



# Test Report: ERG-5000

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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

## 4 Channels 5KW Energy Recycling Grid Type Power Inverter

### DC INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RATED INPUT POWER (TYP)	5000W (1250W*4CH)	I/P: 48VDC O/P:230VAC LOAD: FULL LOAD Ta:25°C	Pin=5000W/48VDC
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: 48VDC O/P:230VAC LOAD: FULL LOAD Ta:25°C	Pin=6000W/48VDC 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	10VDC~ 60VDC	I/P: TESTING O/P:230VAC LOAD: FULL LOAD Ta: 25°C	10V~60 V
			I/P: (1) LOW-LINE-0.2= 9.8VDC (2) HIGH-LINE+3= 63VDC O/P:230VAC LOAD: FULL LOAD ON: 30 Sec . OFF: 30 Sec 10MIN	Test OK
4	RATED INPUT CURRENT (TYP)	105A*4CH	I/P: 12VDC O/P:230VAC LOAD: FULL LOAD Ta: 25°C	105A
5	MAX. INPUT CURRENT (TYP)	125A*4CH	I/P: 10VDC O/P:230VAC LOAD: FULL LOAD Ta: 25°C	125A

### AC OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RATED OUTPUT POWER (Typ.)	2600 ~ 4320VA (For input 10 ~ 12VDC) 4320 ~ 4400VA (For input 12 ~ 60VDC)	I/P : 10 ~ 12VDC I/P : 12 ~ 60VDC O/P:230VAC LOAD: FULL LOAD Ta: 25°C	TEST : OK
2	AC VOLTAGE RANGE	180 ~ 264±5VAC, single phase	I/P: 48V O/P: TESTING LOAD: FULL LOAD Ta: 25°C	180V~ 264 V
3	AC GRID FREQUENCY	47HZ ~63 HZ NO DAMAGE	I/P: 48V O/P: 180VAC ~ 264VAC LOAD: FULL LOAD Ta: 25°C	TEST : OK
4	MAX. OUTPUT CURRENT (Typ.)	230VAC/24A	I/P: 48V O/P: 230VAC LOAD: FULL LOAD Ta: 25°C	230VAC / 22.9A
5	POWER FACTOR (AT RATED POWER)	0.97/230VAC	I/P: 48V O/P: 230VAC LOAD: FULL LOAD Ta: 25°C	PF = 0.9793

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6	THD (AT RATED POWER) (Typ.)	<5%/230VAC	I/P: 48V O/P: 230VAC LOAD: FULL LOAD Ta: 25°C	4.64%
7	EFFICIENCY (Typ.)	88%@48VDC input/5000W	I/P: 48V O/P: 230VAC LOAD: FULL LOAD Ta: 25°C	88.02%
8	ENERGY RECYCLING RATIO (Typ.)	80%@48VDC input/5000W (power supply efficiency $\geq$ 90.5%)	I/P: 48V O/P: 230VAC LOAD: FULL LOAD Ta: 25°C	80.5%

### 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: 12V/24V/48V 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: 63V 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: 8.9V 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: 48V O/P: TESTING LOAD: FULL LOAD Ta: 25°C	O/P RANGE : 182V~266V 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: 48VDC 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: 48VDC O/P: 230VAC LOAD: FULL LOAD Ta:25°C	Pmax=6000W/48VDC

### 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) : 0.5~125A( $\pm$ 1%) / per. Channel <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td>model</td> <td>Current range</td> </tr> </table>	model	Current range	I/P: 12VDC / 24VDC / 48VDC O/P: 230VAC LOAD:	TEST : OK <table border="1" style="display: inline-table; vertical-align: middle;"> <tr> <td></td> <td>Min</td> <td>10%</td> <td>50%</td> <td>100%</td> </tr> <tr> <td>12V</td> <td>0.48A</td> <td>10.5A</td> <td>52.7A</td> <td>105.4A</td> </tr> <tr> <td>24V</td> <td>0.48A</td> <td>6.3A</td> <td>26.5A</td> <td>62.4A</td> </tr> </table>		Min	10%	50%	100%	12V	0.48A	10.5A	52.7A	105.4A	24V	0.48A	6.3A	26.5A	62.4A
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		12V	0.5 ~ 105A ±1.25A	Min、10%、50%、100% LOAD Ta:25°C	48V	0.49A	3.3A	13.5A	31.5A	
		24V	0.5 ~ 62.5A ±1.25A		I/P: 10V/12V/24V/48V O/P: 230VAC LOAD: FULL LOAD Ta:25°C	TEST : OK				
		48V	0.5 ~ 31.2A ±1.25A							
		CONSTANT VOLTAGE (CV) : 10~60VDC (±1%)								
		V/I	CV voltage							
12V / 90A	10V ± 0.6 V	20A	25A	48A		90A				
14V / 90A	12V ± 0.6 V	10V	10.04V	10.05V	10.06V	10.07V				
26V / 48A	24V ± 0.6 V	12V	12.09V	12.09V	12.08V	12.08V				
50V / 25A	48V ± 0.6 V	24V	24.33V	24.33V	24.33V					
		48V	48.73V	48.73V						
3	PARALLEL	TOLERANCE <±1%		I/P: 12V O/P: 230VAC LOAD: FULL LOAD Ta:25°C	CMU2 : CC=120A PSU1 : 120.2 A PSU2 : 119.5 A PSU3 : 120.7 A PSU4 : 119.8 A CMU2 : CV=11V PSU1 : 124.5 A PSU2 : 124.4 A PSU3 : 124.3 A PSU4 : 124.7 A					

### COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	Power Transistor ( D to S ) or ( C to E ) <b>Peak Voltage</b> ( G to S ) Peak Voltage	ERM-1250 MODULE: Q432、Q442、Q402、Q422 300A/100V Vgs±25V	(1)input:60V@25A (2) input:24V@62.5A (3) input:12V@104.2A O/P:230VAC LOAD:Full Load Ta:25°C	Vds Q432 (1)68.3V (2)58.6V (3)58.4V Q442 (1)65.1V (2)65.1V (3)70.5V Q402 (1)65.9V (2)57.8V (3)59.2V Q422 (1)65.1V (2)65.1V (3)70.5V
2	Power Transistor ( D to S ) or ( C to E ) <b>Peak Voltage</b> ( G to S ) Peak Voltage	ERM-1250 MODULE: Q653/Q651/Q663/Q651 300A/100V	I/P:60V O/P:230Vac LOAD:Full Load Ta:25°C	Vds (1)86.1V-Q653 (2)96.2V-Q651 (3)85.0V-Q663 (4)89.8V-Q651
4	Diode Peak <b>Voltage</b>	ERM-1250 MODULE: D701/D702/D703/D704 8A/650V	I/P:60V O/P:230Vac LOAD:Full Load Ta:25°C	(1)614V-D701 (2)618V-D702 (3)610V-D703 (4)622V-D704
5	BOOST CHOKE CURRENT	ERM-1250 MODULE: L501	I/P:12V O/P:230Vac LOAD:Full Load	(1)62A

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			Ta:25°C	
6	PSFB current	ERM-1250 MODULE: T601	I/P:48VDC O/P:230Vac LOAD:FULL LOAD Ta:25°C	(1)41A
6	Capacitor <b>MEAN Voltage</b>	ERG-5000 MODULE: C104 : 220u/450V	I/P:60VDC O/P:230Vac LOAD: (1)5000W (2)5500W Ta:25°C	(1) 373V (2) 373V
7	Power Transistor ( D to S) or (C to E) <b>Peak Voltage</b> ( G to S) Peak Voltage	ERG-5000 MODULE: Q120: 54A/650V Vgs:±25V	I/P:60VDC O/P:230Vac Full Load (1) 5500W Ta:25°C	Vds/ID (1)510V/28.1A (2)510V/26.5A (3)473V (4)514V  Vgs (1)13.0V (2)13.0V (3)12.6V (4)11.4V
8	PFC CHOKE CURRENT	ERG-5000 MODULE: L12	I/P:60VDC O/P:230Vac LOAD:Full Load (1) 5500W Ta:25°C	(1)33A
9	AUX PRIMARY CURRENT ERM-1000	ERG-5000 MODULE: Q201 Vds/Id/Vgs 150V/56A D231 5A/120V	I/P:60VDC O/P:230Vac LOAD:Full Load (1) 5500W Ta:25°C	Q201: (1)20.4V/2.87A/11.2V D231: (2)79.4V
10	AUX PRIMARY CURRENT ERG-5000	ERG-5000 MODULE: Q801 Vds/Id/Vgs 150V/56A D231 5A/120V	I/P:60VDC 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: 4KVDC/min I/P-FG: 2.5 KVDC/min O/P-FG: 2.5KVDC/min	I/P-O/P: 4.4KVDC/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	9mΩ

## ■ RELIABILITY TEST

### ENVIRONMENT TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT																																																																																																																																				
1	TEMPERATURE RISE TEST	MODEL : ERG-5000 1. ROOM AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 29.2 °C 2. HIGH AMBIENT BURN-IN : 2 HRS I/P : 230VAC O/P : FULL LOAD Ta= 60 °C																																																																																																																																						
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			<table border="1"> <tbody> <tr><td>33</td><td>Q431</td><td>54.2°C</td><td>73.9°C</td></tr> <tr><td>34</td><td>U400</td><td>46.6°C</td><td>67.9°C</td></tr> <tr><td>35</td><td>Q401</td><td>50.7°C</td><td>71.3°C</td></tr> <tr><td>36</td><td>Q651</td><td>59.4°C</td><td>75.6°C</td></tr> <tr><td>37</td><td>U651</td><td>59.2°C</td><td>75.3°C</td></tr> <tr><td>38</td><td>Q652</td><td>59.7°C</td><td>76.1°C</td></tr> <tr><td>39</td><td>L605</td><td>59.2°C</td><td>74.7°C</td></tr> <tr><td>40</td><td>C509</td><td>38.7°C</td><td>62.6°C</td></tr> <tr><td>41</td><td>C513</td><td>53.8°C</td><td>71.3°C</td></tr> <tr><td>42</td><td>C632</td><td>47.1°C</td><td>67.0°C</td></tr> <tr><td>43</td><td>C704</td><td>61.7°C</td><td>74.3°C</td></tr> <tr><td>44</td><td>T202</td><td>52.1°C</td><td>69.3°C</td></tr> <tr><td>45</td><td>D602</td><td>58.4°C</td><td>73.6°C</td></tr> <tr><td>46</td><td>T601 Core</td><td>76.0°C</td><td>85.7°C</td></tr> <tr><td>47</td><td>L701</td><td>87.5°C</td><td>95.4°C</td></tr> <tr><td>48</td><td>Q431</td><td>56.9°C</td><td>73.5°C</td></tr> <tr><td>49</td><td>U400</td><td>48.9°C</td><td>67.7°C</td></tr> <tr><td>50</td><td>Q401</td><td>53.2°C</td><td>71.2°C</td></tr> <tr><td>51</td><td>Q651</td><td>61.2°C</td><td>75.2°C</td></tr> <tr><td>52</td><td>U651</td><td>61.8°C</td><td>75.9°C</td></tr> <tr><td>53</td><td>Q652</td><td>62.8°C</td><td>77.2°C</td></tr> </tbody> </table>	33	Q431	54.2°C	73.9°C	34	U400	46.6°C	67.9°C	35	Q401	50.7°C	71.3°C	36	Q651	59.4°C	75.6°C	37	U651	59.2°C	75.3°C	38	Q652	59.7°C	76.1°C	39	L605	59.2°C	74.7°C	40	C509	38.7°C	62.6°C	41	C513	53.8°C	71.3°C	42	C632	47.1°C	67.0°C	43	C704	61.7°C	74.3°C	44	T202	52.1°C	69.3°C	45	D602	58.4°C	73.6°C	46	T601 Core	76.0°C	85.7°C	47	L701	87.5°C	95.4°C	48	Q431	56.9°C	73.5°C	49	U400	48.9°C	67.7°C	50	Q401	53.2°C	71.2°C	51	Q651	61.2°C	75.2°C	52	U651	61.8°C	75.9°C	53	Q652	62.8°C	77.2°C	
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2	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 48VDC 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 : 60VDC 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 : 48VDC O/P : FULL LOAD Ta= 25 °C LIFE TIME (2) I/P : 48VDC O/P : FULL LOAD Ta= 60 °C LIFE TIME (3) I/P : 48VDC O/P : 75% LOAD Ta= 60 °C LIFE TIME (4) I/P : 48VDC O/P : 50% LOAD Ta= 60 °C LIFE TIME	(1) 316248HRS (2) 66483HRS (3) 117259HRS (4) 171485HRS
8	MTBF	Conducted by Parts Stress Analysis Prediction 148.8K hrs min. Telcordia SR-332 (Bellcore) ; 15K hrs min. MIL-HDBK-217F (25°C)	
9	Ongoing Reliability Test	I/P : 48VDC O/P : 230VAC LOAD : FULL LOAD TA=60°C Demonstration Mean Time Between Failure : 50,000 hours	

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

2020.10.1 TAG-QA-009