



# Test Report: LSP-160-4.2

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160W Slim Type with PFC Switching Power Supply

## ■ DESIGN VERIFY TEST

Output Function Test

Input Function Test

Protection Function Test

Control Function Test

Component Stress Test

## ■ SAFETY & E.M.C. TEST

Safety Test

E.M.C. Test

## ■ RELIABILITY TEST

ENVIRONMENT TEST

DESIGN VERIFY TEST

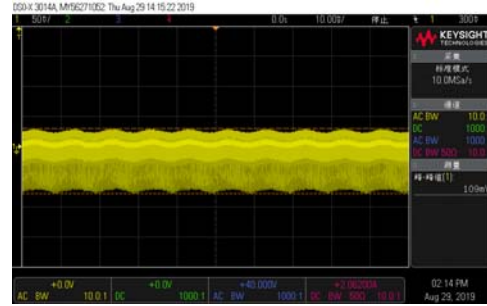
OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	4.0V ~ 4.5V	I/P : 230 VAC O/P : MIN LOAD Ta : 25°C	3.49V~4.61V/230VAC
2	OUTPUT VOLTAGE(Max) TOLERANCE	-2% ~ 2%	I/P: 90VAC /264VAC O/P:FULL/ MIN. LOAD Ta:25°C	-0.21%~ 0.58%
3	LINE REGULATION (Max)	-0.5% ~ 0.5%	I/P: 90VAC~ 264VAC O/P:FULL LOAD Ta:25°C	: -0.08%~ 0%
4	LOAD REGULATION(Max)	-1% ~ 1%	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25°C	-0.36%~ 0.43%
5	OVER/UNDERSHOOT TEST	≤±10%	I/P: 230VAC O/P:FULL LOAD Ta:25°C	1.43 %
6	RIPPLE & NOISE(Max )	V1:200 mVp-p	I/P:230VAC O/P:FULL LOAD Ta:25°C	V1: 109mVp-p/100%LOAD

high frequency :



low frequency :



7	SET UP TIME(Max)	230VAC/2000ms 115VAC/3000ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/978ms 115VAC/1158ms
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INPUT=230VAC/50HZ @ FULL LOAD


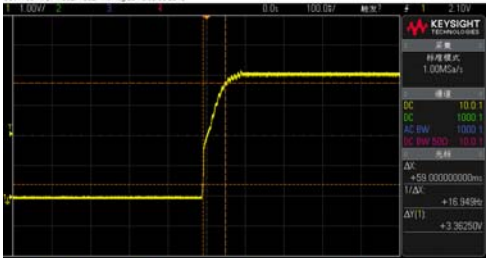


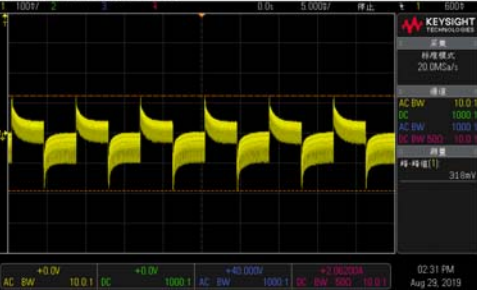
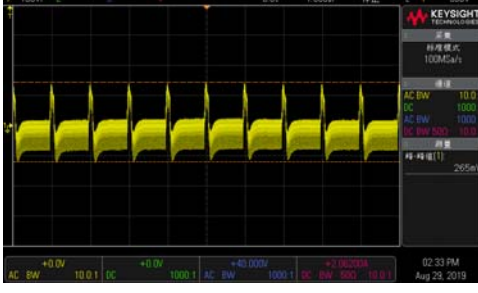
CH1 : Output Voltage CH2 : AC Input Voltage



INPUT=115VAC/60HZ @ FULL LOAD

CH1 : Output Voltage CH2 : AC Input Voltage

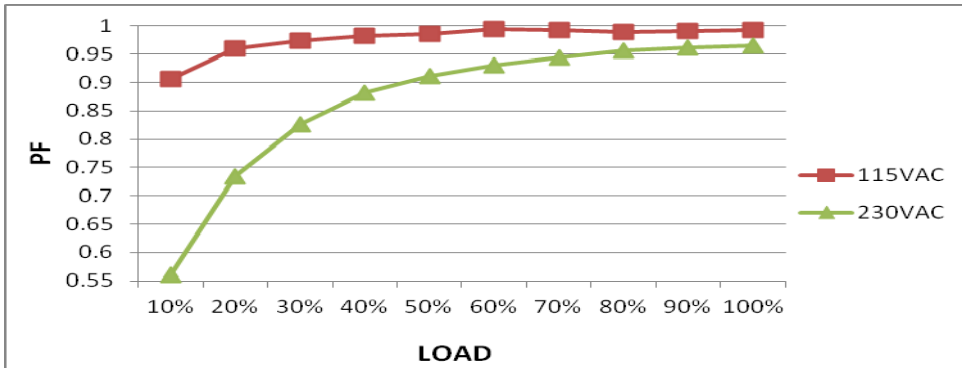


8	RISE TIME (Max)	230VAC/80ms 115VAC/80ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 52ms 115VAC/ 59ms
INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage 		INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage 		
9	HOLD UP TIME (Typ.)	230VAC/10ms 115VAC/10ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 15ms 115VAC/ 17ms
INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage 		INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage 		
10	DYNAMIC LOAD	V1: 840mVp-p	I/P: 230VAC O/P: (1)FULL /50% LOAD 50%DUTY / 120HZ (2)FULL /50% LOAD 50%DUTY / 1KHZ Ta:25°C	(1) 318mVp-p (2) 265mVp-p
FULL /50% LOAD 50%DUTY / 120HZ 		FULL /50% LOAD 50%DUTY / 1KHZ 		

### INPUT FUNCTION TEST

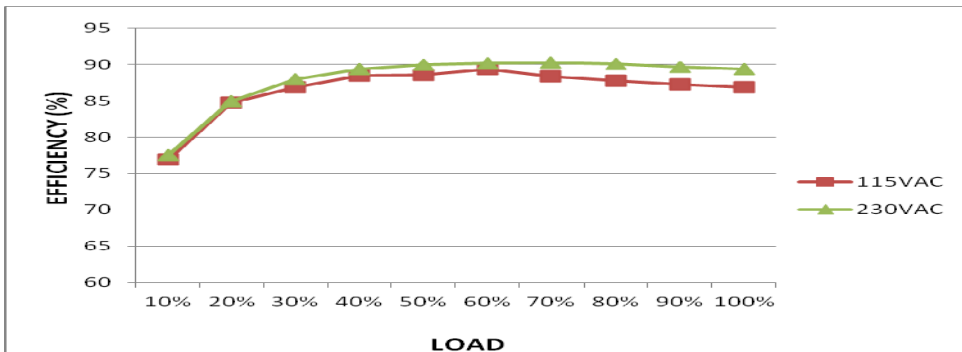
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	100VAC~264VAC	I/P:TESTING O/P:FULL LOAD Ta:25°C	97V~300V
			I/P: LOW-LINE-3V=97VAC HIGH-LINE+15%=300VAC O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON: 30 Sec OFF: 30 Sec 10MIN (POWER ON/OFF NO DAMAGE)	TEST: OK
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE	I/P:100VAC ~264 VAC O/P:FULL~MIN LOAD Ta:25°C	TEST: OK
3	INPUT CURRENT (Typ.)	230V/ 1.1A 115V/ 2.2A	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I=0.672A/ 230VAC I=1.352/ 115VAC
4	LEAKAGE CURRENT	<0.75 mA / 240 VAC	I/P : 240 VAC O/P : Min LOAD Ta : 25°C	L-FG : 0.5214mA N-FG : 0.5269mA
5	POWER FACTOR (Typ.)	0.94/ 230VAC 0.98/115VAC	I/P : 230 VAC	PF=0.965/230VAC
			I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	PF=0.990/115VAC

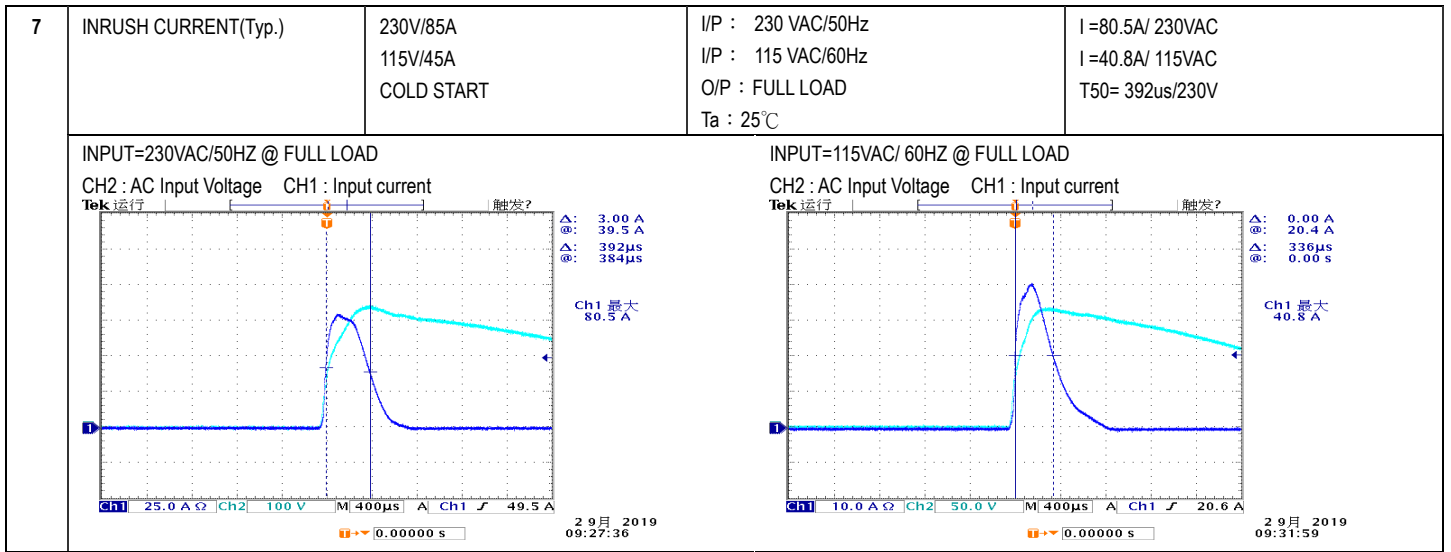
P.F vs LOAD



6	EFFICIENCY(Typ.)	88.5%	I/P:230 VAC O/P:FULL LOAD Ta:25°C	89.32%
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EFFICIENCY vs LOAD





### PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	110%~ 140%	I/P: 264VAC I/P: 230VAC I/P: 100VAC O/P: TESTING Ta: 25°C	129.06%/ 264VAC 129.06%/ 230VAC 129.06%/ 100VAC PROTECTION TYPE: Constant current limit, continous increase of load will be hiccup protection, recovers automatically after fault condition is removed.
2	OVER VOLTAGE PROTECTION	4.62V~5.46V	I/P: 264VAC I/P: 230VAC I/P: 100VAC O/P: MIN LOAD Ta: 25°C	5.18V/264VAC 5.14 V/ 230VAC 5.18V/ 100VAC PROTECTION TYPE : Shut down o/p voltage , re-power on to recovery
3	OVER TEMPERATURE PROTECTION	Protection type : NO DAMAGE	I/P: 264VAC I/P: 100VAC O/P: FULL LOAD	O.T.P.Active OK Protection type : Shut down o/p voltage , re-power on to recovers after temperature goes down
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE	I/P: 264VAC I/P: 100VAC O/P: FULL LOAD Ta: 25°C	NO DAMAGE OK PROTECTION TYPE : Hiccup mode, recovers automatically after fault condition is removed

### CONTROL FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	DC OK CONTACT RATINGS	15VDC/10mA RESISTIVE LOAD	I/P: 230VAC O/P: FULL LOAD Ta: 25°C	TEST : OK
2	CURRENT SHARING (3.3V、4.2V、5V only)	PSU1-PSU2   < 10%	I/P : 230 VAC O/P : FULL/50% LOAD Ta : 25°C	O/P : 100% PSU1 : 29.1A PSU2 : 28.5A O/P : 50% PSU1 : 16.14A PSU2 : 15.36A



3	REDUNDANT CONTROL	over shoot /undershoot<10% RIPPLE & NOISE<1000mVp-p	I/P : 100VAC/230VAC/264VAC O/P : NO LOAD /FULL LOAD Ta : 25°C	O/P: FULL LOAD PSU1: -4.05% / 107mVp-p PSU2: -4.05% / 98mVp-p O/P: NO LOAD PSU1: 0% / 51 mVp-p PSU2: -4.05%/ 64mVp-p
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### COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor ( D to S) or (C to E) Peak Voltage	Q2 Rated 11A/650V	<p>AC ON/OFF</p> <p>I/P:High-Line +3V =267V VDS: O/P: (1)Full Load (2)Output Short (3)Dynamic Load Full Load/ Min. Load 90%Duty/1KHz (4)Dynamic Load Full Load/ Min. Load 90%Duty/3KHz (5)Dynamic Load Full Load/ Min. Load 90%Duty/5KHz (6)Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz</p> <p>I/P:Low-Line -3V = 97V O/P: (1)Full Load (2)Output Short (3)Dynamic Load Full Load/ Min. Load 90%Duty/1KHz (4)Dynamic Load Full Load/ Min. Load 90%Duty/3KHz (5)Dynamic Load Full Load/ Min. Load 90%Duty/5KHz (6)Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz</p> <p>Ta:25°C</p>	<p>VDS:</p> <p>(1) 423V (2)423V (3) 419V (4) 419V (5)423V (6)419V</p> <p>VDS:</p> <p>(1)419V (2)419V (3)423V (4)423V (5)423V (6)423V</p>

<p>2</p>	<p>P.F.C Transistor ( D to S) or (C to E) Peak Voltage</p>	<p>Q3 Rated 600V/12A</p>	<p>I/P:High-Line +3V =267 V AC ON/OFF O/P: (1)Full Load (2)Output Short (3)Dynamic Load Full Load/ Min. Load 90%Duty/1KHz (4)Dynamic Load Full Load/ Min. Load 90%Duty/3KHz (5)Dynamic Load Full Load/ Min. Load 90%Duty/5KHz (6)Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz</p> <p>I/P:Low-Line -3V = 97V AC ON/OFF O/P: (1)Full Load (2)Output Short (3)Dynamic Load Full Load/ Min. Load 90%Duty/1KHz (4)Dynamic Load Full Load/ Min. Load 90%Duty/3KHz (5)Dynamic Load Full Load/ Min. Load 90%Duty/5KHz (6)Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz</p> <p>Ta:25°C</p>	<p>VDS: (1)427V (2)427V (3)423V (4)423V (5)427V (6)423V</p> <p>VDS: (1)507V (2)507V (3)507V (4)503V (5)507V (6)503V</p>
<p>4</p>	<p>P.F.C DIODE</p>	<p>D6 Rated 8A/600V</p>	<p>I/P:High-Line +3V =267 V AC ON/OFF O/P: (1)Full Load (2)Output Short (3)Dynamic Load Full Load/ Min. Load 90%Duty/5KHz (4)Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz</p> <p>I/P:Low-Line -3V = 97V O/P: (1)Full Load (2)Output Short (3)Dynamic Load Full Load/ Min. Load 90%Duty/5KHz (4)Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz</p> <p>Ta:25°C</p>	<p>(1) 411V (2) 419V (3) 411V (4) 411V</p> <p>(1) 411V (2) 407V (3) 411V (4) 411V</p>

5	SR MOS	Q100 Rated 100A/ 30 V  Q104 Rated 100A/ 30 V	AC ON/OFF  I/P:High-Line +3V =267 V O/P: (1)Full Load (2)Output Short (3)Dynamic Load Full Load/ Min. Load 90%Duty/1KHz (4)Dynamic Load Full Load/ Min. Load 90%Duty/3KHz (5)Dynamic Load Full Load/ Min. Load 90%Duty/5KHz (6)Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz (7)NO LOAD Ta:25°C	Q100:  VDS: (1)10.01V (2)7.68V (3)12.02V  (4)12.10V  (5)12.26V  (6)11.30V (7) 9.29V	Q104  VDS: (1)10.25V (2)6.23V (3)11.30V  (4)10.33V  (5)10.33V  (6)12.34V (7) 10.9V	
6	Input Capacitor Voltage	C5 Rated: 56 $\mu$ l / 420 V	I/P:High-Line +3V =267V O/P: (1)Full Load input on/off (2) Min load input on /Off (3)Full Load /Min load Change (4)Full load continue Ta:25°C	(1)403V (2)399V (3)403V (4)387V		
7	Control IC Voltage Test	PWM IC U2 Rated 20V  PFC IC U1 Rated 20V  O/P IC U100 Rated 26 V	AC ON/OFF  I/P:High-Line +3V =267 V O/P(1)FULL LOAD (2) Output Short (3)O.L.P (4)O.V.P. (5)NO LOAD VRmin(Low LINE) Ta:25°C	U1 (1)15.7V (2)15.9V (3)16.1V (4)16.5V (5)15.3V	U2 16.5V 16.7V 16.5V 15.9V 15.9V	U100 14.7V 9.9V 9.9V 14.3V 14.7V
8	VCC Diode Peak Voltage	D20 Rated: 1A/200V  D201 Rated: 1A/200V	I/P: High-Line +3V = 267VAC O/P: (1) FULL Load input on/off (2) Output Short (3) NO Load (4) Dynamic Load Full Load/ Min. Load 90%Duty/1KHz	D20 (1) 120.8V (2) 123.2V (3) 120.0V (4) 120.8V	D201 52V 31.9V 53.2V 52V	

### SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P: 3.75KVAC/min I/P-FG : 2KVAC/min O/P-FG:1.25KVAC/min	I/P-O/P: 4.2KVAC/min I/P-FG: 2.4 KVAC/min O/P-FG:1.5KVAC/min Ta:25°C	I/P-O/P: 3.087mA I/P-FG: 3.048mA O/P-FG: 2.727mA NO DAMAGE
2	ISOLATION RESISTANCE	I/P-O/P:500VDC>100M $\Omega$ I/P-FG: 500VDC>100M $\Omega$ O/P-FG:500VDC>100M $\Omega$	I/P-O/P: 500 VDC I/P-FG: 500 VDC O/P-FG: 500 VDC Ta:25°C	I/P-O/P: >9999M $\Omega$ I/P-FG: >9999M $\Omega$ O/P-FG: >9999M $\Omega$ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 m $\Omega$	40A / 2min Ta:25°C	5 m $\Omega$
4	Withstand surge input	I/P: 300VAC*5s	I/P: 310VAC*5s O/P: FULL LOAD/NO LOAD Ta:25°C	NO DAMAGE OK



**E.M.C TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	HARMONIC	EN61000-3-2 CLASS A	I/P:230VAC/50HZ O/P:FULL LOAD Ta:25°C	PASS
2	CONDUCTION	EN55032 CLASS B	I/P : 230 VAC (50HZ) O/P : FULL/50% LOAD Ta : 25°C	PASS Test by certified Lab
3	RADIATION	EN55032 CLASS B	I/P : 230 VAC (50HZ) O/P : FULL LOAD Ta : 25°C	PASS Test by certified Lab
4	E.S.D	EN61000-4-2 HEAVY INDUSTRY Contact: 4KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A
5	E.F.T	EN61000-4-4 HEAVY INDUSTRY INPUT : 2KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A
6	SURGE	IEC61000-4-5 HEAVY INDUSTRY L-N : 2KV L,N-PE : 4KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A
7	Test by certified Lab & Test Report Prepare. Any contradictions of the test results please refer to the latest EMC test report.			

■ RELIABILITY TEST

ENVIRONMENT TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT																																																																																																								
1	TEMPERATURE RISE TEST	MODEL : LSP-160-5R 1. ROOM AMBIENT BURN-IN : 2HRS I/P : 230VAC O/P : FULL LOAD Ta=26 °C 2. HIGH AMBIENT BURN-IN : 2HRS I/P : 230VAC O/P : FULL LOAD Ta=51.9 °C																																																																																																										
		<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta=26 °C</th> <th>HIGH AMBIENT Ta=51.9 °C</th> </tr> </thead> <tbody> <tr><td>1</td><td>ZNR1</td><td>41.2°C</td><td>67.4°C</td></tr> <tr><td>2</td><td>RTH2</td><td>61.0°C</td><td>81.7°C</td></tr> <tr><td>3</td><td>L1</td><td>49.2°C</td><td>75.3°C</td></tr> <tr><td>4</td><td>C5</td><td>47.0°C</td><td>73.4°C</td></tr> <tr><td>5</td><td>C6</td><td>46.1°C</td><td>72.8°C</td></tr> <tr><td>6</td><td>C22</td><td>47.3°C</td><td>74.2°C</td></tr> <tr><td>7</td><td>C20</td><td>47.3°C</td><td>74.0°C</td></tr> <tr><td>8</td><td>R20</td><td>49.9°C</td><td>76.8°C</td></tr> <tr><td>9</td><td>BD1</td><td>62.5°C</td><td>87.4°C</td></tr> <tr><td>10</td><td>Q2</td><td>48.3°C</td><td>75.2°C</td></tr> <tr><td>11</td><td>Q3</td><td>48.9°C</td><td>75.7°C</td></tr> <tr><td>12</td><td>D6</td><td>46.7°C</td><td>73.2°C</td></tr> <tr><td>13</td><td>U1</td><td>47.4°C</td><td>73.9°C</td></tr> <tr><td>14</td><td>U2</td><td>45.9°C</td><td>72.7°C</td></tr> <tr><td>15</td><td>T1</td><td>61.0°C</td><td>88.9°C</td></tr> <tr><td>16</td><td>Q101</td><td>52.4°C</td><td>79.6°C</td></tr> <tr><td>17</td><td>Q104</td><td>53.7°C</td><td>81.1°C</td></tr> <tr><td>18</td><td>U100</td><td>53.3°C</td><td>80.3°C</td></tr> <tr><td>19</td><td>J103</td><td>55.7°C</td><td>84.5°C</td></tr> <tr><td>20</td><td>C106</td><td>57.5°C</td><td>85.9°C</td></tr> <tr><td>21</td><td>C107</td><td>58.5°C</td><td>86.8°C</td></tr> <tr><td>22</td><td>RTH3</td><td>46.6°C</td><td>73.4°C</td></tr> <tr><td>23</td><td>C13</td><td>46.7°C</td><td>72.8°C</td></tr> <tr><td>24</td><td>Q201</td><td>52.1°C</td><td>80.1°C</td></tr> <tr><td>25</td><td>TC</td><td>42.1°C</td><td>68.6°C</td></tr> </tbody> </table>	NO	Position	ROOM AMBIENT Ta=26 °C	HIGH AMBIENT Ta=51.9 °C	1	ZNR1	41.2°C	67.4°C	2	RTH2	61.0°C	81.7°C	3	L1	49.2°C	75.3°C	4	C5	47.0°C	73.4°C	5	C6	46.1°C	72.8°C	6	C22	47.3°C	74.2°C	7	C20	47.3°C	74.0°C	8	R20	49.9°C	76.8°C	9	BD1	62.5°C	87.4°C	10	Q2	48.3°C	75.2°C	11	Q3	48.9°C	75.7°C	12	D6	46.7°C	73.2°C	13	U1	47.4°C	73.9°C	14	U2	45.9°C	72.7°C	15	T1	61.0°C	88.9°C	16	Q101	52.4°C	79.6°C	17	Q104	53.7°C	81.1°C	18	U100	53.3°C	80.3°C	19	J103	55.7°C	84.5°C	20	C106	57.5°C	85.9°C	21	C107	58.5°C	86.8°C	22	RTH3	46.6°C	73.4°C	23	C13	46.7°C	72.8°C	24	Q201	52.1°C	80.1°C	25	TC	42.1°C	68.6°C		
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17	Q104	53.7°C	81.1°C																																																																																																									
18	U100	53.3°C	80.3°C																																																																																																									
19	J103	55.7°C	84.5°C																																																																																																									
20	C106	57.5°C	85.9°C																																																																																																									
21	C107	58.5°C	86.8°C																																																																																																									
22	RTH3	46.6°C	73.4°C																																																																																																									
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25	TC	42.1°C	68.6°C																																																																																																									
2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )	I/P : 230 VAC O/P : 125.6% LOAD Ta : 25°C	TEST : OK																																																																																																								
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 264VAC/110VAC O/P : 100% LOAD Ta= -35°C	TEST : OK																																																																																																								
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 50°C /95 %R.H NO DAMAGE	I/P : 272 VAC O/P : FULL LOAD Ta= 50°C HUMIDITY= 95 %R.H	TEST : OK																																																																																																								
5	TEMPERATURE COEFFICIENT	± 0.03 %/°C (0-50°C)	I/P : 230 VAC O/P : FULL LOAD	± 0.0156%/°C (0-50°C)																																																																																																								



6	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
7	THERMAL SHOCK TEST	-30~50°C	1. Thermal shock Temperature : -35°C~ +55°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:230V/ FULL LOAD AC ON 3sec/AC OFF 1sec TEST 1cycle:230V/ FULL LOAD Burn In Test
8	VIBRATION TEST	10 ~ 500Hz, 5G 10min./1cycle, 60min. each along X, Y, Z axes	1 Carton & 1 Set (1) Waveform : Sine Wave (2) Frequency : 10~500Hz (3) Sweep Time : 12min/sweep cycle (4) Acceleration : 6G (5) Test Time : 180min in each axis (X.Y.Z) (6) Ta : 25°C
9	CAPACITOR LIFE CYCLE	LSP-160-5R : SUPPOSE C107 IS THE MOST CRITICAL COMPONENT (1) I/P : 230VAC O/P : FULL LOAD Ta= 25 °C LIFE TIME (2) I/P : 230VAC O/P : FULL LOAD Ta=50 °C LIFE TIME (3) I/P : 230VAC O/P : 75% LOAD Ta=50 °C LIFE TIME (4) I/P : 230VAC O/P : 50% LOAD Ta=50 °C LIFE TIME	(1) 4742747HRS (2) 202316HRS (3) 726156HRS (4) 2167854HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 699.54 K hrs min. Telcordia SR-332 (Bellcore) 282.71K hrs min. MIL-HDBK-217F (25°C)	
11	Ongoing Reliability Test	I/P : 230VAC O/P : FULL LOAD TA=50°C Demonstration Mean Time Between Failure : 30,000 hours	

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	WUWQ/ZHOUBIAO	WENF	LIUWY

2018.4.30 GP-A50-F010