



# Test Report: NTU-2200-148

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2200W High Reliable True Sine Wave with UPS 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	2200W	IP: 48VDC Ta:25°C	<u>2245</u> W
2	MAXIMUM OUTPUT POWER (TYP)	(1)2530W/180sec. (2)3300w/10sec (3)SURGE POWER 4400W FOR 30CYCLE Vin (30 ± 5 CYCLE)	IP: 50VDC OP:TESTING LOAD Ta:25°C	(1) <u>108.36</u> V / <u>22.12</u> A / <u>180.09</u> Sec (2) <u>108.06</u> V / <u>29.88</u> A / <u>10.07</u> Sec (3) <u>108.14</u> V / <u>39.4</u> A / <u>33</u> Cycle

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

Fig1

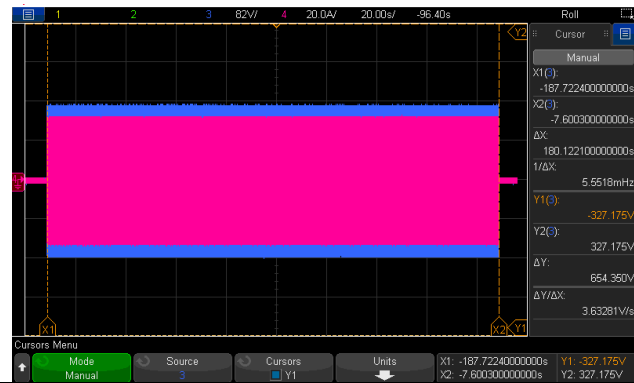


Fig2

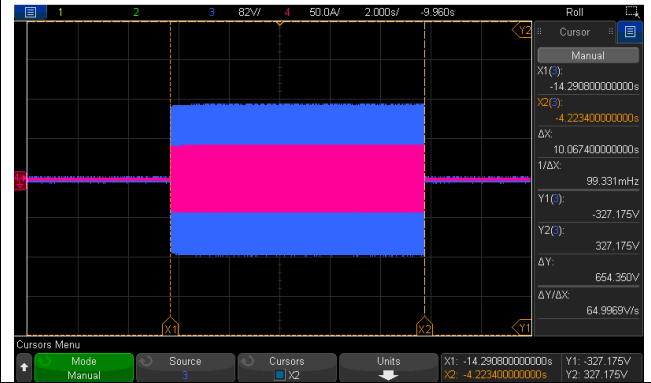
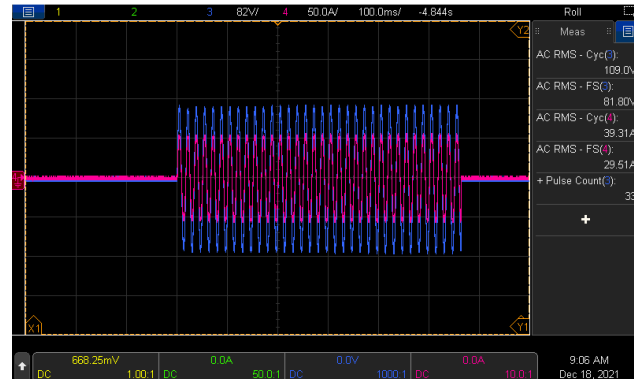


Fig3



3	AC Voltage	100 / 110 / 115 / 120Vac selectable by DIP S.W	IP: 48VDC OP: FULL LOAD Ta:25°C	DIP S.W 100VAC: <u>98.48</u> V DIP S.W 110VAC: <u>108.38</u> V DIP S.W 115VAC: <u>113.68</u> V DIP S.W 120VAC: <u>118.36</u> V
4	FREQUENCY	50/60Hz (±0.1HZ) selectable by DIP S.W	IP: 48VDC OP: FULL LOAD Ta:25°C	DIP S.W 50HZ: <u>50.06</u> HZ DIP S.W 60HZ: <u>59.95</u> HZ
5	WAVEFORM	True sine wave (THD<3%)	IP: 50VDC OP: 1650W (1) Vo(min) (2) Vo(nor) (3) Vo(max) Ta:25°C	(1) <u>1.85</u> % / Vo(min) /1650W (2) <u>2.13</u> % / Vo(nor) /1650W (3) <u>2.11</u> % / Vo(max) /1650W

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

Fig1

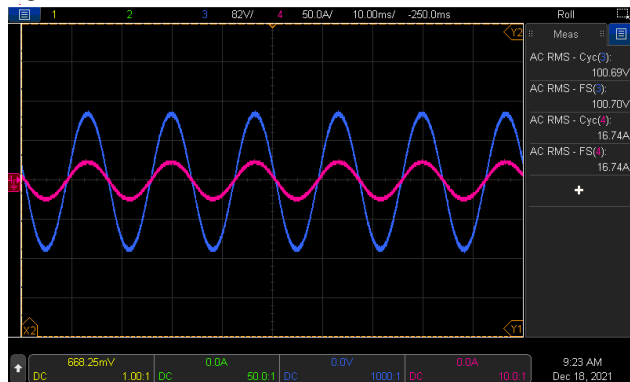


Fig2

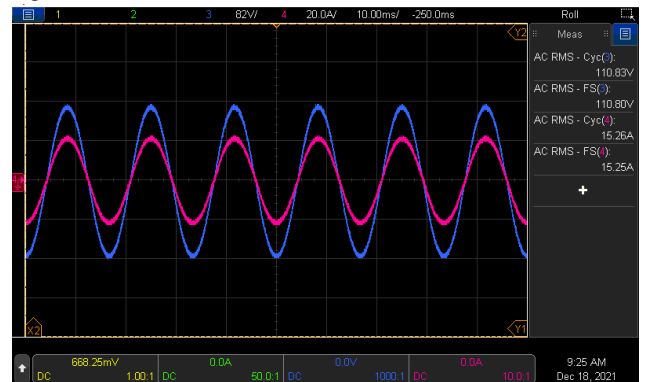
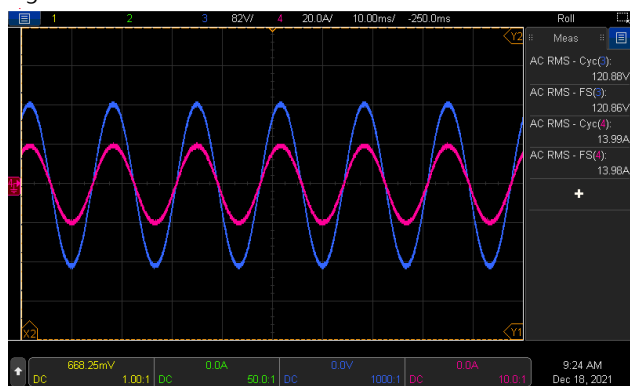


Fig3



6	AC REGULATION	±3%	IP: 50VDC OP: 1650W Ta:25°C	<u>        -1.38        </u> %
7	Overshoot /Undershoot	<±10%	IP: 48VDC OP: (1) full load turn on (2) no load turn on (3) full /no load change Ta:25°C	(1) <u>        -6.36        </u> % (2) <u>        1.82        </u> % (3) <u>        -6.54        </u> %
8	O/P voltage DC offset	Vin(nor)= <u>    48    </u> V · Vo<200mV · no load : <u>    66.7    </u> mV / full load: <u>    86.7    </u> mV		

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</td> <td>OK</td> </tr> <tr> <td>Orange ☀</td> <td>No AC Output at Saving mode</td> <td>OK</td> </tr> <tr> <td>Red ●</td> <td>Inverter Fail</td> <td>OK</td> </tr> </tbody> </table> </li> <li> <b>DC Input test</b> <table border="1"> <thead> <tr> <th>LED</th> <th>Battery RANGE</th> <th>RESULT</th> </tr> </thead> <tbody> <tr> <td>Green ●</td> <td>50.0~62.0 Vdc±1V</td> <td>50.185Vdc ~ 61.96 Vdc</td> </tr> <tr> <td>Orange ●</td> <td>44.0~50.0Vdc ±1V</td> <td>44.143Vdc ~ 50.125 Vdc</td> </tr> <tr> <td>Red ●</td> <td>&lt;44.0 Vdc ±1V &gt; 62.0Vdc±1V</td> <td>&lt; 44.043 Vdc &gt; 62.15 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>Green ●</td> <td>Min. load ~ 40%±5% LOAD</td> <td>Min. load ~ 38.41 %</td> </tr> <tr> <td>Orange ●</td> <td>40%±5% ~ 80%±5% LOAD</td> <td>41.18% ~ 78.64 %</td> </tr> <tr> <td>Red ●</td> <td>≥ 80%±5% LOAD</td> <td>≥ 80.81%</td> </tr> </tbody> </table> </li> <li> <b>AC Input</b> <table border="1"> <thead> <tr> <th>LED</th> <th>LOAD RANGE</th> <th>RESULT</th> </tr> </thead> <tbody> <tr> <td>Green ●</td> <td>Utility OK</td> <td>OK</td> </tr> <tr> <td>Green ☀</td> <td>Utility error</td> <td>OK</td> </tr> <tr> <td>Colorless ○</td> <td>Utility disconnected</td> <td>OK</td> </tr> </tbody> </table> </li> </ul>	LED	Status	RESULT	Green ●	Inverter OK	OK	Orange ●	Remote off	OK	Orange ☀	No AC Output at Saving mode	OK	Red ●	Inverter Fail	OK	LED	Battery RANGE	RESULT	Green ●	50.0~62.0 Vdc±1V	50.185Vdc ~ 61.96 Vdc	Orange ●	44.0~50.0Vdc ±1V	44.143Vdc ~ 50.125 Vdc	Red ●	<44.0 Vdc ±1V > 62.0Vdc±1V	< 44.043 Vdc > 62.15 Vdc	LED	LOAD RANGE	RESULT	Green ●	Min. load ~ 40%±5% LOAD	Min. load ~ 38.41 %	Orange ●	40%±5% ~ 80%±5% LOAD	41.18% ~ 78.64 %	Red ●	≥ 80%±5% LOAD	≥ 80.81%	LED	LOAD RANGE	RESULT	Green ●	Utility OK	OK	Green ☀	Utility error	OK	Colorless ○	Utility disconnected	OK
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**INPUT FUNCTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	VOLTAGE RANGE (TYP)	40VDC~66VDC	IP: TESTING OP:NO LOAD/FULL LOAD Ta:25°C	<u>40.183</u> VDC~ <u>66.06</u> VDC/NO LOAD <u>40.187</u> VDC~ <u>66.02</u> VDC/FULL LOAD

			I/P: LOW-LINE=42V HIGH-LINE=65V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON:30Sec OFF:30Sec 10MIN (POWER ON/OFF NO DAMAGE) I/P: 48V O/P:FULL LOAD ON:30ec OFF:30ec 12Hr (POWER ON/OFF NO DAMAGE)	10MIN Test: <u>OK</u> 12Hr Test: <u>OK</u>
2	DC CURRENT (TYP)	60A	IP: 48VDC OP:FULL LOAD Ta:25°C	<u>50.2</u> A
3	NO LOAD DISSIPATION	$\leq 15W$ @ saving mode $\leq 25W$ @NON-Saving Mode	IP: 48VDC OP:NO LOAD Ta:25°C	<u>5.98</u> W@ saving mode <u>20.8</u> W@NON- Saving Mode
4	SAVING MODE TO NORMAL	$P_o \geq 25W$	IP: 48VDC OP: TESTING LOAD Ta:25°C	$\geq$ <u>15</u> W
5	NORMAL TO SAVING MODE	$P_o \leq 10W$	IP: 48VDC OP: TESTING LOAD Ta:25°C	$\leq$ <u>11</u> W
6	OFF MODE CURRENT DRAW (Typ.)	$\leq 2mA$	IP: 48VDC OP: Sw off Ta:25°C	<u>1.06</u> mA
7	EFFICIENCY(TYP)	1650W /91%	IP:50VDC OP: $P_o=1650W$ 110V/60HZ Ta:25°C	<u>92.23</u> %

AC UPS MODE(Only for NTU)

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	
1	AC Taper Voltage Range	AC input high / low line limit:No Load			
		AC Voltage	limit	Voltage Range	RESULT
		110V	High limit (To INV mode)	$V_{ac} > 128V \pm 4V$	<u>126.7</u> V
			Recovery to high (To AC mode)	$V_{ac} < 124V \pm 4V$	<u>121.3</u> V
			Low limit (To INV mode)	$V_{ac} < 92V \pm 4V$	<u>90.8</u> V
Recovery to low (To AC mode)	$V_{ac} > 96V \pm 4V$		<u>95.4</u> V		
2	FREQUENCY RANGE	45 ~ 65Hz	IP:48VDC OP: FULL LOAD Ta:25°C	TEST: <u>OK</u>	

3	TRANSFER TIME (TYP)	t<10ms±3ms inverter→by pass	IP: 48VDC OP: (1) no load (2) full load Ta:25°C	(1) no load a. INTER→BY PASS <u>2.2</u> ms b. BY PASS-INVERTER <u>9.0</u> ms (2) full load c. INTER→BY PASS <u>1.72</u> ms d. BY PASS-INVERTER <u>11.6</u> ms
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**PROTECTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	BAT LOW ALARM	44V±1VDC	IP: TESTING OP: FULL LOAD SW: ON Ta:25°C	<u>43.983</u> V
2	BAT LOW SHUT DOWN	40V±1VDC	IP: TESTING OP: FULL LOAD SW: ON Ta:25°C	<u>40.10</u> V
3	BAT LOW RESTART	50V±1VDC	IP: TESTING OP: FULL LOAD SW: ON Ta:25°C	<u>50.143</u> V
4	BAT HIGH ALARM	62V±1VDC	IP: TESTING OP: FULL LOAD SW: ON Ta:25°C	<u>62.12</u> V
5	BAT HIGH SHUT DOWN	66V±1VDC	IP: TESTING OP: FULL LOAD SW: ON Ta:25°C	<u>66.08</u> V
6	BAT HIGH RESTART	60V±1VDC	IP: TESTING OP: FULL LOAD SW: ON Ta:25°C	<u>60.06</u> V
7	BAT. POLARITY	By internal fuse open	IP: BAT +/- (Reverse) OP: FULL LOAD Ta:25°C	TEST: <u>OK</u>
8	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>
9	OUTPUT SHORT	Shut down o/p voltage: re-power on	IP: 48VDC O/P: FULL LOAD SW: ON Ta:25°C	Shut down o/p voltage, re-power on to recover LED DISPLAY: <u>OK</u>
10	OVER LOAD (typ.)	105%~115%LOAD 180sec 115%~150%LOAD 10 sec Shut down o/p voltage, re-power on to recover	IP: 48VDC OP: TESTING SW: ON Ta:25°C	(1). <u>105.72 % ~ 114.55%</u> <u>180.09</u> sec (2). <u>115.23% ~ 148.3%</u> <u>10.066</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	(1) Power ON-OFF remote control by front panel dry contact connector (by RELAY) Open : Normal work Short : Remote off (2) IRC3	IP: 48VDC OP: FULL LOAD Ta:25°C	Open : <u>Normal work</u> Short : <u>Remote off</u> (1). TEST: Vo= <u>0.002</u> V Pin= <u>6.27</u> W (2).TEST: <u>OK</u>

**APPLICATION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	LAMP	LAMP: <u>839</u> · turn on <u>OK</u> LAMP: <u>1222</u> · turn on <u>OK</u> LAMP: <u>1622</u> · turn on <u>OK</u>	1. Vin=HIGH LINE 2. 110V/60Hz	TEST: <u>OK</u>
2	INDUCTION MOTOR	<u>0.22</u> HP	1. Vin=HIGH LINE 2. 110V/60Hz	TEST: <u>OK</u>
3	SWITCHING POWER SUPPLY	WITH PFC: RSP-3000-48 O/P= <u>1743</u> W	1. Vin=HIGH LINE 2. 110V/60Hz	TEST: <u>OK</u>
		NO PFC: SE-1000-48 O/P= <u>1188</u> W	1. Vin=HIGH LINE 2. 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	Q106 /Q112/Q126/Q132  Rated: 200 V / 65 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(4400W) Turn On (4) NO LOAD Turn On (5) Saving mode Ta:25°C	Q112                      Q126 VDS:                      VDS: (1) 166V                      (1) 169V (2) 164V                      (2) 168V (3) 165V                      (3) 169V (4) 166V                      (4) 170V (5) 165V                      (5) 170V  Q106                      Q132 VDS:                      VDSS: (1) 166V                      (1) 170V (2) 165V                      (2) 170V (3) 166V                      (3) 170V (4) 168V                      (4) 171V (5) 168V                      (5) 171V

2	DC TO DC Diode Peak Voltage	D 901 Rated : 400V/ 20 A	I/P: high line O/P: V(max) /Freq 60HZ O/P: (1)Full Load Turn On (2) Output Short (3)O.L.P(4400W) Turn On (4) NO LOAD Turn On (5) Saving mode Ta:25°C	(1) 273V (2) 276V (3) 276V (4) 281V (5) 281V
3	DC BUS Capacitor Voltage	C905 Rated: 680u/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(4400W) Turn On (4) NO LOAD Turn On (5) Saving mode Ta:25°C	C905 (1) 273V (2) 292V (3) 279V (4) 273V (5) 273V
4	DC TO AC Power Transistor ( D to S) or (C to E) Peak Voltage	Q 1 Rated : 650 V/ 40 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(4400W) Turn On (4) NO LOAD Turn On (5) Saving mode Ta:25°C	Q1: VDS: (1) 305V (2) 366V (3) 316V (4) 300V (5) 300V
5	AUX PWM MOS	Q201 Rated: 65 A/ 200 V  Q504 Rated : 46 A/ 250 V	I/P: high line O/P:V(max) /Freq 60HZ O/P: (1)Full Load Turn On (2) Output Short (3)O.L.P(4400W) Turn On (4) NO LOAD Turn On (5) Saving mode Ta:25°C	Q201 (1) 169V (2) 169V (3) 169V (4) 170V (5) 169V  Q504 (1) 121V (2) 121V (3) 122V (4) 122V (5) 122V
6	Control IC Voltage Test	MCU IC U301 Rated 2.4 V~ 3.6 V  AUX IC U201 Rated 8.2V~30V  CHARGE IC U501 Rated 8.4V~30V  Gate Driver IC U1 Rated 3V~18V	I/P: high line O/P:V(max) /Freq 60HZ O/P: (1)Full Load Turn On (2) Output Short (3)O.L.P(4400W) Turn On (4) NO LOAD Turn On (5) Saving mode Ta:25°C	U301 (1) 3.30V (2) 3.30V (3) 3.30V (4) 3.30V (5) 3.30V  U501 (1) 12.47V (2) 12.47V (3) 12.47V (4) 12.47V (5) 12.47V  U201 (1) 12.2V (2) 12.2V (3) 12.2V (4) 12.2V (5) 12.2V  U1 (1) 5.07V (2) 5.07V (3) 5.07V (4) 5.07V (5) 5.07V



## SAFETY & EMC TEST

### SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	BAT I/P-AC O/P: 3 KVAC/min BAT I/P-AC I/P: 3 KVAC/min AC O/P-FG: 1.5 KVAC/min	BAT I/P-AC O/P 3.6 KVAC/min BAT I/P-AC I/P: 3.6 KVAC/min AC O/P-FG:1.8 KVAC/min Ta:25°C	BAT I/P-ACO/P: 11.47 mA AC O/P-FG: 11.32 mA AC O/P-FG: 7.57 mA NO DAMAGE
2	GROUNDING CONTINUITY	EN 60950 FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40 A / 2min Ta:25°C	6mΩ

### E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	CONDUCTION	FCC CLASS A	I/P: 24 VDC O/P: FULL LOAD/50% LOAD Ta:25°C	PASS
2	RADIATION	FCC CLASS A	I/P:24 VDC O/P: :FULL/50% LOAD Ta:25°C	PASS
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 : NTU-2200-124 1. ROOM AMBIENT BURN-IN : 2 HRS I/P : 24 VDC O/P : FULL LOAD Ta= 25 °C 2. HIGH AMBIENT BURN-IN : 2 HRS I/P : 24 VDC O/P : FULL LOAD Ta= 40 °C I/P : 24 VDC O/P : FULL LOAD Ta= 40 °C																																																														
			<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta= 25 °C</th> <th>HIGH AMBIENT Ta= 40 °C</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>C140</td> <td>53.3°C</td> <td>62.6°C</td> </tr> <tr> <td>2</td> <td>C144</td> <td>52.4°C</td> <td>61.8°C</td> </tr> <tr> <td>3</td> <td>T102 Coil1</td> <td>61.3°C</td> <td>70.0°C</td> </tr> <tr> <td>4</td> <td>T102 Core</td> <td>57.2°C</td> <td>65.4°C</td> </tr> <tr> <td>5</td> <td>C100</td> <td>55.5°C</td> <td>64.0°C</td> </tr> <tr> <td>6</td> <td>C105</td> <td>53.0°C</td> <td>61.9°C</td> </tr> <tr> <td>7</td> <td>T102 NTC</td> <td>54.3°C</td> <td>63.8°C</td> </tr> <tr> <td>8</td> <td>T101 Coil1</td> <td>65.4°C</td> <td>73.7°C</td> </tr> <tr> <td>9</td> <td>T101 Core</td> <td>59.0°C</td> <td>67.4°C</td> </tr> <tr> <td>10</td> <td>Q104</td> <td>49.3°C</td> <td>59.4°C</td> </tr> <tr> <td>11</td> <td>Q115</td> <td>42.9°C</td> <td>53.3°C</td> </tr> <tr> <td>12</td> <td>D902</td> <td>64.0°C</td> <td>71.2°C</td> </tr> <tr> <td>13</td> <td>D912</td> <td>61.4°C</td> <td>70.1°C</td> </tr> <tr> <td>14</td> <td>D908</td> <td>67.6°C</td> <td>74.8°C</td> </tr> </tbody> </table>	NO	Position	ROOM AMBIENT Ta= 25 °C	HIGH AMBIENT Ta= 40 °C	1	C140	53.3°C	62.6°C	2	C144	52.4°C	61.8°C	3	T102 Coil1	61.3°C	70.0°C	4	T102 Core	57.2°C	65.4°C	5	C100	55.5°C	64.0°C	6	C105	53.0°C	61.9°C	7	T102 NTC	54.3°C	63.8°C	8	T101 Coil1	65.4°C	73.7°C	9	T101 Core	59.0°C	67.4°C	10	Q104	49.3°C	59.4°C	11	Q115	42.9°C	53.3°C	12	D902	64.0°C	71.2°C	13	D912	61.4°C	70.1°C	14	D908	67.6°C	74.8°C	
NO	Position	ROOM AMBIENT Ta= 25 °C	HIGH AMBIENT Ta= 40 °C																																																													
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9	T101 Core	59.0°C	67.4°C																																																													
10	Q104	49.3°C	59.4°C																																																													
11	Q115	42.9°C	53.3°C																																																													
12	D902	64.0°C	71.2°C																																																													
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2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )	I/P : 24VDC O/P : 102%LOAD Ta : 25°C	TEST : OK																																																																																																																															
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 24VDC O/P : 100%LOAD Ta= -30 °C	TEST : OK																																																																																																																															
4	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= 38.7 °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 : 10 CYCLE 5. Input /Output condition : STATIC	TEST : OK
6	THERMAL SHOCK TEST	1. Thermal shock Temperature : -30°C~ +45°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 : 15cycle:24VDC/ FULL LOAD DC ON 11sec/DC OFF 1sec TEST 1cycle:24VDC/ FULL LOAD Burn In Test	TEST : OK
7	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
8	CAPACITOR LIFE CYCLE	SUPPOSE C100 IS THE MOST CRITICAL COMPONENT (1) I/P : 24VDC O/P : FULL LOAD Ta= 25 °C LIFE TIME (2) I/P : 24VDC O/P : FULL LOAD Ta= 40 °C LIFE TIME (3) I/P : 24VDC O/P : 75% LOAD Ta= 40 °C LIFE TIME (4) I/P : 24VDC O/P : 50% LOAD Ta= 40 °C LIFE TIME	(1) 455777.6HRS (2) 252858.4HRS (3) 432600.8HRS (4) 675704.3HRS
9	MTBF	Conducted by Parts Stress Analysis Prediction 344.9K hrs min. Telcordia SR-332 (Bellcore) ; 34.8K hrs min. MIL-HDBK-217F (25°C)	
10	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

2020.10.1 TAG-QA-009