

UL TEST REPORT AND PROCEDURE

Standard:	UL 60950-1, 2nd Edition, 2014-10-14 (Information Technology Equipment - Safety - Part 1: General Requirements) CAN/CSA C22.2 No. 60950-1-07, 2nd Edition, 2014-10 (Information Technology Equipment - Safety - Part 1: General Requirements)
Certification Type:	Component Recognition
CCN:	QQGQ2, QQGQ8 (Power Supplies for Information Technology Equipment Including Electrical Business Equipment)
Product:	Switch Mode Power Supply
Model:	QM and QS and KQM5001V-x switch mode power supplies (see Test Report model differences for details of models and nomenclature)
Rating:	QM and QS (1200W): 100-240Vac nom, 47-440Hz, 19Arms max QM and QS (1500W): 166.7-240Vac, 47-440Hz, 14Arms max KQM5001V-x: 100-240Vac, 47-63Hz, 12Arms max (see Test Report model differences for details of models and nomenclature)
Applicant Name and Address:	TDK-LAMBDA UK LTD KINGSLEY AVENUE 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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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 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 (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) and a non-standard model KQM5001V-x, see "Non-standard models" below for details. 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.

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 5 for KQM5001V-x Non-standard model only
	a	=	Cooling: C for customer air (KQM5001V-x model only) 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 13.5H for 13.5V/0.6A (KQM5001V-x model only)

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)
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QSSs-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, reduced OVP)

May be followed by:

Blanking plates

B/S

Where B/S = Blanking plate

Input Parameters

input voltage 100 - 240 Vac (166.7 - 240 Vac)*

Input voltage range 90 - 264 Vac (150 - 264 Vac)*

Input frequency range 47 - 440 Hz (47 - 63Hz for KQM5001V-x)

Maximum input current 19Arms (14Arms for 1500 W option, 12Arms for model KQM5001V-x)

* 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

Output parameters

Module output ratings are in accordance with the following table.

Module	Note	Number of slots	Output Channel	Vout nom	Adjustment range (V)	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	12	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	5	1	CH1	3.4	3.2 to 3.6	37	126	No
SB	-	1	CH1	5	5 to 5.5	30	150	No
SB	-	1	CH1	12	12 to 13.2	25	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 13.2	50	600	Yes
SC	-	2	CH1	24	24 to 26.4	25	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.

Note 5: KQM5001V-x model only

QS7 Output Parameters

Single Output Module	Number Note	Output of slots	Output Channel	Vout nom (V)	Adjustment range	Output Current (A)	Output Power (W)	Hazard. 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

Non-standard models:

KQM5001V-x(where x may be any letter for non-safety differences)

The KQM5001V-x is a 5 slot, 815W non-standard QM5 model:

QM5CSDL13.5H 3.4SBS 12.2SBS 5.2SBS-D100 5.2SCS-D100 (this is the only QM5 model)

Input rating: 100-240Vac, 12Arms max

Max output power: 815W

Max ambient 50°C

Customer air (see Cooling for Customer air in Additional Information)

Technical Considerations

- Equipment mobility : for building-in
- Connection to the mains : Connection to mains via host equipment
- Operating condition : continuous
- Access location : For building in
- Over voltage category (OVC) : OVC II
- Mains supply tolerance (%) or absolute mains supply values : +10%, -10%
- Tested for IT power systems : Yes, Norway only
- IT testing, phase-phase voltage (V) : 230Vac
- Class of equipment : Class I (earthed)
- Considered current rating of protective device as part of the building installation (A) : 20A branch circuit
- Pollution degree (PD) : PD 2
- IP protection class : IP X0
- Altitude of operation (m) : 5000m
- Altitude of test laboratory (m) : 64m
- Mass of equipment (kg) : 3kg (2kg for KQM5001V-x)
- The product was submitted and evaluated for use at the maximum ambient temperature (T_{ma}) permitted by the manufacturer's specification of: 70° C (output power and module output power derated 2.5% per °C above 50°C)
- The product is intended for use on the following power systems: TN, TT, IT (Norway Only)
- The equipment disconnect device is considered to be: provided by the end equipment
- The product was investigated to the following additional standards: EN 60950-1:2006 + A11:2009 + A1:2010 + A12:2011 + A2:2013 (which includes all European national differences, including those specified in this test report).
- The following were investigated as part of the protective earthing/bonding: Printed wiring board trace (refer to Enclosure 5 Schematics + PWB for layouts)
- The following are available from the Applicant upon request: Installation (Safety) Instructions / Manual
- Multi-layer PWBs accepted under CTR ref. No. E349607-A23 dated 2014-07-31 and letter report in Enclosure 8-06

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 end-product Electric Strength Test is to be based upon a maximum working voltage of: Primary-SELV: 439Vrms, 635Vpk, Primary-Earthed Dead Metal: 373Vrms, 680Vpk
- The following secondary output circuits are SELV: All
- The following secondary output circuits are at hazardous energy levels: SC (All models), SB (12 and 24 models), DH (all models), DM (CH1 12 and 24 models)
- The following secondary output circuits are at non-hazardous energy levels: Global options, SB

(3.4V, 5V modules), DM (CH2: 3.3, 5, 12 and 24 modules)

- 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: 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 magnetic devices (e.g. 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) 50°C in normal conditions permitted by the manufacturer, see additional information for details
- The power supply was additionally tested according to the standard IEC 61010-1:2010 and EN 61010-1:2010 and fulfills the requirements of these standards (except KQM5001V-x)
- 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.

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 units with customer supplied air (KQM5001V-x only):

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: KQM5001V-x only

Circuit Ref: ++	Description	Max. Temperature (??C)+
PFC	-	-
J1	Input connector	105
C1, C3, C14	X capacitor	100
L1, L2, L5	Common mode choke winding	130
ASY2 D1	Bridge diode	125 (130)
L3	Boost choke	120
C5, C6, C9, C12, C15		
C16	Y capacitors	110
C7, C8	Boost capacitors	85 (105)
RLY1	Relay	100
TX1 PFC flyback	Windings and core	110
CC10, C11	Electrolytic capacitor	105
Global option	-	-
TX1 Global option	Windings and core	130
XU3	Opto-Coupler	100
C6	Electrolytic capacitor	105
Modules	-	-
TX1	Windings and core	110
L1	Primary choke winding	120
U1	Opto-Coupler	100
XR252	Resistor	130
C209	Y capacitor	110
C207	Electrolytic Capacitor	80 (105)

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

++ When fitted

Additional Standards

The product fulfills the requirements of: The product fulfills the requirements of: UL60950-1, 2nd Edition, 2014-10-14, CSA C22.2 No. 60950-1-07, 2nd Edition, 2014-10, EN 60950-1:2006 + A1:2010 + A11:2009 + A12:2011 + A2:2013

Markings and instructions

Clause Title	Marking or Instruction Details
Power rating - Ratings	Ratings (voltage, frequency/dc, current)
Power rating - Company identification	Listee's or Recognized company's name, Trade Name, Trademark or File Number
Power rating - Model	Model Number
Fuses - Non-operator access/soldered-in fuses	Unambiguous reference to service documentation for instructions for replacement of fuses replaceable only by service personnel