

## UL TEST REPORT AND PROCEDURE

<b>Standard:</b>	UL 62368-1, 2nd Ed, 2014-12-01 (Audio/video, information and communication technology equipment Part 1: Safety requirements) CAN/CSA C22.2 No. 62368-1-14, 2nd Ed-(Audio/video, information and communication technology equipment Part 1: Safety requirements)
<b>Certification Type:</b>	Component Recognition
<b>CCN:</b>	QQJQ2, QQJQ8 (Power Supplies for Use in Audio/Video, Information and Communication Technology Equipment)
<b>Complementary CCN:</b>	N/A
<b>Product:</b>	Switch-mode Power Supply
<b>Model:</b>	QM4, QI4 or QS4, QM5, QI5 or QS5, QM7, QI7 or QS7, QM8, QI8, QM8B, QI8B and KQM5001V-x switch mode power supplies (followed by alphanumeric characters - see Model Differences section in Test Report for details of models and nomenclature)
<b>Rating:</b>	QM4, QI4 or QS4 (550W): 100-240Vac nom, 47-440Hz, 9A rms max QM4, QI4 or QS4 (600W): 115-240Vac nom, 47-440Hz, 9A rms max QM4, QI4 or QS4 (650W): 200-240Vac nom, 47-440Hz, 6A rms max QM4, QI4 or QS4 (550W): 144-318Vdc nom, 6Adc max QM4, QI4 or QS4 (650W): 239-318Vdc nom, 5Adc max  QM5, QI5 or QS5 (700W): 100-240Vac nom, 47-440Hz, 11A rms max QM5, QI5 or QS5 (750W): 115-240Vac nom, 47-440Hz, 11A rms max QM5, QI5 or QS5 (800W): 200-240Vac nom, 47-440Hz, 9A rms max QM5H, QI5H or QS5H (700W): 100-240Vac nom, 47-440Hz, 11A rms max QM5H, QI5H or QS5H (750W): 115-240Vac nom, 47-440Hz, 11A rms max QM5H, QI5H or QS5H (800W): 200-240Vac nom, 47-440Hz, 9A rms max QM5H, QI5H or QS5H (1200W): 200-240Vac nom, 47-440Hz, 9A rms max  QM5, QI5 or QS5 (700W): 144-318Vdc nom, 7Adc max QM5, QI5 or QS5 (800W): 239-318Vdc nom, 7Adc max QM5H, QI5H or QS5H (700W): 144-318Vdc nom, 7Adc max QM5H, QI5H or QS5H (800W): 239-318Vdc nom, 7Adc max QM5H, QI5H or QS5H (1200W): 239-318Vdc nom, 7Adc max  QM7, QI7 or QS7 (1200W): 100-240Vac nom, 47-440Hz, 19A rms max QM7, QI7 or QS7 (1300W): 115-240Vac nom, 47-440Hz, 19A rms max

	<p>QM7, QI7 or QS7 (1500W): 166.7-240Vac nom, 47-440Hz, 14A rms max</p> <p>QM7, QI7 or QS7 (1200W): 144-318Vdc nom, 13Adc max QM7, QI7 or QS7 (1500W): 239-318Vdc, 9Adc max</p> <p>QM8, QI8 (1200W): 100-240Vac nom, 47-440Hz, 19A rms max QM8, QI8 (1500W): 166.7-240Vac nom, 47-440Hz, 14A rms max QM8, QI8 (1200W): 144-318Vdc nom, 13Adc max QM8, QI8 (1500W): 239-318Vdc, 10Adc max</p> <p>QM8B, QI8B (1200W): 100-240Vac nom, 47-440Hz, 19A rms max QM8B, QI8B (1500W): 166.7-240Vac nom, 47-440Hz, 14A rms max QM8B, QI8B (2000W): 200-240Vac nom, 47-440Hz, 15A rms max QM8B, QI8B (1200W): 144-318Vdc nom, 13Adc max QM8B, QI8B (1500W): 239-318Vdc, 10Adc max QM8B, QI8B (2000W): 239-318Vdc, 12Adc max</p>
<b>Applicant Name and Address:</b>	<p>TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE EX34 8ES UNITED KINGDOM</p>

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.

The applicant is authorized to reproduce the referenced Test Report provided it is reproduced in its entirety.

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Any information and documentation involving UL Mark services are provided on behalf of UL LLC (UL) or any authorized licensee of UL.

Prepared By: Mark John De Sagun / 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, QI or QS series of switch mode power supply consists 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, 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, 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, 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**

See Enclosure 7-01.

**Test Item Particulars**

Classification of use by	Skilled person
Supply Connection	AC Mains DC Mains
Supply % Tolerance	+10%/-10%
Supply Connection – Type	mating connector

Considered current rating of protective device as part of building or equipment installation	20 A; building;
Equipment mobility	for building-in
Over voltage category (OVC)	OVC II
Class of equipment	Class I
Access location	N/A
Pollution degree (PD)	PD 2
Manufacturer's specified maximum operating ambient (°C)	70°C (de-rated output power by 2.5% per °C above 50°C)
IP protection class	IPX0
Power Systems	TN
Altitude during operation (m)	5000 m
Altitude of test laboratory (m)	2000 m or less
Mass of equipment (kg)	3.6kg QM8, 3.2kg for QM7, 2.3kg for QM5 and 1.9/kg for the QM4

#### Technical Considerations

- The product was submitted and evaluated for use at the maximum ambient temperature (T<sub>ma</sub>) permitted by the manufacturer's specification of : 70°C, (65°C for QM5 option I), total output power and module output power de-rated 2.5% per °C above 50°C
- The product is intended for use on the following power systems : TN, TT
- The equipment disconnect device is considered to be : provided in the end product
- The following were investigated as part of the protective earthing/bonding : Printed wiring board trace (refer to Enclosure - Schematics + PWB for layouts)
- The following are available from the Applicant upon request : Installation (Safety) Instructions / Manual
- The product was investigated to the following additional standard : EN 62368-1:2014 + A11:2017
- Capacitors are rated for 230V due to the IT power system used in Norway. Further evaluation may be required in the end use product.

#### 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 product-line tests are conducted for this product : Earthing Continuity
- The end-product Electric Strength Test is to be based upon a maximum working voltage of : Primary-Secondary: 457Vrms, 665Vpk, Primary-Earthed Dead Metal: 373Vrms, 680Vpk
- The following output circuits are at ES1 energy levels : see Model differences in Enclosure 7-01
- The following output circuits are at ES2 energy levels : see Model differences in Enclosure 7-01
- The following output circuits are at ES3 energy levels : see Model differences in Enclosure 7-01
- The following output circuits are at PS3 energy levels : all circuits
- The maximum investigated branch circuit rating is : 20 A
- The investigated Pollution Degree is : 2
- Proper bonding to the end-product main protective earthing termination is : Required
- An investigation of the protective bonding terminals has : been conducted
- The following end-product enclosures are required : Mechanical, Fire, Electrical (excluding QM5 option I, non-customer air version, front end)
- The following magnetic devices (e.g. transformers or inductor) are provided with an OBJY2 insulation system with the indicated rating greater than Class A (105°C) : examples: T2 (Class B) or L1 (155°C), examples: T2 (Class B) or L1 (155°C), examples: T2 (Class B) or L1 (155°C), PFC : TX1 Class F, MODULES: TX1 (TX2 for SA modules) Class B except 12V SC Module TX1 Class F. GLOBAL OPTIONS/PMBUS: TX1 Class F. See Critical Components Table for details of insulation systems used.
- Fans: The fan provided in this sub-assembly is not intended for operator access.
- All models require component temperatures to be monitored as detailed in the additional information.
- Model KQM5001V-x is a customer air model and due consideration to the cooling in end equipment as described in the Additional Information section must be applied.
- TS3 metal chassis/enclosure accessible to skilled person, skilled safeguard to be considered in the end-product.
- For frequencies above 63Hz, the requirements of clause 5.7 must be considered in the end application.

### 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.

#### Cooling for unit

Component temperatures for customer air cooled models, must be monitored in the end use application described in the "Cooling for Unit Temperature Table" below:

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 stabilised.

Cooling for unit temperature table (see layout drawings in handbook):

Cooling for unit temperature table:

Circuit Ref:	Description	Max. Temperature (°C)
PFC	-	-
QM7	-	-
L2	Common Mode Choke	115 (140)
L3	Boost choke	125
C2	Electrolytic Capacitors	71 (105)
C10	Electrolytic Capacitors	64 (105)
C7	Electrolytic Capacitors	64 (105)
C8	Electrolytic Capacitors	73 (105)
C11	Electrolytic Capacitors	77 (105)
C3, C14,	X Capacitor	100
C12	Y Capacitors	105
TX1	Fly back Transformer	120
D1	Diode bridge	114 (130)
D3	PFC diode	130
U4	Opto-coupler	100
U3	Voltage regulator	120 (130)
Q2	Boost FETS	130
QM5	-	-
L2	Common Mode Choke	115 (140)
L4	Boost choke	125
C2	Electrolytic Capacitors	71 (105)
C10	Electrolytic Capacitors	71 (105)
C7	Electrolytic Capacitors	64 (105)
C8	Electrolytic Capacitors	60 (105)
C11	Electrolytic Capacitors	77 (105)
C3, C14,	X Capacitor	100
C12	Y Capacitors	105
TX1	Fly back Transformer	120
D1	Diode bridge	118 (130)
D3	PFC diode	130
U4	Opto-coupler	100
U3	Voltage regulator	120 (130)
Q2	Boost FETS	130
QM8	-	-
L2	Common Mode Choke	115 (140)
L3	Boost choke	125
C2	Electrolytic Capacitors	71 (105)
C10	Electrolytic Capacitors	64 (105)
C7C	Electrolytic Capacitors	74 (105)
C8	Electrolytic Capacitors	73 (105)
C11	Electrolytic Capacitors	77 (105)
C3, C14,	X Capacitor	100
C12	Y Capacitors	105
TX1	Fly back Transformer	120
D1	Diode bridge	114 (130)
D3	PFC diode	130
U4	Opto-coupler	100
U3	Voltage regulator	120 (130)
Q2	Boost FETS	130

QM4	-	-
L2	Common Mode Choke	115 (140)
L3	Boost choke	125
C8	Electrolytic Capacitors	57 (105)
C10	Electrolytic Capacitors	71 (105)
C11	Electrolytic Capacitors	77 (105)
C5	X Capacitor	100
C12, C15	Y Capacitors	105
TX1	Fly back Transformer	120
D1	Diode bridge	118 (130)
D3	PFC diode	130
U3	Voltage regulator	120 (130)
Q1	Boost FET	130
Low Power Options	-	-
U6	Opto-couplers	100
High Power Options	-	-
C6	Electrolytic Capacitors	73 (105)
XU3	Opto-couplers	100
TX1	Transformer Class F	130
Q PMbus -	-	-
XU3	Opto-couplers	100
DM/DH Modules	-	-
C206	Y Capacitors	105
C207	Electrolytic Capacitors	84 (105)
U8	Opto-couplers	100
Q1	Primary FET	120 (130)
D201	Output diode	124 (130)
TX1	Transformer Class B	110
SC module Modules	-	-
C206	Electrolytic Capacitors	83 (105)
C209	Y Capacitors	105
U1	Opto-couplers	100
TX1	Transformer Class B	110
TX1 (12V)	Transformer Class F	130
Q1	Primary FET	127 (130)
Q203	Secondary FET	130
SB module Modules	-	-
C206	Electrolytic Capacitors	83 (105)
C209	Y Capacitors	105
U1	Opto-couplers	100
TX1	Transformer Class B	110
Q1	Primary FET	127 (130)
Q203	Secondary FET	130
SA module Modules	-	-
C202	Electrolytic Capacitors	76 (105)
C209	Y Capacitors	105
XU206	Opto-couplers	100
TX2	Transformer Class B	110
XQ1	Primary FET	130
XU202	Secondary FET	130

Higher temperature limits (in brackets) may be used but product life may be reduced.

#### Additional Standards

The product fulfills the requirements of: EN 62368-1:2014 + A11:2017