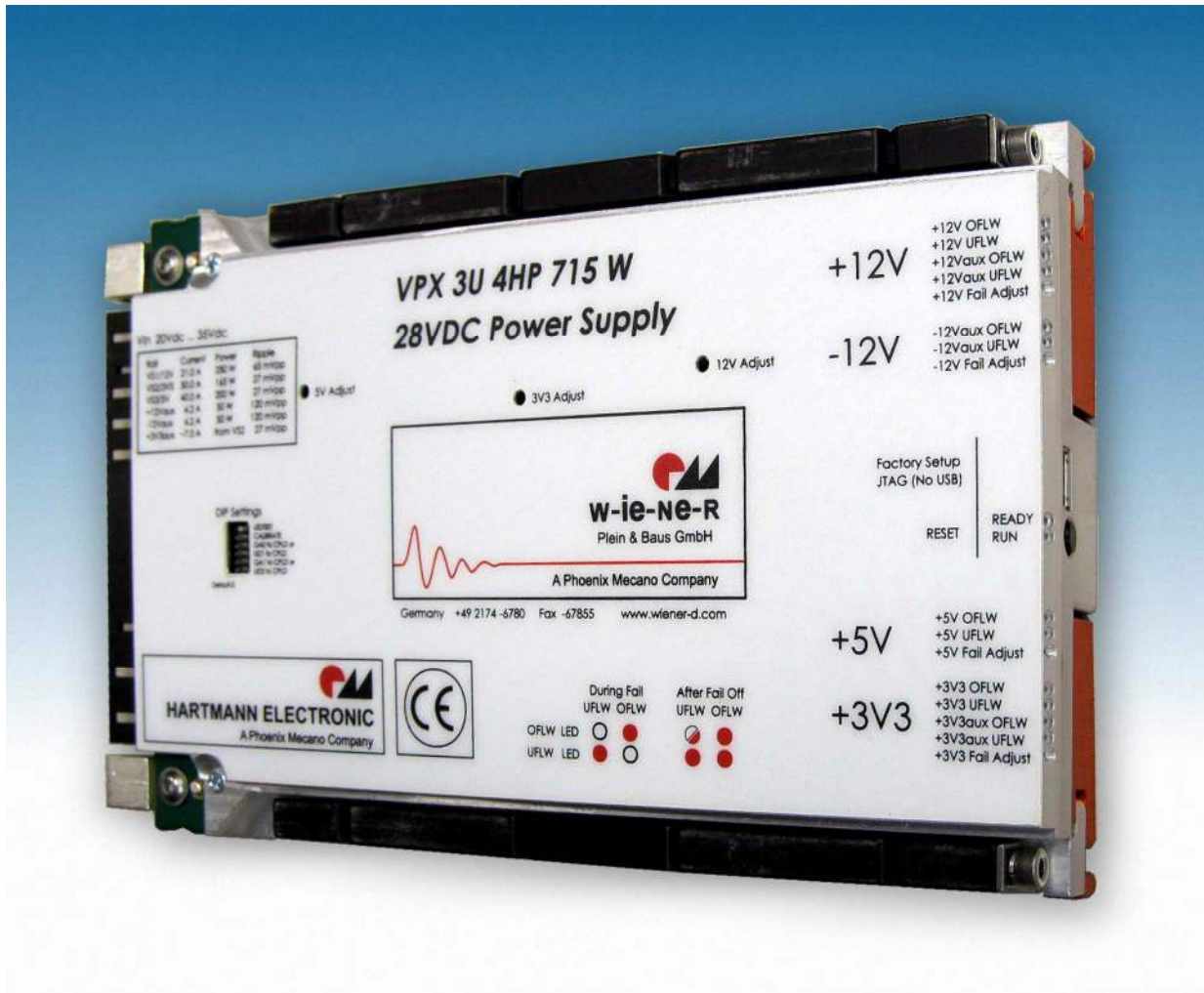


# W-IE-NE-R

## VPX3C Power Supply



## 3U 4HP 28 VDC Conduction Cooled 715 W VPX™ Power Supply

### User's Manual V2.1

## **General Remarks**

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The only purpose of this manual is a description of the product. It must not be interpreted as a declaration of conformity for this product including the product and software.

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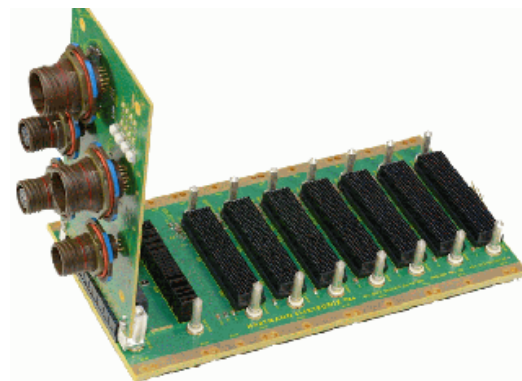
## 1 General Description

The **W-IE-NE-R VPX3C** is a high power density power supply in a 3U height 4HP width VPX form factor designed according to **VITA 62.0** VPX conduction cooled standard and largely to **VITA 46.0** VPX. It provides with 715W more than sufficient power to all main and auxiliary power rails deliverable by VPX at high efficiency and of low ripple and noise.

Efficiencies up to 93% are reached by using newest zero voltage switching (ZVS) technologies for the conduction cooled converters. Hence lower power losses can be more effectively distributed through the highly heat conductive aluminum case to the wedge locks to the outer ATR case. An integrated load sharing device allows for paralleling of two or more power supplies on customized VPX backplanes when even more power is needed.

Our Phoenix Mecano partner **HARTMANN Electronic** offers a wide range of air and conduction cooled U3 ATR chassis and backplanes for laboratory, test and also professional use for airborne equipment. Please refer to <http://www.hartmann-elektronik.de/> for more information.

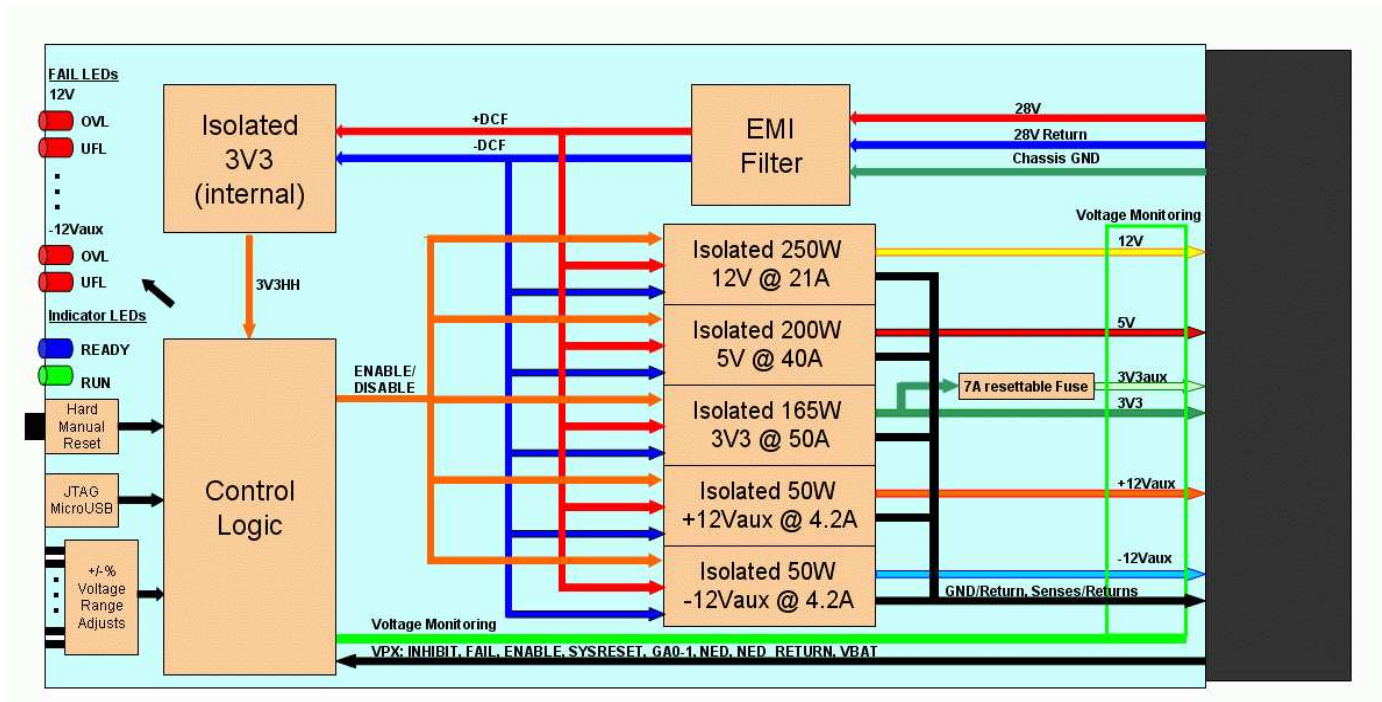
Additional input filters like the DSF500 from XPPower™ will allow to upgrade input protection to military levels MIL-STD 1275A-D, MIL-STD-461F, DEF-STAN 61-5 Pt 6.



## 2 Main Features

- 715W continuous wattage, low noise power supply acc. to **VITA 62/46** VPX specification
- 3U (half height) 4HP (slim size, 0.8" pitch) conduction cooled VPX form factor
- Zero Voltage Switching Converter Design with up to 93% efficiency @ 28V DC input
- VS1: 21A @ 12 V, VS2: 50A @ 3V3, VS3: 40A @ 5V
- AUX1: 7A @ 3V3 aux, AUX2: 4.2A @ +12Vaux, AUX3: 4.2A @ -12Vaux
- Industrial storage and operating temperatures
- Fully overall and individual power rail protections:
  - Over Temperature OVT
  - Over Voltage OVLW
  - Under Voltage UFLW
  - Over Current OC
- No input current protection, input overvoltage protection, input surge protection, reverse polarity protection – individual external protections needed acc. to the diverse applications

## 3 Functional Description



All voltage ZVS converters are isolated (1500V isolation voltage) and fed via a common Filter Network from the same 28V main supply (20V – 35V). 3V3aux is not independent but protected by a resettable fuse (PTC). All individual output voltages (6x) are sensed by window comparators for over- and under voltages which are monitored from a central control logic device (CPLD). Any failure on the output voltages are signaled on the front panel by corresponding FAIL LEDs and lead to a switch off of all voltages (by default). If all internals are normal the blue READY LED is working. Figure 1 shows gives an overview over the front panel elements.

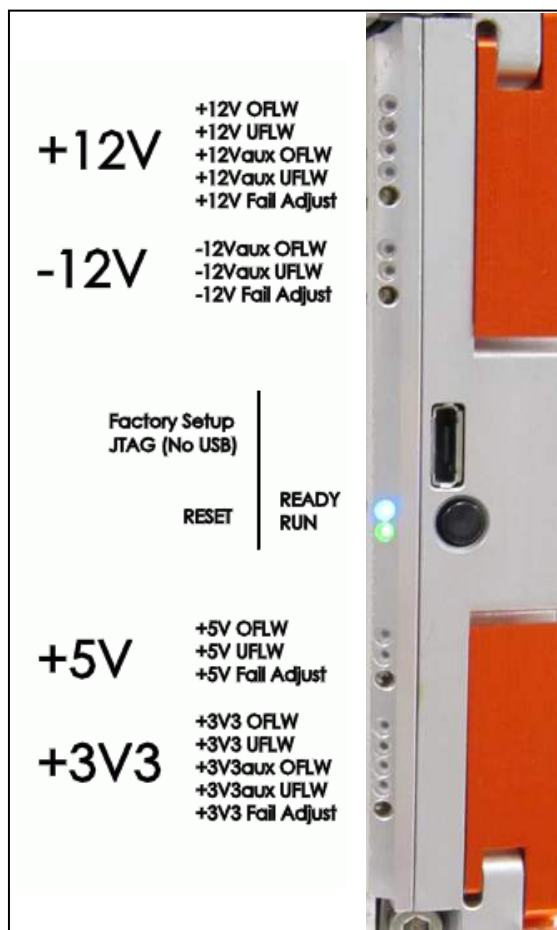


Figure 1: Front panel functional elements of the VPX3C Power Supply

### **Control Logic:**

Depending on the main bus signals also the green RUN LED goes on and the power supply tries to start working. According to VITA 62 and VITA 46 the logic *run line condition* is – when “#” is nomenclature for the negative logic main bus signals, logic negation is signaled by the “¬” sign, and a positive logic transition by “↑”:

$$\begin{aligned}
 \text{RUN} = & (\neg \#ENABLE \text{ AND } \#INHIBIT \text{ AND } \#FAIL \text{ AND } \neg\text{INTERNAL\_FAIL}) \\
 & \text{“REFRESHED AFTER FAIL WHEN”} \\
 & \uparrow (\neg \#SYSRESET \text{ OR } \neg \#RESET\_BUTTON \text{ OR } \text{POWER\_ON})
 \end{aligned}$$

This means that the if the global inhibit is not set (= released to H), whether no internal or external failure occurs (both are released to H) the power supply starts. After some kind of failure (internal or external) the power supply restarts by one of the following three conditions: A power cycle, a push onto the front panel button or a remote reset via the main bus system reset (#SYSRESET).

By default all voltages go down promptly if one of the run line conditions is not met.

When an internal failure occurs the delay or failure hold time to a complete switch off of the power supply is a half second to a second. This logic prevents any hardware from defects caused by unsymmetrical power faults (analogue operational circuits) or partial power faults (CPUs).

### Failure LEDs:

To know exactly the reason of the last failure two fail LEDs on the front panel for every voltage will indicate the origin. Window discriminators directly steer the upper or lower LEDs if over- or under voltage actually takes place (OFLW, UFLW). This actual state can be watched shortly before the failure hold time is reached and/or by flickers of the corresponding LEDs. If the failure origin lasts longer than the hold time the power supply shuts down.

After a shutdown all under voltage LEDs must go on showing that no power is online. Now it is easily possible to distinguish where an over- or under voltage failure occurred: A steady over-voltage LED at the corresponding power rail shows an over voltage problem, a blinking over-voltage LED an under-voltage problem. Largely under-voltage is caused by over current or over heat of the corresponding power rail. Figure 2 gives the list of failure interpretations.

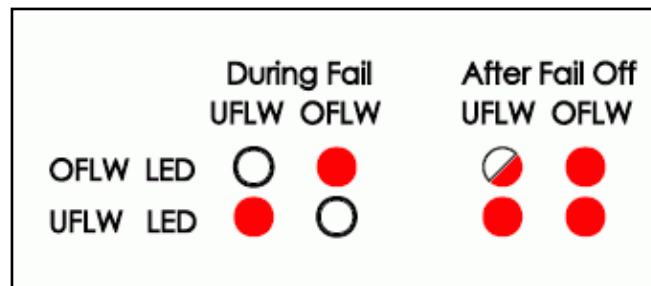


Figure 2: Failure LED failure origin interpretation

The +/- window range of the power rail is adjusted by factory to +/- 5..7 % and may be carefully readjusted by the named front panel trimmer elements (+/- 0%..50%).

After origin of failure has removed a reset restarts the module.

Figure 3 shows an example of a manual control PCB to easily operate and view all the VPX (open collector) backplane signals from our laboratory test rig from HARTMANN Electronic.

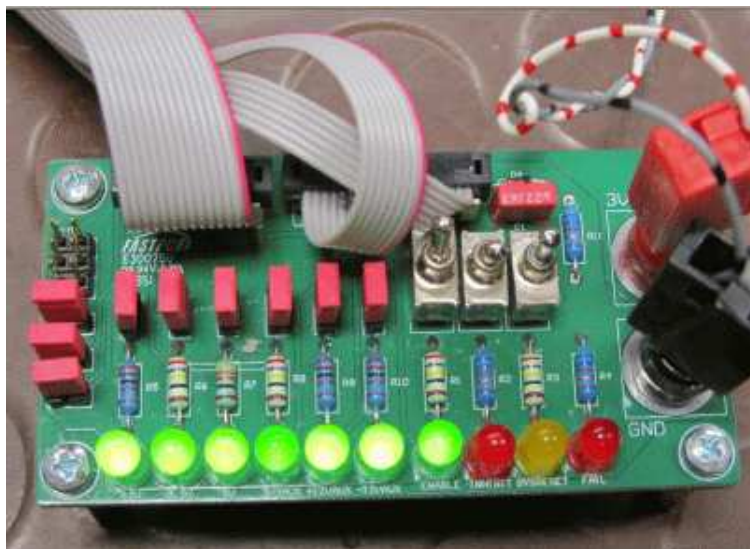


Figure 3: Example of a manually operated VPX bus controller

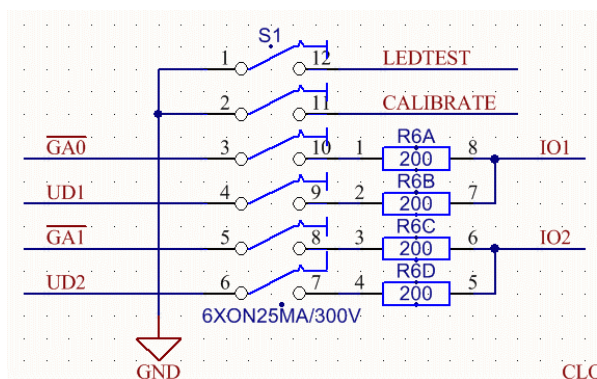
## JTAG Interface:

**No** USB communication interface!

The Control Logic is stored within the CPLD firmware and can be updated via the factory Micro USB JTAG firmware connector. Hence other custom configurations like another grouping for the power rails and failure shutdown conditions are principally possible.

## DIP Switch Features:

DIP Switch S1 is internally connected in the following way:



IO1 and IO2 go to the CPLD and can be selected exclusively to install connections to the main bus signals #GA0, UD1 or #GA1, UD2 for customization purposes (it should be avoided to switch both 3, 4 and both 5, 6 into the ON position). Switches 1 and 2 are thought for factory or functional test and should not be used else:

CALIBRATE	LEDTEST	FUNCTION
OFF	OFF	Normal Operation
OFF	ON	Test of LEDs - 1 Hz blinking
ON	OFF	Turn OFF all voltages for external calibration
ON	ON	Override Mode: Turn on all voltages what happens



## 4 Technical Specification

Form Factor	3U VPX CC
Pitch	4HP / 0.8 inch
Weight	0.6 kg / 1.23 Lbs / 21.2 oz.
Storage Temperature	-55°C to 105°C
Operating Temperature	-40°C to 85°C
Input to Output Insulation	1500V
Input to Output Isolation with Case	550V
Input to Case Ground Isolation	500V
Output to Case Ground Isolation	50V
Case Ground to Safety Ground Resistance	< 10 mΩ
<b>Main Power</b>	
Maximum Output Power	715W
Maximum Input Power	~760W
Maximum Dissipated Power @ max. Power	~45W
Minimum Turn ON Voltage:	20 V
Minimum Turn OFF Voltage	19 V
Hysteresis	1 V
Maximum Continuous Input Voltage	35 V
Maximum/Minimum Short Time Input Voltage (15 s)	36 V / - 0.5 V
Maximum Currents: 12V / 3V3 / 5V	21 A / 50 A / 40 A
Fixed Switching Frequencies: 12V / 3V3 / 5V	120 kHz / 125 kHz / 130 kHz
Peak Efficiencies: 12V / 3V3 / 5V	94% / 92% / 92%
Minimum Capacitive Loading: 12V / 3V3 / 5V	220 μF / 470 μF / 470 μF
Maximum Capacitive Loading: 12V / 3V3 / 5V	5 mF / 50 mF / 40 mF
Typical Output Ripple and Noise: 12V / 3V3 / 5V (0-20 MHz Bandwidth, 2-3x of min. capacitive loading)	15 mVrms / 4 mVrms / 4 mVrms 65 mVpp / 27 mVrms / 27 mVpp
Line Regulation: 12V / 3V3 / 5V	40 mV / 2 mV / 4 mV
Vin=Vin,min to Vin,max, Io and Tc fixed	< 0.1%
Load Regulation: 12V / 3V3 / 5V	70 mV / 2 mV / 4 mV
Vin=Vin,nom, Io=Io,min to Io,max, Tc fixed	< 0.1%
Controlled Overvoltage Protection: +/-12V / 3V3 / 5V	+ 0 %..+ 50 % variable by trimmer + 5..7 % per factory setup
Uncontrolled	14.4 V / 4.1 V / 6.1 V (hardware)
Controlled Undervoltage Protection: +/-12V / 3V3 / 5V	- 0 %..- 50 % variable by trimmer - 5..7 % per factory setup
Temperature Protection Sensing Point (identical to case)	85°C (Latching)
Maximum Internal Working Temperatures	125°C
<b>Auxiliary +/-12V Power</b>	
Maximum Current	4.2 A
Fixed Switching Frequency	900 kHz
Peak Efficiency	88%
Min./Max. Capacitive Loading	100 μF / 4700 μF
Typ. Output Ripple and Noise (0-20 MHz Bandwidth, 220μF load)	120 mVpp / 30 mVrms
Load Transient Recovery Time	100 μs

### Control Logic

Failure hold time

0.5..1 s\*

Full\* Shutdown

OVC, OVT, OFLW, UFLW

### Timing

Minimum Hold up Time (at max. Power)

~ 1 ms

Minimum Input Voltage start up rise time

> 50 V/s

Output Voltage rise time: 12 V / 3V3 / 5V / 12Vaux

38 V/s, 30 V/s, 27 V/s, 30 V/s (exponential)

Startup Delay time: 12 V / 3V3 / 5V / +/- 12Vaux

30 ms, 28 ms, 30 ms, 80 ms

Inrush Transient

0.07 A²s || 3,3 mF external capacitance

Inrush Current at 500V/s Voltage Rise Time

< 2 A

\*by default firmware

### Compatibility

UL 60950 (US and Canada)

VDE 0805

IEC 950

CE Mark (EN60950)

## 5 Switch-On Behavior

All voltage outputs are switched on exponentially with relatively slow rise times of 30-80 ms and do settle smooth to the final voltage without any overshoot or glitch, see fig. 3 e.g.

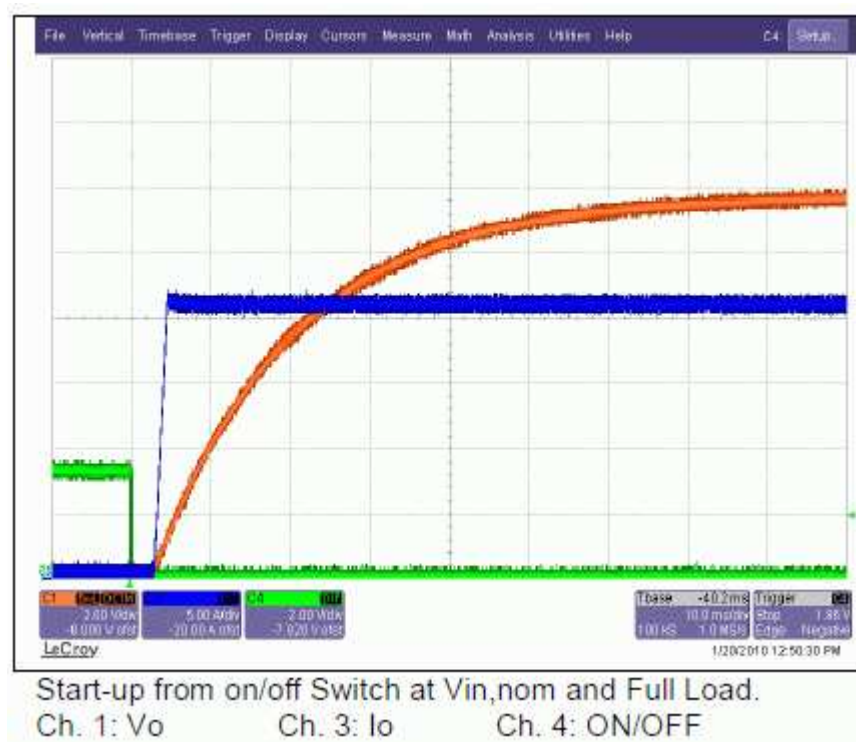


Figure 3: Startup Delay and Exponential Rise (orange) of  $V_{S1} = 12V$  Output Voltage

The **W-IE-NE-R VPX3C** power supply has to be switched on by a source of a minimum ramp up speed of the 28V source voltage of  $> 50 \text{ V/s}$  or a maximum ramp up time  $< \sim 500 \text{ ms}$ . If the ramp up time is longer than half a second the control logic may stall during switch on.

If sourced by a laboratory power supply with manual hand wheels this short ramp up time may not be safely guaranteed. In this case if possible invoke the enable/disable function of the laboratory power supply. Instead use a high current manual switch or plug to short the just established 28V with the power supply.

## 6 Derating Curves

At time of writing no conduction cooled performance curves exist which would describe the thermal performance independent of the final implementation indifferent of the kind of ATR chassis chosen.

Alternatively as orientation the derating of power plays a role for case temperatures above  $60^\circ\text{C}$  which can be derived as rule of thumb from the air-conditioned data of the individual converters. Figure 4 gives an example for the VS1 12V main voltage.

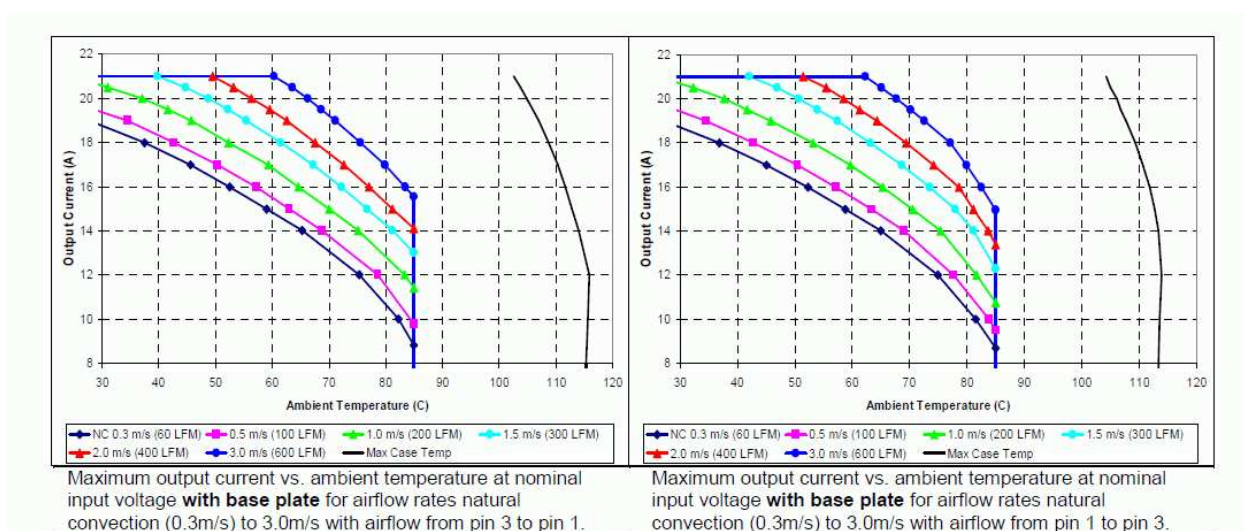


Figure 4: *Derating curves dependent on the airflow speed and direction by example for the 12V VS1 main voltage*

Laboratory tests resulted in a good thermal performance with temperature settling times about much more than 10 minutes and possible safe annealing temperatures at  $65^\circ\text{C}$  for maximum power and power losses. For e.g. only 500W of input power consumption the heat has been found to be easily dissipated also for non-optimal setups.