TDK·Lambda

XMS500 & XMS500A

AC/DC Power Supply Series

APPLICATION NOTE

Contents

1. INPUT

AC INPUT LINE REQUIREMENTS

See datasheet for specification of input line requirements (including Input voltage range, Input frequency, Input harmonics, Input current and leakage current)

The power supply will automatically recover from AC power loss and is capable of start-up with maximum loading at an input of 85VAC.

Repetitive ON/OFF cycling of the AC input voltage will not damage the power supply or cause the input fuse to blow.

- Input Fuses

Two internal fuses are fitted, one in each AC line. These fuses are not user serviceable. Fuses are rated F10AH; 250Vac. An option with a single input fuse located on the live line is available, please contact technical sales for assistance.

- Input Undervoltage

The power supply is protected against the application of an input voltage below the minimum specified so that it shall not cause damage to the power supply.

The typical turn on voltage is 80VAC, typical turn off voltage is 65VAC. (Full load, 25°C ambient)

2. DC OUTPUT

OUTPUT VOLTAGE ADJUSTMENT

Consult technical sales for Voltage Adjustment (Factory Set)

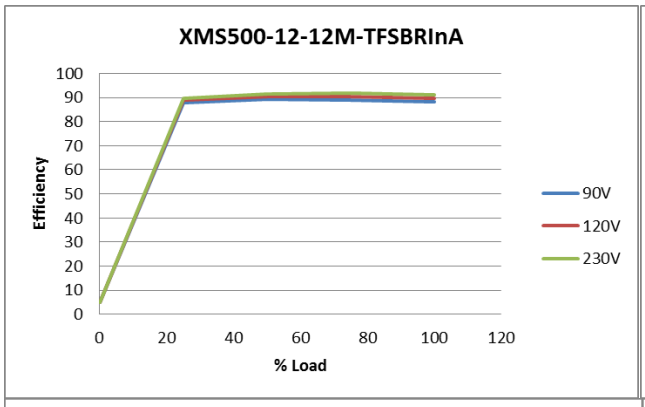
Model	Nominal Output Voltage	Adjustment Range
XMS500-12	12V	11.6 to 13.2V
XMS500A-12	12V	11.6 to 13.2V
XMS500-24	24V	23.8 to 25.2V
XMS500A-24	24V	23.8 to 25.2V
XMS500-36	36V	35.4 to 37.8V
XMS500A-36	36V	35.4 to 37.8V
XMS500-48	48V	47.0 to 50.0V
XMS500A-48	48V	47.0 to 50.0V

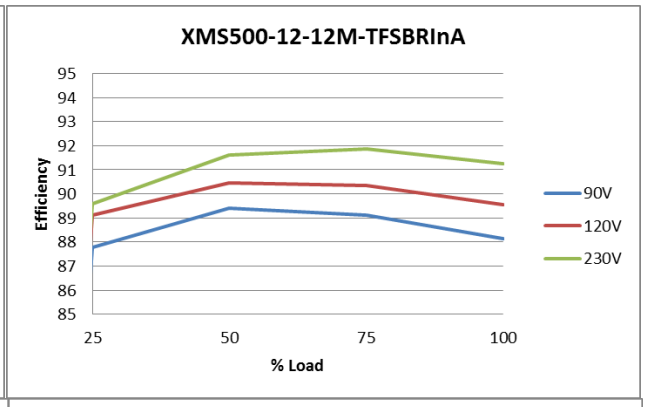
REMOTE SENSE

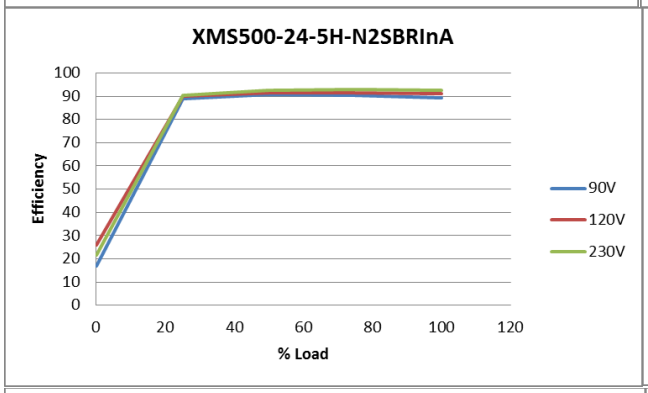
No remote sense connection is available

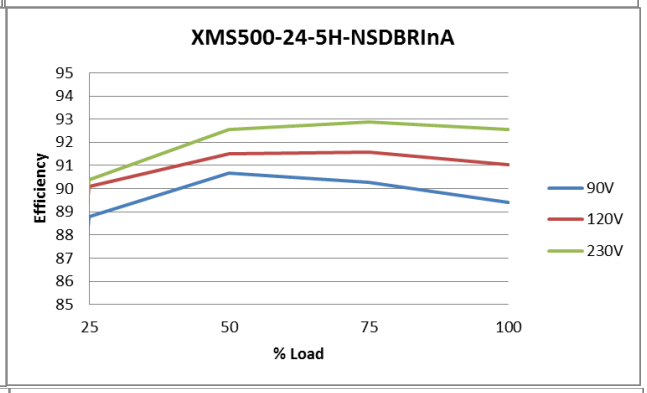
EFFICIENCY

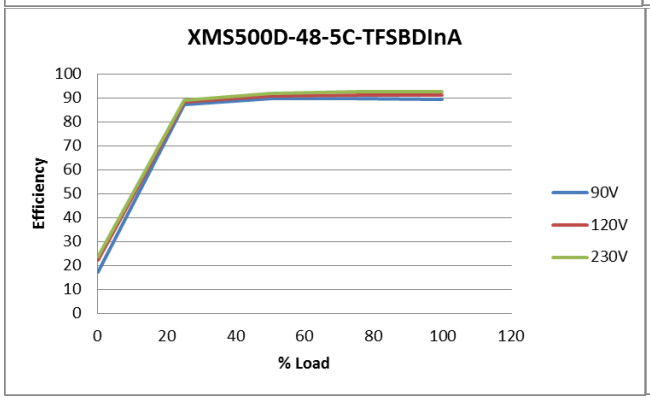
The following charts show the typical efficiency of the XMS500 & XMS500A ranges.

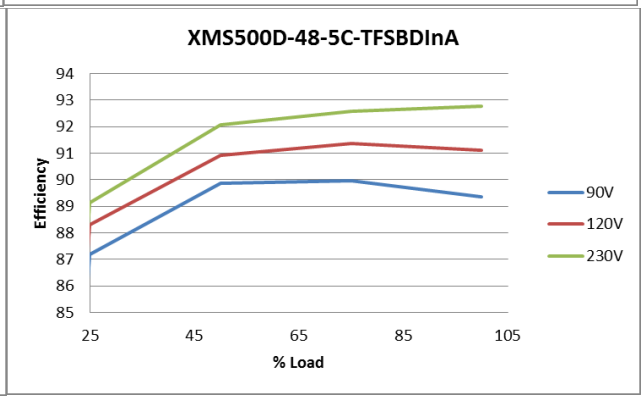












NO LOAD OPERATION

No minimum load is required for the power supply to operate within specification.

CAPACITIVE LOAD OPERATION

The maximum capacitance that can be connected to the output is as follows:

Model Number	XMS500-12	XMS500-24	XMS500-36	XMS500-48
Maximum Capacitance (µF)	40,000	16,000	5,700	4,100

SERIES CONNECTION

It is possible to connect multiple XMS500/XMS500A power supplies in series. Do not exceed 150V for the total voltage of outputs connected in series.

Each unit should have a diode fitted across the output and rated for the output current of the XMS500.

The outputs connected in series are non-SELV (Safety Extra Low Voltage) if the total output voltage plus 30% of the highest maximum rated output voltage, exceeds 60V (the 30% addition allows for a single fault in any one individual channel).

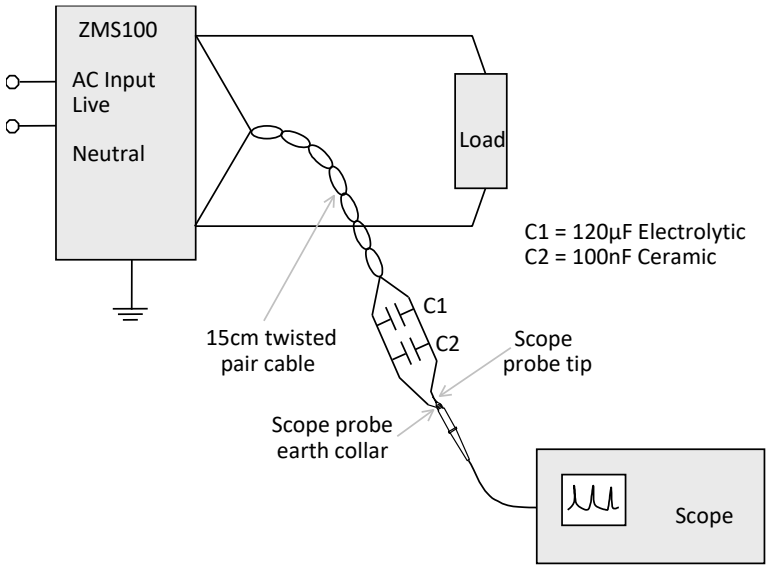
PARALLEL CONNECTION

Outputs must not be connected in parallel as this may cause overheating and reduced field life.

OUTPUT CHARACTERISTICS

RIPPLE AND NOISE

Ripple and noise is defined as periodic or random signals over a frequency range of 10Hz to 20MHz. Measurements are to be made with a 20MHz bandwidth oscilloscope. Measurements are taken at the end of a 150mm length of a twisted pair of cables, terminated with a 100nF ceramic capacitor and a 120µF electrolytic capacitor. The earth wire of the oscilloscope probe should be as short as possible; winding a link wire around the earth collar of the probe is the preferred method.



Ripple and Noise Measurement

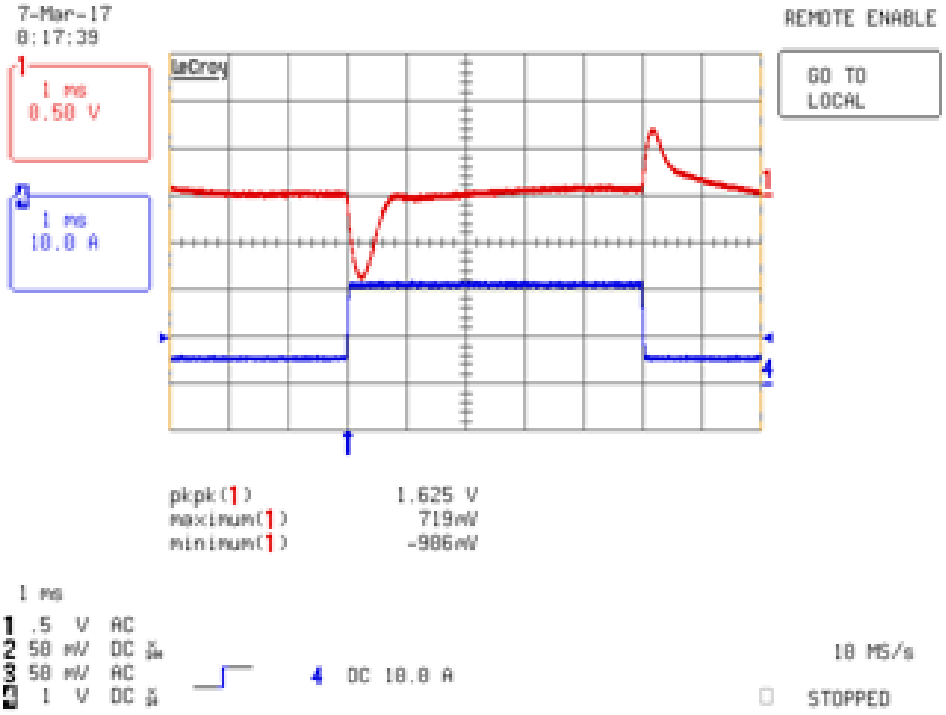
TRANSIENT RESPONSE PERFORMANCE

The transient response specification refers to a 25% - 100%, 100Hz repetition rate, 50% duty cycle at >/=25°C ambient temperature

Dynamic Load Response

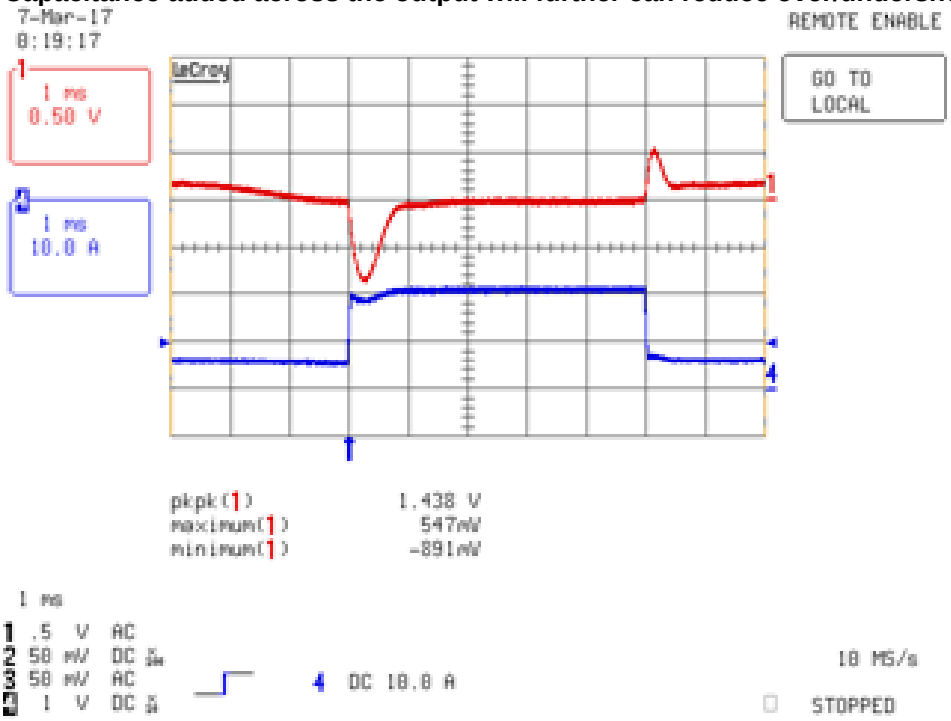
For a 75%, 25% - 100%, load change the output voltage will remain within 5% of the nominal output voltage. The output will recover to within 2% of the nominal output voltage in ≤ 1ms for a 25% - 100% load change.

XMS500-12 model



25% to 100% load change; 264Vac input

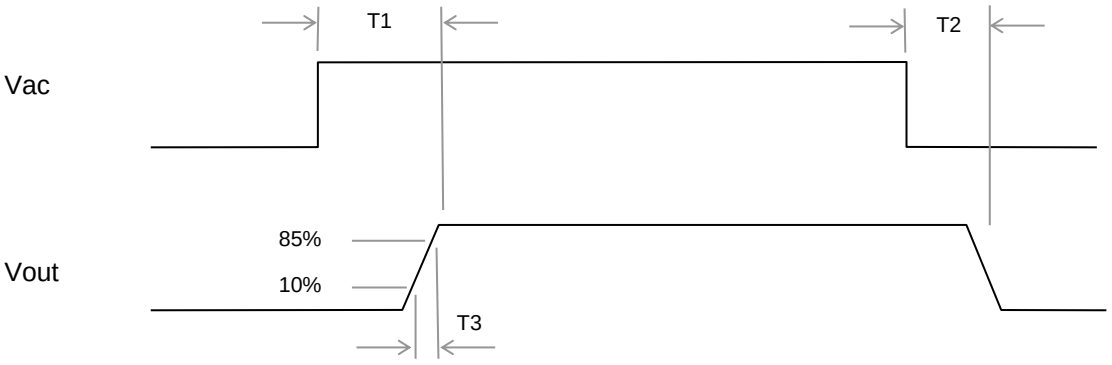
Capacitance added across the output will further can reduce over/undershoot as shown below



25% to 100% load change with 22,000uF capacitance; 264Vac Input

POWER SUPPLY TIMING

Output timing diagram



	min	Typical	max	Description
T1			1 Sec	Turn on time
T2 (XMS500A Range)	20ms			Hold up time
T2 (XMS500 Range)	16ms			
T3			100ms	Rise time

SIGNALS

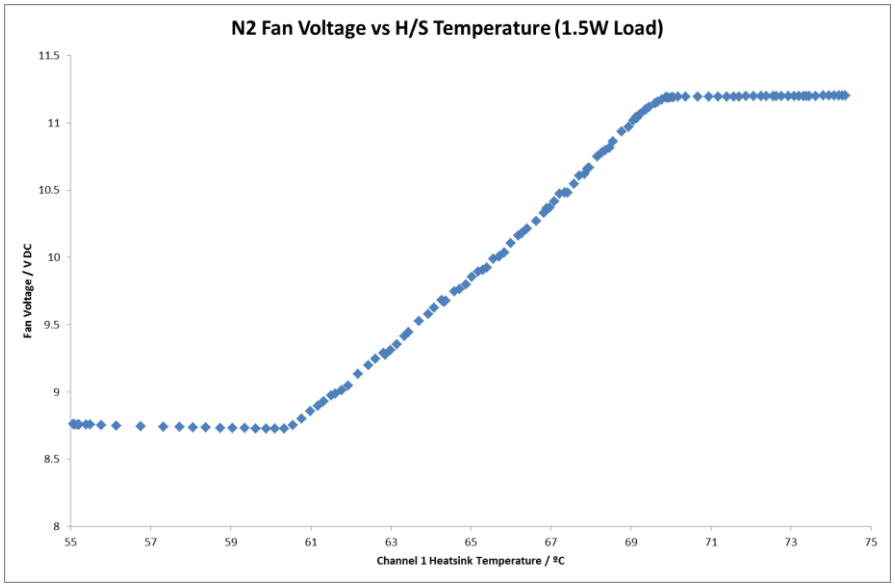
STANDBY SUPPLY

Do not connect if Standby type “NN” (none) is fitted.
An output that has its negative output connected to that of the main output channel. The standby is not affected by the remote on/off.
5V / 0.5A, 5V / 2A and 12V / 1A versions are available.

FAN SUPPLY

- No connection available if Fan Supply type “N” is fitted.
- Fan Supply type “TF” is not user accessible. Top Fan provides fixed speed fan operation.
- Fan Supply type “N2” provides a variable output. As the temperature of PSU increases/decreases, the Fan Supply output voltage increases/decreases across a range of 7V to 11.5V. Variation depends on load on Channel 1 and ambient temperature. The temperature sensor is mounted on top of the channel 1 output heatsink.
- Fan Supply type “N3” provides a fixed 12V.

The maximum output current of an N2 or N3 Fan Supply is 250mA on a unit with a 12V main output, and 150mA otherwise.



AC FAIL / POWER GOOD SIGNAL OPTIONS

It is highly recommended to use the XMS500A range if an AC Fail or ATX Power Good Option is desired.
Do not connect if AC Fail type “N” (none) is fitted.
The following options are available.

- XMS500A AC Fail. The AC Fail signal goes high to indicate that the line input voltage is bad. When the input AC is disconnected, the AC Fail signal will go high at least 12ms before the Ch1 output collapses. A `Critical Warning' version that will not go high during a 100-70Vrms 5ms line dip but still provides an AC Fail warning time of at least 1ms is available (consult technical sales). Logic low is less than 0.4V. Logic high is between 80-100% of the output voltage of the standby. This signal can source up to 200uA and sink up to 4mA.
- XMS500A ATX Power Good. A signal which meets the `ATX/ATX12V Power Supply Design Guide' for a `PWR_OK' signal. The ATX Power Good signal goes high to indicate that, for the whole of the last 200ms (typical), the line input has remained good, the Ch1 output has been enabled and the Ch1 output voltage has been at a good level. When the AC input is disconnected, this signal will go low at least 12ms before the Ch1 output voltage collapses. A `Critical Warning' version that will not go low during a 100-70Vrms 5ms line dip but still provides an AC Fail warning time of at least 1ms is available (consult technical sales). Logic low is less than 0.4V. Logic high is between 80-100% of the output voltage of the standby. This signal can source up to 200uA and sink up to 4mA.
- XMS500 AC Fail. The AC fail signal is internally pulled up to the standby supply. When AC power is removed the AC Fail Signal will go to a logic high state, no advance timing of AC fail.

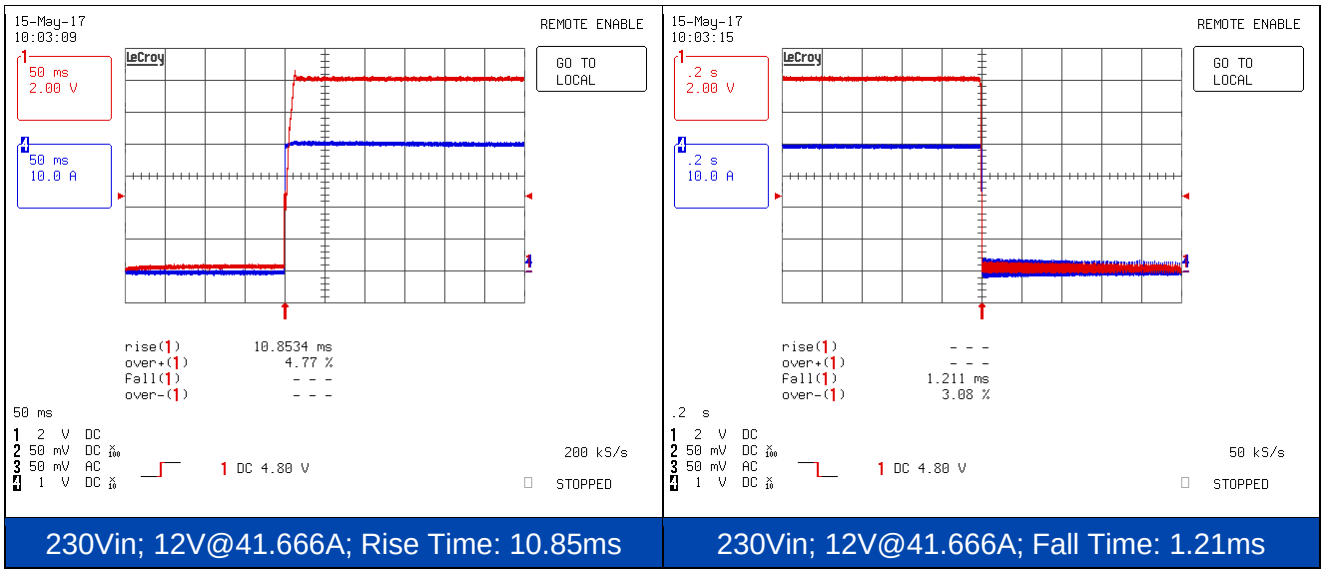
REMOTE ON/OFF

Control is fitted with an internal pull down resistor to - Vout (0V).
Enable option: Connect to Standby+ to enable Channel 1, open circuit or 0V to inhibit
Inhibit option: Connect to Standby+ to inhibit Channel 1, open circuit or 0V to enable

OVERSHOOT AT TURN ON/OFF

The output voltage overshoot upon the application or removal of the input mains voltage shall be less than 5% (typically <1%) above the nominal voltage. No opposite polarity voltage is present at any time.

The typical turn on/off characteristics for the XMS500-12 unit is shown below.



230Vin; 12V@41.666A; Rise Time: 10.85ms | 230Vin; 12V@41.666A; Fall Time: 1.21ms

Channel 1 Rise and fall time and overshoot

OUTPUT PROTECTION

No Load Operation

The power supply will operate with no load on the output with no damage, hazardous condition or reduction in performance.

Over current protection

If a load is applied which puts the power supply into over current then the power supply will enter a hiccup state. This will turn the output off for typically 1 second, then on for typically 50ms. This state will continue until the over load is removed.

Short-Circuit Protection

A short circuit is defined as an impedance of <0.1 Ohms placed between the DC return and any output. A short circuit on the output will cause no damage to the power supply and will cause it to shutdown. The power supply will attempt to restart until the short circuit is removed. After removal of the short circuit, the power supply will maintain normal operation.

Over temperature protection

If the power supply is operated without adequate cooling it will result in an over temperature condition and the power supply will shutdown and latch off. To correct this, improve the cooling of the power supply. To restart, remove AC supply for 10 seconds and then reapply.

Over voltage protection

An overvoltage on the output will cause the power supply to shut-down. To restart, remove the ac supply for at least 10 seconds and then reapply.

COOLING REQUIREMENTS

Convection Cooling

The XMS500/XMS500A is suitable for use in certain convection applications. Its suitability depends on many factors including the load profile and ambient temperature. Please contact technical sales for assistance.

Output Derating for High Ambient Temperature Operation

Above 50°C ambient, the output power (and output current) of the Ch1 output and the standby output must be de-rated by 2.5%/°C up to 50% at 70°C.

Fan Noise

The fan noise figures detailed below are for Top Fan type units. 12V, 36V and 48V units use a different fan from 24V units. The sound measurements were made in accordance with ISO 3744

12V, 36V and 48V Channel 1 Top Fan Versions

Lp(B)	29.06	
L'p(ST)	30.97	
K1	4.49	
K2	1.19	
Lp	**25.30** dB	Surface Time Averaged Sound Pressure level
Lw	33.28 dB	Sound Power level
V*Ir	1.45 dB	Apparent surface sound pressure level non-uniformity index

24V Channel 1 Top Fan type

Lp(B)	28.05	
L'p(ST)	33.73	
K1	1.37	
K2	1.19	
Lp	**31.17** dB	Surface Time Averaged Sound Pressure level
Lw	39.15 dB	Sound Power level
V*Ir	0.88 dB	Apparent surface sound pressure level non-uniformity index

3. RELIABILITY

Mean Time between Failures Calculation

Calculated according to Telcordia SR332 Issue 2, Method I, Case 3, Ground Benign Controlled, at 510W, 230Vac and 35°C

510W forced air cooled – 476,339 hours

Electrolytic Capacitor Lifetime

XMS500

U-Chassis variant - Wind tunnel – Ducted - Electrolytic capacitor lifetime (Hours)				
		Main output voltage variant		
Ref	Description	12V	24V	48V
C4	Main Output Capacitor	520049 / 520049	595800 / 893700	763557 /
C15	Main Output Capacitor	557684 / 557684	657759 / 986639	766363
C9	Boost Capacitor	602001 / -		
C13	Boost Capacitor	376028 / 378380		
		Auxiliary output voltage variant		
		5H	5C	12M
C17	AUX_SEC Decoupling Cap	215959 / 215959	139604 / -	NF
C19	Aux Output Capacitor	112315 / 70635	184103 / -	596087 / 198696
C20	Aux Output Capacitor	129714 / 88788	261864 / -	683712 / 227904
C16	VCC Decoupling Capacitor	66023 / -	65535 / -	65850 /-
C5	+V Decoupling Capacitor	240948 / 240652	235582 / 235003	234525 / 233891
Top Fan variant - Thermal chamber - Electrolytic capacitor lifetime (Hours)				
		Main output voltage variant		
Ref	Description	12V	24V	48V
C4	Main Output Capacitor	387890 / 387890	534737 / 802105	565974 / 454120
C15	Main Output Capacitor	474842 / 474842	604842 / 907264	636441 / 511296
C9	Boost Capacitor	382581 / -		
C13	Boost Capacitor	437669 / 440407		
		Auxiliary output voltage variant		
		5H	5C	12M
C17	AUX_SEC Decoupling Cap	216709 / 216709	140088 / -	NF
C19	Aux Output Capacitor	111771 / 70293	183212 / -	593201 / 197734
C20	Aux Output Capacitor	107574 / 73634	217169 / -	567015 / 189005
C16	VCC Decoupling Capacitor	135009 /-	134010 / -	134654 / -
C5	+V Decoupling Capacitor	245160 / 244859	239700 / 239110	238625 / 237979

XMS500A

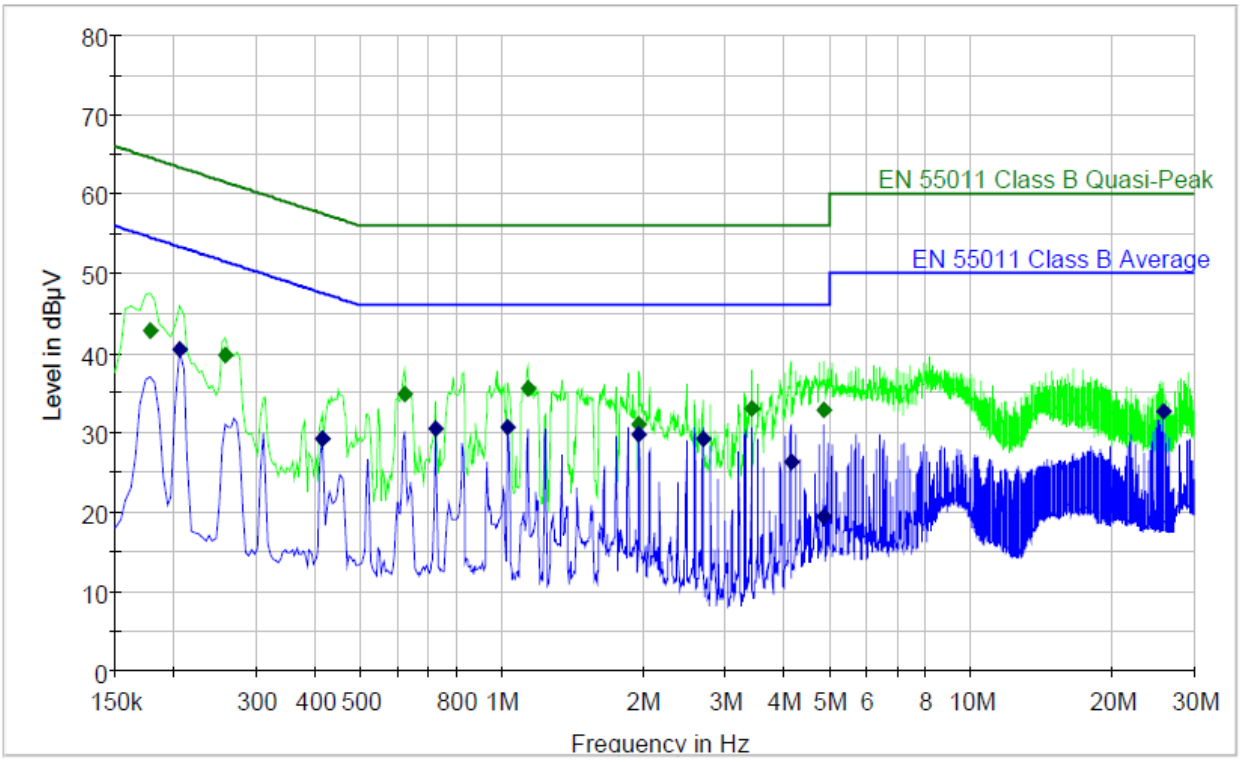
Results for 40°C ambient, 100Vrms line input & 75% Load.

Main Output Voltage Variant Capacitors C4/C15/C9/C13 have the same Lifetime as on the XMS500. The Auxiliary Capacitors have the following life:

Capacitor		Life for Standby Variant (Hours)			
Ref	**Description**	**5H**	**5C**	**12M**	**NN**
C5	Internal Auxiliary	159824 / 155639	159824 / 155639	160505 / 156794	160505 / 156794
C17	Internal Auxiliary	269811	269811	Not Fitted	Not Fitted
C19	Standby Output	717844 / 610781	717844 / 493755	1794610 / 472704	Not Fitted
C20	Standby Output	597077 / 609922	597077 / 462923	1492691 / 461603	190173
C25	Internal Auxiliary	140893	140893	138197	138197

4. ELECTROMAGNETIC COMPATIBILITY

Typical Conducted Emissions result for the XMS500-24-5H at 510W output:



INSTALLATION FOR OPTIMUM EMC PERFORMANCE

Mounting

All equipment should ideally be mounted inside an earthed metal box. Alternatively an earthed metal plate can be used to mount the power supply and load. All four mounting holes (one in each corner) on the XMS500/XMS500A should be utilized for best electrical and mechanical performance, with 6mm (minimum height) metal stand offs.

The XMS500/XMS500A can be ordered as a Class II power supply (without a ground connection).
Perforated Frame option available for Class II PSU mounted in plastic enclosure (consult technical sales for details)

Cables

All cables (both AC input and DC output) should be run as close as possible to the earthed metal box/plane. AC input cable should be a twisted group laid as flat to the earthed metal box/plane as possible.

All output cables should be routed as far away from the input cables as possible. If the input and output cables must be run close to each other screen one (or ideally both).

The positive and negative supply cables should be twisted together.
All cable run loops should be kept as small as possible (this should be implemented in the system PCB design also).

Connecting between boxes

If cables must be connected between equipment boxes, then at the closest possible point to the port where the cables exit the 1st enclosure connect 100nF decoupling Y caps (between the output and earth). Note that these capacitors must be rated at the working voltage. Ideally these capacitors should be between all signal cables which have to connect between boxes although this may not be practical if fast switching [digital] signals are involved (if this is the case then smaller value Y capacitors should be used).

Earth star point

Where the AC supply enters the equipment, this should be taken to a 'star point' chassis mounted earth point (Note for compliance with EN60950-1 requires the main protective earth to have its own dedicated spring washer and nut) as close as possible to the mains inlet. All other earth points should be taken back to this point only.

ESD

Where signal or control ports are connected to a user accessible panel (for example PSU inhibit to a switch, AC Good to an indicator circuit), these ports must be protected from electrostatic discharges. This can be done by selecting suitable panel controls or by fitting ESD suppression devices to the connections on the panel.

Switching frequency

The XMS500/XMS500A has a variable switching frequency ranging from 64kHz to 150kHz, depending upon the input voltage, output voltage and output load.

5. CONNECTIONS

(J1) AC Input Mating Connector Parts

PSU	Molex Part Numbers		Crimps
Class	Housing	Crimp	Required
I	09-50-8051	08-70-1030	3
II	09-50-1031	08-70-1030	2

(J1) Class I AC Input Connector Pin Definition

Pin	Function
J1-1	Live
J1-2	No connection
J1-3	Neutral
J1-4	No connection
J1-5	Earth

(J1) Class II AC Input Connector Pin Definition

Pin	Function
J1-1	Live
J1-2	No connection
J1-3	Neutral

(J2) Signal Output Mating Connector Parts

Molex Part Numbers		Crimps
Housing	Crimp	Required
90142-0008	901190109	6*

*Depending on configuration. e.g. where no standby is configured , no crimps are required

(J2) Signal Output Connector Pin Definition

Pin	Function
J2-1	+ Vout Standby
J2-2	- Vout (0V)
J2-3	+ Vout Standby
J2-4	- Vout (0V)
J2-5	Remote ON/OFF
J2-6	AC Fail / ATX Power Good
J2-7	Temperature Sense**
J2.8	Temperature Sense**

** Custom option only

(J3) Fan Output Mating Connector Parts

Molex Part Numbers		Crimps Required
Housing	Crimp	
51191-0200	50802-9001	2

(J3) Fan Output Connector Pin Definition

Pin	Function
J2-1	- Vout (0V)
J2-2	+ Vout Fan

6. MOUNTING

Please refer to handbook for allowable orientations.

Mount using all four corner holes for Class I models.

7. WEIGHT

XMS500/XMS500A Top Fan models weigh approximately 860 grams

XMS500/XMS500A U chassis models weigh approximately 730 grams

XMS500/XMS500A Open Frame models weigh approximately 600 grams

XMS500/XMS500A Perforated Frame models weigh approximately 695 grams