>, 120V<sub>RMS</sub> and 220V<sub>RMS</sub>. All modules are adjusted to nominal voltages and are equally loaded.

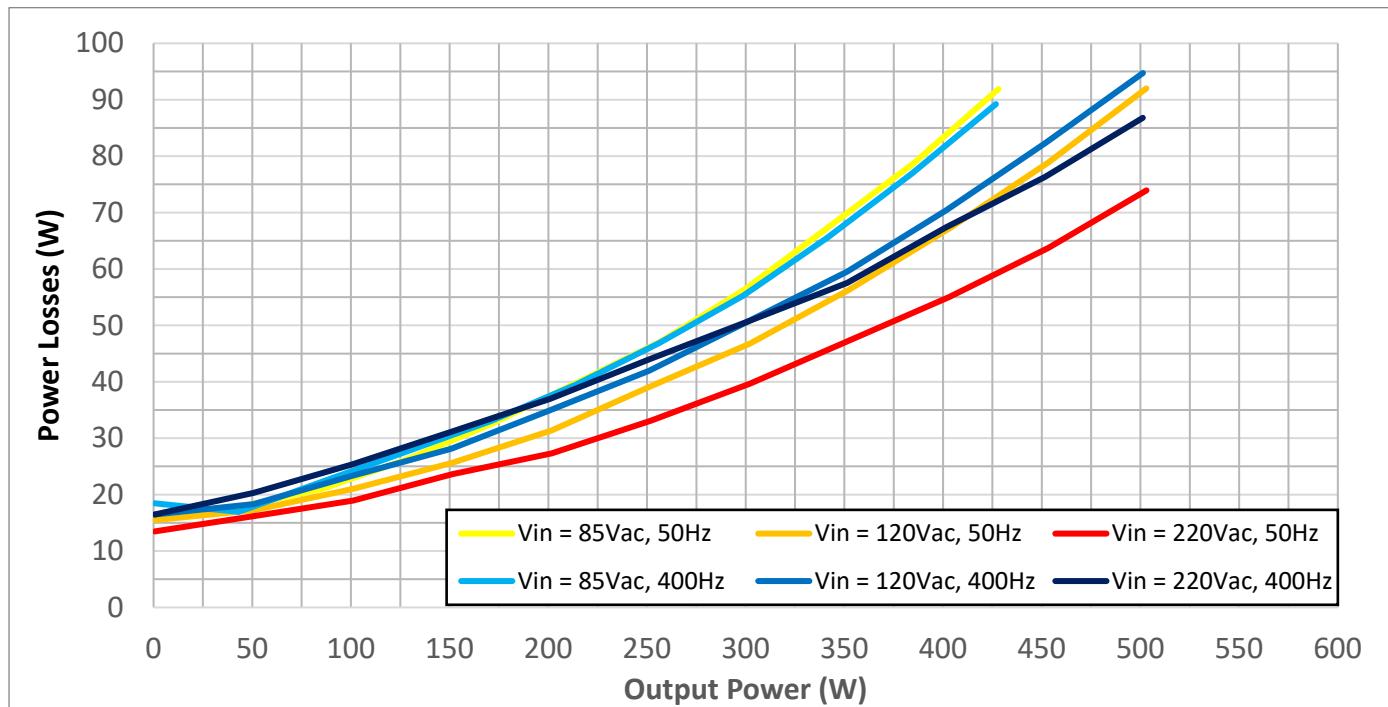
The list below shows the different configurations tested.

1. VCCM600-AAAA (Maximum power 500W)
2. VCCM600-BBBB (Maximum power 600W)

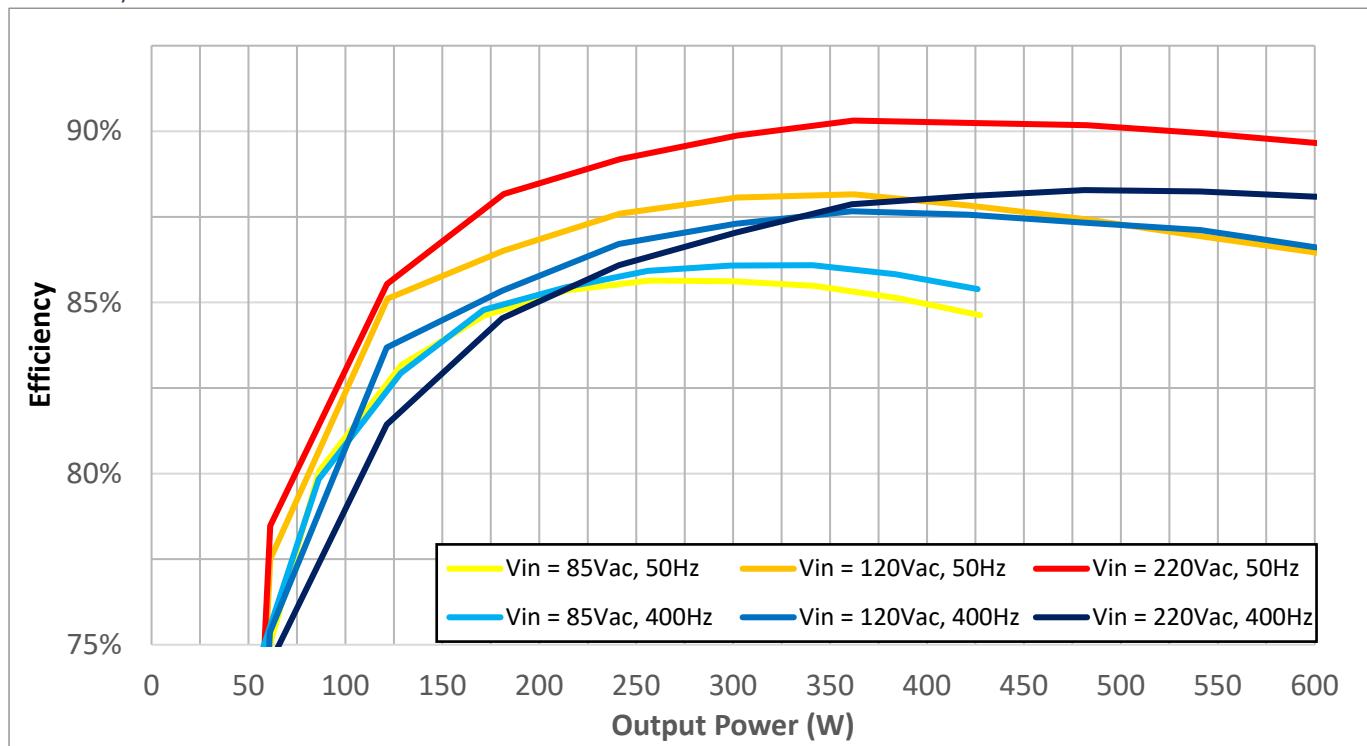
## Efficiency



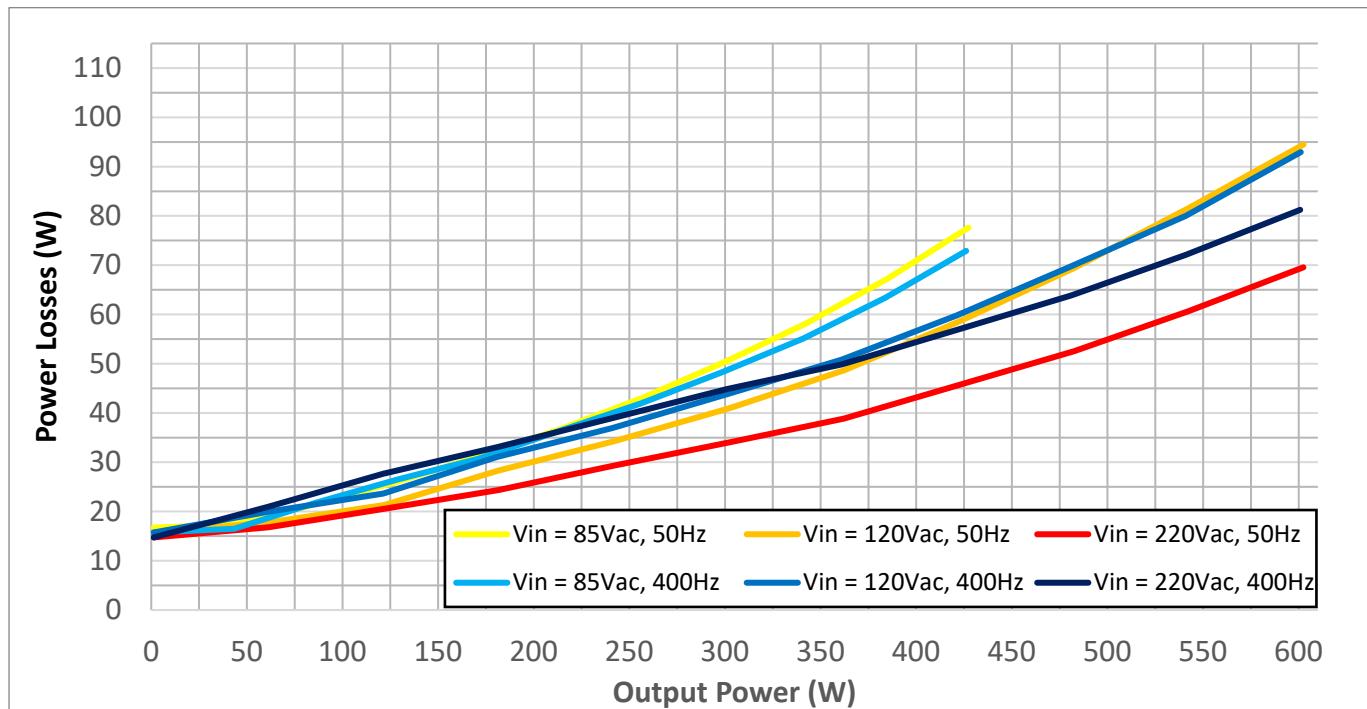
## Power Loss



## Efficiency



## Power Loss



# Power Factor

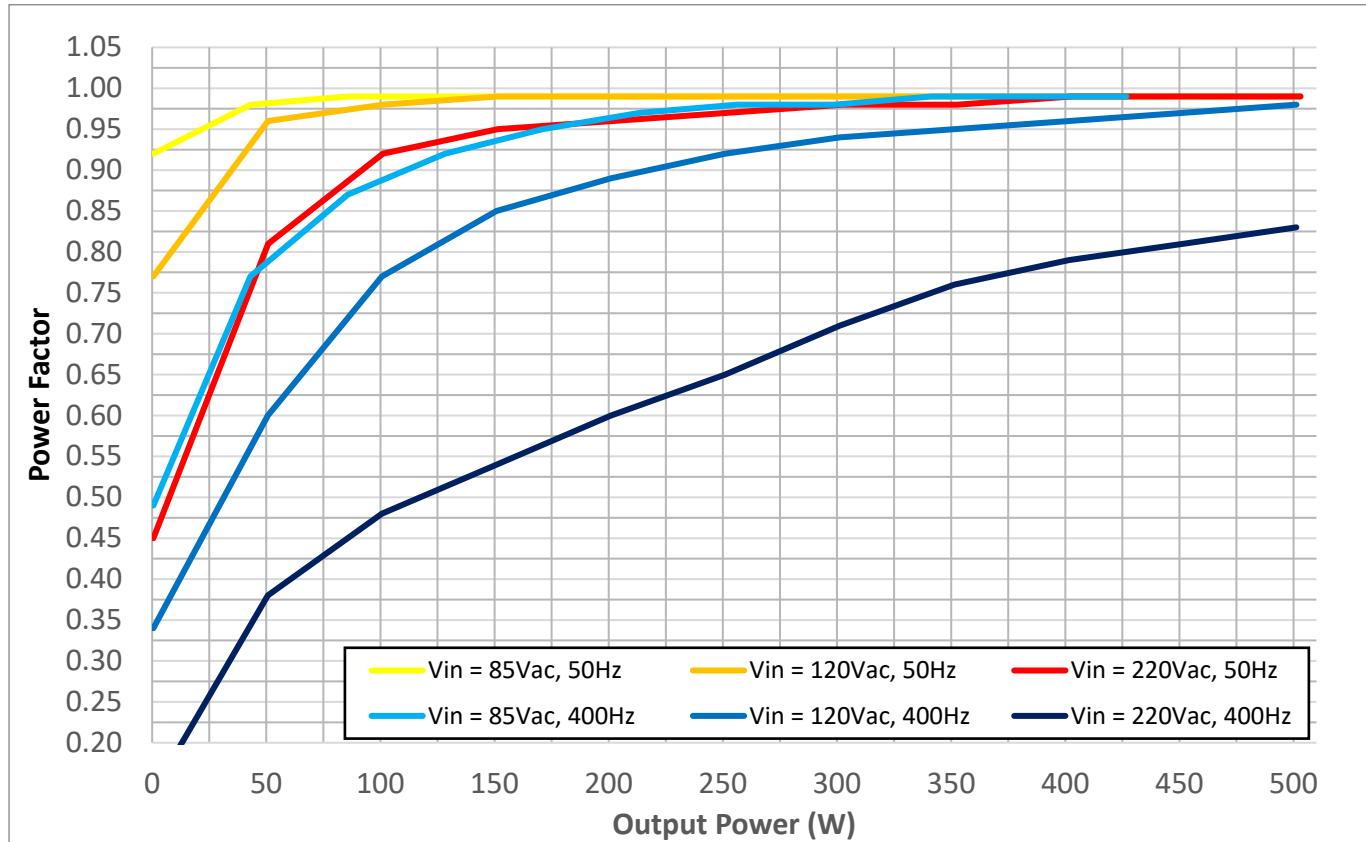
The plots below compare typical power factors for 50Hz and 400Hz input voltage frequencies. The plots cover the VCCM600 series power supplies configured for their maximum output power configurations and derated output power configurations. They include the full load range for 85V<sub>RMS</sub>, 120V<sub>RMS</sub> and 220V<sub>RMS</sub>. All modules are adjusted to nominal voltages and are equally loaded.

The list below shows the different configurations tested.

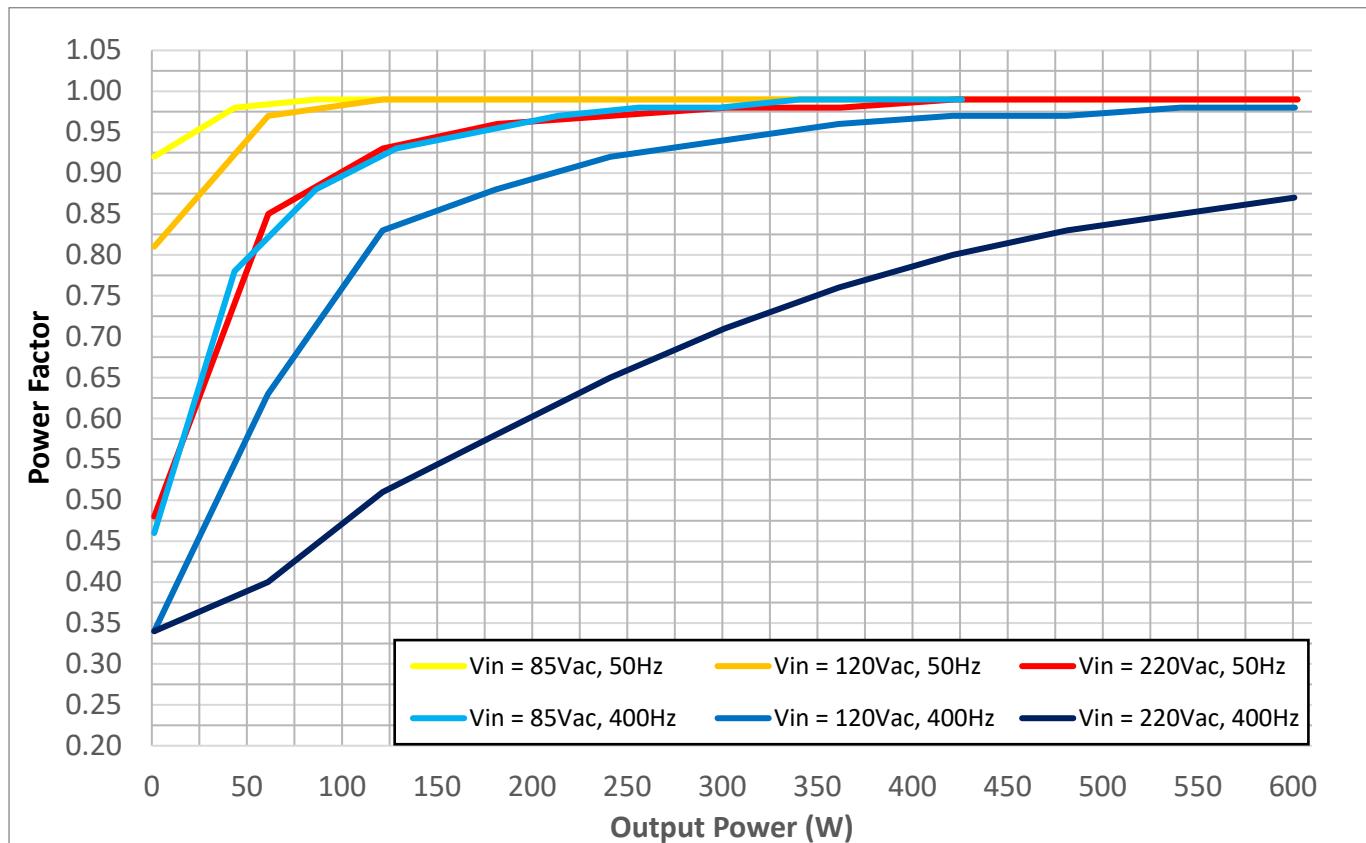
1. VCCM600-AAAA (Maximum power 500W)
2. VCCM600-BBBB (Maximum power 600W)

The input voltage and current waveforms were also measured and compared.

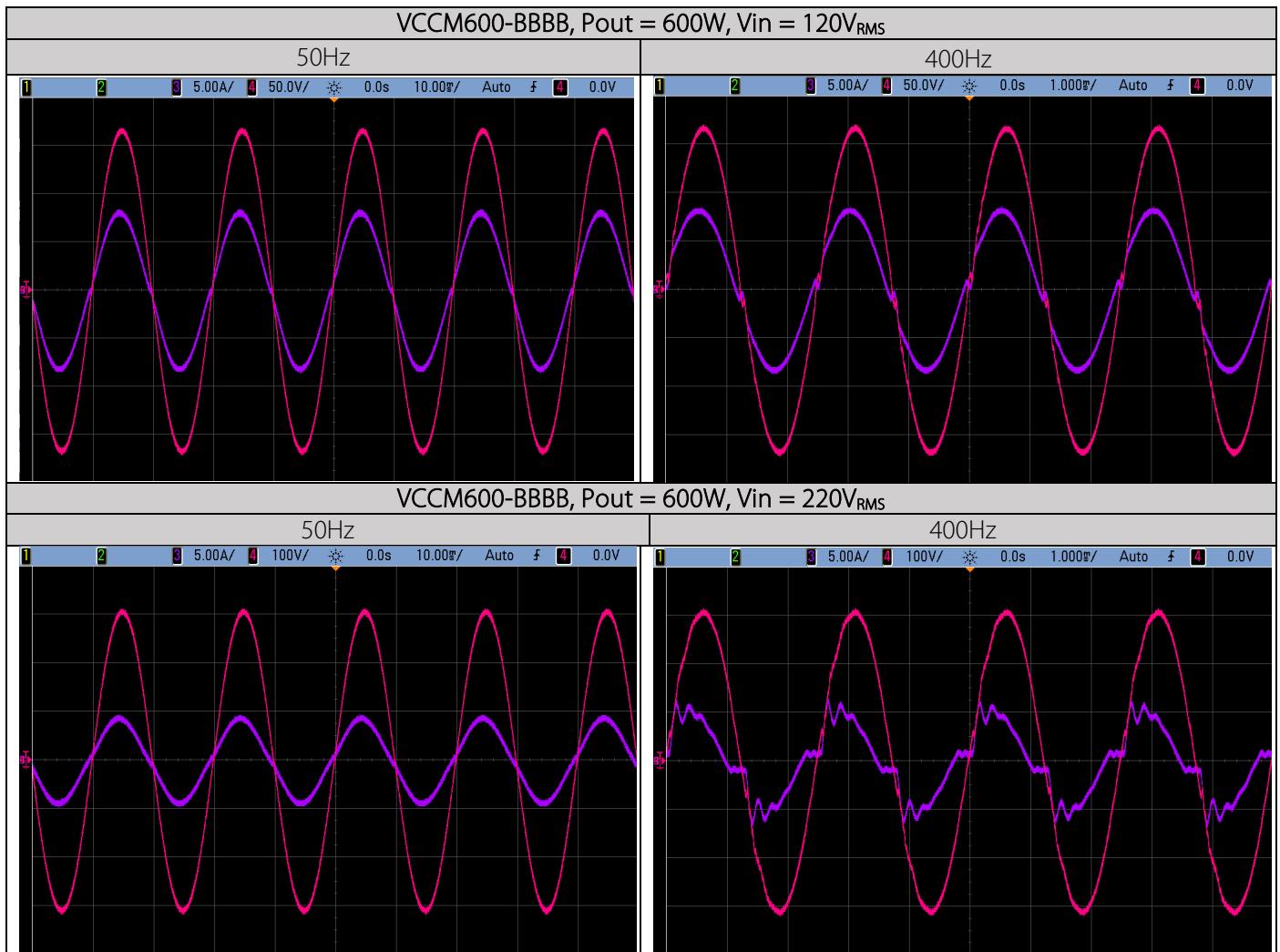
## VCCM600-AAAA Power Factor



## VCCM600-BBBB Power Factor



# Waveforms



# Other considerations

- Customer should be aware that input to earth leakage currents will increase in proportion to the input voltage frequency.
- The VCCM600 series has been tested to comply with MIL-STD-704F (Part 2) as shown below.

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) sinewave AM 80% 1kHz
Proximity fields from RF wireless communications equipment	IEC61000-4-3	Test levels as per IEC60601-1-2:2014 Table 9
Radiated susceptibility, electric field, 2 MHz to 40 GHz, Electrical Fast Transients/bursts	MIL-STD-461F: RS103 IEC61000-4-4	20V Test Level 3: (2kV Power, 1kV I/O) 5kHz(ed3) & 100kHz(ed4)
Conducted susceptibility, Bulk cable injection, impulse excitation	MIL-STD-461F: CS115	
Surges	IEC61000-4-5	Test Level 3: 1kV L-N, 2kV L-E
Conducted susceptibility, damped sinusoidal transients, cables and power leads, 10kHz-100MHz	MIL-STD-461F: CS116	
Shipboard Electric Power, Voltage Spike Test	MIL-STD-1399, SECTION 300A	Type 1, 115V 60Hz single phase
Conducted disturbances induced by RF fields	IEC61000-4-6	Test Level 3: 10V, 0.15 to 80MHz sinewave AM 80% 1kHz
Conducted susceptibility, power leads, 30Hz-150kHz	MIL-STD-461F: CS101	
Conducted susceptibility, Bulk cable injection, 10kHz-200MHz	MIL-STD-461F: CS114	
Power Frequency Magnetic Fields	IEC61000-4-8	Test level 4: 30A/m 50Hz
Radiated susceptibility, Magnetic field, 30Hz-100kHz	MIL-STD-461F: RS101	
Voltage Dips	IEC61000-4-11 <sup>(a)</sup>	0% 10ms, 0% 20ms, 70% 0.5s (Criterion A) 40% 200ms (Criterion A at 240V and Criterion C at 100V) 50% 200ms (Criterion A at 240V and Criterion C at 100V) Criterion A is achieved for full power when Vin >= 160V Criterion A is achieved at all input voltages when Pout <= 350W
Voltage Sag Immunity	SEM-F47-0706 <sup>(a)</sup>	0% 250/300 cycle as per IEC60601-1-2:2014 (Criterion C)
Voltage interruptions	IEC61000-4-11	
Aircraft Electric Power Characteristic	MIL-STD-704F	SAC102, 104, 105, 109, 110 (MIL-HDBK-704-2) & SKF102, 104, 105, 109, 110 (MIL-HDBK-704-6)

# Conclusions

1. The VCCM600 Series power supplies show a small decrease in efficiency when operated at 400Hz input voltage frequency. An additional 10% power derating is recommended.
2. The power factor can be severely reduced at 400Hz input voltage especially at high input voltages and low loads. The data provided in this document should be examined carefully when specifying the VCCM600 series in 400Hz systems.