



**rise**

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<b>TEST REPORT</b>			
<b>Performance of Standalone Inverters to Draft Australian Inverter Performance Standard</b>			
<b>Report reference No.</b> .....:	REP-R005-T-0009-Rev B		
Tested by (name + signature) .....	Wayne Clark		
Supervised by (name + signature) :	Oscar Arteaga		
Approved by (name + signature)....:	Oscar Arteaga		
Date of issue.....:	30/Jan/2009		
<b>Testing laboratory</b> .....	ResLab		
Address .....	Research Institute for Sustainable Energy, Murdoch University, Perth WA 6150		
<b>Applicant</b> .....	RISE		
Address .....			
<b>Test specification</b>			
Standard .....	Draft Australian Standard: Inverter – Performance requirements		
Test procedure .....	TP-RESL-T-0004 Rev E_Test procedures for stand alone inverters		
Non-standard method.....:	N/A		
<b>Type of test item</b> .....	Standalone Portable Inverter		
Manufacturer .....	[REDACTED]		
Model.....:	[REDACTED]		
Serial No.....:	[REDACTED]		
Date of manufacture.....:	Not specified		
Hardware version .....	N/A		
Firmware version .....	N/A		
<b>Uncertainties</b>			
The uncertainties quoted in this test report have been calculated at the 95% confidence level. This means that the chance of the reported value to be in error by more than the stated uncertainty is five in one hundred. All measurements are carried out using equipment that holds calibration traceable to national standards held by the National Measurements Institute.			
DC Voltage .....	± 0.2% of reading	Apparent Power .....	± 0.5% of reading
DC Current .....	± 0.3% of reading	Power Factor .....	± 0.01
DC Power .....	± 0.3% of reading	Frequency .....	± 0.17% of reading
AC Voltage .....	± 0.3% of reading	THD (V) .....	± 0.1% of fundamental
AC Current.....:	± 0.3% of reading	THD (I).....:	± 0.1% of fundamental
AC Power .....	± 0.3% of reading	Harmonic components :	± 0.1% of fundamental
Reactive Power .....	± 0.5% of reading	Temperature Rise .....	± 3 °K

**GENERAL INFORMATION**

**Nameplate**



**EUT Pictures**



## GENERAL INFORMATION

### Test item specifications

Nominal D.C. input voltage	:	12 V DC
D.C. operating voltage range	:	10.5 to 17 V DC
Nominal a.c. output voltage (1 ph or 3 ph)	:	240 V $\pm$ 4% @ 12V
Nominal a.c. frequency and frequency range	:	50 Hz $\pm$ 0.01 %
Power factor range:	:	Not specified
Output voltage harmonic distortion	:	< 4%
Cont. output power rating at unity p.f. and 25°C	:	350 W
Cont. output power rating at unity p.f. and 40°C	:	Not specified
Cont. output power rating 0.75 p.f. and 25°C	:	Not Specified
30 min. output power rating	:	450 W
Surge (3 sec) output power rating at 25°C	:	1000 Watts (5 sec)
Surge (3 sec) output power rating at 40°C	:	Not specified
Demand start load (default setting)	:	10 W
Demand stop load (default setting)	:	Not specified
Low d.c. voltage disconnect setpoint (default)	:	10 V $\pm$ 0.5 V
Low d.c. voltage reconnect setpoint (default)	:	Not specified
High d.c. voltage disconnect setpoint (default)	:	17 V
High d.c. voltage reconnect setpoint (default)	:	Not specified
Accessories included for testing	:	None
Other options	:	None

### Bi-directional inverters and inverter chargers only

Rated D.C. charging current	:	N/A
Battery charging stages	:	N/A
Bulk voltage and duration (defaults)	:	N/A
Float voltage (default)	:	N/A
Absorption voltage and duration (defaults)	:	N/A
Equalise voltage, duration and periodicity (defaults)	:	N/A
Other stages voltage and duration (defaults)	:	N/A

### Testing

Date of receipt of test item .....	:	N/A
Date(s) of performance of test .....	:	20/05/2008 to 13/06/2007

### Summary of testing / verification:

This report summarises the stand-alone inverter performance tests results and compliance with the draft Australian standard "Inverter—Performance requirements". The results in this report cover DC operating voltage range, DC voltage trip set points, standby and no load tests, efficiency and power quality, load handling, step-load transient response and motor load handling.

### Possible test case verdicts

- test case does not apply to the test object .....	:	N/A
- test object meets the requirements of the clause .....	:	Pass (P)
- test object meets requirements of class A for the clause ...	:	A
- test object meets requirements of class B for the clause ...	:	B
- test object meets requirements of class C for the clause ...	:	C
- test object does not meet the requirements of the clause ..	:	Fail (F)

**GENERAL INFORMATION**

**Abbreviations and acronyms used in this report**

- average .....	: avg.	- not tested .....	: N/T
- equipment under test .....	: EUT	- pulse width modulation .....	: PWM
- maximum power point tracking .....	: MPPT	- stand alone inverter .....	: SAI
- not specified .....	: N/S	- temperature.....	: temp.

**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 point is used as the decimal separator.  
The tests 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 testing laboratory.  
List of test equipment must be kept on file and available for review.  
Summary of contents provided on the last page of this report.  
This Test Report Form is intended for the investigation of stand alone inverter performance testing in accordance with draft Australian standard Inverter – Performance requirements.

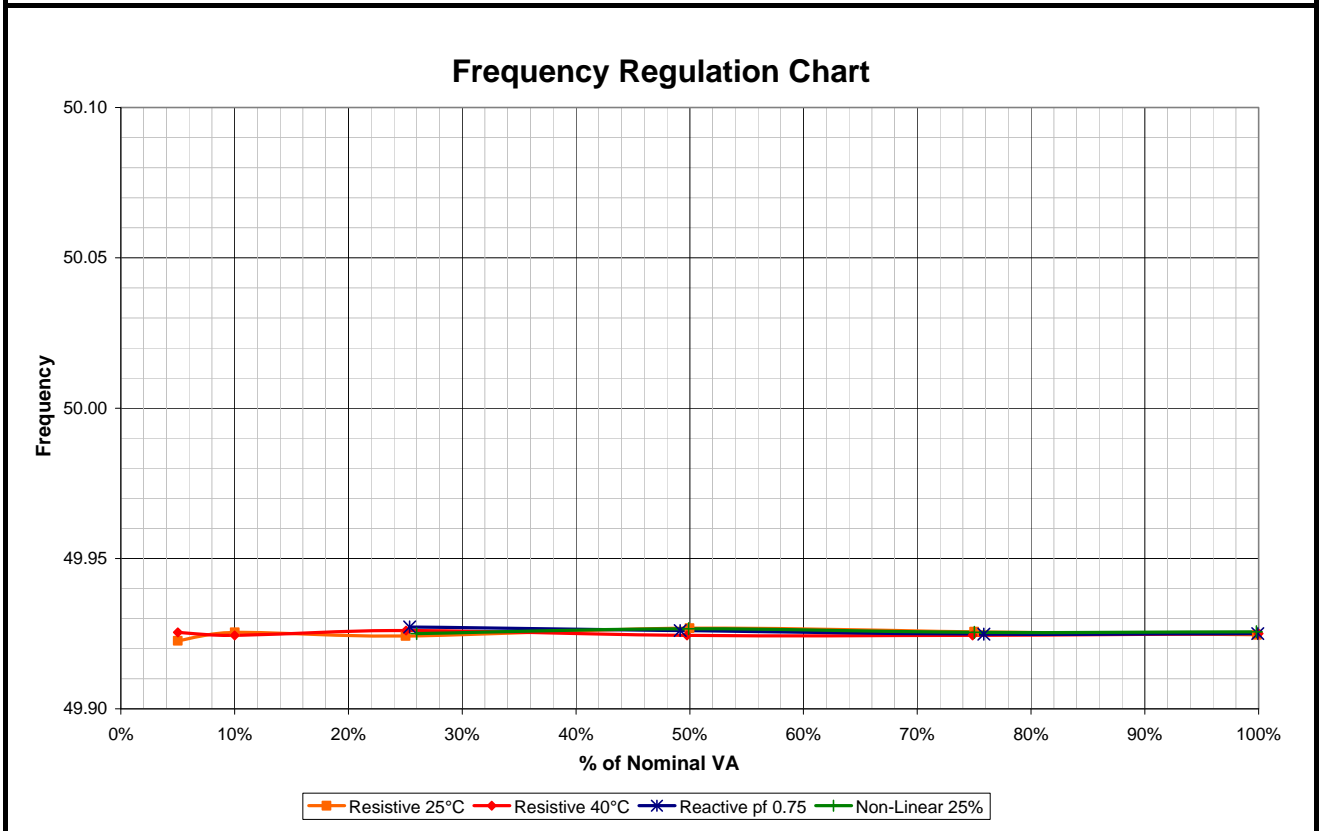
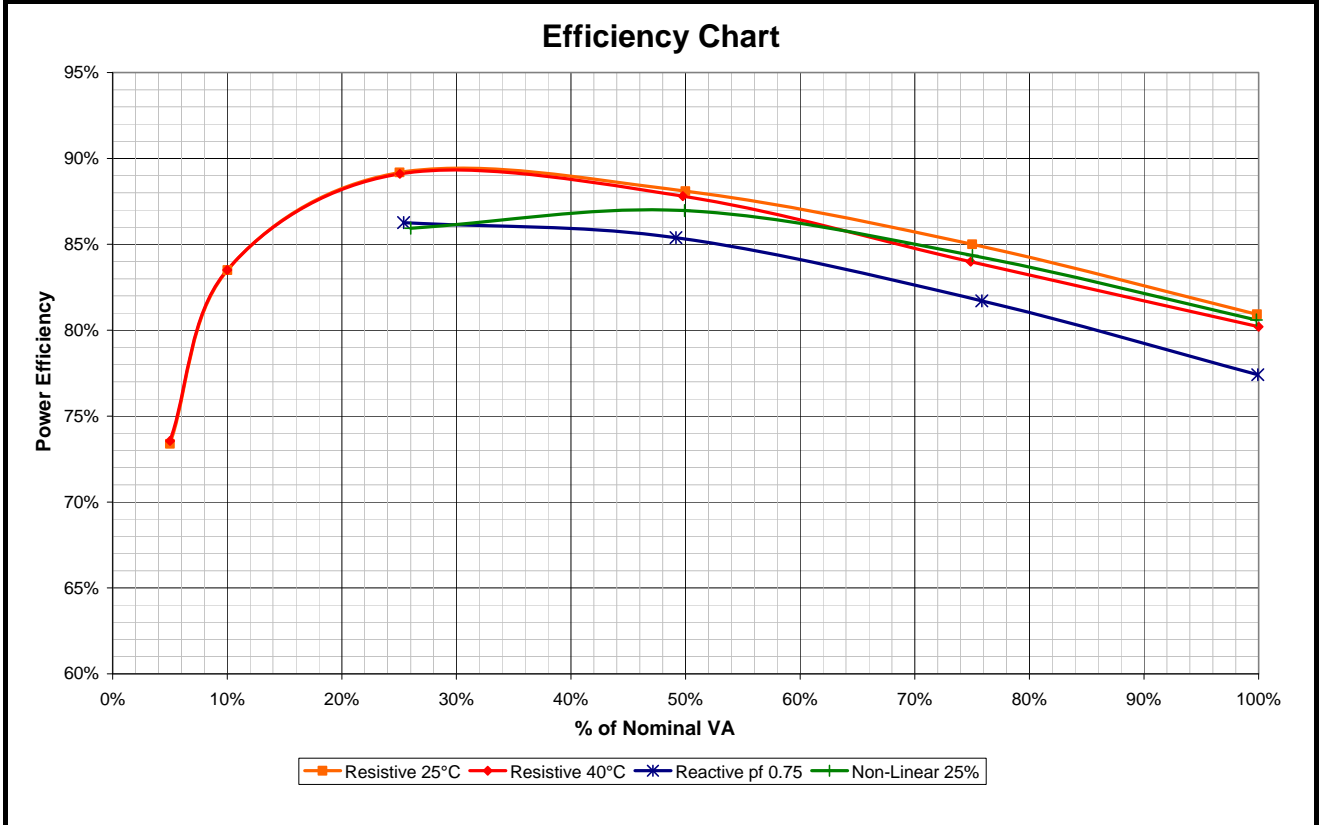
<b>TEST RESULTS</b>			
<b>Cl.</b>	<b>Requirement – Test</b>	<b>Result</b>	<b>Verdict</b>
2.2	Inverter specifications	Some missing (see above)	Fail
3.2	<b>D.C. OPERATING VOLTAGE RANGE</b>		Fail
	A.C. output voltage within specifications	220.13 V (-8.3%) at 10.5 V	Fail
	A.C. output voltage THD within specifications	9% at 10.5 V	Fail
	A.C. output frequency within specifications	49.924 Hz (-0.15%) at 14.5 V	Fail
3.3	<b>D.C. VOLTAGE TRIP POINTS</b>		—
3.3.1	<b>D.C. overvoltage setpoints</b>		Pass
	High voltage disconnect point within 2% of setpoint	See table 1	Pass
	High voltage reconnect point within 2% of setpoint	Not Specified	—
3.3.2	<b>D.C. undervoltage setpoints</b>		Pass
	Low voltage disconnect point within 2% of setpoint	See Table 1	Pass
	Low voltage reconnect point within 2% of setpoint	Not Specified	—
3.4	<b>STANDBY AND NO-LOAD POWER LOSS</b>		—
	No load loss class according to clause 3.11 limits	6.97 W	B
	Standby loss class according to clause 3.11 limits	1.13 W (average)	A
	$P_{ACTIVE}$ within 15% of $P_{ACTIVE SET}$	See table 1	Pass
	$P_{STANDBY}$ within 15% of $P_{STANDBY SET}$	Not Specified, See table 1	—
3.5	<b>EFFICIENCY AND POWER QUALITY</b>		Fail
	Efficiency class according to clause 3.11 limits	See table 2	Fail
	Voltage THD class according to clause 3.11 limits	See table 2	B
	Voltage reg. class according to clause 3.11 limits	See table 2	B
	Frequency regulation = $\pm 3\%$	See table 2	Pass
3.6	<b>LOAD HANDLING AND TEMPERATURE RISE</b>		Pass
	Continuous rating at 25°C for at least 5 hours	See Table 3	Pass
	30 min. rating at 25°C for at least 30 minutes	See Table 3	Pass
	Surge rating at 25°C for at least 3 seconds	See Table 3	Pass
	Surge rating at 40°C for at least 3 seconds	See Table 3	Pass
	Continuous rating at 40°C for at least 5 hours	See Table 3	Pass
3.7	<b>STEP-LOAD TRANSIENT RESPONSE</b>		Pass
	Voltage within transient limits	See Table 4	Pass
3.8	<b>MOTOR LOAD HANDLING</b>		N/A
	Inverter capable of supplying motor load & a.c. voltage within transient limits, or operating instructions state that inverter is unsuitable to supply motor loads		—
3.9	<b>CHARGING EFFICIENCY AND CURRENT THD</b>		N/A
	Efficiency class evaluated according to clause 3.11		—
	Current THD class evaluated according to clause 3.11		
3.10	<b>THREE-PHASE INVERTERS</b>		N/A
(a)	A.C. voltages within AS60038 limits under balanced 100% 3 phase load		—
(b)	A.C. voltages within AS60038 limits under unbalanced 100% single phase load on each phase		—

Table 1 Set-Point Measurement Results							
Description		HVD	HVR	LVD	LVR	P <sub>ACTIVE</sub>	P <sub>STANDBY</sub>
EUT Setting	Setpoint (V)	17	N/S	11	N/S	10	N/S
	Temperature Compensated	N/S	N/S	N/S	N/S	N/S	N/S
	Time/Delay (hh:mm:ss)	N/S	N/S	N/S	N/S	N/S	N/S
25°C Tests	Actual Test Temperature (°C)	24.7	24.7	24.4	24.4	N/A	N/A
	Measured Values (V)	17.09	17.10	11.17	12.01	10.42	8.35
	Corrected Setpoints (V)	N/A	N/A	N/A	N/A	N/A	N/A
	Measured Setpoint Error (%)	0.52%	N/A	1.53%	N/A	4.2%	N/A
	Time / Delay (hh:mm:ss)	N/A	N/A	N/A	N/A	N/A	N/A
40°C Tests	Actual Test Temperature (°C)	N/A	N/A	N/A	N/A	N/A	N/A
	Measured Values (V)	N/T	N/T	N/T	N/T	N/T	N/T
	Corrected Setpoints (V)	N/A	N/A	N/A	N/A	N/A	N/A
	Measured Setpoint Error	N/A	N/A	N/A	N/A	N/A	N/A
	Time / Delay (hh:mm:ss)	N/A	N/A	N/A	N/A	N/A	N/A
Additional EUT programmed or manufacturer declared parameters							
Temperature compensation (mV/°C-Cell)						Not Specified	
Nominal system voltage (V)						12	
Reference temperature (°C)						Not Specified	
Notes:							
1.							

**Table 2 Efficiency & Power Quality Results**

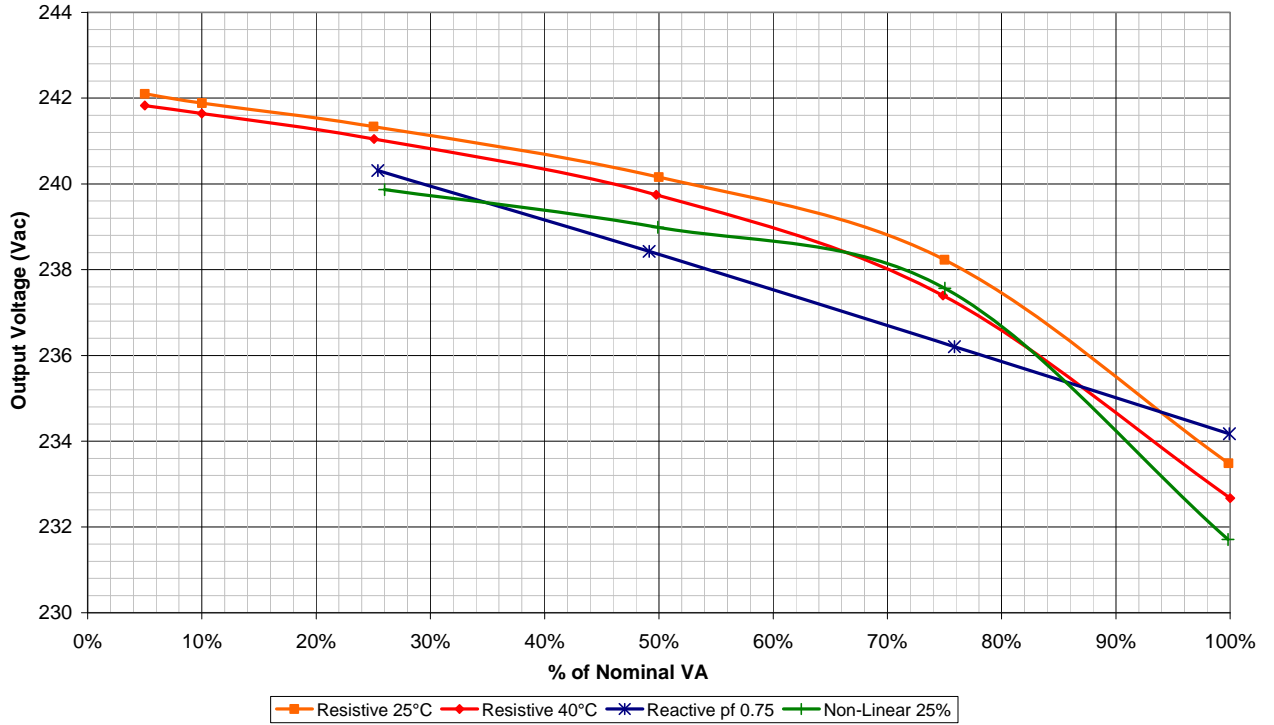
Load Type	Temp (°C)	% of nominal VA	Vin [rms]	Iin [rms]	Pin	Vin [dc]	Iin [dc]	Ripple factor %	Vout	Iout	Pout	Sout	Qout	pf	% of Nom	Freq.	Eff	Voltage THD	Current THD
Resistive	25°C	5%	12.03	2.03	23.86	12.03	1.99	21.1%	<b>242.10</b>	0.07	17.51	17.52	0.66	1.00	5.0%	<b>49.92</b>	<b>73.4%</b>	<b>4.7%</b>	5.0%
Resistive	25°C	10%	12.00	3.61	41.95	12.00	3.50	24.4%	<b>241.89</b>	0.14	35.03	35.04	0.66	1.00	10.0%	<b>49.93</b>	<b>83.5%</b>	<b>4.9%</b>	5.0%
Resistive	25°C	25%	12.01	9.40	98.26	12.01	8.24	55.0%	<b>241.34</b>	0.36	87.63	87.64	0.65	1.00	25.0%	<b>49.92</b>	<b>89.2%</b>	<b>5.4%</b>	5.4%
Resistive	25°C	50%	12.02	19.47	198.60	12.01	16.76	59.1%	<b>240.16</b>	0.73	174.97	174.97	0.86	1.00	50.0%	<b>49.93</b>	<b>88.1%</b>	<b>5.7%</b>	5.7%
Resistive	25°C	75%	12.03	30.53	308.80	12.02	26.19	59.9%	<b>238.23</b>	1.10	262.50	262.50	0.90	1.00	75.0%	<b>49.93</b>	<b>85.0%</b>	<b>5.9%</b>	5.8%
Resistive	25°C	100%	12.03	42.51	431.88	12.02	36.90	57.2%	<b>233.48</b>	1.50	349.50	349.52	1.60	1.00	99.9%	<b>49.92</b>	<b>80.9%</b>	<b>6.4%</b>	6.4%
Resistive	40°C	5%	12.01	2.03	23.84	12.01	1.99	20.9%	<b>241.83</b>	0.07	17.53	17.55	0.69	1.00	5.0%	<b>49.93</b>	<b>73.6%</b>	<b>4.7%</b>	4.9%
Resistive	40°C	10%	12.02	3.60	41.90	12.02	3.50	24.1%	<b>241.64</b>	0.14	34.99	35.00	0.68	1.00	10.0%	<b>49.92</b>	<b>83.5%</b>	<b>4.8%</b>	4.9%
Resistive	40°C	25%	12.01	9.39	98.45	12.01	8.26	53.9%	<b>241.05</b>	0.36	87.73	87.73	0.68	1.00	25.1%	<b>49.93</b>	<b>89.1%</b>	<b>5.4%</b>	5.4%
Resistive	40°C	50%	12.02	19.34	198.36	12.02	16.73	58.0%	<b>239.75</b>	0.73	174.17	174.17	0.88	1.00	49.8%	<b>49.92</b>	<b>87.8%</b>	<b>5.7%</b>	5.7%
Resistive	40°C	75%	11.83	31.14	312.00	11.82	26.94	58.0%	<b>237.40</b>	1.10	262.04	262.04	0.90	1.00	74.9%	<b>49.92</b>	<b>84.0%</b>	<b>5.9%</b>	5.9%
Resistive	40°C	100%	12.03	42.83	436.38	12.01	37.25	56.7%	<b>232.67</b>	1.50	349.98	349.98	1.50	1.00	100.0%	<b>49.93</b>	<b>80.2%</b>	<b>6.5%</b>	6.5%
Reactive 0.75pf	25°C	25%	12.20	7.37	77.24	12.20	6.37	58.0%	<b>240.31</b>	0.37	66.63	88.87	58.82	0.75	25.4%	<b>49.93</b>	<b>86.3%</b>	<b>4.1%</b>	5.7%
Reactive 0.75pf	25°C	50%	12.09	15.20	151.30	12.09	12.70	65.8%	<b>238.43</b>	0.72	129.20	172.04	113.60	0.75	49.2%	<b>49.93</b>	<b>85.4%</b>	<b>3.6%</b>	3.4%
Reactive 0.75pf	25°C	75%	12.07	24.96	243.66	12.07	20.63	68.2%	<b>236.20</b>	1.12	199.10	265.50	175.64	0.75	75.9%	<b>49.92</b>	<b>81.7%</b>	<b>3.4%</b>	3.1%
Reactive 0.75pf	25°C	100%	12.04	34.85	338.86	12.03	28.99	66.7%	<b>234.18</b>	1.49	262.30	349.78	231.40	0.75	99.9%	<b>49.93</b>	<b>77.4%</b>	<b>3.7%</b>	3.4%
Non-Linear 25%	25°C	25%	12.01	9.37	82.79	12.01	6.99	89.2%	<b>239.87</b>	0.38	71.15	91.02	56.76	0.78	26.0%	<b>49.93</b>	<b>85.9%</b>	<b>6.9%</b>	55.3%
Non-Linear 25%	25°C	50%	12.02	20.04	189.90	12.01	16.13	73.7%	<b>238.99</b>	0.73	165.14	174.67	56.89	0.95	49.9%	<b>49.93</b>	<b>87.0%</b>	<b>6.2%</b>	28.7%
Non-Linear 25%	25°C	75%	12.01	31.59	304.10	12.00	26.01	68.9%	<b>237.56</b>	1.11	256.50	262.60	56.30	0.98	75.0%	<b>49.93</b>	<b>84.3%</b>	<b>6.6%</b>	17.9%
Non-Linear 25%	25°C	100%	12.02	43.70	428.88	12.01	36.80	64.0%	<b>231.71</b>	1.51	345.70	349.30	49.70	0.99	99.8%	<b>49.93</b>	<b>80.6%</b>	<b>7.4%</b>	10.5%

**Table 2A Efficiency & Power Quality Results (Charts)**

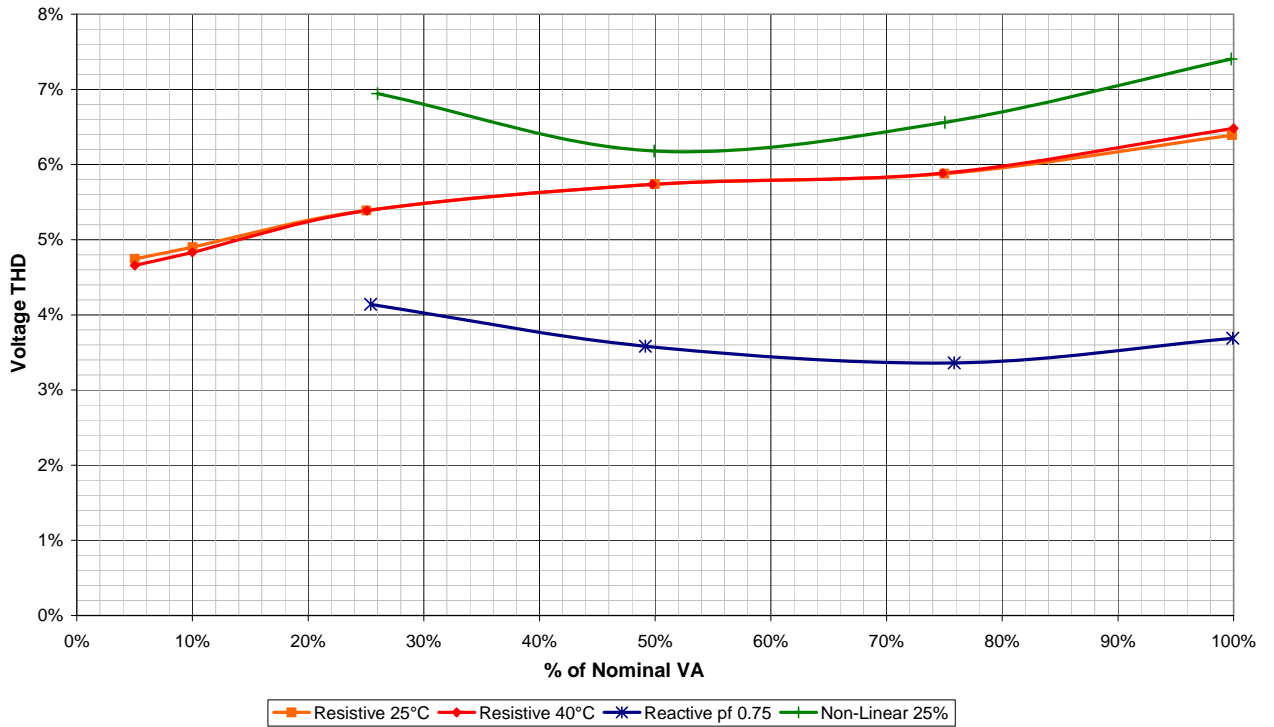


**Table 2A Efficiency & Power Quality Results (Charts)**

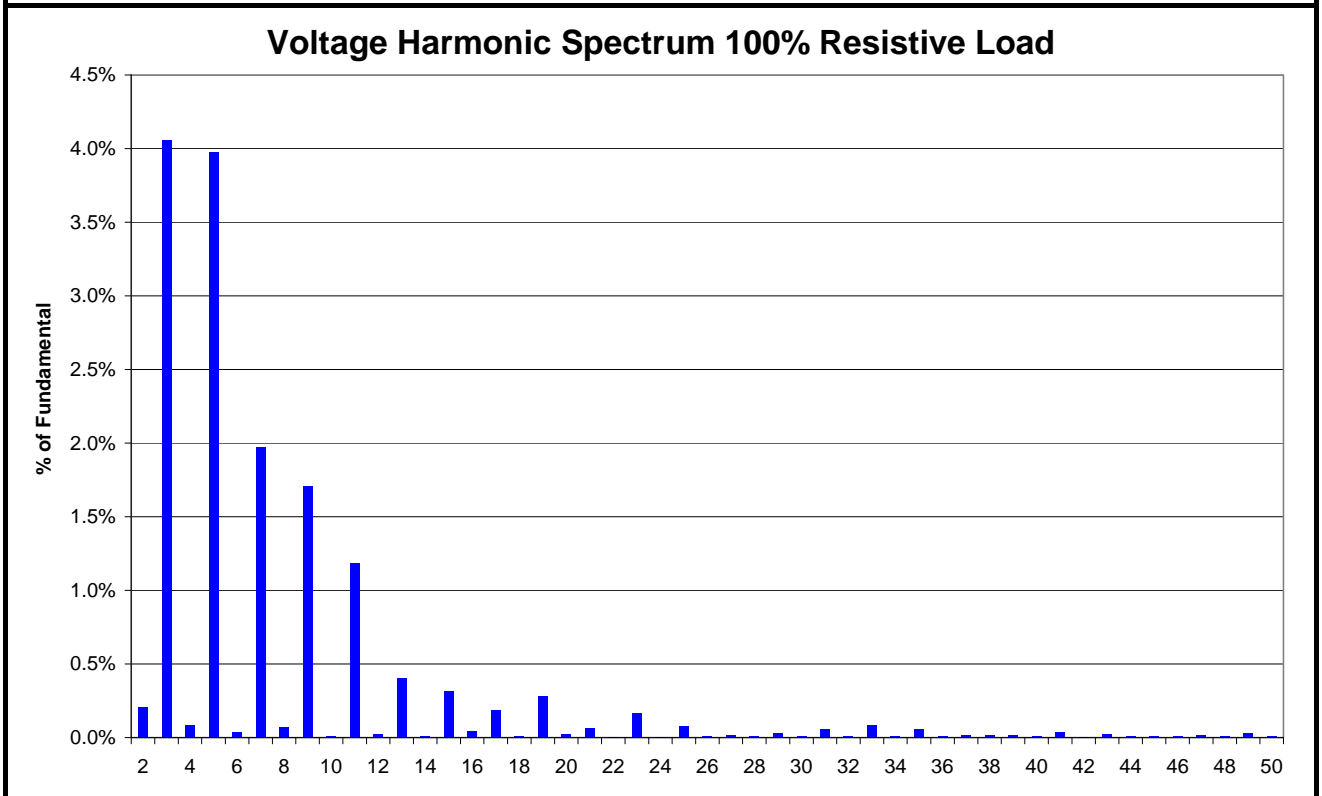
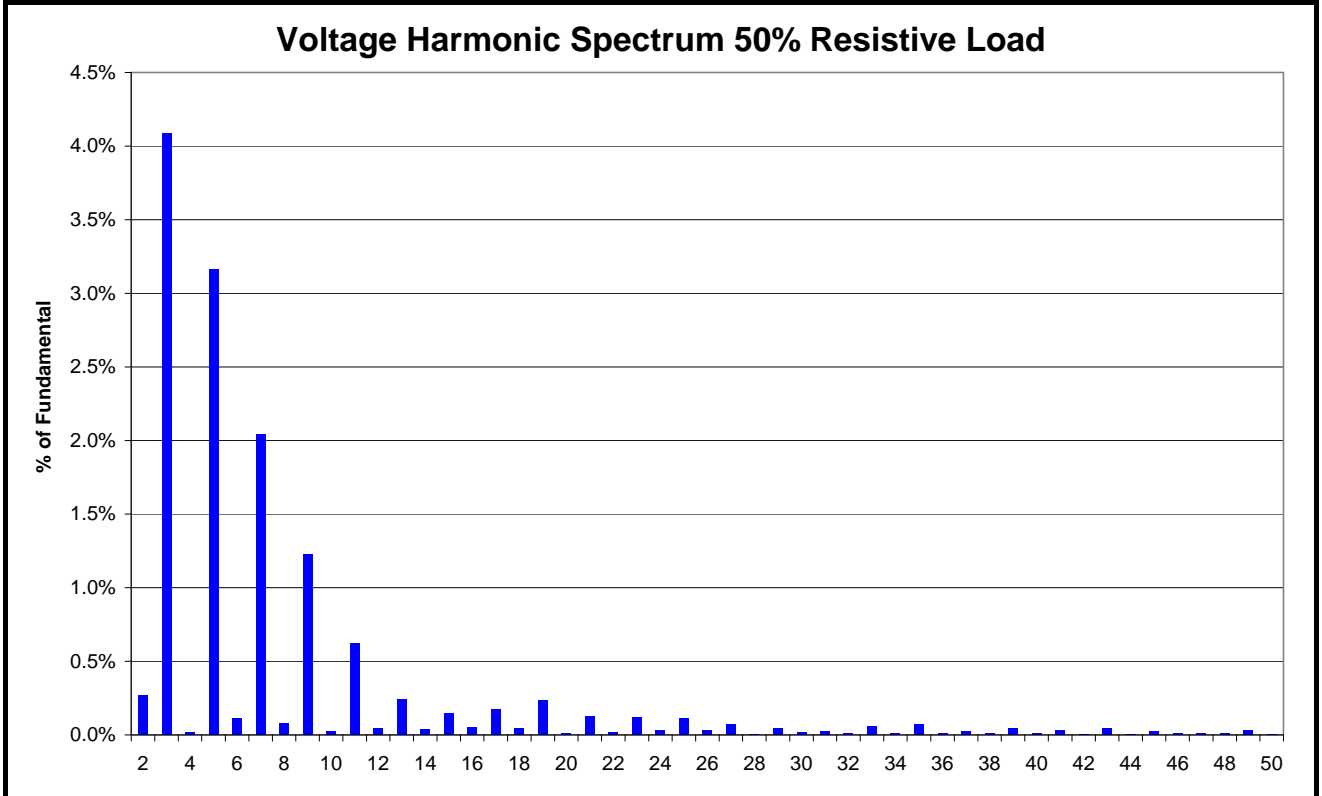
**Voltage Regulation Chart**



**Voltage THD Chart**

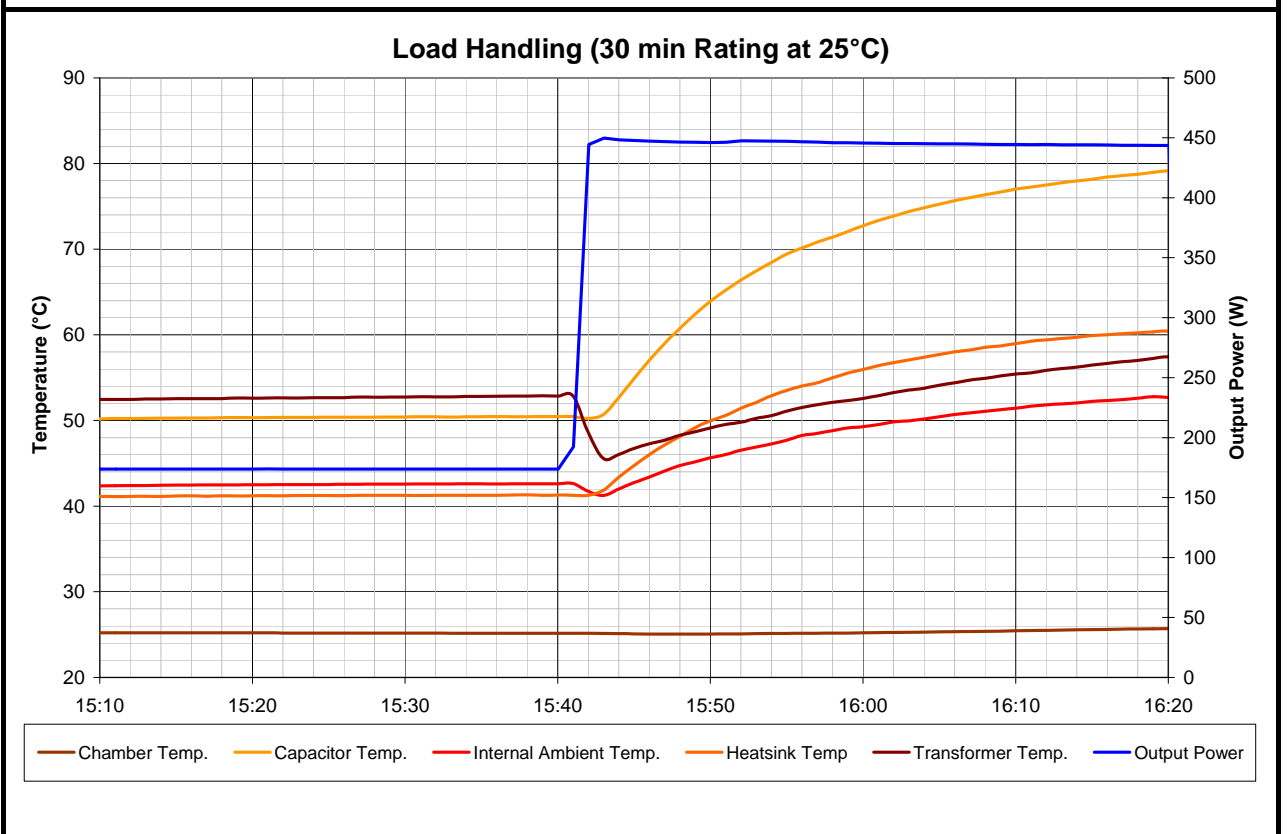
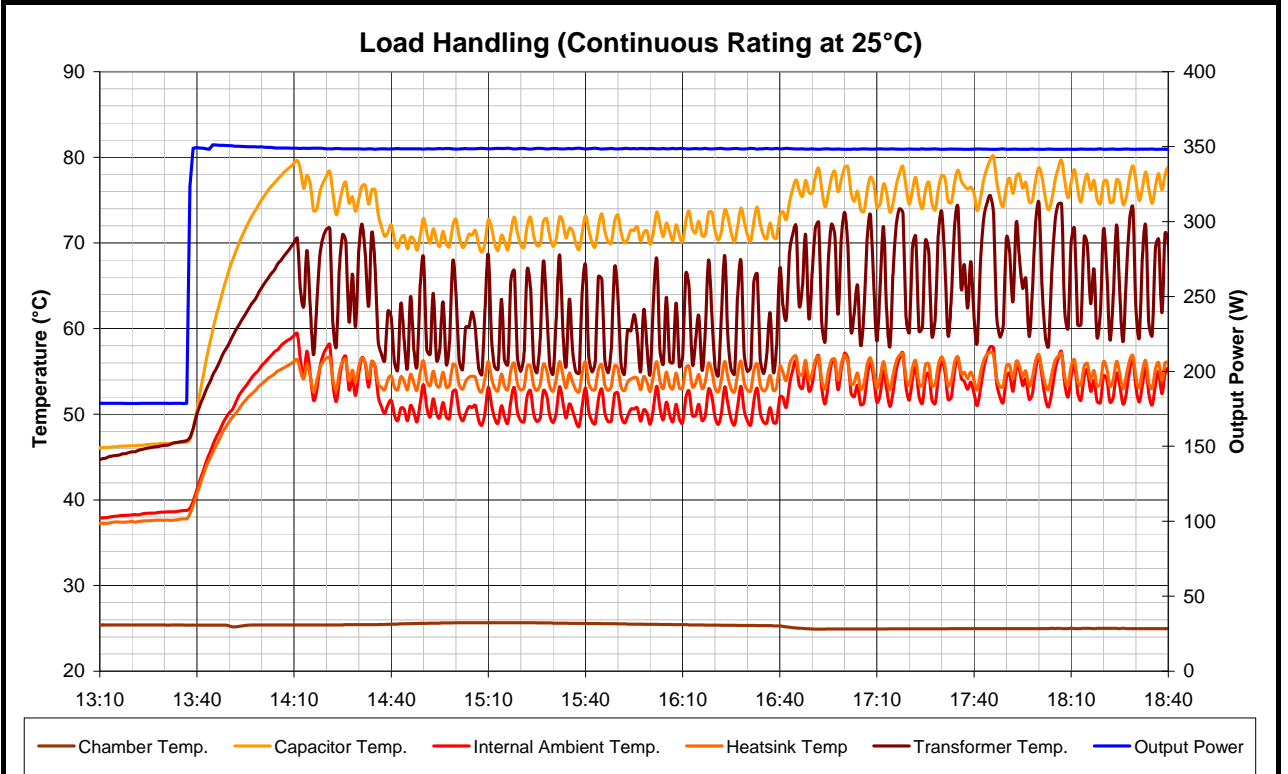


**Table 2A Efficiency & Power Quality Results (Charts)**



<b>Table 3 Load Handling Results</b>					
<b>Target Load (W)</b>	<b>350</b>	<b>450</b>	<b>1000</b>	<b>1000</b>	<b>400</b>
<b>Test Conditions</b>					
Avg. output power (W)	348.6	445.6	647.1	634.9	298.8
Actual load (%)	99.6%	99.0%	64.7%	63.5%	99.6%
Avg. test temp. (°C)	25.3	25.3	25.3	40.1	40.2
Avg. input voltage (V)	12.00	12.04	11.62	11.60	12.02
<b>Test Results</b>					
Average Output Voltage	232.73	226.65	193.94	190.70	236.73
Max Internal Temp	59.4	52.8	—	—	55.2
Max Heatsink Temp	57.2	60.4	—	—	57.6
Max Transformer Temp.	75.5	64.8	—	—	64.6
Max Capacitor Temp	80.1	79.1	—	—	71.8
Test Time	5:05:06	0:39:01	7 sec	7.25 sec	5:04:05
Automatic trip	No	No	No	No	No
Inverter status at end of test	On	On	On	On	On
Notes: No damage was observed on inverter after the tests					

**Table 3 Load Handling Results**



**Table 3 Load Handling Results**

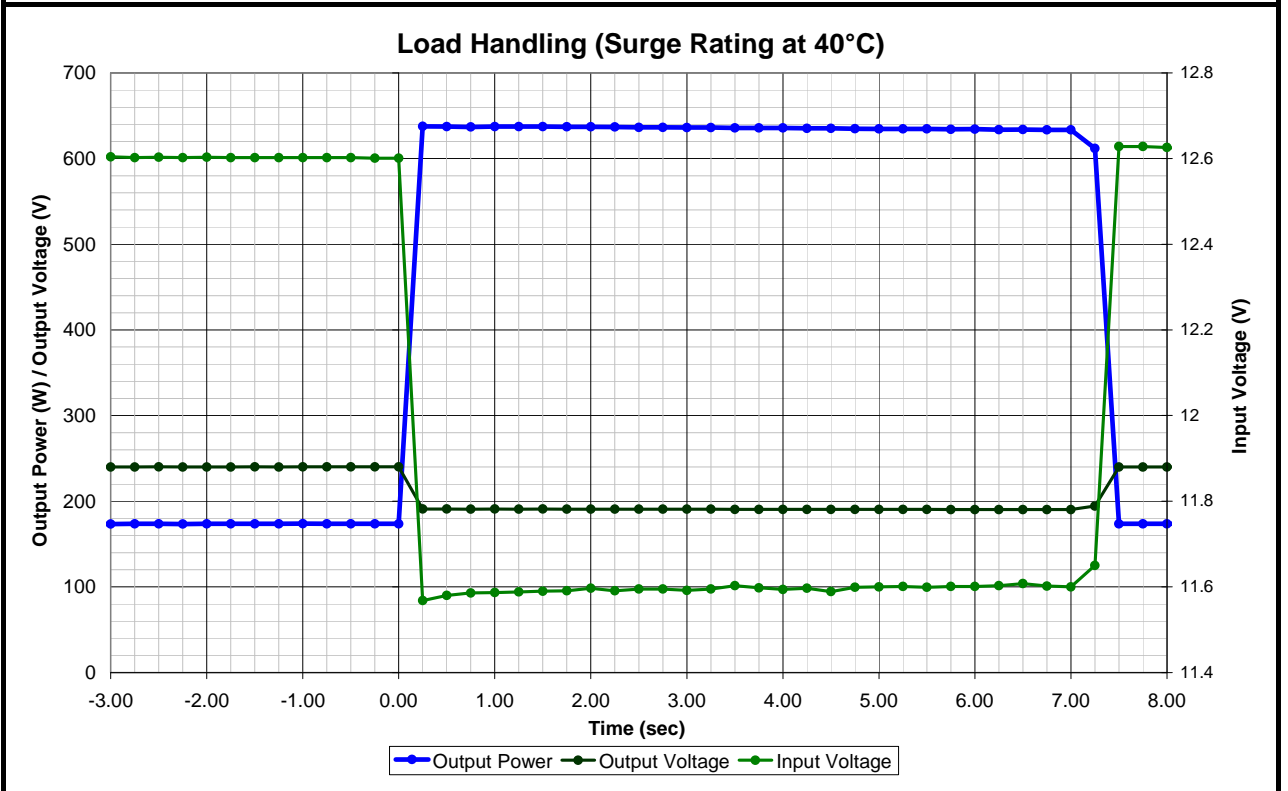
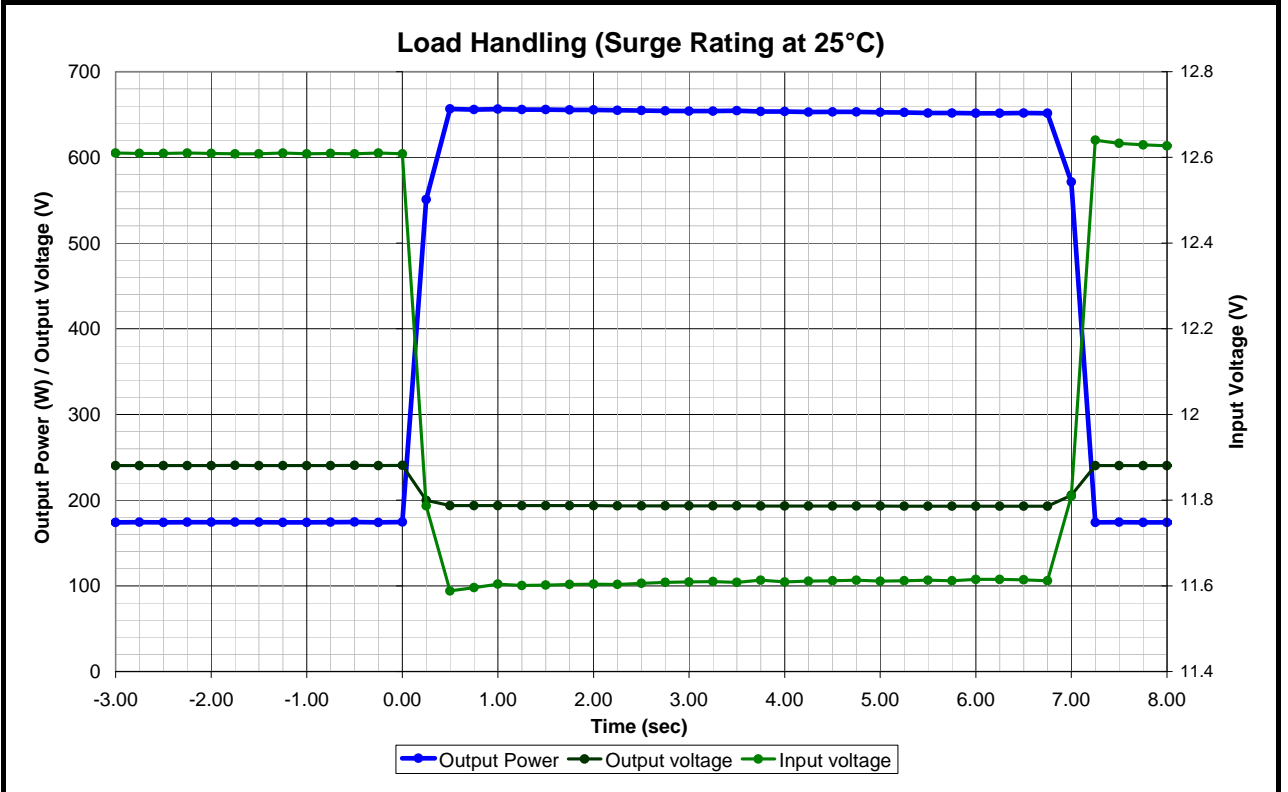
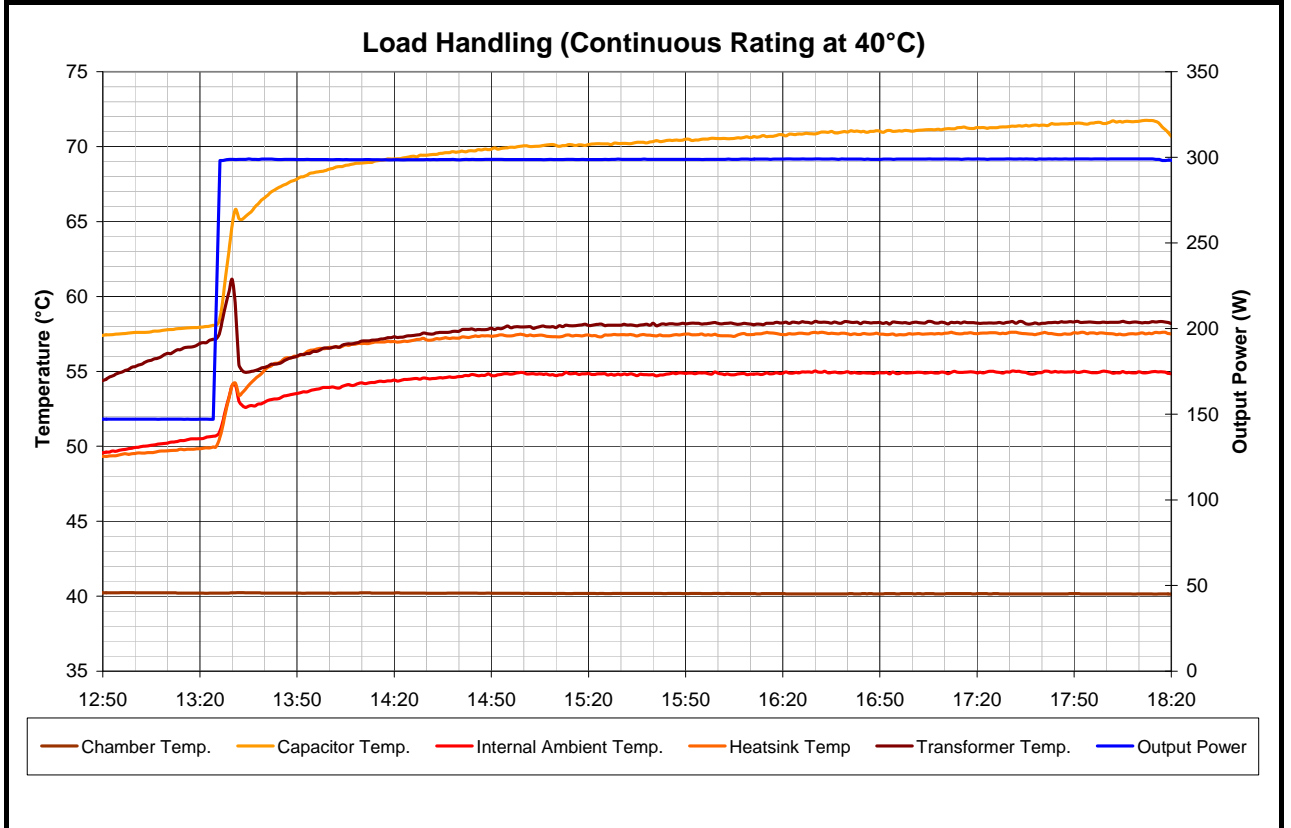


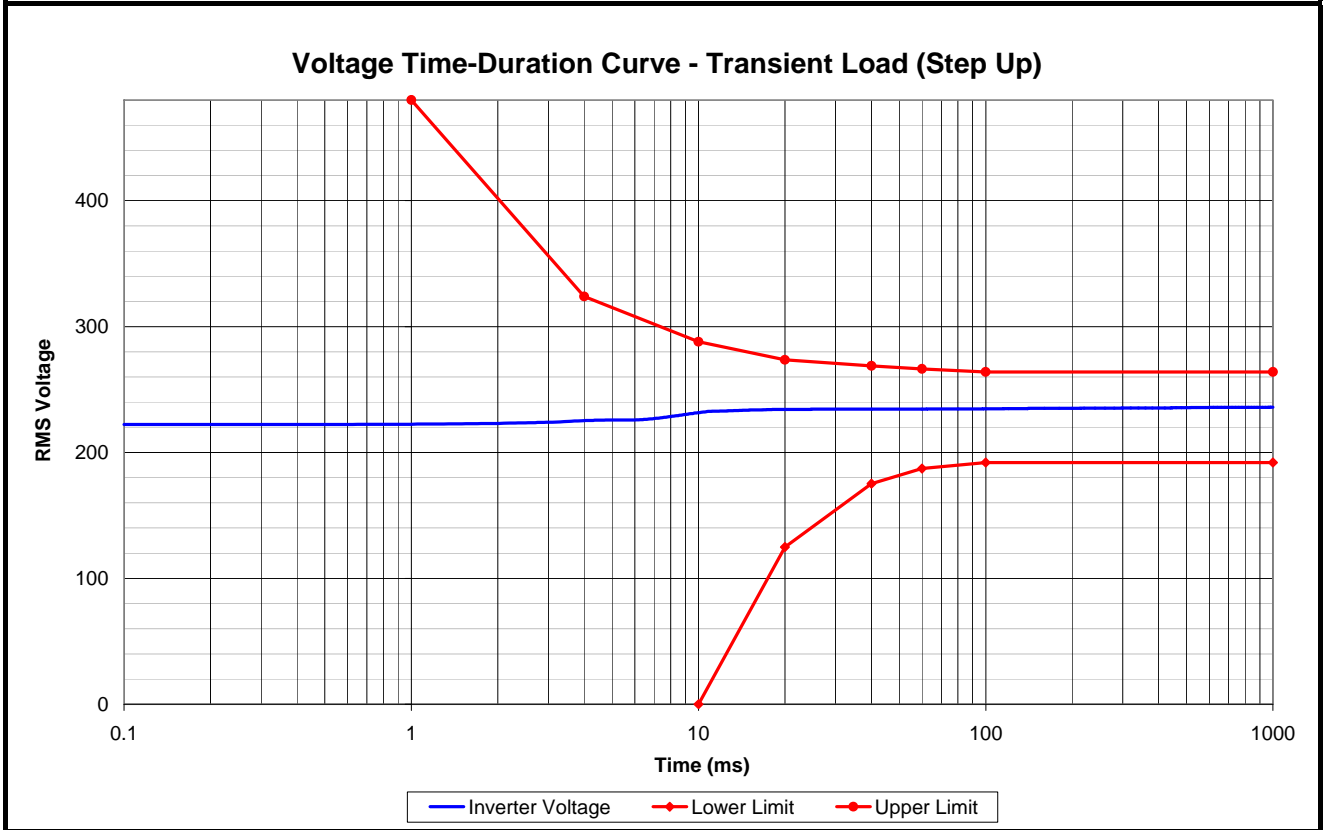
Table 3 Load Handling Results



**Table 4a Step Load Transient Response (Step-Up)**

Nominal step load (W)	Peak a.c. voltage (V)	Max Output voltage (Vrms)	Min Output voltage (Vrms)	Time outside low limit (ms)	Min Input Voltage (Vdc)	Max Input Voltage (Vdc)
280	-348.43	241.93	222.27	0	10.99	12.40

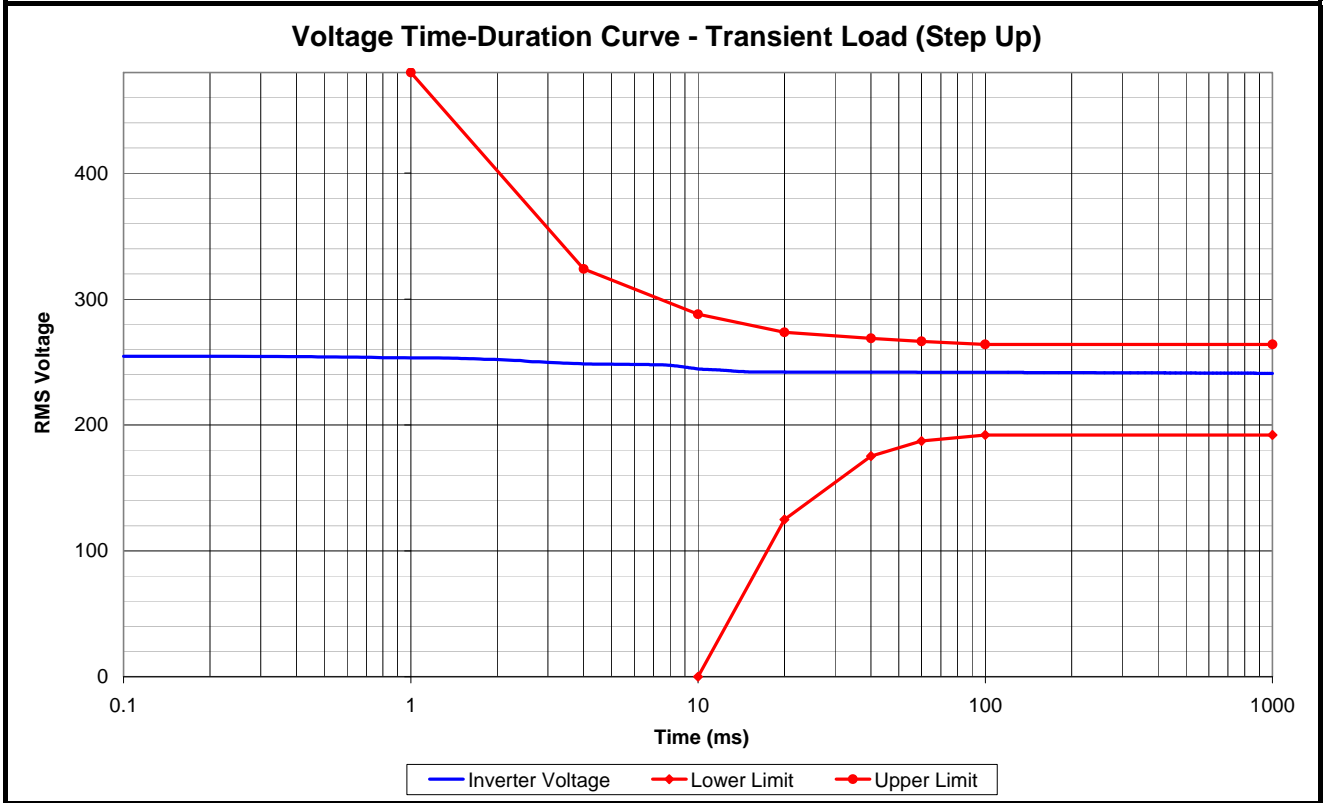
Notes:



**Table 4b Step Load Transient Response (Step-down)**

Nominal step load (W)	Peak a.c. voltage (V)	Max Output voltage (Vrms)	Min Output voltage (Vrms)	Time outside high limit (ms)	Min Input Voltage (Vdc)	Max Input Voltage (Vdc)
280	348.07	254.55	234.42	0	11.18	12.45

Notes:



<b>Table 5 Motor Load Transient Response</b>						
Resistive load applied (W)	Nominal motor current (A)	Peak load current (A)	Maximum load current (Arms)	Time to reach rated motor current (ms)	Min voltage (Vrms)	Time outside the limits (ms)
N/A	N/A	N/A	N/A	N/A	N/A	N/A
Notes:						

<b>Table 6 Three Phase Balanced and Unbalanced Load Results</b>						
Load Conditions	Line to Neutral Voltage (V a.c.)			Line to Line Voltage (V a.c.)		
	Phase 1	Phase 2	Phase 3	Phases 1,2	Phases 2,3	Phases 3,1
3 phase, 100%	N/A	N/A	N/A	N/A	N/A	N/A
Phase 1, 100%	N/A	N/A	N/A	N/A	N/A	N/A
Phase 2, 100%	N/A	N/A	N/A	N/A	N/A	N/A
Phase 3, 100%	N/A	N/A	N/A	N/A	N/A	N/A
Notes:						