

## UL TEST REPORT AND PROCEDURE

<b>Standard:</b>	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)
<b>Certification Type:</b>	Component Recognition
<b>CCN:</b>	QQHM2, QQHM8 (Power Supplies, Medical and Dental)
<b>Product:</b>	Switch mode power supply
<b>Model:</b>	QM and QS (followed by alphanumeric characters - see model differences section in Test Report for details of models and nomenclature)
<b>Rating:</b>	100-240Vac nom, 19A rms max, 47-63 Hz
<b>Applicant Name and Address:</b>	TDK LAMBDA UK LTD KINGSLEY AVENUE ILFRACOMBE NORTH 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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Prepared by: Wojciech Czerniak (Project Handler) Reviewed by: Dennis Butcher (Reviewer)

**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**

The QM or QS series of switch mode power supplies consist of:

**Main board**

1. Input filter, consisting of the input fuse(s), X and Y capacitors, common mode chokes up to the bridge.
2. PFC (boost circuit), consisting of the boost choke and associated switching FETs/circuitry.
3. Low power Standby circuit and Fan outputs consisting of the fly-back transformer and switching IC/circuitry supplying the Low Power Standby option and Fan outputs.
4. Secondary circuits (SELV), consisting of supply to the Low Power Standby output and fan supply.

**Modules**

5. Forward converter situated on the module, consisting of the main transformer and switching FETs/circuitry.
6. Secondary circuits (SELV), consisting of Module output, CH1/2 good and inhibit/enable.

**Standby options**

7. High power Standby circuit, consisting of the standby transformer and switching IC/circuitry supplying the High Power standby output.
8. Low power Standby circuit, supplied from the Main board.
9. Secondary circuits (SELV), consisting of High Power Standby output, Low Power Standby output, fan supply, AC fail and inhibit/enable.

(See Model Differences for details of nomenclature)

**Model Differences**

This report covers the QM and QS series of switch mode power supplies. The QS is identical to the QM series but allows for only one output made up from modules either in series or in parallel. The QM and QS series consists of 7 slot models (QM7) with each slot capable of fitting single or dual modules (SC module requires two slots). The QM7 or QS7 are available as 1200W or 1500W depending on the input voltage. High power or Low power Standby Options may also be fitted. See the Model Differences section for variations and options for each model.

Units may be marked with a Product Code: KQMxy or KQSxy where x is the number of available slots and 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).

Nomenclature

QMabcdefklm for modular configurations

Where	s	=	7 for QM7 models
	a	=	Cooling: F for variable speed forward air fan
	b	=	Input connector: S for screw F for faston
	c	=	Input fuse: D for dual AC fuses E for single AC fuse in the Live line
	d	=	Leakage option: L for 300µA R for 150µA T for 60µA
	e	=	Primary option: blank for none fitted (must also have no accessible standby) E for global enable T for global inhibit P for PMBus
	f	=	Standby supply: Blank for none fitted 5H for 5V/2A 5L for 5V/0.25A

May be followed by:

Single Output modules

vMcd

Where	v	=	output voltage
	M	=	module name (SB or SC)
	c	=	S for screw terminal output 'F' for faston
	d	=	'N' for no signals, omit for standard signals

Optionally followed by '-Dxxx' where xxx is the number of mV of droop

Dual output modules

v1/v2DHcd

Where v1 = CH1 output voltage  
 v2 = CH2 output voltage  
 DH = module name (DH)  
 c = 'S' for screw terminal output, 'F' for faston  
 d = 'N' for no signals, omit for standard signals

v1/v2DMcd

Where v1 = CH1 output voltage  
 v2 = CH2 output voltage  
 DM = module name (DM)  
 c = 'S' for screw terminal output, 'F' for faston  
 d = 'N' for no signals, omit for standard signals

Blanking plates  
 B/S

Where B/S = Blanking plate

Parallel combinations

vZxcd

Where v = output voltage  
 Z = Paralleled Output module comprising SB or SC modules  
 x = Number of slots. C for 2, D for 3, F for 4  
 c = 'S' for screw terminal output, 'F' for faston  
 d = 'N' for no signals, omit for standard signals

Optionally followed by '-Dxxx' where xxx is the number of mV of droop

Series connected modules

vYxcd

Where v = output voltage  
 Y = Series output module comprising SB, SC or DH modules  
 x = Number of slots. B for 1, C for 2, D for 3, F for 4  
 c = 'S' for screw terminal output, 'F' for faston  
 d = 'N' for no signals, omit for standard signals

Optionally followed by '-Dxxx' where xxx is the number of mV of droop

Unit options

klm

Where 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/features, e.g. reduced primary current limit, reduced OVP)

QSS-vg-ef-abcd-klm for single output only

Where	s	=	1200
	a	=	Cooling: Blank or F for variable speed forward air fan
	b	=	Input connector: Blank or S for screw F for faston
	c	=	Input fuse: Blank or D for dual AC fuses E for single AC fuse in the Live line
	d	=	Leakage option: Blank or L for 300µA R for 150µA T for 60µA

If any of a, b, c or d are specified then all of a, b, c and d must not be blank.

	e	=	Primary option: blank for none fitted (must also have no accessible standby) E for global enable T for global inhibit P for PMBus
	f	=	Standby supply: Blank for none fitted 5H for 5V/2A 5L for 5V/0.25A
	v	=	5 for 5V 12 for 12V 24 for 24V 48 for 48V
	g	=	Blank for Screw terminal F for Faston terminal

Unit options

klm

Where	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/features, e.g reduced primary current limit,
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reduced OVP)

May be followed by:

Blanking plates  
B/S

Where B/S = Blanking plate

Input Parameters

Nominal input voltage 100 - 240 Vac (166.7 - 240 Vac)\*  
 Input voltage range 90 - 264 Vac (150 - 264 Vac)\*  
 Input frequency range 47 - 63 Hz  
 Maximum input current 19Arms (14Arms)\*

\* Input for 1500W models.

Maximum ambient 70°C, total output power and module output power de-rated by 2.5% per °C above 50°C

QM7 Output parameters

Module output ratings are in accordance with the following table.

Module	Note	Number of slots	Output Channel	Vout nom (V)	Adjustment range	Output Current (A)	Output Power (W)	Hazardous Energy
DM	1	1	CH1	12	11.9 to 16.1	10	120	Yes
DM	1, 4	1	CH1	24	20.8 to 28.2	5	120	Yes
DM	-	1	CH2	3.3	2.8 to 3.8	10	33	No
DM	-	1	CH2	5	4.25 to 5.75	10	50	No
DM	2	1	CH2	14	11.9 to 16.1	10	120	No
DM	3	1	CH2	24	23.5 to 24.5	4.16	100	No
DH	1	1	CH1	12	10.2 to 13.8	10	120	Yes
DH	1	1	CH1	24	20.4 to 27.6	5	120	Yes
DH	2	1	CH2	12	10.2 to 13.8	10	120	Yes
DH	2	1	CH2	24	20.4 to 27.6	5	120	Yes
SB	-	1	CH1	5	5 to 5.5	30	150	No
SB	-	1	CH1	12	12 to 13.225	300	Yes	
SB	-	1	CH1	24	24 to 26.4 12.5	300	Yes	
SC	-	2	CH1	5	5 to 5.5	60	300	Yes
SC	-	2	CH1	12	12 to 13.250	600	Yes	
SC	-	2	CH1	24	24 to 26.425	600	Yes	

Note 1: CH1 limited to 80W when CH2 at 120W. Maximum of 200W across module.

Note 2: CH2 Limited to 80W when CH1 at 120W. Maximum of 200W across module.

Note 3: CH2 (24V) has a maximum of 100W. Maximum of 200W across the module.

Note 4: CH1 (24V) has a reduced adjustment range when CH2 is 24V. Reduced adjustment range is 21.6V to 28.8V.

QS7 output parameters

Single Output Module	Note	Number of slots	Output Channel	Vout nom (V)	Adjustment range	Output Current (A)	Output Power (W)	Hazardous Energy
5	1	4	CH1	5	5 to 5.3	110	550	Yes
12	1	4	CH1	12	12 to 12.8 85	1020	Yes	
24	2	4	CH1	24	24 to 26.4 50	1200	Yes	
48	2	4	CH1	48	48 to 52.8 25	1200	Yes	

Note 1: Uses 2 SC modules in parallel.

Note 2: Uses 2 SC modules in series.

#### Technical Considerations

- Classification of installation and use : Switch mode power supply for building into end medical equipment
- Supply connection : Power supply for building in. Not for direct connection to mains supply.
- 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, (except EMC limitations, EN 60601-1-2, Biocompatibility, EN 10993-1, Programmable Electronic Systems, IEC 60601-1-4), CAN/CSA-C22.2 No. 601.1-M90 (R2005) (includes National Differences for Canada)
- 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, Mechanical
- The degree of protection against harmful ingress of water is:: Ordinary
- The following accessories were investigated for use with the product:: No accessories
- 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 8-06 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
- The following secondary output circuits are at hazardous energy levels: 12 and 24V SB modules, all SC modules, DH modules and DM modules
- The following secondary output circuits are non-hazardous energy levels: 5V SB module, and Global options.
- 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: II
- Proper bonding to the end product main protective earthing termination is: required
- The following magnetic devices (eg. transformers or inductor) are provided with an OBJY2 insulation system with the indicated rating greater than Class A (105°C): PFC: TX1 Class B or F, MODULES: TX1 Class B or F except 12V SC module TX1 Class F, GLOBAL OPTION: TX1 Class F. See table 1.5.1 for details of insulation systems used.
- The following end-product enclosures are required: Mechanical, Fire, Electrical
- All models require component temperatures to be monitored as detailed in the additional information
- The product was tested for use at the maximum ambient temperature (TMA) 70° C (output power and module output power de-rated 2.5% per °C above 50°C) in normal conditions permitted by the manufacturer, see additional information for details
- An investigation of the protective bonding terminals has been conducted
- EMC compliance has not been verified nor has it been taken into consideration. An accredited EMC Test Report will be required in conjunction with the Certification of the end product.
- The product was evaluated for use at the maximum altitude of operation: 5000 m

**Additional Information**

For best thermal performance and to ensure safety requirements are met at full load conditions, products are configured with modules starting from slot 1 in the following order:-

1. Highest power SC modules
2. Lower power SC modules
3. Any other modules

Consult TDK-Lambda UK Ltd if a non-standard configuration is required.