

UL TEST REPORT AND PROCEDURE

Standard:	UL 60601-1, 1st Edition, 2006-04-26 (Medical Electrical Equipment, Part 1: General Requirements for Safety) CAN/CSA-C22.2 No. 601.1-M90, 2005 (Medical Electrical Equipment - Part 1: General Requirements for Safety)
Certification Type:	Component Recognition
CCN:	QQHM2, QQHM8 (Power Supplies, Medical and Dental)
Product:	Switch Mode Power Supply
Model:	XMS350 or XMS-350 and XMS500 or XMS-500 series switch mode power supplies (see report Model Differences for details of nomenclature)
Rating:	XMS350, XMS-350: 100-240Vac nom, 47-63Hz, 5.3A rms max. XMS500, XMS-500: 100-240Vac nom, 47-63Hz, 7A rms max. (see report Model Differences for details of nomenclature)
Applicant Name and Address:	TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE DEVON EX34 8ES UNITED KINGDOM

This is to certify that representative samples of the products covered by this Test Report have been investigated in accordance with the above referenced Standards. The products have been found to comply with the requirements covering the category and the products are judged to be eligible for Follow-Up Service under the indicated Test Procedure. The manufacturer is authorized to use the UL Mark on such products which comply with this Test Report and any other applicable requirements of UL LLC ('UL') in accordance with the Follow-Up Service Agreement. Only those products which properly bear the UL Mark are considered as being covered by UL's Follow-Up Service under the indicated Test Procedure.

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Supporting Documentation

The following documents located at the beginning of this Procedure supplement the requirements of this Test Report:

- A. Authorization - The Authorization page may include additional Factory Identification Code markings.
- B. Generic Inspection Instructions -
 - i. Part AC details important information which may be applicable to products covered by this Procedure. Products described in this Test Report must comply with any applicable items listed unless otherwise stated in the body of this Test Report.
 - ii. Part AE details any requirements which may be applicable to all products covered by this Procedure. Products described in this Test Report must comply with any applicable items listed unless otherwise stated in the body of each Test Report.
 - iii. Part AF details the requirements for the UL Certification Mark which is not controlled by the technical standard used to investigate these products. Products are permitted to bear only the Certification Mark(s) corresponding to the countries for which it is certified, as indicated in each Test Report.

Product Description

XMS350 or XMS500 series switch mode power supplies
(See Model Differences for details of nomenclature)

The series consists of two power outputs, a 350W and 500W, these use the same topology with some component variations.

The XMS series switch mode power supply consists of:

1. Input filter, consisting of the input fuse(s), X and Y capacitors, common mode chokes up to the bridge and series choke after the bridge.
2. PFC (boost circuit), consisting of the boost choke and associated switching FETs/circuitry.
3. Forward converter, consisting of the main transformer and switching FETs/circuitry supplying channel 1 and fan supply outputs.
4. Standby circuit, consisting of the standby transformer and switching IC/circuitry supplying the standby output.
5. Secondary circuits (SELV), consisting of channel 1 output, standby output, fan supply, power OK and inhibit/enable.

Model Differences

XMS350 or XMS500 series (may also be marked as XMS-350 or XMS-500) as described below:

Units may be marked with a Product Code: Xy where y may be any number of characters.

Unit Configuration Code (Description): may be prefixed with NS # followed by / or - (where # may be any number of characters indicating non-safety related model differences).

Unit Configuration (Description)

XMSxy-a-bc-defghijklm

where:

- x = 350 for 350W model
500 for 500W model
500P for 576W peak power models (36V, 40V and 48V output models only)
- y = Blank for Class I
D for Class II
- a = Channel 1 Output Voltage (see Ch1 in the table below, adjustment range column).
- b = Standby Output Voltage: see standby voltage in table below
N for no supply
5 for 5 volt
12 for 12 volt
- c = Standby Output Current:
C for 0.5A
M for 1.0A
H for 2.0A
N for no supply or 0 amps output
- d = Fan Supply:

N for no fan supply (customer cooling)
N1 for 24V fan supply (customer cooling)
N2 for 12V variable supply
N3 for 12V fixed supply
KF for non-standard top fan
TF for top-fan

e = U for non-standard U chassis
P for perforated frame
N for Open Frame
C for custom chassis/covers for non-standard models
S for standard U chassis
B for standard U chassis with perforated cover

f = Touch (Enclosure) current:
B for <100uA
T for <75uA

g = Earth leakage current:
D for Class II (no Earth)
L for <300uA
R for <150uA
T for <100uA

h = E or In for inhibit
T or En for enable

i = A for AC OK option
N for no AC OK option

j = Blank for dual fuses fitted
FL for single fuse fitted in the Live line

klm = Blank for standard output settings

May be three numbers from 0 to 9 (preceded by -) which denotes various output voltage/current settings within the specified ranges of each output for a particular unit. (may define non-safety related parameters/feature, e.g. reduced primary current limit, reduced OVP)

Input Parameters

Nominal input voltage	100 - 240 Vac
Input voltage range	90 - 264 Vac
Input frequency range	47 - 63 Hz
Maximum input current	7A (5.3A*) rms

* Input for 350W models.

All ratings apply for ambient temperatures up to 50°C.

Output Parameters

Output ratings are in accordance with the following table:

Standard models:

Output Channel	Voltage Designation	Vout nom.(V)	Adjustment Range (V)	Output Current (A)	Output Power (W)
CH1 (500W)	12	12	11.6 - 13.2	41.6	500
	24	24	23.8 - 25.2	20.8	500
	36	36	35.4 - 37.8	13.8(16*)	500(576*)
	40	40	38 - 42	12.5(15.16*)	500(576*)
	48	48	47-50	10.4(12*)	500(576*)
CH1 (350W)	24	24	23.8 - 25.2	14.6	350
Standby Option	5	5	5 - 5.5	0.5	2.75
	5	5	5 - 5.5	2.0	11.0
	12	12	12-13.2	1	13.2
	N	10	5 - 15	0	0
Fan Supply	N	-	-	-	-
	N1	24	Fixed	0.2	4.8
	N2	12	6-12	-	3.0
	N3	12	Fixed	0.25	3.0

*576W peak power up to 2 minutes with 500Wrms power using the following formula:

$$500Wrms = ((peakpower^2 \times T1 + reducedpower^2 \times T2)/(T1 + T2))^{1/2}$$

Where T1 = peakpower time on in seconds
T2 = reducedpower time on in seconds

Non-Standard Models:

X00011#	XMS350-24-NN-N1CBLEN	Customer specific chassis
X00023#	XMS500D-24.5-5C-KFCBDEN	Customer specific top fan/chassis model
X00073#	XMS500-24-NN-NCBRInA	Customer specific chassis/cover

Where # can be any letter denoting non-safety related changes.

Output Limitations:

All outputs are SELV
Channel 1 is hazardous energy

Technical Considerations

- Classification of installation and use : Component part of host equipment
- Supply connection : Component part of host equipment
- Accessories and detachable parts included in the evaluation : None
- Options included : None
- The product was investigated to the following additional standards:: EN 60601-1: 1990 + A1:1993 + A2:1995, CAN/CSA-C22.2 No. 601.1-M90 (R2005) (includes National Differences for Canada), UL 60601-1, 1st Edition, 2006-04-26 (includes National Differences for USA),
- The product was not investigated to the following standards or clauses:: Clause 52.1, Programmable

Electronic Systems (IEC 601-1-4), Clause 48, Biocompatibility (ISO 10993-1), Clause 36, Electromagnetic Compatibility (IEC 601-1-2)

- The product is Classified only to the following hazards:: Shock, Fire
- The degree of protection against harmful ingress of water is:: Ordinary (IPX0)
- The mode of operation is:: Continuous
- Software is relied upon for meeting safety requirements related to mechanical, fire and shock:: No
- The product is suitable for use in the presence of a flammable anesthetics mixture with air or oxygen or with nitrous oxide:: No
- Multilayer PWB's accepted under CBTR Ref No. E349607-A23 dated 2014-07-31 and letter report in Enclosure 8-07 of this report.

Engineering Conditions of Acceptability

For use only in or with complete equipment where the acceptability of the combination is determined by UL LLC. When installed in an end-product, consideration must be given to the following:

- The following Production Line tests are conducted for this product: Electric Strength, Earthing Continuity (except XMSxD model)
- The following secondary output circuits are SELV: All
- The following secondary output circuits are at hazardous energy levels: Channel 1
- The following secondary output circuits are at non-hazardous energy levels: Standby output, fan output
- The following output terminals were referenced to earth during performance testing. All outputs and their return lines individually referenced to earth to obtain maximum working voltage.
- The power supply terminals and/or connectors are: Not investigated for field wiring
- The maximum investigated branch circuit rating is: 20A
- The investigated Pollution Degree is: 2
- Proper bonding to the end-product main protective earthing termination is: Required (except XMSxD model)
- The following magnetic devices (e.g. transformer or inductor) are provided with an OBJY2 insulation system with the indicated rating greater than Class A (105°C): TX1 (Class F), TX3 (Class B or F).
- The following end-product enclosures are required: Mechanical, Fire, Electrical
- The end-product Electric Strength Test is to be based upon a maximum working voltage of: Primary-SELV: 405Vrms, 655Vpk, Primary-Earthed Dead Metal: 365Vrms, 632Vpk
- An investigation of the protective bonding terminals has: been conducted.
- Open frame models, H3 is connected to the input connector earth (not applicable to XMSxD model)
- All models require component temperatures monitored as detailed in the Additional Information (except -KF and TF fan models)
- The product was tested for use at maximum ambient temperature (Tma) 50°C in normal conditions permitted by the manufacturer, see Additional Information for details.
- The chassis/cover when fitted to the XMSxD (Class II) has basic/supplementary insulation to primary and basic/supplementary insulation to secondary.
- The Customer fixings screw penetration require special attention: see handbook in enclosures for details.

Additional Information

Cooling for units with customer supplied air (all models except KF and TF fan supplies)

The following method must be used for determining the safe operation of PSUs.

The components listed in the following table must not exceed the temperatures given. To determine the component temperatures the heating tests must be conducted in accordance with the requirements of the standard in question. Consideration should also be given to the requirements of other safety standards. Test requirements include: PSU to be fitted in its end-use equipment and operated under the most adverse conditions permitted in the end-use equipment handbook/specification and which will result in the highest temperatures in the PSU. To determine the most adverse conditions consideration should be given to the end use equipment maximum operating ambient, the PSU loading and input voltage, ventilation, end use equipment orientation, the position of doors & covers etc. Temperatures should be monitored using type K fine wire thermocouples (secured with cyanoacrylate adhesive or similar) placed on the hottest part of the component (out of any direct airflow) and the equipment should be run until all temperatures have stabilized.

Cooling for unit temperature table:

Circuit Ref:	Description	Max. Temperature (??C) ++
J1	Input Connector	105
C7, C8	X Capacitor	100
L2, L4	Common Mode Choke Winding	130 (145)
L6	Series Mode Choke Winding	130
ASY5 D7	Bridge Diode	125 (130)
C14, C11, C21, C22, C10, C23, C24, C6, C18 (++)	Y Capacitors	100
C26	Capacitor	85 (105)
RLY1	Relay	100
U1, U2, U5, U6, U7 (++)	Opto-Coupler	100
TX1 (Standby)	Windings and core	120 (130)
TX3 500W	Windings and core	120 (130)
TX3 350W	Windings and core	100 (110)
ASY6 Q3	Boost FET	127 (130)
ASY4 Q1	Forward FET	127 (130)
ASY3 Q4	Output FET	127 (130)
C13	Boost Capacitor	80 (105)
C9	Boost Capacitor	70 (105)
L3, L5	Boost Choke Winding	130 (140)
L7	Channel 1 Output Choke	130 (140)
C4, C5, C15, C16, C17 C19, C20 (++)	Electrolytic Capacitors	80 (105)

+ The higher temperature limits in brackets may be used but product life may be reduced.

++ When fitted

ADDITIONAL STANDARDS

EN60601-1:1990 + A1:1993 + A2:1995, UL60601-1, 1st Edition 2006-04-26 (includes National Differences for USA), CAN/CSA-C22.2 No. 601-1-M90 (R2005) (includes National Differences for Canada)