



Test Report: ERG-5000H

4 Channels 5KW Energy Recycling Grid Type Power Inverter

■ DESIGN VERIFY TEST

DC Input Function Test

AC Output Function Test

PROTECTION FUNCTION TEST

Function Test

Component Stress Test

■ SAFETY & E.M.C. TEST

Safety Test

E.M.C. Test

■ RELIABILITY TEST

ENVIRONMENT TEST

DC INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RATED INPUT POWER (TYP)	5000W (1250W*4CH)	I/P: 380VDC O/P:230VAC LOAD: FULL LOAD Ta:25°C	Pin=5000W/380VDC
2	MAX INPUT POWER (TYP)	6000W (1500W*4CH) It achieves max input power up to 6000W, auto derating to rated power by ambient temperature increasing , OTP occurs when the internal temperature exceeds the limit.	I/P: 380VDC O/P:230VAC LOAD: FULL LOAD Ta:25°C	Pin=6000W/380VDC It achieves max input power up to 6000W, auto derating to rated power by ambient temperature increasing , OTP occurs when the internal temperature exceeds the limit.
3	INPUT VOLTAGE RANGE	60VDC~ 420VDC	I/P: TESTING O/P:230VAC LOAD: FULL LOAD Ta: 25°C	59.8V~423 V
			I/P: (1) LOW-LINE-0.2= 59.8VDC (2) HIGH-LINE+3= 423VDC O/P:230VAC LOAD: FULL LOAD ON: 30 Sec . OFF: 30 Sec 10MIN	Test OK
4	RATED INPUT CURRENT (TYP)	21A*4CH	I/P: 60VDC O/P:230VAC LOAD: FULL LOAD Ta: 25°C	21A
5	MAX. INPUT CURRENT (TYP)	25A*4CH	I/P: 60VDC O/P:230VAC LOAD: FULL LOAD Ta: 25°C	25A

AC OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RATED OUTPUT POWER (Typ.)	4500 ~ 4600VA (For input 60 ~ 420VDC)	I/P : 60 ~ 380VDC O/P:230VAC LOAD: FULL LOAD Ta: 25°C	TEST : OK
2	AC VOLTAGE RANGE	180 ~ 264±5VAC, single phase	I/P: 380VDC O/P: TESTING LOAD: FULL LOAD Ta: 25°C	180V~ 264V
3	AC GRID FREQUENCY	47HZ ~63 HZ NO DAMAGE	I/P: 380VDC O/P: 180VAC ~ 264VAC LOAD: FULL LOAD Ta: 25°C	TEST : OK
4	MAX. OUTPUT CURRENT (Typ.)	230VAC/24A	I/P: 380VDC O/P: 230VAC LOAD: FULL LOAD Ta: 25°C	230VAC / 23A
5	POWER FACTOR (AT RATED POWER)	0.97/230VAC	I/P: 380VDC O/P: 230VAC LOAD: FULL LOAD Ta: 25°C	PF = 0.976

6	THD (AT RATED POWER) (Typ.)	<5%/230VAC	I/P: 380VDC O/P: 230VAC LOAD: FULL LOAD Ta: 25°C	3.9%
7	EFFICIENCY (Typ.)	91%@380VDC input/5000W	I/P: 380VDC O/P: 230VAC LOAD: FULL LOAD Ta: 25°C	91.7%
8	ENERGY RECYCLING RATIO (Typ.)	88%@380VDC input/5000W (power supply efficiency \geq 96.5%)	I/P: 380VDC O/P: 230VAC LOAD: FULL LOAD Ta: 25°C	88.3%

PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER TEMPERATURE	Protection type : Shuts down AC output voltage, reset after fault condition removed	I/P: 380VDC O/P: 230VAC LOAD: FULL LOAD Ta: 25°C	Protection type : Shuts down AC output voltage, reset after fault condition removed
2	DC INPUT OVER VOLTAGE	Protection type : Shuts down AC output voltage, reset after fault condition removed	I/P: TESTING O/P: 230VAC LOAD: MIN LOAD Ta: 25°C	I/P: 434VDC Protection type : Shuts down AC output voltage, reset after fault condition removed
3	DC INPUT UNDER VOLTAGE	Protection type : Shuts down AC output voltage, reset after fault condition removed	I/P: TESTING O/P: 230VAC LOAD: MIN LOAD Ta: 25°C	I/P: 59V Protection type : Shuts down AC output voltage, reset after fault condition removed
4	GRID FAULT	Grid Fault: Includes AC output over voltage protection and under voltage protection. Protection type : Shuts down AC output voltage, reset after fault condition removed	I/P: 380VDC O/P: TESTING LOAD: FULL LOAD Ta: 25°C	O/P RANGE : 180V~264V Protection type : Shuts down AC output voltage, reset after fault condition removed
5	COMMUNICATION ERROR	Protection type : Shuts down AC output voltage after communication is failed for 4s. Reset after communication is re-built	I/P: 380VDC O/P: 230VAC LOAD: FULL LOAD Ta:25°C	TEST : OK Protection type : Shuts down AC output voltage after communication is failed for 4s. Reset after communication is re-built
6	OVER POWER	6000W (1500W*4CH) Constant power limiting at MAX input power	I/P: 380VDC O/P: 230VAC LOAD: FULL LOAD Ta:25°C	Pmax=6000W/380VDC

CONTROL FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT														
1	COMMUNICATION INTERFACE	CANBus, Baud Rate 250k bps (Maximum 64 units ERG-5000 series)	* SW51 and SW52 S.W For CANBus interface address setting, please refer to the user manual for more details Ta:25°C	TEST : OK														
2	CC/CV MODE SELECT ERM-1250 MODULE:	CONSTANT CURRENT (CC) : 0.1~25A(\pm 1%) / per. Channel <table border="1" data-bbox="466 2011 794 2072"> <tr> <th>model</th> <th>Current range</th> </tr> <tr> <td>60V</td> <td>0.1~ 25 A \pm0.25A</td> </tr> </table>	model	Current range	60V	0.1~ 25 A \pm 0.25A	O/P: 230VAC Ta:25°C <table border="1" data-bbox="849 2011 1476 2072"> <tr> <th></th> <th>Min</th> <th>10%</th> <th>50%</th> <th>100%</th> </tr> <tr> <td>60V</td> <td>CMD=0.1A</td> <td>CMD=2.5A</td> <td>CMD=12.5A</td> <td>CMD=25A</td> </tr> </table>		Min	10%	50%	100%	60V	CMD=0.1A	CMD=2.5A	CMD=12.5A	CMD=25A	
model	Current range																	
60V	0.1~ 25 A \pm 0.25A																	
	Min	10%	50%	100%														
60V	CMD=0.1A	CMD=2.5A	CMD=12.5A	CMD=25A														

		230V	0.1~ 6.52A±0.25A			lin=0.071A	lin=2.46AA	lin=12.58A	lin=25.09A																																			
		400V	0.1~ 3.75A±0.25A		230V	CMD=0.1A lin=0.089A	CMD=0.7A lin=0.6A	CMD=3.3A lin=3.25A	CMD=6.5A lin=6.54A																																			
		420V	0.1~ 3.57A±0.25A		400V	CMD=0.1A lin=0.085A	CMD=0.4A lin=0.3A	CMD=1.9A lin=1.83A	CMD=3.7A lin=3.68A																																			
					420V	CMD=0.1A lin=0.02A	CMD=0.4A lin=0.21A	CMD=1.8A lin=1.65A	CMD=3.6A lin=3.42A																																			
		CONSTANT VOLTAGE (CV) : 60~420VDC (±1%)		I/P: 60V/230V/380V/410V O/P: 230VAC LOAD: FULL LOAD Ta:25°C		TEST : OK																																						
		<table border="1"> <tr> <th>V/I</th> <th>CV voltage</th> </tr> <tr> <td>65V / 21A</td> <td>60V ± 4.2V</td> </tr> <tr> <td>240V / 5.4A</td> <td>230V ± 4.2V</td> </tr> <tr> <td>390V / 3.3A</td> <td>380V ± 4.2 V</td> </tr> <tr> <td>420V / 3.5A</td> <td>410V ± 4.2V</td> </tr> </table>		V/I	CV voltage	65V / 21A	60V ± 4.2V	240V / 5.4A	230V ± 4.2V	390V / 3.3A	380V ± 4.2 V	420V / 3.5A	410V ± 4.2V			<table border="1"> <tr> <td></td> <td>3.5A</td> <td>3.3A</td> <td>5.4A</td> <td>21A</td> </tr> <tr> <td>60V</td> <td></td> <td>60.06</td> <td>60.03V</td> <td>61.52V</td> </tr> <tr> <td>230V</td> <td></td> <td>230.7</td> <td>230.6</td> <td></td> </tr> <tr> <td>380V</td> <td></td> <td>380.9</td> <td></td> <td></td> </tr> <tr> <td>410V</td> <td>409V</td> <td></td> <td></td> <td></td> </tr> </table>					3.5A	3.3A	5.4A	21A	60V		60.06	60.03V	61.52V	230V		230.7	230.6		380V		380.9			410V	409V			
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3	PARALLEL	TOLERANCE <±1%		I/P: 380VDC O/P: 230VAC LOAD: FULL LOAD Ta:25°C		CMU2 : CC=21A PSU1 : 21.2 A PSU2 : 20.9 A PSU3 : 20.8 A PSU4 : 21.1 A CMU2 : CV=127V (3500W) PSU1 : 6.35A PSU2 : 6.48 A PSU3 : 6.41 A PSU4 : 6.19 A																																						

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	Power Transistor (Interleave boost) (D to S) or (C to E) Peak Voltage (G to S) Peak Voltage	ERM-1250H MODULE: Q442 600V 29A@25°C 18A@100°C Q442 Vgs±20V(static) ±30V(dynamic)	O/P:230VAC LOAD:Full Load VDS: I/P: (1) 60V@25A (2) 230V@6.52A (3) 400V@3.75A (4) 420V@3.57 Ta:25°C	Vds Q442 (1) 374.91 (2) 440.34V (3)436.39V (4) 450V
2	Diode Peak Voltage (Interleave boost)	ERM-1250H MODULE: D410 8A/650V	O/P:230VAC LOAD:Full Load I/P: (1) 400V@3.75A (2) 420V@3.57 Ta:25°C	D410 (1)434.39V (2) 458V
3	Power Transistor (PSFB) (D to S) or (C to E) Peak Voltage (G to S) Peak Voltage	ERM-1250H MODULE: Q653/Q654 600V/28A@100°C	O/P:230VAC LOAD:Full Load VDS I/P: 400V@3.75A I/P: 420V@3.57A Ta:25°C	Q653 VDS : 434.39V VDS : 450V Q654 VDS : 434.39V VDS : 450V
4	Diode Peak Voltage (PSFB sec_rect)	ERM-1250H MODULE: D701 1200V/11A@135°C	O/P:230VAC LOAD:Full Load I/P: (1) 400V@3.75A	(1)728.06V (2)740V

			(2) 420V@3.57A Ta:25°C	
5	BOOST CHOKE CURRENT	ERM-1250H MODULE: L501	O/P:230VAC LOAD:Full Load I/P: (1) 60V@25A Ta:25°C	(1)14.877A peak 12.559A rms
6	PSFB current	ERM-1250H MODULE: T601	O/P:230VAC LOAD:Full Load I/P: (1) 60V@25A Ta:25°C	(1)6.7A peak 5.34 rms
7	PSFB switching current	ERM-1250H MODULE: PSFB switching current (DC+)	O/P:230VAC LOAD:Full Load I/P: (1) 60V@25A Ta:25°C	(1)12.776A peak 5.34 rms
8	Capacitor MEAN Voltage	ERG-5000 MODULE: C104 : 220u/450V	I/P:420VDC O/P:230VAC LOAD:Full Load (1)5000W (2)5500W Ta:25°C	(1)393V peak (2)397V peak
9	Power Transistor (D to S) or (C to E) Peak Voltage (G to S) Peak Voltage	ERG-5000 MODULE: Q120:54A/650V	I/P:420VDC O/P:230VAC LOAD:Full Load (1) 5500W Ta:25°C	Vds/ID (1)510V/28.1A (2)510V/26.5A (3)473V (4)514V
10	PFC CHOKE CURRENT	ERG-5000 MODULE: L12	I/P:60VDC O/P:230VAC LOAD:Full Load (1) 5500W Ta:25°C	(1)33A
11	AUX PRIMARY CURRENT ERM-1000	ERG-5000 MODULE: Q201 Vds/Id 150V/56A D231 5A/120V	I/P:420VDC O/P:230VAC LOAD:Full Load (1) 5500W Ta:25°C	Q201: (1)20.4V/2.87A/11.2V D231: (2)79.4V
12	AUX PRIMARY CURRENT ERG-5000	ERG-5000 MODULE: Q801 Vds/I 150V/56A D231 5A/120V	I/P:420VDC O/P:230VAC LOAD:Full Load (1) 5500W Ta:25°C	Q801: (1)20.4V/3.28A/11.4V D231: (2)89.8V

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P: 2.5KVDC/min I/P-FG: 2.5 KVDC/min O/P-FG: 2.5KVDC/min	I/P-O/P: 3KVDC/min I/P-FG: 3KVDC/min O/P-FG:3KVDC/min Ta:25°C	I/P-O/P: 0.002mA I/P-FG: 0.002mA O/P-FG: 0.002mA NO DAMAGE

2	ISOLATION RESISTANCE	I/P-O/P:500VDC>100MΩ I/P-FG: 500VDC>100MΩ O/P-FG:500VDC>100MΩ	I/P-O/P: 500 VDC I/P-FG: 500 VDC O/P-FG: 500 VDC Ta:25°C	I/P-O/P: >100MΩ I/P-FG: >100MΩ O/P-FG: >100MΩ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25°C	6mΩ

■ **RELIABILITY TEST**

ENVIRONMENT TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT																																																																																																								
1	TEMPERATURE RISE TEST	MODEL : ERG-5000H 1. ROOM AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 25 °C 2. HIGH AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 60 °C																																																																																																										
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		27	4-T601_wire	48.6°C	86.2°C
		28	4-T601_Core(R299)	49.4°C	87.1°C
		29	4-L701_wire	52.5°C	88.2°C
2	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR		I/P : 420VDC O/P : 230VAC LOAD: 100 %LOAD Ta=-25 °C	TEST : OK
3	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 60 °C/95 %R.H NO DAMAGE		I/P : 420VDC O/P : 230VAC LOAD: 100 %LOAD Ta= 60°C HUMIDITY= 95 %R.H	TEST : OK
4	STORAGE TEMPERATURE TEST	-40~85°C		1. Thermal shock Temperature : -45°C~ +90°C 2. Temperature change rate : 25°C / MIN 3. Dwell time low and high temperature : 30 MIN/EACH 4. Total test cycle : 10 CYCLE 5. Input/Output condition : STATIC	
5	THERMAL SHOCK TEST	-20~60°C		1. Thermal shock Temperature : -25°C~ +65°C 2. Temperature change rate : 25°C / MIN 3. Dwell time low and high temperature : 30 MIN/EACH 4. Total test cycle : 16 CYCLE 5. Input/Output condition : I/P:48VDC · O/P:230VAC LOAD:FULL LOAD	
6	VIBRATION TEST	10 ~ 500Hz, 2G 10min/1cycle, 60min. each along X, Y, Z axes		1 Carton & 1 Set (1) Waveform : Sine Wave (2) Frequency : 10~500Hz (3) Sweep Time : 10min/sweep cycle (4) Acceleration : 3G (5) Test Time : 180min in each axis (X.Y.Z) (6) Ta : 25°C	
7	CAPACITOR LIFE CYCLE	SUPPOSE C513 IS THE MOST CRITICAL COMPONENT (1) I/P : 380VDC O/P : FULL LOAD Ta= 25 °C LIFE TIME (2) I/P : 380VDC O/P : FULL LOAD Ta= 60 °C LIFE TIME (3) I/P : 380VDC O/P : 75% LOAD Ta= 60 °C LIFE TIME (4) I/P : 380VDC O/P : 50% LOAD Ta= 60 °C LIFE TIME			(1) 347042HRS (2) 284522HRS (3) 309274HRS (4) 330864HRS
8	MTBF	Conducted by Parts Stress Analysis Prediction 172K hrs min. Telcordia SR-332 (Bellcore) ; 19.5K hrs min. MIL-HDBK-217F (25°C)			
9	Ongoing Reliability Test	I/P : 230VAC O/P : FULL LOAD TA=50°C Demonstration Mean Time Between Failure : 50,000 hours			

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	DANIEL GAO	SANFORD SU	VINCENT TSENG

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