



# Test Report: NTS-450-112

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450W High Reliable Built-in Type True Sine Wave DC-AC Power Inverter

- **DESIGN VERIFY TEST**
  - Output Function Test
  - Input Function Test
  - Protection Function Test
  - Control Function Test
  - APPLICATION Test
  - Component Stress Test
- **SAFETY & E.M.C. TEST**
  - Safety Test
  - E.M.C. Test
- **RELIABILITY TEST**
  - ENVIRONMENT TEST

DESIGN VERIFY TEST

OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RATED POWER	450W	IP: 12VDC Ta:25°C	459 W
2	MAXIMUM OUTPUT POWER (TYP)	(1)517.5W/180sec. (2)675w/10sec (3)SURGE POWER 900W FOR 30CYCLE Vin (30±5 CYCLE)	IP: 12.5VDC OP: TESTING LOAD Ta:25°C	(1) 108.9 V / 4.63 A / 180.07 Sec (2) 108.6 V / 6.0 A / 10.06 Sec (3) 109.04 V / 8.13 A / 33 Cycle

CH3:O/P VAC CH4:O/P IAC

Fig1

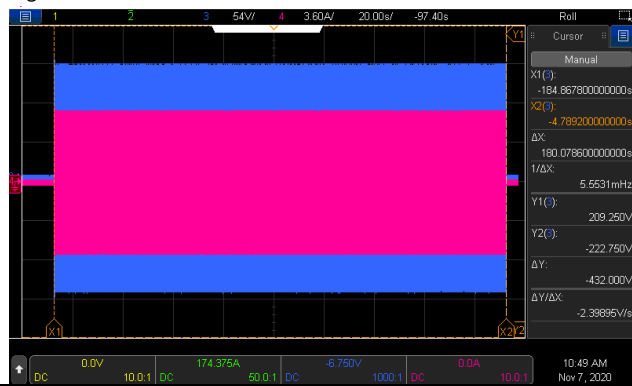


Fig2

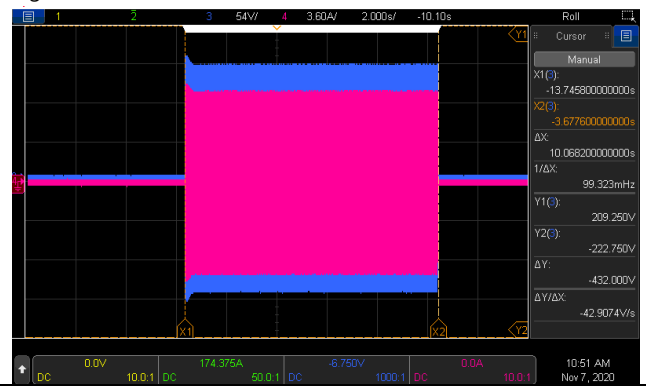


Fig3

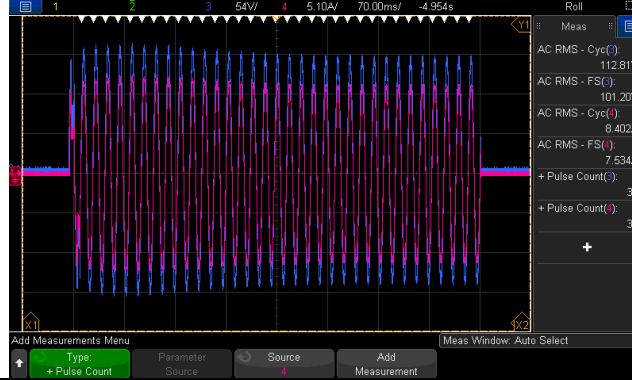


Fig4



3	AC Voltage	100 / 110 / 115 / 120Vac selectable by DIP S.W	IP: 12VDC OP: FULL LOAD Ta:25°C	DIP S.W 100VAC: 99.02 V DIP S.W 110VAC: 109.04 V DIP S.W 115VAC: 113.53 V DIP S.W 120VAC: 119.19 V
4	FREQUENCY	50/60Hz (±0.1HZ) selectable by DIP S.W	IP: 12VDC OP: FULL LOAD Ta:25°C	DIP S.W 50HZ: 50.042 HZ DIP S.W 60HZ: 59.959 HZ
5	WAVEFORM	True sine wave (THD<3%)	IP: 12.5VDC OP: FULL LOAD (1) Vo(min) (2) Vo(nor) (3) Vo(max) Ta:25°C	(1) 1.35 % / Vo(min) /FULL LOAD (2) 1.22 % / Vo(nor) /FULL LOAD (3) 1.12 % / Vo(max) /FULL LOAD

CH3:O/P VAC CH4:O/P IAC				
6	AC REGULATION	±3%	IP: 12.5VDC OP: FULL LOAD/NO LOAD Ta:25°C	<u>-0.45</u> %
7	Overshoot /Undershoot	<±10%	IP: 12VDC OP: (1) full load turn on (2) no load turn on (3) full /no load change Ta:25°C	(1) <u>-1.36</u> % (2) <u>-0.98.7</u> % (3) <u>-3.25</u> %
8	O/P voltage DC offset	Vin(nor)= <u>12</u> v · Vo<200mv · no load : <u>90 mV</u> / full load: <u>60 mV</u>		

9	LED STATUS	<ul style="list-style-type: none"> <li> <b>Status test</b> <table border="1"> <thead> <tr> <th>LED</th> <th>Status</th> <th>RESULT</th> </tr> </thead> <tbody> <tr> <td>Green</td> <td> Inverter OK</td> <td>OK</td> </tr> <tr> <td>Orange</td> <td> Remote off  Saving mode</td> <td>OK</td> </tr> <tr> <td>Red</td> <td> Abnormal Status (See SPEC)</td> <td>OK</td> </tr> </tbody> </table> </li> <li> <b>Battery test</b> <table border="1"> <thead> <tr> <th>LED</th> <th>Battery RANGE</th> <th>RESULT</th> </tr> </thead> <tbody> <tr> <td><b>Green</b> </td> <td>12.5Vdc±0.3v~15.5±0.3v</td> <td>12.54 Vdc~15.59</td> </tr> <tr> <td><b>Orange</b> </td> <td>11~ 12.5Vdc ±0.3v</td> <td>11.218Vdc ~ 12.429Vdc</td> </tr> <tr> <td><b>Red</b> </td> <td>&lt;11 Vdc ±0.3v or &gt;15.5 Vdc ±0.3v</td> <td>&lt;11.012 Vdc or &gt;15.064 Vdc</td> </tr> </tbody> </table> </li> <li> <b>Load test</b> <table border="1"> <thead> <tr> <th>LED</th> <th>LOAD RANGE</th> <th>RESULT</th> </tr> </thead> <tbody> <tr> <td><b>Green</b> </td> <td>Min. load ~ 40%±5% LOAD</td> <td>Min. load ~ 42.2%</td> </tr> <tr> <td><b>Orange</b> </td> <td>40%±5% ~ 80%±5% LOAD</td> <td>41.8% ~ 78.8 %</td> </tr> <tr> <td><b>Red</b> </td> <td>≥ 80%±5% LOAD</td> <td>≥ 81.6%</td> </tr> </tbody> </table> </li> </ul>			LED	Status	RESULT	Green	Inverter OK	OK	Orange	Remote off Saving mode	OK	Red	Abnormal Status (See SPEC)	OK	LED	Battery RANGE	RESULT	<b>Green</b>	12.5Vdc±0.3v~15.5±0.3v	12.54 Vdc~15.59	<b>Orange</b>	11~ 12.5Vdc ±0.3v	11.218Vdc ~ 12.429Vdc	<b>Red</b>	<11 Vdc ±0.3v or >15.5 Vdc ±0.3v	<11.012 Vdc or >15.064 Vdc	LED	LOAD RANGE	RESULT	<b>Green</b>	Min. load ~ 40%±5% LOAD	Min. load ~ 42.2%	<b>Orange</b>	40%±5% ~ 80%±5% LOAD	41.8% ~ 78.8 %	<b>Red</b>	≥ 80%±5% LOAD	≥ 81.6%
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**INPUT FUNCTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	VOLTAGE RANGE (TYP)	10VDC~16.5VDC	IP: TESTING OP:NO LOAD/FULL LOAD Ta:25°C  I/P: LOW-LINE=10.5V HIGH-LINE=16.2V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE ) ON:30Sec OFF:30Sec 10MIN (POWER ON/OFF NO DAMAGE) I/P: 12V O/P:FULL LOAD ON:30ec OFF:30ec 12Hr (POWER ON/OFF NO DAMAGE)	<u>9.95 VDC~ 16.49 VDC/NO LOAD</u> <u>10.25 VDC~ 16.36 VDC/FULL LOAD</u>  Test: <u>OK</u>

2	DC CURRENT (TYP)	50A	IP: 12VDC OP:FULL LOAD Ta:25°C	<u>42.9</u> A
3	NO LOAD DISSIPATION (Typ.)	$\leq 1.2W$ @ Saving Mode $\leq 10W$ @NON-Saving Mode	IP: 12VDC OP:NO LOAD Ta:25°C	<u>0.785</u> W <u>7.2</u> W
4	SAVING MODE TO NORMAL	$P_o \geq 25W$	IP: 12VDC OP: TESTING LOAD Ta:25°C	$\geq 21.7$ W
5	NORMAL TO SAVING MODE	$P_o \leq 10W$	IP: 12VDC OP: TESTING LOAD Ta:25°C	$\leq 12.7$ W
6	OFF MODE CURRENT DRAW (Typ.)	$\leq 1mA$	IP: 12VDC OP: Sw off Ta:25°C	<u>0.4</u> mA
7	EFFICIENCY(TYP)	450W/88%	IP: 12.5VDC OP: $P_o=450W$ 110V/60HZ (factory setting) Ta:25°C	<u>89.1</u> %

**PROTECTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	BAT LOW ALARM	11V±0.3VDC	IP: TESTING OP:FULL LOAD SW:ON Ta:25°C	<u>11.1</u> V
2	BAT LOW SHUT DOWN	10V±0.3VDC	IP: TESTING OP: FULL LOAD SW:ON Ta:25°C	<u>10.26</u> V
3	BAT LOW RESTART	12.5V±0.3VDC	IP: TESTING OP: FULL LOAD SW:ON Ta:25°C	<u>12.525</u> V
4	BAT HIGH ALARM	15.5V±0.3VDC	IP: TESTING OP:FULL LOAD SW:ON Ta:25°C	<u>15.57</u> V
5	BAT HIGH SHUT DOWN	16.5V±0.3VDC	IP: TESTING OP: FULL LOAD SW:ON Ta:25°C	<u>16.62</u> V
6	BAT HIGH RESTART	15V±0.3VDC	IP: TESTING OP: FULL LOAD SW:ON Ta:25°C	<u>14.89</u> V

7	OVER TEMPERATURE	Shut down o/p voltage: re-power on	IP: HI LINE/LOW-LINE OP: FULL LOAD SW:ON Ta:25°C	Shut down o/p voltage, re-power on to recover LED DISPLAY: <u>  OK  </u>
8	OUTPUT SHORT	Shut down o/p voltage: re-power on	IP: 10.3VDC/16.2 VDC O/P: FULL LOAD SW:ON Ta:25°C	Shut down o/p voltage, re-power on to recover LED DISPLAY: <u>  OK  </u> (1).TEST: <u>  OK  </u>
9	OVER LOAD (typ.)	105%~115%LOAD 180sec 115%~150%LOAD 10 sec Shut down o/p voltage, re-power on to recover	IP: 12VDC OP: TESTING SW:ON Ta:25°C	(1). <u>  107%  </u> ~ <u>  112%  </u> <u>  180.07  </u> sec (2). <u>  117%  </u> ~ <u>  146%  </u> <u>  10.06  </u> sec Shut down o/p voltage, re-power on to recover

**CONTROL FUNCTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	REMOTE CONTROL	Power ON-OFF remote control by front panel dry contact connector (by RELAY) Open : Normal work Short : Remote off	IP: 12VDC OP: FULL LOAD Ta:25°C	Open : Normal work Short : Remote off TEST: <u>  OK  </u>

**APPLICATION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	LAMP	LAMP: <u>  242  </u> W · turn on <u>  OK  </u> LAMP: <u>  472  </u> W · turn on <u>  OK  </u> LAMP: <u>  399  </u> W · turn on <u>  OK  </u>	1. Vin=HIGH LINE 2. O/P=110V/60Hz TEST: <u>  OK  </u>	
2	INDUCTION MOTOR	<u>  0.15  </u> HP	1. Vin=HIGH LINE 2. O/P=110V/60Hz TEST: <u>  OK  </u>	
3	SWITCHING POWER SUPPLY	WITH PFC: <u>  EPP-500-48  </u> · O/P= <u>  447  </u> W	1. Vin=HIGH LINE 2. O/P=110V/60Hz TEST: <u>  OK  </u>	
		NO PFC: <u>  LRS-350-36  </u> · O/P= <u>  143  </u> W	1. Vin=HIGH LINE 2. O/P=110V/60Hz TEST: <u>  OK  </u>	

**COMPONENT WEAFORM TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	DC TO DC Power Transistor ( D to S) or (C to E) Peak Voltage	Q102 Rated :200 V /18 A	I/P: high line O/P:V(max)/Freq 60HZ VDS: O/P: (1)Full Load Turn On (2) Output Short (3)O.L.P(200%) Turn On (4) NO LOAD Turn On (5) Saving mode Ta:25°C	(1) 37.3V (2) 36.5V (3) 38.1V (4) 38.1V (5) 34.1V

2	DC TO DC Diode Peak Voltage	D 105 Rated : 600V/ 10A	I/P: high line O/P:V(max) /Freq 60HZ O/P: (1)Full Load Turn On (2) Output Short (5)O.L.P(200%) Turn On (4) NO LOAD Turn On (5) Saving mode Ta:25°C	(1)301V (2)303V (3)295V (4)297V (5)303V
3	DC BUS Capacitor Voltage	C119 Rated : 330 u/ 315V	I/P: high line O/P:V(max) /Freq 60HZ O/P: (1)Full Load Turn On (2) Output Short (3)O.L.P(200%) Turn On (4) NO LOAD Turn On (5) Saving mode Ta:25°C	C119 (1)290 V (2) 290V (3) 290V (4) 290V (5) 290V
4	DC TO AC Power Transistor ( D to S) or (C to E) Peak Voltage	Q 200 IKP15N65H5 Rated : 650V / 20 A	I/P: high line O/P:V(min)/Freq 50HZ VDS: O/P: (1)Full Load Turn On (2) Output Short (3)O.L.P(200%) Turn On (4) NO LOAD Turn On (5) Saving mode Ta:25°C	(1) 329V (2) 390V (3) 358V (4) 306V (5) 306V
5	AUX PWM MOS	Q504 Rated : 40 A/ 200 V  Q105 Rated : 18A/ 200 V	I/P: high line O/P:V(max) /Freq 60HZ O/P: (1)Full Load Turn On (2) Output Short (5)O.L.P(200%) Turn On (4) NO LOAD Turn On (5) Saving mode Ta:25°C	Q504 (1) 49.9V (2) 49.9V (3) 49.9V (4) 49.5V (5) 49.9V  Q105 (1) 36.2V (2) 36.2V (3) 35.8V (4) 35.8V (5) 35.8V
6	Control IC Voltage Test	MCU IC U303 Rated 2.4 V~ 3.6 V  AUX IC U501 Rated 8.2V~30V  CHARGE IC U101 Rated -0.3V~20V  Gate Driver IC U200 Rated	I/P: high line O/P:V(max) /Freq 60HZ O/P: (1)Full Load Turn On (2) Output Short (3)O.L.P(200%) Turn On (4) NO LOAD Turn On (5) Saving mode Ta:25°C	U303 (1)3.33 V (2) 3.33V (3) 3.31V (4) 3.31V (5) 3.31V  U501 (1) 11.55V (2) 11.55V

		-0.3V~20V		(3) 11.56V (4) 11.56V (5) 11.55V  U101 (1) 12.9V (2) 12.9V (3) 12.9V (4) 12.9V (5) 12.9V  U200 (1) 5.05V (2) 5.05V (3) 5.05V (4) 5.05V (5) 5.05V
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## SAFETY & EMC TEST

### SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	BAT I/P-ACO/P: 3 KVAC/min AC O/P-FG: 1.5 KVAC/min	BAT I/P-ACO/P 3.6 KVAC/min AC O/P-FG:1.8 KVAC/min Ta:25°C	BAT I/P-ACO/P: 1.674 mA AC O/P-FG: 2.139 mA NO DAMAGE
2	GROUNDING CONTINUITY	IEC62368 FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40 A / 2min Ta:25°C	3mΩ

### E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RADIATION	FCC CLASS A	I/P:12 VDC O/P: :FULL/50% LOAD Ta:25°C	CLASS A
2	E.S.D	EN61000-4-2 AIR : 8KV / Contact : 4KV	I/P: 12VDC O/P:FULL LOAD Ta:25°C	<input checked="" type="checkbox"/> CRITERIA A <input type="checkbox"/> CRITERIA B
3	Test by certified Lab & Test Report Prepare Any contradictions of the test results, please refer to the latest EMC test report			



**Reliability Test**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT			
1	TEMPERATURE RISE TEST	MODEL : NTS-450-124					
		1. ROOM AMBIENT BURN-IN : 2 HRS I/P : 25VDC O/P : FULL LOAD Ta= 25.0 °C					
		2. HIGH AMBIENT BURN-IN : 2 HRS I/P : 25VDC O/P : FULL LOAD Ta= 40.0 °C					
				NO	Position	ROOM AMBIENT Ta=25.0 °C	HIGH AMBIENT Ta= 40.0 °C
				1	C100	51.3°C	60.9°C
				2	C101	53.1°C	62.3°C
				3	Q103	53.9°C	64.5°C
				4	T101	67.8°C	76.0°C
				5	L100	61.1°C	67.6°C
				6	C112	53.2°C	60.3°C
				7	D107	62.4°C	72.1°C
				8	C119	52.3°C	59.6°C
				9	D105	62.9°C	72.5°C
				10	C118	51.8°C	57.8°C
				11	Q200	75.7°C	86.0°C
				12	U501	66.9°C	73.0°C
				13	L201	47.5°C	56.0°C
				14	C219	53.3°C	57.8°C
				15	L200	84.7°C	86.4°C
				16	Q203	69.4°C	78.7°C
				17	TSW1	70.2°C	75.6°C
				18	ZR200	40.4°C	50.4°C
				19	C114	44.5°C	53.7°C
				20	T100	46.0°C	55.8°C
				21	T501	57.8°C	65.4°C
				22	U101	48.1°C	57.2°C
				23	Q501	60.0°C	67.1°C
				24	Q105	46.4°C	55.8°C
				25	RT300	53.1°C	62.5°C
				26	Q504	60.0°C	68.7°C
				27	U303	55.0°C	64.6°C
		28	U100	56.9°C	67.0°C		
		29	U500	56.1°C	66.0°C		
		30	U201	56.5°C	65.6°C		
2	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 25VDC O/P : 100%LOAD Ta= -25 °C	TEST : OK			
3	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 40 °C NO DAMAGE	I/P : 32.5VDC O/P : FULL LOAD Ta= 40 °C HUMIDITY= 95 %R.H	TEST : OK			

5	STORAGE TEMPERATURE TEST	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 : 5 CYCLE 5. Input/Output condition : STATIC	TEST : OK
7	THERMAL SHOCK TEST	1. Thermal shock Temperature : -25°C~ +45°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 : 24VDC/Full Load	TEST : OK
8	VIBRATION TEST	1 Carton & 1 Set (1) Waveform : Sine Wave (2) Frequency : 10~500Hz (3) Sweep Time : 10min/sweep cycle (4) Acceleration : 4G (5) Test Time : 60min in each axis (X.Y.Z) (6) Ta : 25°C	TEST : OK
9	CAPACITOR LIFE CYCLE	SUPPOSE C101 IS THE MOST CRITICAL COMPONENT (1) I/P : 25VDC O/P : FULL LOAD Ta= 25 °C LIFE TIME (2) I/P : 25VDC O/P : FULL LOAD Ta= 40 °C LIFE TIME	(1) 526723.6HRS (2) 378378.2HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 843.9K hrs min. Telcordia SR-332 (Bellcore) ; 85.0K hrs min. MIL-HDBK-217F (25°C)	
11	Ongoing Reliability Test	I/P : 25VDC O/P : 80% LOAD TA=50°C Demonstration Mean Time Between Failure : 30,000 hours	

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	LIUTT		WANGDZ

2018.4.30 GP-A50-F010