

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:	QM4 or QS4, QM5 or QS5, QM7 or QS7, QM8 and KQM5001V-x switch mode power supplies (followed by alphanumeric characters - see Test Report model differences for details of models and nomenclature)
Rating:	QM4 or QS4 (550W): 100-240Vac nom, 47-440Hz, 9A rms max QM4 or QS4 (650W): 200-240Vac nom, 47-440Hz, 6A rms max QM4 or QS4 (550W): 144-318Vdc nom, 6Adc max QM4 or QS4 (650W): 239-318Vdc nom, 5Adc max QM5 or QS5 (700W): 100-240Vac nom, 47-440Hz, 11A rms max QM5 or QS5 (800W): 200-240Vac nom, 47-440Hz, 9A rms max QM5H or QS5H (700W): 100-240Vac nom, 47-440Hz, 11A rms max QM5H or QS5H (800W): 200-240Vac nom, 47-440Hz, 9A rms max QM5H or QS5H (1200W): 200-240Vac nom, 47-440Hz, 9A rms max QM5 or QS5 (700W): 144-318Vdc nom, 7Adc max QM5 or QS5 (800W): 239-318Vdc nom, 7Adc max QM5H or QS5H (700W): 144-318Vdc nom, 7Adc max QM5H or QS5H (800W): 239-318Vdc nom, 7Adc max QM5H or QS5H (1200W): 239-318Vdc nom, 7Adc max QM7 or QS7 (1200W): 100-240Vac nom, 47-440Hz, 19A rms max QM7 or QS7 (1500W): 166.7-240Vac nom, 47-440Hz, 14A rms max QM7 or QS7 (1200W): 144-318Vdc nom, 13Adc max QM7 or QS7 (1500W): 239-318Vdc, 9Adc max QM8 (1200W): 100-240Vac nom, 47-440Hz, 19A rms max QM8 (1500W): 166.7-240Vac nom, 47-440Hz, 14A rms max QM8 (1200W): 144-318Vdc nom, 13Adc max QM8 (1500W): 239-318Vdc, 10Adc max QM8B (1200W): 100-240Vac nom, 47-440Hz, 19A rms max QM8B (1500W): 166.7-240Vac nom, 47-440Hz, 14A rms max QM8B (2000W): 200-240Vac nom, 47-440Hz, 15A rms max QM8B (1200W): 144-318Vdc nom, 13Adc max QM8B (1500W): 239-318Vdc, 10Adc max QM8B (2000W): 239-318Vdc, 12Adc max KQM5001V-x: 100-240Vac, 47-63Hz, 12Arms max

Applicant Name and Address:	TDK-LAMBDA UK LTD KINGSLEY AVENUE ILFRACOMBE DEVON EX34 8ES, UNITED KINGDOM
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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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Reviewed by: Piotr A. Bizunowicz / 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

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.

*Non SELV if certain modules are in series. See Engineering Conditions of acceptability.

(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 4 slot models (QM4/QS4), 5 slot models (QM5/QS5), 7 slot models (QM7/QS7) and 8 slot models (QM8) with each slot capable of fitting single or dual modules (SC module requires two slots) and Non-standard models, see below for details. The QM4 or QS4 are available as 550W or 650W and the QM5 or QS5 are available as 700W, 800W or 1200W and the QM7, QM8 or QS7 are available as 1200W or 1500W depending on the input voltage. There is a QM8B version which is available as 2000W. High power/Low power and PMBus Standby Options may 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

QMshabcdefghklm for modular configurations

Where	s	=	4 for QM4 models 5 for QM5 models 7 for QM7 models 8 for QM8 models
	h	=	Hold Up Option Blank for none fitted H for extended hold up B for 2000W converter (QM8 only)

a	=	Cooling: C for customer air (not applicable to QM5 IEC Models) F for variable speed forward air fan R for variable speed, reverse air
b	=	Input connector: Blank or S for screw F for faston I for IEC connector (QM5 only)
c	=	Input fuse: D for dual AC fuses E for single AC fuse in the Live line F for dual AC/DC fuses G for single AC/DC fuse in the +ve input line
d	=	Leakage option: S for 3.5mA L for 300µA R for 150µA T for 60µA
e	=	Primary option: blank for none fitted E for global enable T for global inhibit P for PMBus Q for PMBus with individual module enable (KQM700HJx model only, where x can be any letter for non-safety related differences)
f	=	Standby supply: Blank for none fitted 5 for 5V/2A (Primary option Q or P only) 5H for 5V/2A (Primary option E or T only) 5L for 5V/0.25A (Primary option E or T only) 12 for 12V/1A (Primary option Q or P only) 12H for 12V/1A (Primary option E or T only) 13.5H for 13.5V/0.6A (KQM5001V-x model only)
g	=	Blank if Primary option P or Q not fitted H for Input Power Present C for Control Pin Active High D for Control Pin Active Low F for PMBus and Control Pin Active High G for PMBus and Control Pin Active Low J for Individual output control, followed by two hexadecimal numbers specifying which modules are on/off (for Q type PMBus option only)
h	=	Blank for non-industrial leakage C for Industrial leakage, output Y capacitors up to 100nF(Leakage option S only)

May be followed by:

Single Output modules

vMcde

Where	v	=	output voltage
	M	=	module name (SA, SB or SC)
	c	=	S for screw terminal output 'F' for faston
	d	=	See letter from Module Signal Option Table
	e	=	C for Industrial Leakage, omit for standard leakage

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

Dual output modules

v1/v2DHcde

Where	v1	=	CH1 output voltage
	v2	=	CH2 output voltage
	DH	=	module name (DH)
	c	=	'S' for screw terminal output, 'F' for faston
	d	=	See letter from Module Signal Option Table
	e	=	C for Industrial Leakage, omit for standard leakage

v1/v2DMcde

Where	v1	=	CH1 output voltage
	v2	=	CH2 output voltage
	DM	=	module name (DM)
	c	=	'S' for screw terminal output, 'F' for faston
	d	=	See letter from Module Signal Option Table
	e	=	C for Industrial Leakage, omit for standard leakage

Blanking plates

B/S

Where	B/S	=	Blanking plate
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Parallel combinations

vZxcde

Where	v	=	output voltage
	Z	=	Paralleled output module comprising SB or SC modules
	x	=	Number of slots. See table below.
	c	=	'S' for screw terminal output, 'F' for faston
	d	=	See letter from Module Signal Option Table
	e	=	C for Industrial Leakage, omit for standard leakage

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

Series connected modules

vYxcde

Where	v	=	output voltage
	Y	=	Series output module comprising SB, SC or DH modules
	x	=	Number of slots. See tables below
	c	=	'S' for screw terminal output, 'F' for faston
	d	=	See letter from Module Signal Option Table
	e	=	C for Industrial Leakage, omit for standard leakage

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

Series connected Paralleled modules

vHxcde

Where	v	=	output voltage
	H	=	Series connected parallel SB and/or SC modules
	x	=	Number of slots. See tables below
	c	=	'S' for screw terminal output, 'F' for faston
	d	=	See letter from Module Signal Option Table
	e	=	C for Industrial Leakage, omit for standard leakage

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

Combined DM modules - seriated Channel 1 only

vMxcde

Where	v	=	output voltage
	M	=	Series CH1 output comprising DM modules
	x	=	Number of slots. See tables below
	c	=	'S' for screw terminal output, 'F' for faston
	d	=	See letter from Module Signal Option Table
	e	=	C for Industrial Leakage, omit for standard leakage

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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Module Signal Option Table

Letter	Voltage adjustment	Module output	Module output	Remote
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	pot	inhibit	good	sense
Blank	Yes	Yes	Yes	Yes
N	Yes	No	No	No
L	No	No	No	No
R	No	No	No	Yes
B	No	No	Yes	No
D	No	No	Yes	Yes
F	No	Yes	No	No
G	No	Yes	No	Yes
H	No	Yes	Yes	No
J	No	Yes	Yes	Yes
K	Yes	No	No	Yes
M	Yes	No	Yes	No
P	Yes	No	Yes	Yes
Q	Yes	Yes	No	No
S	Yes	Yes	No	Yes
T	Yes	Yes	Yes	No

QS[Number of available slots][Hold Up Option]-[Power]-[Voltage][Output Terminal][Standby/Signals][Unit Options]-[non safety related]

Number of available slots = 4, 5 or 7

Hold Up Option = Blank for none fitted, H for Extended Hold Up

Power (max) = 550, 600, 1044, 1080 or 1200 from QS Output Parameters table below

Voltage = Output Voltage from the Vout range in the QS Output Parameters table below

Output Terminal = Blank for Screw terminal, F for Faston terminal

Standby/Signals Where: = Blank or -E5H, -E5L, -T5H, -T5L, -E12H, -T12H, -P5H or -P12H
E = Enable, T = Inhibit and P = PMBus
5H is 5V/2A, 5L is 5V/0.25A and 12H is 12V/1A

Followed by: (P option only)

H for Input Power Present
C for Control Pin Active High
D for Control Pin Active Low
F for PMBus and Control Pin Active High
G for PMBus and Control Pin Active Low

Unit Options option] = Blank for defaults or all of -[cooling][input connector][input fuse][leakage

Where [cooling] = F for Variable speed, forward air fan (default), R for Variable speed, reverse air fan, C for Customer air

[Input Connector] = S for screw (default), F for Faston, I for IEC

[Input Fuse] = D for dual AC fuses (default), E for single AC fuse in the live line
F for dual AC/DC fuses, G for single AC/DC fuse in the +ve line

[Leakage Option] = S for 3.5mA, L for 300 µA (default), R for 150µA, T for 60 µA

[Non-safety related] = optional - followed by any number of characters indicating non-safety

QS Output Parameters

Model	Note	Power (max)	Vout (range)	Current (max)	Hazardous Energy	Modules used
QS4	6	550	5-5.3V	110A	Yes	1 x ZF Module
-	-	600	12-13.2V	50A	Yes	1 x SC Module
-	-	600	24-26.4V	25A	Yes	1 x SC Module
-	-	600	30-33V	20A	Yes	1 x YC Module
-	-	600	36-39.6V	6.67A	Yes	1 x SC Module
-	-	600	48-52.8V	12.5A	Yes	1 x SC Module
-	-	600	56-61.6V	10.7A	Yes	1 x YC Module
-	-	600	96-105.6V	6.25A	Yes	1 x YC Module
QS5	6	550	5-5.3V	110A	Yes	1 x ZF Module
-	-	600	12-13.2V	50A	Yes	1 x SC Module
-	-	600	24-26.4V	25A	Yes	1 x SC Module
-	-	600	30-33V	20A	Yes	1 x YC Module
-	-	600	36-39.6V	16.67A	Yes	1 x SC Module
-	-	600	48-52.8V	12.5A	Yes	1 x SC Module
-	-	600	56-61.6V	10.7A	Yes	1 x YC Module
-	-	600	96-105.6V	6.25A	Yes	1 x YC Module
-	-	1080	12-12.8V	90A	Yes	1 x ZF Module
-	-	1200	24-26.4V	50A	Yes	1 x YF Module
-	-	1200	48-52.8V	25A	Yes	1 x YF Module
QS7	-	1080	12-12.8V	90A	Yes	1 x ZF Module
-	-	1200	24-26.4V	50A	Yes	1 x YF Module
-	-	1044	36-38.4V	29A	Yes	1 x ZF Module
-	-	1200	48-52.8V	29A	Yes	1 x YF Module
-	-	1200	72-79.2	16.6A	Yes	1 x YF Module
-	-	1200	96-105.6V	12.5A	Yes	1 x YF Module

Parallel and Series combinations Tables

Series connection number of slots.

Qty of modules	SB		SC		DH	
	Name	Slots	Name	Slots	Name	Slots
1	SB	1	SC	2	YB	1
2	YC	2	YF	4	YP	2
3	YD	3	YM	6	YQ	3
4	YG	4	YN	8	YR	4
5	YH	5	-	-	YS	5
6	YJ	6	-	-	YT	6
7	YK	7	-	-	YV	7
8	YL	8	-	-	YW	8

Limitations of use:

1. Output voltage is the combined seriated modules voltage.
2. Module limitations apply to seriated modules.

Series connection of parallel connected modules

Module	Qty	Slots	Name
ZC	2	4	HC
ZD	2	6	HD
ZF	2	8	HF
ZT	2	6	HT
ZV	2	8	HV
ZC	3	6	HW
ZC	4	8	HX

Limitations of use:

1. Output voltage is the combined seriated modules voltage.
2. Module limitations apply to seriated/parallel modules.

Parallel connection number of slots

Number of modules in parallel

Slots	SB	SC	Name
2	2	0	ZC
3	1	1	ZD
4	0	2	ZF
6	0	3	ZH
3	3	0	ZT
4	4	0	ZV

See ratings in Module output ratings table below

DH outputs in series but split to create extra outputs.

Qty of modules Split after Name output (first output is 1)

2	1	CB
2	3	CD
3	1	FB
3	3	FD
3	5	FG
4	1	GB
4	3	GD
4	5	GG
4	7	GJ
5	1	JB
5	3	JD

5	5	JG
5	7	JJ
5	9	JL
6	1	KB
6	3	KD
6	5	KG
6	7	KJ
6	9	KL
6	11	KN
7	1	LB
7	3	LD
7	5	LG
7	7	LJ
7	9	LL
7	11	LN
7	13	LQ
8	1	MB
8	3	MD
8	5	MG
8	7	MJ
8	9	ML
8	11	MN
8	13	MQ
8	15	MS

Limitations of use:

1. Output voltage is the combined seriated modules voltage.
2. Module limitations apply to seriated modules

Combined DM modules - seriated Channel 1 only.

Number of modules	outputs	Nomenclature
2	3	v1/v2/v3MC
3	4	v1/v2/v3/v4MD
4	5	v1/v2/v3/v4/v5MF
5	6	v1/v2/v3/v4/v5/v6MG
6	7	v1/v2/v3/v4/v5/v6/v7MH
7	8	v1/v2/v3/v4/v5/v6/v7/v8MJ
8	9	v1/v2/v3/v4/v5/v6/v7/v8/v9MK

Limitations of use:

1. Output voltage is the combined seriated modules voltage.
2. Module limitations apply to seriated modules

Series modules:

For SB and SC modules, all outputs are SELV except under the following circumstance: Outputs connected in series are non-SELV if the total output voltage + 40% of the nominal rated output voltage of the output with the highest rated adjustment range voltage exceeds 60Vdc (the 40% addition allows for a single fault in any one individual channel).

For DH modules, all outputs are SELV except under the following circumstance: Outputs connected in series

are non-SELV if the total output voltage + 35% of each nominal rated output voltage of the highest rated adjustment range voltage exceeds 60Vdc (the 35% addition allows for a single fault in any one individual channel).

For DM modules, all outputs are SELV except under the following circumstance: CH1 Outputs connected in series are non-SELV if the total output voltage + 30% of the nominal rated output voltage of the highest rated adjustment range voltage exceeds 60Vdc (the 30% addition allows for a single fault in any one individual channel).

Input Parameters

QM4

Input voltage nom. 100 - 240Vac, 144 - 318Vdc (200 - 240Vac, 239 - 318Vdc)*
Input voltage range **85 - 264Vac, 130 - 350Vdc (180 - 264Vac, 215 - 350Vdc)*
Input frequency range 47 - 440Hz or dc
Maximum input current 9Arms or 6Adc (6Arms or 5Adc for 650W model)

* Input for 650W models.

**Output power is de-rated to 500W between 85-89.9Vac

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

QM5

Input voltage nom. 100 - 240Vac, 144 - 318Vdc (200 - 240Vac, 239 - 318Vdc)*
Input voltage range **85 - 264Vac, 130 - 350Vdc (180 - 264Vac, 215 - 350Vdc)*
Input frequency range 47 - 440Hz or dc
Maximum input current 11Arms or 7Adc (9Arms or 7Adc for 800 and 1200W model)

* Input for 1200W models.

**Output power is de-rated to 650W between 85-89.9Vac

Maximum ambient 70°C, (65°C for option I) total output power and module output power de-rated by 2.5% per °C above 50°C

QM7

Input voltage nom. 100 - 240Vac, 144 - 318Vdc (166.7 - 240Vac, 239 - 318Vdc)*
Input voltage range **85 - 264Vac, 130 - 350Vdc (150 - 264Vac, 215 - 350Vdc)*
Input frequency range 47 - 440Hz or dc
Maximum input current 19Arms or 13Adc (14Arms or 9Adc for 1500W model)

* Input for 1500W models.

**Output power is de-rated to 1100W between 85-89.9Vac

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

QM8

Input voltage nom. 100 - 240Vac, 144 - 318Vdc (166.7 - 240Vac, 239 - 318Vdc)*
Input voltage range **85 - 264Vac, 130 - 350Vdc (150 - 264Vac, 215 - 350Vdc)*
Input frequency range 47 - 440Hz or dc
Maximum input current 19Arms or 13Adc (14Arms or 10Adc for 1500W model),

* Input for 1500W models.

**Output power is de-rated to 1100W between 85-89.9Vac

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

QM8B

Input voltage nom. 100 - 240Vac, 144 - 318Vdc (166.7 - 240Vac, 239 - 318Vdc)*
(200 - 240Vac, 239 - 318Vdc)**
Input voltage range ***85 - 264Vac, 130 - 350Vdc (150 - 264Vac, 215 - 350Vdc)*
(180 - 264Vac, 215 - 350Vdc)**

Input frequency range 47 - 440Hz or dc
Maximum input current 19Arms or 13Adc (14Arms or 10Adc for 1500W model), (15Arms or 12Adc for 2000W model)

* Input for 1500W models.

**Input for 2000W models

***Output power is de-rated to 1100W between 85-89.9Vac

Maximum ambient 70°C, total output power and module output power de-rated by 2.5% per 2°C above 50°C

QM4, QM5, QM7 and QM8 Output parameters

Module output ratings table.

Module	Note	Number of slots	Output Channel	Vout nom	Adjustmen range	Output Current	Output Power	Hazardous Energy
DM	5,8, 11	1	CH1	12	11.9 to 16.1	10	120	Yes
DM	2	1	CH1	17	16 to 21.6	7.5	120	Yes
DM	4,5	1	CH1	24	20.8 to 28.2	5	120	Yes
DM	-	1	CH2	0	0	0	0	No
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	-	1	CH2	8	7 to 9.5	10	95	No
DM	3,8,11	1	CH2	14	11.9 to 16.1	8.3	100	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	15	12.75 to 17.25	8	120	Yes
DH	1	1	CH1	24	20.4 to 27.6	5	120	Yes
DH	1	1	CH1	27	23 to 31	4.4	120	Yes
DH	-	1	CH2	0	0	0	0	No
DH	2	1	CH2	12	10.2 to 13.8	10	120	Yes
DH	2	1	CH2	15	12.75 to 17.25	8	120	Yes
DH	2	1	CH2	24	20.4 to 27.6	5	120	Yes
DH	2	1	CH2	27	23 to 31	4.4	120	Yes
SA	-	1	CH1	5	5 to 5.3	15	75	No
SA	-	1	CH1	12	12 to 13.2	12.5	150	No
SA	-	1	CH1	15	15 to 16.5	10	150	No
SA	-	1	CH1	24	24 to 26.4	6.25	150	No
SB	-	1	CH1	3.3	3.3 to 3.63	37	122	No
SB	7	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	8.1	8 to 8.8	25	200	Yes
SB	-	1	CH1	12	12 to 13.2	25	300	Yes
SB	-	1	CH1	15	15 to 16.5	20	300	Yes
SB	-	1	CH1	18	18 to 19.8	16.7	300	Yes
SB	-	1	CH1	20	20 to 22	15	300	Yes
SB	-	1	CH1	24	24 to 26.4	12.5	300	Yes
SB	-	1	CH1	28	28 to 30.8	10.7	300	Yes
SB	-	1	CH1	48	48 to 52.8	6.25	300	Yes
SC	6	2	CH1	5	5 to 5.5	60	300	Yes
SC	-	2	CH1	12	12 to 13.2	50	600	Yes
SC	-	2	CH1	17	17 to 18.7	35.29	600	Yes
SC	-	2	CH1	24	24 to 26.4	25	600	Yes
SC	-	2	CH1	30	30 to 33	20	600	Yes
SC	-	2	CH1	36	36 to 39.6	16.7	600	Yes
SC	-	2	CH1	48	48 to 52.8	12.5	600	Yes

ZC	-	2	CH1	15	15 to 16	36	540	Yes
ZC	-	2	CH1	18	18 to 19.2	30	540	Yes
ZC	-	2	CH1	28	28 to 30	19.3	540	Yes
ZD	-	3	CH1	5	5 to 5.3	80	400	Yes
ZD	-	3	CH1	12	12 to 12.8	65	780	Yes
ZD	-	3	CH1	24	24 to 25.6	30	720	Yes
ZD	-	3	CH1	48	48 to 51.2	15	720	Yes
ZF	6	4	CH1	5	5 to 5.3	110	550	Yes
ZF	-	4	CH1	12	12 to 12.8	90	1080	Yes
ZF	9	4	CH1	17	17 to 18.19	63.5	1080	Yes
ZF	-	4	CH1	36	36 to 38.4	29	1044	Yes
ZH	10	6	CH1	24	24 to 25.6	62.4	1200	Yes
ZT	-	3	CH1	15	15 to 16	50	750	Yes
ZV	-	4	CH1	15	15 to 16	66.4	996	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 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: CH1 limited to 100W when CH2 at 100W. Maximum of 200W across module.

Note 6: Please see Further De-ratings Table below

Note 7: KQM5001V-x model only

Note 8: 12/12DM Module limited to 180W in slot 2 or 45°C ambient. (QM8 only) or 190W in slot 2 or 45°C ambient at low line (QM4 only)

Note 9: 67A for 10 seconds

Note 10: 1500W at high-line

Note 11: 12/24DM Module limited to 180W at low line in slot 2 or 45°C ambient (QM4 only).

Further De-ratings Table

Converter Module	40°C Ambient	45°C Ambient	50°C Ambient	Global Option fitted	Comments (applicable to 50C ambient only)	
QM4*	5SC	60A	-	55A	N/A	Fitted in slots 1+2
	5SC	60A	-	54A	N/A	Fitted in slots 3+4
-	10YF	60A	-	54A	N/A	-
-	5ZF	110A	-	100A	N/A	-
QM5*	SC	60A	-	50A	N/A	-
-	YF	60A	-	50A	N/A	-
-	ZF	110A	-	90A	N/A	-
QM8	SC	-	60A	50A	Yes	Fitted in slots 1+2
-	SC	-	60A	60A	No	Fitted in slots 1+2
-	SC	-	60A	55A	No	Fitted in slots 3+4
-	SC	-	60A	55A	Yes	Fitted in slots 3+4
-	SC	-	60A	55A	N/A	Fitted in slots 7+8
-	YF, YM & YN	-	60A	55A	No	Limited by SC Module in slots 1+2
-	YF, YM & YN	-	60A	50A	Yes	Limited by SC Module in slots 1+2
-	HF	-	110A	90A	Yes	-
-	HF	-	110A	90A	No	-
-	ZF	-	110A	90A	Yes	Fitted in slots 1 to 4
-	ZF	-	110A	90A	No	Fitted in slots 1 to 4
-	ZF	-	110A	100A	Yes	Fitted in slots 3 to 8
-	ZF	-	110A	100A	No	Fitted in slots 3 to 8
QS4*						

QS5*

Cooling options QM4/QS4

Cooling option	Input voltage (Vac nom)	Output power (W)	Ambient (°C)
F (Forward air, variable speed)	100 - 240*	550	50
	200 - 240**	650	50
C (Customer air)	100 - 240*	550	50
	200 - 240**	650	50
R (Reverse air, variable speed fan)	100 - 240*	550	40
	200 - 240**	650	40
	100 - 240*	300	50
	200 - 240**	300	50

*144 - 318Vdc nom.

**239 - 318Vdc nom.

Cooling options QM5/QS5

Cooling option	Input voltage (Vac nom)	Output power (W)	Ambient (°C)
F (Forward air, variable speed)	100 - 240*	700	50
	200 - 240**	800	50
	200 - 240**	1200	50
C (Customer air***)	100 - 240*	700	50
	200 - 240**	800	50
	200 - 240**	1200	50
R (Reverse air, variable speed fan)	100 - 240*	700	35
	200 - 240**	800	30
	200 - 240**	1200	30

*144 - 318Vdc nom.

**239 - 318Vdc nom.

Cooling options QM7/QS7

Cooling option	Input voltage (Vnom)	Output power (W)	Ambient (°C)
F (Forward air, variable speed)	100 - 240*	1200	50
	166.7 - 240**	1500	50
C (Customer air)	100 - 240*	1200	50
	166.7 - 240**	1500	50
R (Reverse air, variable speed fan)	100 - 240*	1200	40

*144 - 318Vdc nom.

**239 - 318Vdc nom.

Cooling options QM8

Cooling option	Input voltage (Vnom)	Output power (W)	Ambient (°C)
F (Forward air, variable speed)	100 - 240*	1200	50
	166.7 - 240**	1500	50
C (Customer air)	100 - 240*	1200	50
	166.7 - 240**	1500	50
R (Reverse air, variable speed fan)	100 - 240*	1000	45

*144 - 318Vdc nom.
**239 - 318Vdc nom.

Cooling options QM8B

Cooling option	Input voltage (Vnom)	Output power (W)	Ambient (°C)
F (Forward air, variable speed)	100 - 240*	1200	50
	166.7 - 240**	1500	50
	200 - 240**	2000	50
C (Customer air)	100 - 240*	1200	50
	166.7 - 240**	1500	50
	200 - 240**	2000	50
R (Reverse air, variable speed fan)	100 - 240*	1000	45

*144 - 318Vdc nom.
**239 - 318Vdc nom.

Non-standard models (as standard models except where stated below):

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

The KQM5001V-x is a non-standard QM5 model:
QM5CSDLE13.5H 3.4SBS 12.2SBS 5.2SBS-D100 5.2SCS-D100
Input rating: 47 - 63Hz, 12Arms max
Max output power: 815W
Max ambient 50°C
Customer air

KQM700HJx (where x may be any letter for non-safety differences)

The KQM700HJx is 7 slot non-standard QM7 model:
NS-TLA/QM7FSDLQ5J3E B/S 24SBS 24SBS 24SBS 24SBS 12SBS B/S
This model has an option Q PMBus fitted in slot

KQM700HJx (where x may be any letter for non-safety differences)

The KQM700HJx is 7 slot non-standard QM7 model:
NS-TLA/QM7FSDLQ5J3E B/S 24SBS 24SBS 24SBS 24SBS 12SBS B/S
This model has an option Q PMBus fitted in slot

The KQM700NNx (where x may be any letter) is a non-standard QM7 model:

NS-TLA/QM7FSDR 48FYS B/S B/S B/S

With standard module output and the following peak output:

Max frequency (Hz) 750
Output voltage (Vnom) 48
Pulse duration (ms) 0.15 to 1
Max Duty cycle % 60
Peak current (A) 35

KQM7016Mx (where x may be any letter for non-safety differences)

The KQM7016Mx is a 7 slot non-standard QM7 model:
NS-TLI/QM7FSDL 165YD 48SBS 48SBS B/S B/S

This model uses 3 non-standard 48VSB modules, adjusted to 55Vdc, to give a maximum output of 165Vdc.
Total output power of converter is 1305W

KQM70143x (where x may be any letter for non-safety differences)

The KQM70143x is a 7 slot non-standard QM7 model:
NS-TLA/QM7FSDLT5H 48YFS 24SBS B/S B/S

The total output power for this configuration is 1500W, at an input of 120Vac nom.

Technical Considerations

- Equipment mobility : for building-in
- Connection to the mains : Connection to mains via host equipment or via appliance inlet for QM5 option I only
- 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) : 3.6kg QM8, 3.2kg for QM7, 2.3kg for QM5 and 1.9/kg for the QM4
- The product was submitted and evaluated for use at the maximum ambient temperature (T_{ma}) 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, 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: 457Vrms, 665Vpk, Primary-Earthed Dead Metal: 373Vrms, 680Vpk
- The following secondary output circuits are SELV: All except specific series modules. Refer to model differences for series modules which may not be SELV.,
- The following secondary output circuits are at hazardous energy levels: All models except those listed as non-hazardous below
- The following secondary output circuits are at non-hazardous energy levels: 5V, 12V Standby outputs, SB (3.3V, 3.4V, 5V modules), DM (CH2: 3.3, 5, 8, 12 and 24 modules), SA (5, 12, 15 and 24V 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 OBJ2 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 Class B except 12V SC Module TX1 Class F. GLOBAL OPTIONS/PMBUS: TX1 Class F. See table 1.5.1 for details of insulation systems used.
- The following end-product enclosures are required: Mechanical, Fire, Electrical (excluding QM5 option I, non-customer air version, front end)
- 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
- 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 fulfils 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 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 FETS	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.

Technical Amendment 1

This report is the 1st amendment to CB Test Report No. E135494-A111-CB-2, dated 2018-05-14 & CB Test Certificate No. DK-73021-UL dated 2018-05-15.

Based on conducted testing and the review of product technical documentation including photos, schematics, wiring diagrams and similar, it has been determined that the product continues to comply with the standard and only a limited test evaluation was required.

The original report has been modified to include the following changes/additions:

The original report was modified to include the following changes/additions:

1. QM8B version added. B version is the standard QM8 with bigger value capacitors to allow for 2KW output.
2. QM4 converter added to the QM range.
3. QM4, 7 and 8 evaluated for dc input.
4. QM range evaluated for 85Vac input (with de-rating).
5. Single channel output DH/DM modules added.
6. SA modules added
7. Non standards KQM70143x and KQM7016Mx added
8. Model Differences section updated
9. Enclosures updated
10. Addition of alternates components and corrections to the Critical Components Table

The official TRF used for this evaluation has not been updated to include CTF information. As a temporary solution the NCB included missing CTF page and informed IECEE Secretariat about the required TRF update.

Previously conducted tests:

End Product Reference Page

General Guidelines

Power Supply Reference Page

Guide Information Page - Maximum Output Voltage, Current, and Volt Ampere Measurement (1.2.2.1)

Input: Single-Phase (1.6.2)

Access to Energized Parts (2.1.1.1, 2.8.2, Part 21 4.2)

Energy Hazard Measurements (2.1.1.5, 2.1.2, 1.2.8.10)

Capacitance Discharge (2.1.1.7)

SELV Reliability Test Including Hazardous Voltage Measurements (2.2.2, 2.2.3, 2.2.4, Part 22 6.1)

Limited Short-Circuit (2.6.3.4)
 Protective Bonding II (2.6.3.4, 2.6.1)
 Humidity (2.9.1, 2.9.2, 5.2.2)
 Determination of Working Voltage; Working Voltage Measurement (2.10.2)
 Steady Force (4.2.1 - 4.2.4)
 Impact (4.2.5, 4.2.1, Part 22 10.2)
 Heating (4.5.1, 1.4.12, 1.4.13)
 Ball Pressure (4.5.5, 4.5)
 Touch Current (Single-Phase; TN/TT System) (5.1, Annex D)
 Electric Strength (5.2.2)
 Component Failure (5.3.1, 5.3.4, 5.3.7)
 Abnormal Operation (5.3.1 - 5.3.9)
 Transformer Abnormal Operation (5.3.3, 5.3.7b, Annex C.1)
 Power Supply Output Short-Circuit/Overload (5.3.7)
 Locked-Rotor Overload for DC Motors in Secondary Circuits (Annex B.7)

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

Special Instructions to UL Representative

N/A