



Test Report issued under the responsibility of:



TEST REPORT
IEC 60950-1
Information technology equipment – Safety –
Part 1: General requirements

Report Number: E135494-A111-CB-2
Date of issue: 2018-05-14 ; Amendment 3 : 2020-09-23
Total number of pages..... 312

Name of Testing Laboratory UL VS Limited
preparing the Report: Unit 1-3 Horizon, Wade Road, Kingsland Business Park, Basingstoke
RG24 8AH, United Kingdom

Applicant's name: TDK-LAMBDA UK LTD
Address: KINGSLEY AVENUE
ILFRACOMBE
DEVON
EX34 8ES, UNITED KINGDOM

Test specification:
Standard.....: IEC 60950-1:2005, AMD1:2009, AMD2:2013
Test procedure: CB Scheme
Non-standard test method: N/A

Test Report Form No.: IEC60950_1G
Test Report Form(s) Originator: SGS Fimko Ltd
Master TRF.....: Dated 2019-07-02

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Test item description	Switch Mode Power Supply
Trade Mark	TDK-Lambda
	
Manufacturer	TDK-LAMBDA UK LTD
	KINGSLEY AVE
	ILFRACOMBE
	EX34 8ES UNITED KINGDOM
Model/Type reference	QM4, QI4 or QS4, QM5, QI5 or QS5, QM7, QI7 or QS7, QM8, QI8 and
	KQM5001V-x switch mode power supplies (followed by alphanumeric
	characters - see Test Report model differences for details of models and
	nomenclature)
Ratings	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
	QM7, QI7 or QS7 (1500W): 166.7-240Vac nom, 47-440Hz, 14A rms
	max
	QM7, QI7 or QS7 (1200W): 144-318Vdc nom, 13Adc max
	QM7, QI7 or QS7 (1500W): 239-318Vdc, 9Adc max
	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

	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 KQM5001V-x: 100-240Vac, 47-63Hz, 12Arms max
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Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):

<input type="checkbox"/>	CB Testing Laboratory:	
Testing location/ address.....:		
Tested by (name, function, signature).....:		
Approved by (name, function, signature)....:		

<input type="checkbox"/>	Testing procedure: CTF Stage 1:	
Testing location/ address.....:		
Tested by (name, function, signature).....:		
Approved by (name, function, signature)....:		

<input type="checkbox"/>	Testing procedure: CTF Stage 2:	
Testing location/ address.....:		
Tested by (name + signature)		
Witnessed by (name, function, signature) .:		
Approved by (name, function, signature)....:		



<input checked="" type="checkbox"/>	Testing procedure: CTF Stage 3:	
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<input type="checkbox"/>	Testing procedure: CTF Stage 4:	
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Testing location/ address.....:	TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE EX34 8ES UNITED KINGDOM	
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Tested by (name, function, signature).....:	N. Marsh. M. Carter / Safety Engineer	
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Witnessed by (name, function, signature) .:	Mark John De Sagun / Project Handler	
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Approved by (name, function, signature)... :	Dennis Butcher / Reviewer	
Supervised by (name, function, signature) :	Dennis Butcher / Reviewer	

<p>List of Attachments (including a total number of pages in each attachment):</p> <p>National Differences (0 pages) Enclosures (178 pages)</p>	
<p>Summary of testing:</p>	
<p>Tests performed (name of test and test clause):</p> <p>Heating (4.5.1, 1.4.12, 1.4.13) Electric Strength (5.2.2) Component Failure (5.3.1, 5.3.4, 5.3.7)</p>	<p>Testing Location: CTF Stage 3: TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE EX34 8ES UNITED KINGDOM</p>
<p>Summary of compliance with National Differences:</p> <p>List of countries addressed: Argentina, Australia / New Zealand, China, EU Group and National Differences, Israel, Japan, Korea, USA, Canada</p> <p>EU Group and National Differences applies to CENELEC member countries: Austria , Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom</p> <p><input checked="" type="checkbox"/> The product fulfils 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</p>	

Copy of Marking Plate - Refer to Enclosure titled Marking Plate for copy.

Test item particulars	
Equipment mobility	for building-in
Connection to the mains	mating connector
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	No
IT testing, phase-phase voltage (V)	--
Class of equipment	--
Considered current rating of protective device as part of the building installation (A)	20
Pollution degree (PD)	PD 2
IP protection class	IP X0
Altitude of operation (m)	5000 m
Altitude of test laboratory (m)	less than 2000 meters
Mass of equipment (kg)	3.6kg QM8, 3.2kg for QM7, 2.3kg for QM5 and 1.9/kg for the QM4

Possible test case verdicts:	
- test case does not apply to the test object	N/A
- test object does meet the requirement	P (Pass)
- test object does not meet the requirement	F (Fail)
Testing	
Date of receipt of test item	2018-11-20 TO 2020-08-21
Date (s) of performance of tests	2020-07-06 TO 2020-08-24
General remarks:	
"(See Enclosure #)" refers to additional information appended to the report. "(See appended table)" refers to a table appended to the report. Throughout this report a <input type="checkbox"/> comma / <input checked="" type="checkbox"/> point is used as the decimal separator.	
Manufacturer's Declaration per sub-clause 4.2.5 of IEC 60950-1:	
The application for obtaining a CB Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> Not applicable
When differences exist; they shall be identified in the General product information section.	

Name and address of factory (ies) :	TDK-LAMBDA UK LTD KINGSLEY AVE ILFRACOMBE EX34 8ES UNITED KINGDOM PANYU TRIO MICROTRONICS CO LTD SHIJI INDUSTRIAL ESTATE DONGYONG NANSHA GUANGZHOU GUANGDONG 511453 CHINA TRIO-TRONICS (THAILAND) LTD 7/295 MU. 6 MAP YANG PHON SUB-DISTRICT PLUAK DAENG DISTRICT RAYONG PROVINCE THAILAND
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General product information:

Report Summary

The original report was modified on 2020-09-23 to include the following changes/additions:

Technical Amendment: This report has been revised to include the following changes:

1. Addition of QI series models which are identical to QM series.
2. Additional power ratings for QM or QI or QS series.
3. Addition of Non-standards KQM701HTx and KQM501DWx
4. High hold up option for the QM4
5. Amendments to the Critical Components List. Updated various component's certificate number, added U2 optocoupler, and updated C8 technical data.
- 6, Revised model nomenclature under model differences section of the report.
7. Added TRIO-TRONICS (THAILAND) LTD. factory.

Based on the previously conducted testing, the review of product technical documentation, and limited tests on QM series, it has been determined that the product continues to comply with the standard.

This report should be read in conjunction with CBTR Ref. No: E135494-A111-CB-2-Reissue, - Amd.1, and - Amd.2, CBTC Ref. no: DK-73020-M2-UL and DK-73021-M2-UL issued on 2020-05-15.

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 *(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, QI and QS series of switch mode power supplies. The QS is identical to the QM and QI series but allows for only one output made up from modules either in series or in parallel. The QM, QI and QS series consists of 4 slot models (QM4/QS4/QI4), 5 slot models (QM5/QS5/QI5), 7 slot models (QM7/QS7/QI7) and 8 slot models (QM8/QI8) 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, QI4 or QS4 are available as 550W or 650W and the QM5, QI5 or QS5 are available as 700W, 800W or 1200W and the QM7, QI7, QM8, QI8 or QS7 are available as 1200W or 1500W depending on the input voltage. There is a QM8B and QI8B version which are available as 2000W. High power/Low power and PMBus Standby Options may be fitted.

Units may be marked with a Product Code: KQMxy, KQIxy 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 (applicable to QM and QI models)

QMshabcdefghklm or QIshabcdefghklm for modular configurations

Where	s	=	4 for QM4 or QI4 models 5 for QM5 or QI5 models 7 for QM7 or QI7 models 8 for QM8 or QI8 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

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)

Module Signal Option Table

Letter	Voltage adjustment pot	inhibit	Module output good	Module output sense	Remote
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 = Blank or -E5H, -E5L, -T5H, -T5L, -E12H, -T12H, -P5H or -P12H
 Where: 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 = Blank for defaults or all of -[cooling][input connector][input fuse][leakage option]
- 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 related model differences.

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
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 output (first output is 1)	Name
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		Nomenclature outputs
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, SC and DM modules, all outputs are SELV except under the following circumstance: Outputs connected in series are non-SELV if, using the formula below, VTotal is found to be >60Vdc

$$V_{Total} = (n-1) \times V_{outmax} + X$$

Where n is the number of seriesed outputs
Where X is taken from the table below
Where Voutmax is taken from the table below

SC modules	Voutmax	OVP (% Voutnom)	X
5	5.5	140	7
12	13.2	140	16.8
24	26.4	130	31.2
36	39.6	140	50.4
SB modules	Voutmax	OVP (% Voutnom)	X
3.3	3.63	140	4.62
5	5.5	140	7
12	13.2	140	16.8
15	16.5	140	21
18	19.8	140	25.2
24	26.4	130	31.2
28	30.8	140	39.2
48	52.8	125	60
DM modules	Voutmax	OVP (% Voutnom)	X
12	16.1	135	21.7
24	28.8	135	38.8

For DH modules, all outputs are SELV except under the following circumstance: Outputs connected in series are non-SELV if, using the formula below, VTotal is found to be >60Vdc

$$V_{Total} = (2 \times V_{outmax} \times 1.3) + (n-2) \times V_{outmax}$$

Where n is the number of outputs connected in series

DH modules	Voutmax	OVP (% Voutnom)
12	13.8	130
15	17.25	130
24	27.6	130
27	31	130

If the total voltage of outputs connected in series exceeds the 60Vdc SELV limit then all outputs must be considered non-SELV.

Input Parameters

QM4/QI4/QS4

Input voltage nom. 100 - 240Vac, 144 - 318Vdc*** (200 - 240Vac, 239 - 318Vdc)* (115 - 240Vac)****
 Input voltage range **85 - 264Vac, 130 - 350Vdc (180 - 264Vac, 215 - 350Vdc)* (103.5 - 264Vac)****
 Input frequency range 47 - 440Hz or dc
 Maximum input current 9Arms or 6Adc (6Arms or 5Adc for 650W model) (9A rms)****
 * 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
 ***Input for 550W models
 ****Input for 600W models

QM5/QI5/QS5

Input voltage nom. 100 - 240Vac, 144 - 318Vdc*** (200 - 240Vac, 239 - 318Vdc)* (115 - 240Vac)****
 Input voltage range **85 - 264Vac, 130 - 350Vdc (180 - 264Vac, 215 - 350Vdc)* (103.5 - 264Vac)****
 Input frequency range 47 - 440Hz or dc
 Maximum input current 11Arms or 7Adc*** (9Arms or 7Adc for 800 and 1200W model) (11A rms)****
 * 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
 ***Input for 700W models

****Input for 750W models

QM7/QI7/QS7

Input voltage nom. 100 - 240Vac, 144 - 318Vdc*** (166.7 - 240Vac, 239 - 318Vdc)* (115 - 240Vac)****
 Input voltage range **85 - 264Vac, 130 - 350Vdc*** (150 - 264Vac, 215 - 350Vdc)* (103.5 - 264Vac)****
 Input frequency range 47 - 440Hz or dc
 Maximum input current 19Arms or 13Adc*** (14Arms or 9Adc for 1500W model) (19A rms)****

* 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

***Input for 1200W models.

****Input for 1300W models

QM8/QI8

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

***Input for 1200W models.

QM8B/QI8B

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 °C above 50°C

****Input for 1200W models.

QM4, QI4 QM5, QI5, QM7, QI7, QI8 and QM8 Output parameters

Module output ratings table.

Module	Note	Number of slots	Output Channel	Vout	Adjustmen nom 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	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	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	Yes
SA	-	1	CH1	5	5 to 5.5	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	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	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	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	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	Yes
SC	-	2	CH1	24	24 to 26.4	25	600	Yes	
SC	-	2	CH1	30	30 to 33		20 600	Yes	Yes
SC	-	2	CH1	36	36 to 39.6		16.7 600	Yes	Yes
SC	-	2	CH1	48	48 to 52.8		12.5 600	Yes	Yes
ZC	-	2	CH1	15	15 to 16	36	540	Yes	
ZC	-	2	CH1	20	20 to 22		27 540	Yes	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	Yes
ZF	6	4	CH1	5	5 to 5.3	110	550	Yes	
ZF	-	4	CH1	12	12 to 12.8		90 1080	Yes	Yes
ZF	9	4	CH1	17	17 to 18.19		63.5 1080	Yes	Yes
ZF	-	4	CH1	36	36 to 38.4		29 1044	Yes	Yes
ZH	10	6	CH1	24	24 to 25.6		62.4 1200	Yes	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 Ambient	Comments (applicable to 50C Option ambient only)
				fitted		

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/QI4*						
QS5/QI5**						
QI8***						

Cooling options QM4/QS4/QI4

Cooling option	Input voltage (Vac nom)	Output power (W)	Ambient (°C)
F (Forward air, variable speed)	100 - 240*	550	50
	115-240	600	50
	200 - 240**	650	50
C (Customer air)	100 - 240*	550	50
	115-240	600	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/QI5

Cooling option	Input voltage (Vac nom)	Output power (W)	Ambient (°C)
F (Forward air, variable speed)	100 - 240*	700	50
	115-240	750	50
	200 - 240**	800	50
C (Customer air***)	200 - 240**	1200	50
	100 - 240*	700	50
	115-240	750	50
R (Reverse air, variable speed fan)	200 - 240**	800	50
	200 - 240**	1200	50
	100 - 240*	700	35
	200 - 240**	800	30
	200 - 240**	1200	30

***not applicable to IEC version

*144 - 318Vdc nom.

**239 - 318Vdc nom.

Cooling options QM7/QS7/QI7

Cooling option	Input voltage (Vnom)	Output power (W)	Ambient (°C)	
F (Forward air, variable speed)	100 - 240*	1200	50	
	115-240	1300	50	
	166.7 - 240**	1500	50	50
C (Customer air)	100 - 240*	1200	50	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/QI8

Cooling option	Input voltage (Vnom)	Output power (W)	Ambient (°C)	
F (Forward air, variable speed)	100 - 240*	1200	50	
	166.7 - 240**	1500	50	
	100 - 240*	1200	50	50
C (Customer air)	100 - 240*	1200	50	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/QI8B

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	
	100 - 240*	1200	50	50
C (Customer air)	100 - 240*	1200	50	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

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

TRF No. IEC60950_1G

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 standard QM7 model using a non-standard module:

NS-TLI/QM7FSDL 165YD 48SBS 48SBS 48SBS B/S

This model uses 3 non-standard 48VSB modules, adjusted to 55Vdc, to give a module with a maximum output of 165Vdc.

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.

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

The KQM700HJx is 7 slot non-standard QM7 model:

NS-TLA/QM7FSDSQ5J3EC B/S 24SBSC 24SBSC 24SBSC 24SBSC 12SBSC B/S

This model has an option Q PMBus fitted in slot 1.

KQM501DWx (where x may be any letter for non-safety differences).

The KQM501DWx is a non-standard QM5 model.

NS-TLI/QM5RSDL 12/5.2DMS 12/5.2DMS 12/3.5DMS 24SBS B/S

This reverse air configuration is limited to a maximum of 350 Watts in a 50°C ambient.

KQM701HTx (where x may be any letter for non-safety differences).

The KQM701HTx is a non-standard QM7 model.

NS-TLA/QM7CSDSP5HC 18ZHSC B/S

This non-standard has additional signal components added to both the PFC and PMbus PCBs.

Additional application considerations – (Considerations used to test a component or sub-assembly) –

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 Considerations

- 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
- 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

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 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 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.
- For frequencies above 63Hz, touch current should be assessed in the end application.

Abbreviations used in the report:

- normal conditions	N.C.	- single fault conditions	S.F.C
- functional insulation	OP	- basic insulation	BI

- double insulation	DI	- supplementary insulation	SI
- between parts of opposite polarity	BOP	- reinforced insulation	RI

Indicate used abbreviations (if any)