

TEST REPORT IEC 62040-3 Uninterruptible power systems Part 3: Method of specifying the performance and test requirements	
Report Number	ES160513047S-1
Date of issue	March 22, 2018
Total number of pages	53 pages
Applicant's name	EAST Group Co., Ltd.
Address	No.6 Northern Industry Road, Songshan Lake Sci. & Tech. industrial park, Dongguan City, Guangdong Province, China
Test specification:	
Standard	IEC 62040-3 (Second Edition): 2011
Test procedure	Compliance with IEC 62040-3 (Second Edition): 2011
Non-standard test method	N/A
Test Report Form No.	IEC62040_3B
Test Report Form(s) Originator	Electrosuisse
Master TRF	Dated 2011-08
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Test item description	Online High frequency UPS
Trade Mark	EAST
Manufacturer	EAST Group Co., Ltd. No.6 Northern Industry Road, Songshan Lake Sci. & Tech. industrial park, Dongguan City, Guangdong Province, China
Model/Type reference	1kVA, 2kVA, 3kVA, 6kVA , 10kVA
Ratings	See marking plate



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TESTING
CNAS L2291

EMTEK
Access to the World

Testing procedure and testing location:		
<input checked="" type="checkbox"/>	Testing Laboratory:	EMTEK (SHENZHEN) CO., LTD.
Testing location/ address.....:		Bldg 69, Majialong Industry Zone, Nanshan District, Shenzhen, Guangdong, China
<input type="checkbox"/>	Associated Laboratory:	
Testing location/ address.....:		
Tested by (name + signature)..... :		Han Liu / Engineer
Approved by (name + signature).. :		William Guo / Manager
<input type="checkbox"/>	Testing procedure: TMP	
Testing location/ address.....:		
Tested by (name + signature)..... :		
Approved by (name + signature).. :		
<input type="checkbox"/>	Testing procedure: WMT	
Testing location/ address.....:		
Tested by (name + signature)..... :		
Witnessed by (name + signature) :		
Approved by (name + signature).. :		
<input type="checkbox"/>	Testing procedure: SMT	
Testing location/ address.....:		
Tested by (name + signature)..... :		
Approved by (name + signature).. :		
Supervised by (name + signature):		
<input type="checkbox"/>	Testing procedure: RMT	
Testing location/ address.....:		
Tested by (name + signature)..... :		
Approved by (name + signature).. :		
Supervised by (name + signature):		

List of Attachments (including a total number of pages in each attachment):

Attachment No. 1: 9 pages of photograph.

Summary of testing:

Tests performed (name of test and test clause):

The submitted samples were found to comply with the requirements of:
IEC 62040-3 (Second Edition):2011

Testing location:

EMTEK (SHENZHEN) CO., LTD.
Bldg 69, Majialong Industry Zone, Nanshan District,
Shenzhen, Guangdong, China

Summary of compliance with National Differences

National differences and Group differences as per CB bulletin.

☒ The product fulfils the requirements of IEC 62040-3 (Second Edition):2011

Copy of marking plate

The artwork below may be only a draft. The use of certification marks on a product must be authorized by the respective NCBs that own these marks.

Model: 1kVA

Input: 208-240Vac 50/60Hz 1 Φ

Output: 208-240Vac 50/60Hz 1 Φ

Capacity: 1kVA/900W

DC input: 24VDC

S/N: 900011608090001



Model: 2kVA

Input: 208-240Vac 50/60Hz 1 Φ

Output: 208-240Vac 50/60Hz 1 Φ

Capacity: 2kVA/1800W

DC input: 48VDC

S/N: 900021608090001



Model: 3kVA

Input: 208-240Vac 50/60Hz 1 Φ

Output: 208-240Vac 50/60Hz 1 Φ

Capacity: 3kVA/2700W

DC input: 72VDC

S/N: 900031608090001



Model: 6kVA

Input: 208-240Vac 50/60Hz 1 Φ

Output: 208-240Vac 50/60Hz 1 Φ

Capacity: 6kVA/5400W

DC input: 192VDC

S/N: 900061608090001



Model: 10kVA

Input: 208-240Vac 50/60Hz 1 Φ

Output: 208-240Vac 50/60Hz 1 Φ

Capacity: 10kVA/9000W

DC input: 192VDC

S/N: 900101608090001



Test item particulars :	
Classification of installation and use :	<input type="checkbox"/> movable <input type="checkbox"/> hand-held <input type="checkbox"/> transportable <input checked="" type="checkbox"/> stationary <input type="checkbox"/> for building-in <input type="checkbox"/> direct plug-in
Supply Connection..... :	<input type="checkbox"/> pluggable equipment <input type="checkbox"/> type A <input type="checkbox"/> type B <input checked="" type="checkbox"/> permanent connection <input type="checkbox"/> detachable power supply cord <input type="checkbox"/> non-detachable power supply cord <input type="checkbox"/> not directly connected to the mains <input type="checkbox"/> built-in component, consider in end system
Operating condition :	<input checked="" type="checkbox"/> continuous <input type="checkbox"/> rated operating / resting time:
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 :	N/A
Date (s) of performance of tests..... :	N/A
General remarks: <p>The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory. "(see Enclosure #)" refers to additional information appended to the report. "(see appended table)" refers to a table appended to the report.</p> <p>Throughout this report a <input checked="" type="checkbox"/> comma / <input type="checkbox"/> point is used as the decimal separator.</p>	
Manufacturer's Declaration per sub-clause 6.2.5 of IEC60950-1: <p>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.....:</p> <div style="display: flex; align-items: center;"> <input type="checkbox"/> Yes <input checked="" type="checkbox"/> Not applicable </div>	
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (ies) :	Santak Electronic (Shenzhen) Co., Ltd. No.6 Northern Industry Road, Songshan Lake Sci. & Tech. industrial park, Dongguan City, Guangdong Province, China

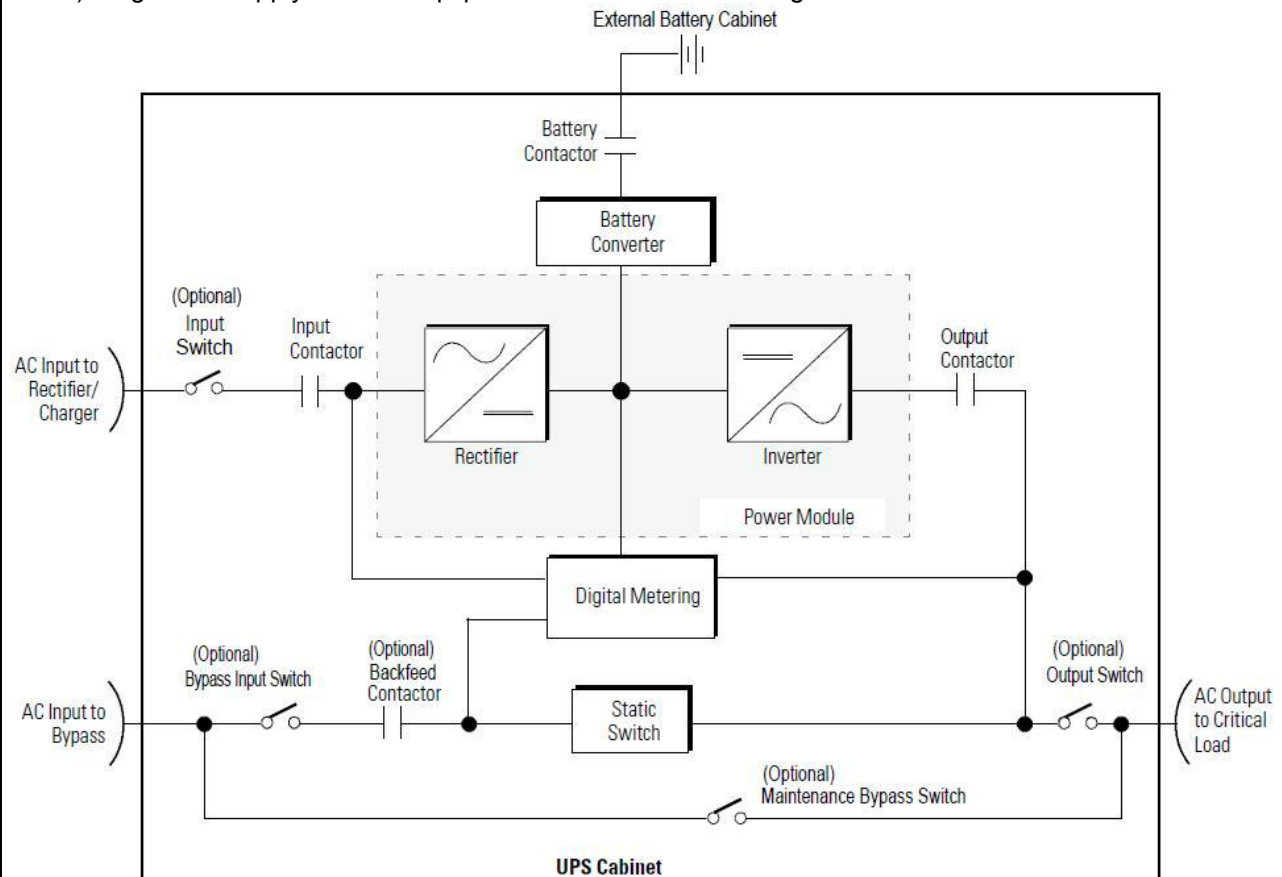
General product information:

This report is amended from previous report no. ES160513047S issued on August 05, 2016 due to below amendments:

- Update certificate and report issued date to March 22, 2018.

No tests need to retest.

The equipment is on-line type uninterruptible power supply with step-sinewave o/p (line mode and battery mode) for general supply of office equipment. See below block diagram for details:



External battery cabinet is optional and not provided with the UPS. No internal batteries inside.

Model difference:

The maximum operating temperature is 40°C, Relative humidity 5 to 95%, no condensation allowed, ambient storage temperature range of -15 to +55°C in the protective package.

Operating altitude up to 2000m above sea level.

IEC 62040-3			
Clause	Requirement + Test		Verdict
5	ELECTRICAL SERVICE CONDITIONS AND PERFORMANCE		--
5.1	General		P
5.1.1	UPS configuration		P
	- quantity of UPS units and their topology	Max 4 units for parallel setup, redundancy configuration, Online double conversion UPS	P
	- Redundancy configuration as applicable	Redundancy configuration is available for parallel setup.	P
	- Any mayor UPS switch	REC input switch, bypass input switch, and maintenance switch and output switch are optional parts.	P
	- operator access or restricted access classification in accordance with IEC 62040-1	See separate safety report.	P
5.1.2	Markings and Instructions		P
	Marked and supplied with adequate instruction for the installation and operation of the UPS and its controls and indications	All required markings are affixed on labels located on the enclosure of UPS.	P
	Markings and instructions in accordance with sub-clause 4.7 of IEC 62040-1	See separate safety report.	P
5.1.3	Safety complies with the safety requirements of UPS prescribed in IEC 62040-1	See separate safety report.	P
5.1.4	Electromagnetic compatibility complies with the requirements of IEC 62040-2	Emission and immunity comply with IEC 62040-2 C3, see separate report	P
5.2	UPS input specification		P
5.2.1	Conditions for normal mode operation		P
	a) rated voltage	208–240V (-15%, +20%) at 100% load.	P
	b) r.m.s. voltage variation	-15% to +20% at 100% load	P
	c) rated frequency	50Hz/60Hz	P
	d) frequency variation	42-70Hz	P
	e) for three phases input, voltage unbalance with an unbalance ratio of 5%	(see appended table 6.2.2.7)	P
	f) total harmonics distortion (THD) of voltage, according to IEC 61000-2-2		P
	g) transient voltage; within the electromagnetic immunity levels prescribed in IEC 62040-2		P
5.2.2	Characteristics to be declared by the manufacturer		P
	a) number of phases	single phases	P
	b) neutral requirements	With neutral	P
	d) power factor at rated current	0.99pf at 100% load	P

IEC 62040-3			
Clause	Requirement + Test	Result - Remark	Verdict
	e) inrush current characteristics	≤120% of rated current for ≤2 cycles.	P
	f) maximum continuous current at the worst-case condition	Maximum 50A at Normal condition, Maximum 60A at bypass condition.	P
	g) overload current	Maximum 40A at Normal condition, Maximum 60A at bypass condition.	P
	h) total harmonic distortion (THD) of current	<5%	P
	i) minimum short current power capacity; in compliance with: - IEC 61000-3-2 (UPS ≤16A) - IEC 61000-3-12 (16A < UPS ≤75A) - IEC 61000-3-4 (UPS > 75A)	50A	P
	j) earth leakage current characteristics	Maximum Earth leakage < 5% of nominal input current rating.	P
	k) a.c. power distribution system compatibility TN, TT or IT):	TN, TN-S, TN-C, TN-C-S, TT (single phase).	P
5.2.3	Characteristics and conditions to be identified by the purchaser		P
	a) pre-existing harmonic voltage distortion when of 75% of IEC 61000-2-2 compatibility level at the intended point of coupling of the UPS	Provided	P
	b) requirements for compatibility with the characteristics of protective devices of the UPS input supply	REC input switch, bypass input switch, maintenance switch and output switch are optional parts.	P
	c) requirements for all-pole isolation		P
	d) stand-by generator characteristics	Compatible with generator of rating typically >1,5x UPS kW.	P
5.3	UPS output specification		P
5.3.1	Conditions for the UPS to supply a load		P
	- the input conditions of 5.2.1 being satisfied, or		P
	- the energy storage system being available		P
5.3.2	Characteristics to be declared by the manufacturer		P
	a) performance classification in accordance with 5.3.4		P

IEC 62040-3			
Clause	Requirement + Test	Result - Remark	Verdict
	b) rated voltage and steady state variation	208-240V, $\pm 1\%$ Balanced static load, $\pm 6\%$ with 5ms recovery from 10% to 90% load step, $\pm 5\%$ Balanced dynamic load for normal mode, $\pm 0.005\text{Hz}$ (single module), $\pm 0.07\text{Hz}$ (Parallel system) for Stored Energy Mode	P
	c) rated frequency and free running variation	50Hz, $\pm 0.1\text{ Hz}$	P
	d) maximum frequency range	$\pm 4\text{Hz}$ (default) selectable from $\pm 1\text{Hz}$ to $\pm 4\text{Hz}$ for normal mode, $\pm 0.005\text{Hz}$ (single module), $\pm 0.07\text{Hz}$ (Parallel system) for Stored Energy Mode	P
	e) rate of change of frequency when synchronizing	0.5Hz/sec (default), 1Hz/s, or 7Hz/s selectable.	P
	f) number of phases available	3 phases	P
	g) neutral availability	With neutral	P
	h) a.c. power distribution system compatibility:	TN, TN-S, TN-C, TN-C-S, TT (Three-phase, four-wire + PE).	P
	i) total harmonic distortion (THD) of voltage (at linear and non-linear load as specified in annex E):		P
	- in normal mode	<1% with linear load, 5% with non-linear load	P
	- in stored energy mode	<1% (Across a linear load); 5% (Across a non-linear load)	P
	j) output voltage transient deviation	Vrms L-L or L-N <5% transient overshoot, 20ms recovery time	P
	k) rated active and apparent output power and rated current	AC208-240V, 50/60Hz, 8A/15A/20A/40A/60A	P
	l) overload capability	103–115% load 10 minutes, 116–125% load 1 minute, 126–149% load 10 seconds, >150% load 150ms at 30°C without bypass 115% load continuous, 1000% for 20ms at 40°C and $\leq 1000\text{m}$ altitude with bypass	P
	m) current limit identification	50A	P
	n) fault clearing capability	Through upstream breaker or fusing for BYPASS. Through fusing and breaker for Rectifier.	P
	o) rated load power factor	0.9	P

IEC 62040-3			
Clause	Requirement + Test	Result - Remark	Verdict
	p) permissible displacement power factor range of the load (cos. Φ)	0.8 lagging to 0.8 leading with de-rating.	P
	q) voltage unbalance and phase angle displacement	< 2%, <2.5 deg.	P
	e) UPS efficiency at 25%, 50%, 75% and 100% reference test load	94.58%, 95.78%, 95.94%, 95.95%	P
5.3.3	Characteristics and conditions to be identified by the purchaser		P
	a) loads generating harmonic currents (max. levels permitted in IEC 61000-3-2, /-12/ -4)	Provided	P
	b) asymmetric loads requiring circulation of a d.c. current	Provided	P
	c) independent earth of the neutral required	Provided	P
	d) load distribution facilities	Provided	P
	e) requirements of all-pole isolation	Provided	P
	f) requirements for coordination with characteristics of protective devices	Provided	P
	g) future extension/expansion requirements	Provided	P
	h) stand-by generator characteristics	Compatible with generator of rating typically >1,5x UPS kW.	P
	i) functional availability and degree of redundancy	Provided	P
	j) output overvoltage protection	Provided	P
5.3.4	Performance classification		P
	UPS complying with this standard in accordance with the coding: AAA BB CCC		P
	AAA = Input dependency characteristic	VFI	P
	BB = Voltage waveform characteristic	SS	P
	CCC = Dynamic output performance	111	P
5.4	Stored energy specification		P
5.4.1	General	See technical specification	P
5.4.2	Battery		P
5.4.2.1	Requirements for all batteries	See separate safety report.	P
5.4.2.2	Characteristic to be declared by the manufacturer		P
	a) life	5 or 10 years (depends)	P
	b) quantity of blocks or cells and of paralleled strings	36 blocks, 216 cells per battery string or 38 blocks, 228 cells per battery string or 40 blocks, 240 cells per battery string (default).	P
	c) nominal voltage of total battery	432V (216 Cells) or 456V (228 Cells) or 480V (240 Cells, Default).	P

IEC 62040-3			
Clause	Requirement + Test	Result - Remark	Verdict
	d) battery technology	Boost/buck.	P
	e) nominal capacity of total battery	Depend on battery size.	N/A
	f) stored energy time	Depend on battery size.	N/A
	g) restored energy time	Restored energy time to 90%: Maximum 10 hours recommended (depend on battery size).	P
	h) ambient reference temperature	Battery (installed separately): +5 to +25 °C without reducing battery life.	P
	i) earth condition of d.c. link/isolation		P
	j) r.m.s. ripple current during normal mode	(see appended table)	P
	k) nominal discharge current during stored energy mode	DC480Vmax, 377Amax.	P
	l) d.c. fault current rating		P
	m) cable voltage drop recommendation	<1% of nominal DC voltage at rated battery current.	P
	n) protection requirements	DC input breaker or fuse.	P
	o) charging regime	Advanced Battery Management (ABM®) = 90% resting, 10% floating/charging (typical).	P
	p) charging voltage and tolerance band	Float charge voltage : 208-240 x 2.30V = 478.4-552V; Maximum charge voltage: 208-240 x 2.35V = 488.8- 564V.	P
	q) end of discharge voltage	216 Cells = 1.8V/Cell, 228 Cells = 1.73V/Cell, 240 Cells = 1.67V/Cell	P
	r) charging current limit or range	Charging current (at full load) 5A.	P
5.4.2.3	Characteristics and conditions to be identified by the purchaser		P
5.5	UPS switch specification	REC input switch, bypass input switch, maintenance switch and output switch are optional parts.	P
5.6	Communication circuits	Mini-Slot cards: Web/SNMP, Relay/RS232, Industrial Relay, ModBus.	P
6	UPS tests		--
6.1	Summary		P
6.1.1	Venue, instrumentation and load		P

IEC 62040-3			
Clause	Requirement + Test	Result - Remark	Verdict
6.1.1.1	Test venue		P
	A UPS shall generally be tested at the manufacturer's premises and in accordance with Table 3		P
6.1.1.2	Test instrumentation		P
6.1.1.3	Test load		P
	Test load are performed as prescribed in the relevant test clause, with		P
	- reference linear load		P
	- reference non-linear load		P
6.1.2	Routine test	Decided by manufacture and purchaser	P
6.1.3	Site test		N/A
6.1.4	Witness test	Decided by manufacture and purchaser	P
6.1.5	Type test		P
6.1.6	Schedule of tests		N/A
	Tests shall be performed in accordance with Table 3		N/A
6.2	Routine test procedure		P
6.2.2	Electrical		P
6.2.2.1	Insulation and dielectric	See separate safety report.	P
6.2.2.2	Cable and interconnection check		P
	All a.c. and d.c. supply terminals are connected to the a.c. input supply, to the stored energy source and to the load		P
	Any communication circuit is connected as required		P
6.2.2.3	Light load and functional test		P
	a) all control switches and other means to activate UPS operation		P
	b) protective devices		P
	c) auxiliary devices, such as contactors, fans, outlets, annunciators and communication devices		P
	d) supervisory, monitoring and remote signalling devices		P
	e) auto transfer to stored energy mode and back to normal mode by failing and subsequently restoring the a.c. input voltage		P
	f) auto transfer to bypass or isolation of the inverter from a common a.c. output bus and back to normal mode by failing and subsequently restoring the inverter a.c. output voltage		P

IEC 62040-3			
Clause	Requirement + Test	Result - Remark	Verdict
	g) manual transfer to bypass or isolation of the inverter from a common a.c. output bus and back to normal mode by operating appropriate switches and/or controls		P
6.2.2.4	No load		P
6.2.2.5	Full load		P
6.2.2.6	Synchronisation		P
6.2.2.7	AC input failure		P
6.2.2.8	AC input return	(see appended table)	P
6.2.2.9	Transfer to bypass		P
6.3	Site test procedure		N/A
	Site test shall preferably occur under conditions representing those of actual service and shall use the load available on site.		N/A
	The load shall not exceed the rated continuous load of the complete UPS as configured on site, or		N/A
	Test performed with reference test load as defined in 3.3.5		N/A
6.4	Type test procedure (electrical)		P
6.4.1	Input – a.c. supply compatibility	(see appended table)	P
6.4.1.1	Steady-state input voltage tolerance	(see appended table)	P
6.4.1.2	Input frequency tolerance	(see appended table)	P
6.4.1.3	Inrush current	(see appended table)	P
6.4.1.4	Harmonic distortion of input current	(see appended table)	P
6.4.1.5	Power factor	(see appended table)	P
6.4.1.6	Efficiency	(see appended table)	P
6.4.1.7	Backfeed protection	See separate report.	P
6.4.1.8	Residual earth current	See separate report.	P
6.4.1.9	Stand-by generator compatibility test		P
6.4.1.10	Electromagnetic compatibility	See separate report.	P
6.4.2	Output-Linear load	(see appended table)	P
6.4.2.1	Normal mode- No load	(see appended table)	P
6.4.2.2	Normal mode – Full load	(see appended table)	P
6.4.2.3	Stored energy mode – No load	(see appended table)	P
6.4.2.4	Stored energy mode – Full load	(see appended table)	P
6.4.2.5	3-phase unbalance	(see appended table)	P
6.4.2.6	DC component		P
6.4.2.7	Load sharing test	Provided	P

IEC 62040-3			
Clause	Requirement + Test	Result - Remark	Verdict
6.4.2.8	Output overvoltage test	(see appended table)	P
6.4.2.9	Periodic output voltage variation test	(see appended table)	P
6.4.2.10	Overload and fault clearing capability		P
6.4.2.10.1	Overload – Normal mode	(see appended table)	P
6.4.2.10.2	Overload – Stored energy mode	(see appended table)	P
6.4.2.10.3	Fault clearing capability – Normal mode	(see appended table)	P
6.4.2.10.4	Fault clearing capability – Stored energy mode	(see appended table)	P
6.4.2.11	Dynamic performance		P
6.4.2.11.1	Normal to stored energy mode	(see appended table)	P
6.4.2.11.2	Stored energy to normal mode	(see appended table)	P
6.4.2.11.3	Normal to bypass mode – Overload	(see appended table)	P
6.4.2.11.4	Step load – Normal mode	(see appended table)	P
6.4.2.11.5	Step load – Stored energy mode	(see appended table)	P
6.4.2.11.6	Test method – linear load	(see appended table)	P
6.4.2.12	Simulation of parallel redundant UPS fault	(see appended table)	P
6.4.3	Output – Non-linear load		P
	Tests performed with non-linear load as defined in annex E	(see appended table)	P
6.4.3.1	Normal mode – Full load	(see appended table)	P
6.4.3.2	Stored energy mode – Full load	(see appended table)	P
6.4.3.3	Dynamic performance		P
6.4.3.3.1	Normal to stored energy mode	(see appended table)	P
6.4.3.3.2	Stored energy to normal mode	(see appended table)	P
6.4.3.3.3	Load step – Normal mode		P
	a) UPS ≤ 4.0 kVA rating		N/A
	b) UPS > 4.0kVA rating	(see appended table)	P
6.4.3.3.4	Load step –stored energy mode	(see appended table)	P
6.4.4	Stored and restored energy		P
6.4.4.1	Stored energy time		N/A
6.4.4.2	Restored energy time (to 90% capacity)		N/A
6.4.4.3	Battery ripple current measurement	(see appended table)	P
6.4.4.4	Restart test		P
6.5	Type test procedure (environment)		P
6.5.1	Environment and transportation test methods	See separate report.	P
6.5.2	Transportation		P
6.5.2.1	Shock test	(See separate report)	P

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Clause	Requirement + Test	Result - Remark	Verdict
	a) initial measurement		P
	b) mode of operation		P
	c) Tests		P
	d) final requirements		P
	e) final measurements		P
6.5.2.2	Free fall test	See separate report.	P
	a) initial measurement		P
	b) mode of operation		P
	c) test		P
	d) measurements during testing		P
	e) final requirements		P
	f) final measurements		P
6.5.3	Storage	See separate report.	P
	a) initial measurement		P
	b) mode of operation		P
	c) tests		P
	d) measurements during test		P
	e) Final requirements		P
	f) Final measurements		P
6.5.4	Operation	See separate report.	P
	a) initial measurement		P
	b) mode of operation		P
	c) test		P
	d) measurements during testing		P
	e) final measurements		P
	f) final requirements		P
6.5.5	Acoustic noise	(See separate report)	P
	Measured when UPS operates at rated steady-state linear load under the following conditions:		P
	- normal mode		P
	- stored energy mode		P
6.6	UPS functional unit tests (where not tested as a complete UPS)		N/A
6.6.1	UPS rectifier test		N/A
6.6.2	UPS inverter tests		N/A
6.6.3	UPS switch tests		N/A
6.6.4	Stored energy / battery tests		N/A

IEC 62040-3			
Clause	Requirement + Test	Result - Remark	Verdict

5.2.1.e 5.3.2.q 6.4.2.5	TABLE: - 3-phase input, voltage unbalance	N/A	
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Description of test conditions / test construction:

- 1) Start the UPS in normal mode at nominal input voltage and frequency (230V/50Hz), apply balance full linear load and unbalance linear load.

2) Voltage regulation is defined as:
$$\Delta_V = \frac{\sqrt{U_{ab}^2 + U_{ca}^2 - 2 * U_{ab} * U_{ca} * \cos\left(\frac{\pi}{3} - \arccos\frac{U_{ab}^2 + U_{ca}^2 - U_{bc}^2}{2 * U_{ab} * U_{ca}}\right)}}{\sqrt{U_{ab}^2 + U_{ca}^2 - 2 * U_{ab} * U_{ca} * \cos\left(\frac{\pi}{3} + \arccos\frac{U_{ab}^2 + U_{ca}^2 - U_{bc}^2}{2 * U_{ab} * U_{ca}}\right)}} \times 100\%$$

3) Angle deviation is defined as:
$$\Delta_{AB} = \frac{1}{\pi} \times \arccos\frac{U_{an}^2 + U_{bn}^2 - U_{ab}^2}{2 * U_{an} * U_{bn}} \times 180 - 120$$

$$\Delta_{BC} = \frac{1}{\pi} \times \arccos\frac{U_{bn}^2 + U_{cn}^2 - U_{bc}^2}{2 * U_{bn} * U_{cn}} \times 180 - 120 \quad \Delta_{CA} = \frac{1}{\pi} \times \arccos\frac{U_{cn}^2 + U_{an}^2 - U_{ca}^2}{2 * U_{cn} * U_{an}} \times 180 - 120$$

Measured data:

1、 Balance load

balance load	Va	Vb	Vc	Yv(%)<2 %	< 2.5 degree		
					△ ab	△ bc	△ ca
Ph. a=b=c 100% Linear load							

2、 Unbalance load

1) Ph. a=0,b=c=100% linear load

unbalance load	Va	Vb	Vc	Yv(%)<2 %	< 2.5 degree		
					△ ab	△ bc	△ ca
Ph. a=0 67%Linear load							

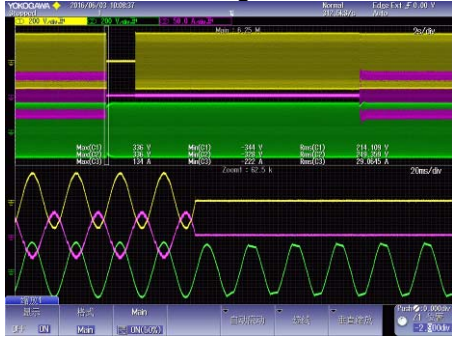
2) Ph. b=0,a=c=100% linear load

unbalance load	Va	Vb	Vc	Yv(%)<2 %	< 2.5 degree		
					△ ab	△ bc	△ ca
Ph. b=0 67%Linear load							

3) Ph. c=0,a=b=100% linear load

unbalance load	Va	Vb	Vc	Yv(%)<2 %	< 2.5 degree		
					△ ab	△ bc	△ ca
Ph. c=0 67%Linear load							


IEC 62040-3			
Clause	Requirement + Test	Result - Remark	Verdict

6.2.2.8 6.4.1.3 6.4.2.11.2	TABLE: - AC input return - Inrush current - Change of operating mode – Stored energy to normal mode	P	
<p>Description of test conditions / test construction:</p> <ol style="list-style-type: none"> AC input return UPS run in normal mode, applying 100% linear load. Then cut off input, UPS transfer to battery. A few seconds later, return AC input, UPS transfer to normal again. UPS run in normal mode, applying 100% linear load. Then cut off input, UPS transfer to battery. A few seconds later, return AC input with improper phase rotation, UPS can't transfer to normal and alarm "Rectifier Phase". Then cut off input, and return AC input with proper phase rotation, UPS transfer to normal again. 			
<p>Measured graph:</p> <p>1 AC input return</p> <p>1) UPS run in normal mode, applying 100% linear load. Then cut off input, UPS transfer to battery. A few seconds later, return AC input, UPS transfer to normal again.</p>  <p>Channel 1 - Input Voltage Channel 2 - Output Voltage Channel 3- Input Current</p> <p>2) UPS run in normal mode, applying 100% linear load. Then cut off input, UPS transfer to battery. A few seconds later, return AC input with improper phase rotation, UPS can't transfer to normal and alarm "Rectifier Phase Rotation Failed". Then cut off input, and return AC input with proper phase rotation, UPS transfer to normal again.</p> <p>2. Inrush current < 2.5X</p> <p>1) Vbus=0 input voltage=187V Inrush current=49A 2) Vbus>0 input voltage=187V Inrush current=35A</p> <p>3) Vbus=0 input voltage=230V Inrush current=56A 4) Vbus>0 input voltage=230V Inrush current=44A</p> <p>5) Vbus=0 input voltage=272V Inrush current=81A 6) Vbus>0 input voltage=272V Inrush current=68A</p>			

IEC 62040-3			
Clause	Requirement + Test	Result - Remark	Verdict

6.4.1.4	TABLE: -Harmonic distortion of input current				P
Description of test conditions / test construction: 1) The harmonic distortion of the input current is tested at reference test load. 2) Test result THDi < 5%					
Load(%)	Harmonic No.	Phase 1 (dB)	Phase 2 (dB)	Phase 3 (dB)	-
99%	3	3.2	/	/	-
99%	5	3.3	/	/	-
99%	7	3.3	/	/	-
99%	9	3.3	/	/	-
THD	Distortion at phase 1	Distortion at phase 2	Distortion at phase 3	Expected value due to the specification of the manufacturer	-
See formula to THD below(100% load)	3.3%	/	/	≤5%	-

$$THD = 100 \cdot \sqrt{\left(\frac{3\%}{10^{20}}\right)^2 + \left(\frac{5\%}{10^{20}}\right)^2 + \left(\frac{7\%}{10^{20}}\right)^2 + \left(\frac{9\%}{10^{20}}\right)^2}$$




IEC 62040-3			
Clause	Requirement + Test	Result - Remark	Verdict

6.4.1.5 & 6.4.1.6	TABLE: - Input power factor - Efficiency-Normal Mode				P
Description of test conditions / test construction: 1) UPS run in normal mode, charge off. The UPS efficiency shall be measured at 25%, 50%, 75% and 100% reference load. Input power factor = 0.999					
Load (%)	Efficiency	Input Power (KW)	Output Power (KW)	Expected value due to the specification of the manufacturer	Verdict
25	90.4%	2.50	2.26	90.00%	P
50	92.3%	4.82	4.45	91.00%	P
75	92.4%	7.10	6.56	92.00%	P
100	92.1%	9.70	8.93	92.00%	P

6.4.1.7 & 6.4.1.8	TABLE: - Input power factor - Efficiency				P
Description of test conditions / test construction: 1) UPS run in ECO mode, charge off. The UPS efficiency shall be measured at 25 %, 50 %, 75 % and 100 % reference load.					
Load (%)	Efficiency	Input power (W)	Output power (W)	Expected value due to the specification of the manufacturer	Verdict
25	95.5	2.47	2.36	95.00%	
50	96.5	4.62	4.46	96.00%	
75	98.1	6.66	6.54	98.00%	
100	98.3	9.28	9.12	98.00%	

6.4.2.1	TABLE: - Output – Linear load: Normal mode – No load - Harmonic components measurement				P
Description of test conditions / test construction: 1) With the UPS operating in normal mode of operation at no load and nominal input voltage and frequency, measure the r.m.s. output voltage and its fundamental and harmonic components.					
Load (%)	Harmonic No.	Phase 1 (dB)	Phase 2 (dB)	Phase 3 (dB)	-
0	3	0.7	/	/	-
0	5	0.8	/	/	-
0	7	0.7	/	/	-
0	9	0.7	/	/	-

IEC 62040-3					
Clause	Requirement + Test			Result - Remark	Verdict
THD	Distortion at phase 1	Distortion at phase 2	Distortion at phase 3	Expected value due to the specification of the manufacturer	-
see formula to THD below	0.7	/	/	≤5%	-
$THD = 100 \cdot \sqrt{\left(\frac{3^o}{10^{20}}\right)^2 + \left(\frac{5^o}{10^{20}}\right)^2 + \left(\frac{7^o}{10^{20}}\right)^2 + \left(\frac{9^o}{10^{20}}\right)^2}$ 					

6.4.2.2	TABLE: - Output – Linear load: Normal mode – Full load Harmonic components measurement					P
Description of test conditions / test construction: 1) UPS runs in normal mode, applying 100% reference test load to the UPS output, then measure output voltage and its fundamental and harmonic components.						
Load (%)	Harmonic No.	Phase 1 (dB)	Phase 2 (dB)	Phase 3 (dB)	-	
100	3	1.0	/	/	-	
100	5	1.0	/	/	-	
100	7	1.0	/	/	-	
100	9	1.0	/	/	-	
THD	Distortion at phase 1	Distortion at phase 2	Distortion at phase 3	Expected value due to the specification of the manufacturer	-	
see formula to THD below	1.0%	/	/	≤5%	-	
$THD = 100 \bullet \sqrt{\left(\frac{3^{\circ}}{10^{20}}\right)^2 + \left(\frac{5^{\circ}}{10^{20}}\right)^2 + \left(\frac{7^{\circ}}{10^{20}}\right)^2 + \left(\frac{9^{\circ}}{10^{20}}\right)^2}$						

IEC 62040-3			
Clause	Requirement + Test	Result - Remark	Verdict



6.4.2.3	TABLE: - Output – Linear load: Stored energy mode – No load - Harmonic components measurement	P
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Description of test conditions / test construction:

1) With the UPS operating in battery mode of operation at no load, measure the r.m.s. output voltage and its fundamental and harmonic components.

Load (%)	Harmonic No.	Phase 1 (dB)	Phase 2 (dB)	Phase 3 (dB)	-
0	3	0.7	/	/	-
0	5	0.7	/	/	-
0	7	0.7	/	/	-
0	9	0.7	/	/	-

THD	Distortion at phase 1	Distortion at phase 2	Distortion at phase 3	Expected value due to the specification of the manufacturer	-
see formula to THD below	0.7%	/	/	≤5%	-

$$THD = 100 \cdot \sqrt{\left(\frac{3}{10^{20}}\right)^2 + \left(\frac{5}{10^{20}}\right)^2 + \left(\frac{7}{10^{20}}\right)^2 + \left(\frac{9}{10^{20}}\right)^2}$$



6.4.2.4	TABLE: - Output – Linear load: Stored energy mode – Full load Harmonic components measurement	P
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Description of test conditions / test construction:

IEC 62040-3			
Clause	Requirement + Test	Result - Remark	Verdict

1) UPS runs in battery mode, applying 100 % reference test load to the UPS output, then measure output voltage and its fundamental and harmonic components.

Load (%)	Harmonic No.	Phase 1 (dB)	Phase 2 (dB)	Phase 3 (dB)	-
100	3	1.0	/	/	-
100	5	1.0	/	/	-
100	7	1.0	/	/	-
100	9	1.0	/	/	-

THD	Distortion at phase 1	Distortion at phase 2	Distortion at phase 3	Expected value due to the specification of the manufacturer	-
see formula to THD below	1.0%	/	/	≤5%	-

$$THD = 100 \cdot \sqrt{\left(10^{\frac{3^0}{20}}\right)^2 + \left(10^{\frac{5^0}{20}}\right)^2 + \left(10^{\frac{7^0}{20}}\right)^2 + \left(10^{\frac{9^0}{20}}\right)^2}$$



IEC 62040-3			
Clause	Requirement + Test	Result - Remark	Verdict

6.4.2.10.1	TABLE: Overload capability test – Normal mode	P
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Description of test conditions / test construction:

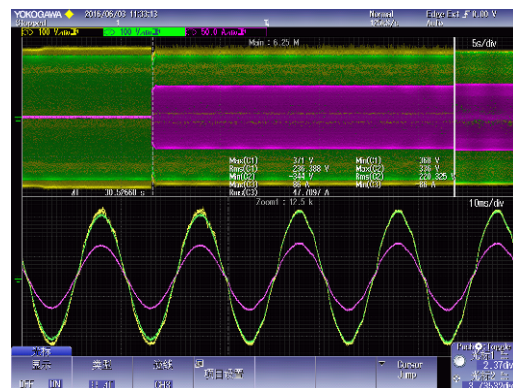
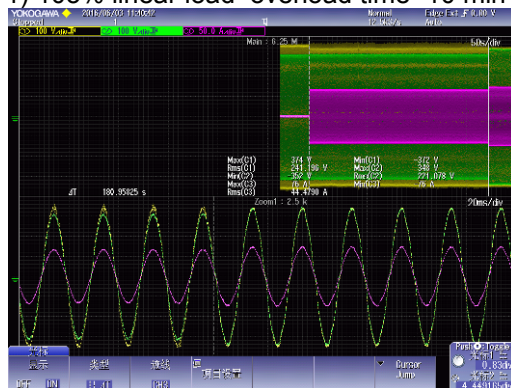
- 1) UPS in normal mode, apply below loads respectively to the output, check UPS performance and alarms.
- 2) Measure the overload time duration, check UPS transfer to bypass and transfer back to normal mode automatically if removing overload.

Condition	Specs
	30C ambient, 1000m, nominal Uin
Overloads	102 - 115% 10minutes
	126-150% 10s
	>150%, 150ms

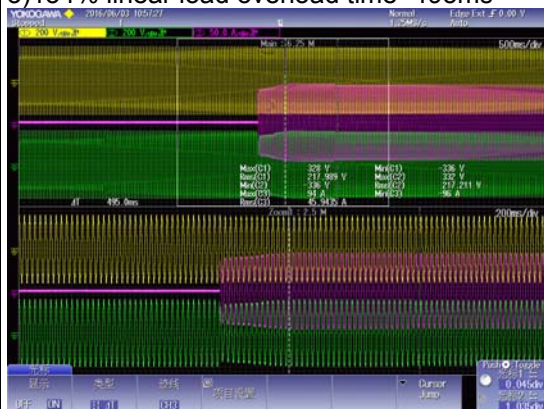
Load/(%)	Specified time interval	Verdict
116%	180	180.9
137%	30	30.5
154%	1	0.495

Measured data:

1) 105% linear load overload time=10 min



3)154% linear load overload time=495ms



Channel 1 - Input Voltage
Channel 2 - Output Voltage
Channel 3- Output Current

IEC 62040-3			
Clause	Requirement + Test	Result - Remark	Verdict

6.4.2.10.2	TABLE: Overload capability test – Stored energy mode	P	
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Description of test conditions / test construction:

- 1) UPS in battery mode, apply below loads respectively to the output, check UPS performance and alarms.
- 2) Measure the overload time duration, check UPS transfer to bypass and transfer back to battery mode automatically if removing overload.

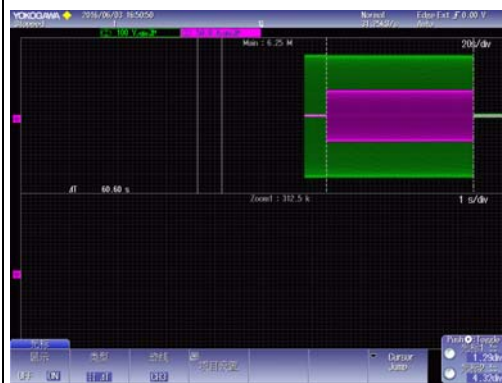
Condition	Specs
	30C ambient, 1000m, nominal Uin
Overloads	102 - 125% 1 minutes
	126-150% 30 seconds
	>150%, 150ms

Load/(%)	Specified time interval	Verdict
116%	60	60.6
138%	30	30.6
155%	1	0.7

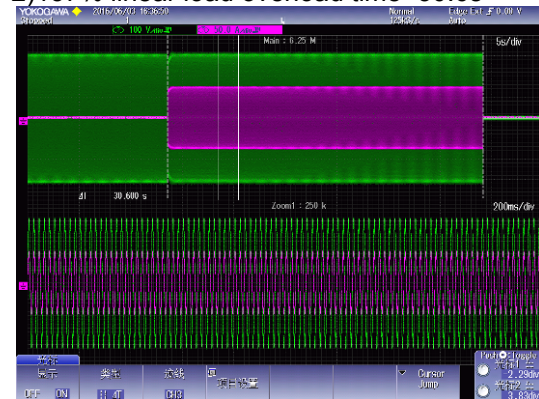
Measured data:

Measured graph:

1) 116% linear load overload time=60.6s



2) 137% linear load overload time=30.6s

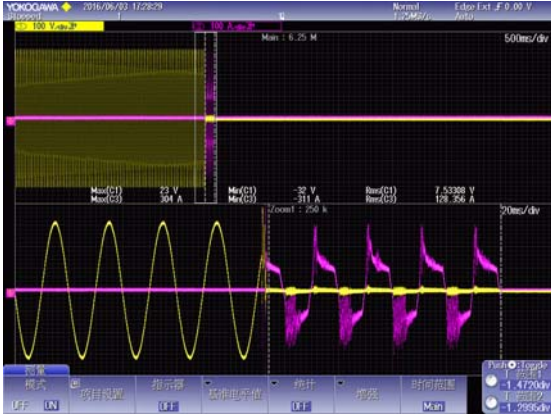



3) 154% linear load overload time=700ms

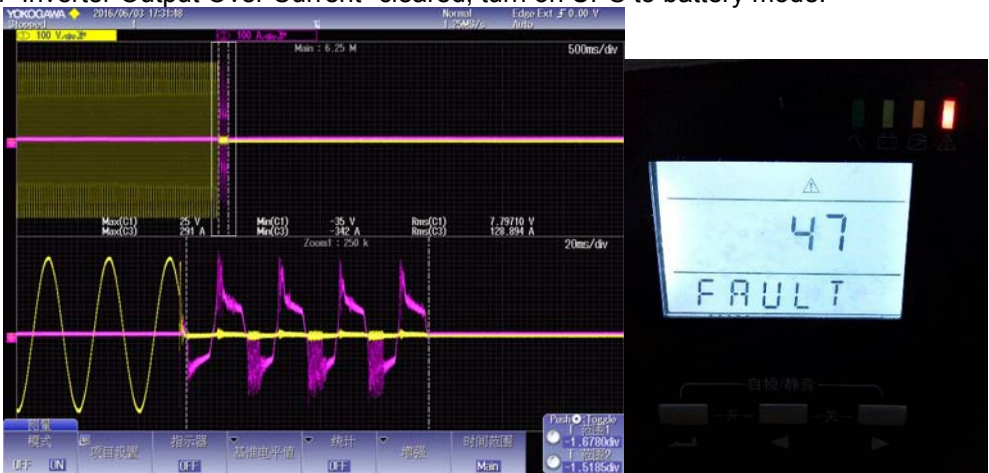


Channel 2 - Output Voltage

Channel 3- Output Current

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Clause	Requirement + Test	Result - Remark	Verdict
6.4.2.10.3	TABLE: - Fault clearing capability – Normal mode - Short circuit test		P
<p>Description of test conditions / test construction:</p> <ol style="list-style-type: none"> 1) UPS operating in normal mode, applying 50% linear load. Input and output both are 240V/50Hz. 2) Then make output shorted, check UPS response. UPS should shut down and alarm "Inverter Output Over Current" 3) Then remove the shorted circuit; Reset alarms, "Inverter Output Over Current" will be cleared. 4) Turn UPS on, UPS run in normal mode again. 			
<p>Measured graph:</p> <ol style="list-style-type: none"> 1) Output shorted, UPS shut down and alarm "Inverter Output Over Current", remove shorted circuit and reset alarm, alarm "Inverter Output Over Current" cleared, turn on UPS to normal mode. 			
			
Channel 2 - Output Voltage		Channel 3 - Output Current	

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Clause	Requirement + Test	Result - Remark	Verdict

6.4.2.10.4	TABLE: - Fault clearing capability – Stored energy mode - Short circuit test	P
<p>Description of test conditions / test construction:</p> <ol style="list-style-type: none"> 1) UPS operating in battery mode, applying 50% linear load. Output is 240V/50Hz. 2) Then make output shorted, check UPS response. UPS should shut down and alarm "Inverter Output Over Current". 3) Then remove the shorted circuit; Reset alarms , "Inverter Output Over Current" will be cleared. 4) Turn UPS on, UPS run in battery mode again. 		
<p>Measured graph:</p> <p>Output shorted, UPS shut down and alarm "Inverter Output Over Current", remove shorted circuit and reset alarm, alarm "Inverter Output Over Current" cleared, turn on UPS to battery mode.</p>  <p>Channel 1 - Output Voltage Channel 3 - Output Current</p>		