



# Test Report: DDRH-60-5

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60W Ultra Wide Input DIN Rail Type DC-DC Converter

## ■ 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

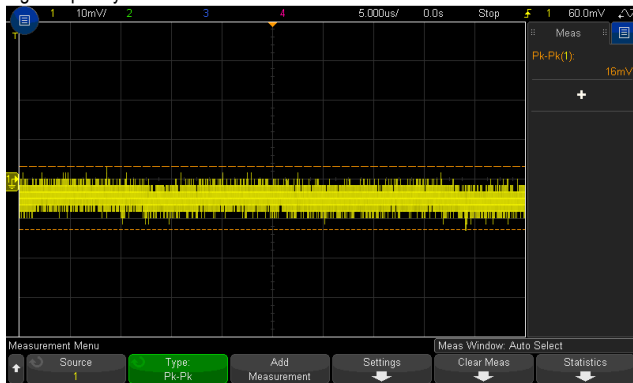
ENVIRONMENT TEST

DESIGN VERIFY TEST

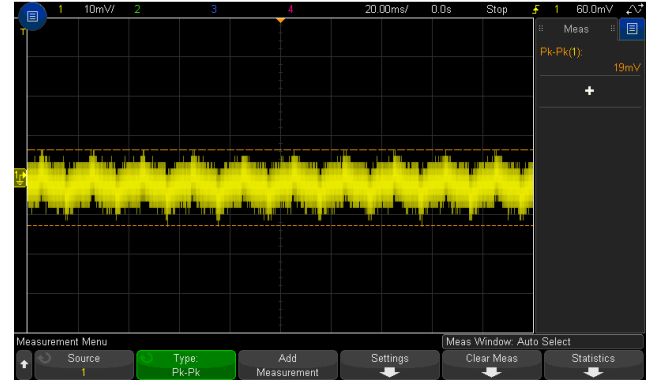
OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 5V~6V	I/P : 1500VDC I/P : 600VDC I/P : 400VDC O/P : MIN LOAD Ta : 25°C	4.76V~6.16V/ 1500 VDC 4.76V~6.16V/ 600 VDC 4.76V~6.16V/ 400 VDC
2	OUTPUT VOLTAGE TOLERANCE (Max)	V1: -1.5%~+1.5%	I/P: 150 VDC~1500 VDC O/P:FULL/ MIN. LOAD Ta:25°C	V1: -1.09%~1.11%
3	LINE REGULATION (Max)	V1: -0.5%~+0.5%	I/P: 150 VDC~1500 VDC O/P:FULL LOAD Ta:25°C	V1: 0.01%~0.04%
4	LOAD REGULATION (Max)	V1: -1.5%~+1.5%	I/P: 600VDC O/P:FULL ~MIN LOAD Ta:25°C	V1: -1.09%~1.11%
5	OVER/UNDERSHOOT TEST	< ±10%	I/P: 600 VDC O/P:FULL LOAD Ta:25°C	TEST: 0.4%
6	RIPPLE & NOISE (Max)	V1: 100mVp-p	I/P: 600 VDC O/P:FULL LOAD Ta:25°C	V1: 19 mVp-p

high frequency : 10us

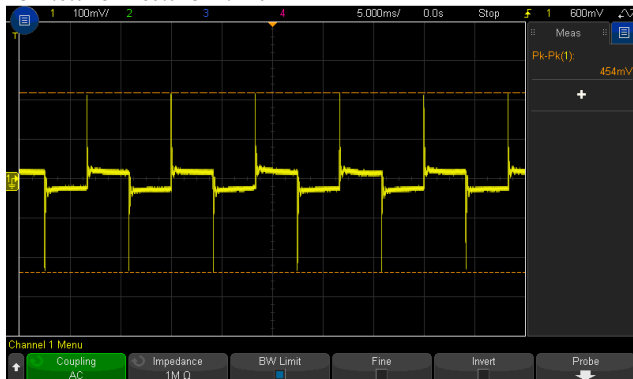


low frequency : 5ms

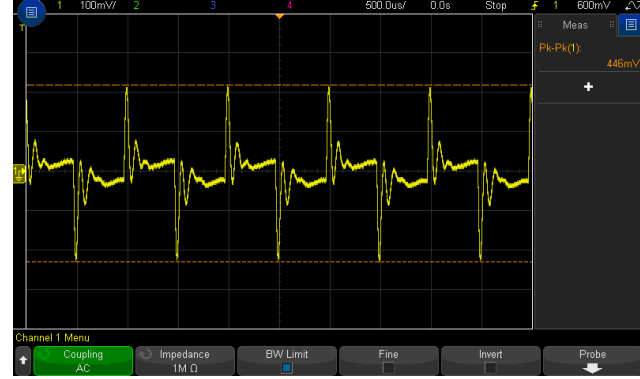


7	DYNAMIC LOAD	V1: 1000mVp-p	I/P: 600VDC O/P: (1)FULL /0% LOAD 50%DUTY / 120HZ (2)FULL /0% LOAD 50%DUTY / 1KHZ Ta:25°C	454mVp-p 446mVp-p
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FULL /0% LOAD 50%DUTY / 120HZ



FULL /0% LOAD 50%DUTY / 1KHZ



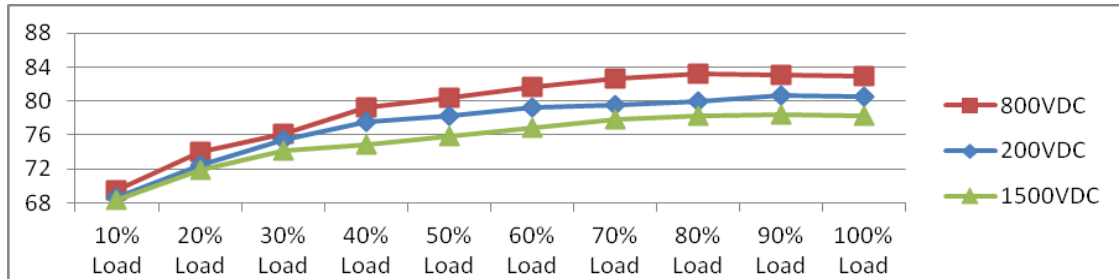


8	TRANSIENT RECOVERY TIME	V1: 1000 mVp-p	I/P: 600VDC O/P:40% LOAD CHANGE 50%DUTY/120HZ 1.25A/us	362mVp-p
9	EXERNAL CAPACITANCE LOAD(Max.)	6000uF	I/P : 600VDC O/P : NO LOAD Ta : 25°C	OK

### INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	150VDC~ 1500 VDC	I/P:TESTING O/P:FULL LOAD Ta:25°C	143V~ 1500 V
			I/P: LOW-LINE-0.2= 198.2 V HIGH-LINE+3V= 1503 V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON: 30 Sec . OFF: 30 Sec 10MIN ( POWER ON/OFF NO DAMAGE )	TEST <u>OK</u>
2	EFFICIENCY(TYP)	80%/200VDC 81%/800VDC 76%/1500VDC	I/P: 200VDC	80.5%/200VDC
			I/P: 800VDC	82.9%/800VDC
			I/P: 1500VDC	78.2%/1500VDC
			O/P:FULL LOAD Ta:25°C	

EFFICIENCY vs LOAD



3	INRUSH CURRENT(TYP)	30A/150VDC 80A/800VDC 120A/1500VDC COLD START	I/P: 150VDC I/P: 800VDC I/P: 1500VDC O/P:FULL LOAD Ta:25°C	I =21.9A/ 150VDC I =58.1A/ 800VDC I =98.3A/ 1500VDC
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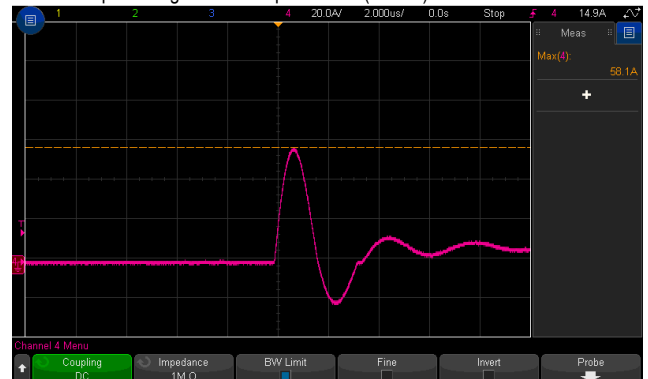
INPUT=150VDC @ FULL LOAD

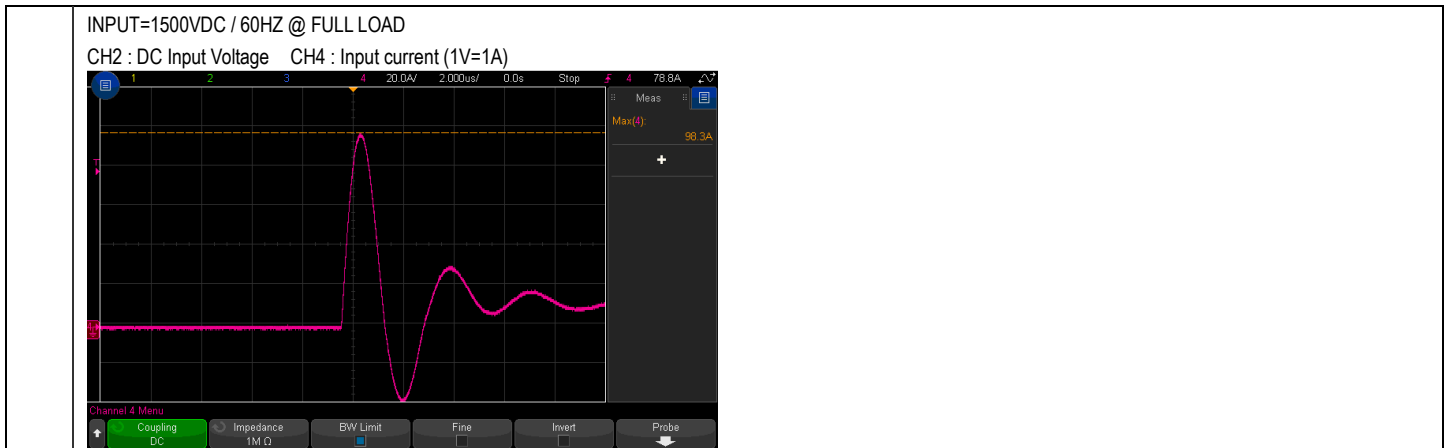
CH2 : DC Input Voltage CH4 : Input current (1V=1A)



INPUT=800VDC / 60HZ @ FULL LOAD

CH2 :DC Input Voltage CH4 : Input current (1V=1A)





### PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	105 %~ 135 % RATED OUTPUT POWER	I/P: 200VDC I/P: 600VDC I/P: 1500VDC O/P: TESTING Ta:25°C	114.1%/ 200 VDC 114.1%/ 600 VDC 114.5%/ 1500 VDC PROTECTION TYPE : Hiccup mode when output voltage < 55%, recovers automatically after fault condition is remove; constant current limiting within 55-100% rated output voltage · recovers automatically after fault condition is remove
2	OVER VOLTAGE PROTECTION	CH: 6.6 V~ 8.4 V PROTECTION TYPE : Hiccup mode , recovers automatically after fault condition is removed	I/P: 150VDC I/P: 600VDC I/P: 1500VDC O/P: MIN LOAD Ta:25°C	7.6V/ 150 VDC 7.6V/ 600 VDC 7.64V/ 1500 VDC PROTECTION TYPE : Hiccup mode , recovers automatically after fault condition is removed
3	OVER TEMPERATURE PROTECTION	PROTECTION TYPE : Hiccup mode , recovers automatically after fault condition is removed	I/P: 150VDC I/P: 1500VDC O/P: FULL LOAD	O.T.P. Active PROTECTION TYPE : Hiccup mode , recovers automatically after fault condition is removed
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE PROTECTION TYPE : Hiccup mode , recovers automatically after fault condition is removed	I/P: 150VDC I/P: 1500VDC O/P: FULL LOAD Ta:25°C	NO DAMAGE PROTECTION TYPE : Hiccup mode , recovers automatically after fault condition is removed
5	UNDER VOLTAGE LOCKOUT	PROTECTION RANGE: 120 V~ 130 V RELEASE RANGE: 130 V~146.5 V NO DAMAGE	INPUT: TESTING O/P: MIN LOAD Ta:25°C	PROTECTION VOLTAGE: 127V RELEASE VOLTAGE: 144V NO DAMAGE
6.	REVERSE POLARITY	NO DAMAGE	I/P: 1500 VDC O/P: FULL LOAD Ta:25°C	NO DAMAGE



### CONTROL FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
7	DC OK SIGNAL	30VDC/1A RESISTIVE LOAD	I/P:600VDC O/P:FULL LOAD Ta:25°C	TEST : OK

### COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor ( D to S) or (C to E) Peak Voltage	Q1/Q2/Q3 Rated : 8A/ 950 V	DC ON/OFF  I/P:High-Line +3V =1503V 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 (7)0%→400% Load.	Q1 VDS: (1) 794V (2) 842V (3) 794V (4) 802V (5) 786V (6) 802V (7) 842V  Q2 VDS: (1) 754V (2) 794V (3) 746V (4) 754V (5) 754V (6) 754V (7) 706V  Q3 VDS: (1) 754V (2) 810V (3) 762V (4) 762V (5) 762V (6) 754V (7) 762V
2	Diode Peak Voltage	Q100 Rated : 75A/ 120 V	DC ON/OFF  I/P:High-Line +3V =1503 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)0%→400% Load. (8).NO LOAD Ta:25°C	Q100: VDS: (1) 102V (2) 102V (3) 102V (4) 102V (5) 102V (6) 104V (7) 104V (8) 102V
3	Diode Peak Voltage	Q10 Rated : 0.1A/ 1500 V	DC ON/OFF  I/P:High-Line +3V =1503 V O/P: (1)Full Load (2)Output Short (3) NO LOAD	(1)1.22 KV (2) 1.21KV (3) 1.19KV
4	Input Capacitor Voltage	C5 / C6/ C7 Rated: : 22 $\mu$ / 550 V	I/P:High-Line +3V =1503V 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	C5 (1) 498V (2) 494V (3) 494V (4) 494V  C7 (1) 506V (2) 502V (3) 506V (4) 506V



				C6 (1) 502V (2) 498V (3) 502V (4) 502V	
5	Control IC Voltage Test	PWM IC U1 Rated -0.3V~28 V OP IC U100 Rated -0.3V~ 27 V MCU IC U200 Rated -0.3 V~ 38 V	DC ON/OFF I/P:High-Line +3V =1503V 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) 17.3V (2) 17.3V (3) 17.3V (4) 17.3V (5) 17.3V U100 (1) 15.5V (2) 15.5V (3) 15.5V (4) 15.3V (5) 11.0V	U200 (1) 16.7V (2) 16.9V (3) 16.9V (4) 16.5V (5) 11.0V
6	Clamp Diode Peak Voltage	D1 / D2 / D3 Rated : 1000V / 1 A	I/P : High-Line +3V =1503 V DC ON/OFF O/P : (1) Dynamic Load 90%Duty/1KHz (2)Full load continue Ta : 25°C	D1 (1) 673V (2) 649V D2 (1) 657V (2) 649V	D3 (1) 673V (2) 665V

### SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P:4KVAC/min O/P-DC OK:0.5KVAC/min	I/P-O/P: 4.4 KVAC/min O/P-DC OK:0.6KVAC/min Ta:25°C	I/P-O/P: 5.3 mA O/P-DC OK: 0.006 mA NO DAMAGE
2	ISOLATION RESISTANCE	I/P-O/P:500VDC>100MΩ	I/P-O/P: 600 VDC Ta:25°C	I/P-O/P: 9999MΩ NO DAMAGE

### E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RADIATION	EN55032 CLASS A	I/P: 400/800 VDC O/P:FULL LOAD Ta:25°C	PASS Test by certified Lab
2	CONDUCTION	EN55032 CLASS A	I/P: 400/800 VDC O/P:FULL LOAD Ta:25°C	PASS Test by certified Lab
3	E.S.D	EN61000-4-2 LEVEL 3 AIR: 8KV / Contact: 4KV	I/P: 400/ 800 VDC O/P:FULL LOAD Ta:25°C	<input checked="" type="checkbox"/> CRITERIA A <input type="checkbox"/> CRITERIA B
4	E.F.T	EN61000-4-4 LEVEL 3 INPUT:2KV	I/P: 400/800 VDC O/P:FULL LOAD Ta:25°C	<input checked="" type="checkbox"/> CRITERIA A <input type="checkbox"/> CRITERIA B
5	SURGE	IEC61000-4-5 LEVEL 4 Vin+~Vin-:2KV	I/P: 400/800 VDC O/P:FULL LOAD Ta:25°C	<input checked="" type="checkbox"/> CRITERIA A <input type="checkbox"/> CRITERIA B
6	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 : DDRH-60-12 1. ROOM AMBIENT BURN-IN : 2 HRS I/P : 600 VDC O/P : FULL LOAD Ta= 27.8 °C 2. HIGH AMBIENT BURN-IN : 2 HRS I/P : 600 VDC O/P : FULL LOAD Ta= 60.8 °C																																																																																																																										
				<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta= 27.8 °C</th> <th>HIGH AMBIENT Ta= 60.8 °C</th> </tr> </thead> <tbody> <tr><td>1</td><td>L1</td><td>46.5°C</td><td>78.0°C</td></tr> <tr><td>2</td><td>LF2</td><td>55.7°C</td><td>87.2°C</td></tr> <tr><td>3</td><td>RTH1</td><td>53.3°C</td><td>84.2°C</td></tr> <tr><td>4</td><td>BD1</td><td>52.4°C</td><td>83.8°C</td></tr> <tr><td>5</td><td>C2</td><td>52.1°C</td><td>83.3°C</td></tr> <tr><td>6</td><td>C5</td><td>64.5°C</td><td>96.1°C</td></tr> <tr><td>7</td><td>C6</td><td>59.5°C</td><td>90.9°C</td></tr> <tr><td>8</td><td>Q1</td><td>61.7°C</td><td>93.2°C</td></tr> <tr><td>9</td><td>Q2</td><td>60.5°C</td><td>91.9°C</td></tr> <tr><td>10</td><td>Q10</td><td>55.7°C</td><td>87.2°C</td></tr> <tr><td>11</td><td>D1</td><td>63.0°C</td><td>94.4°C</td></tr> <tr><td>12</td><td>D3</td><td>68.2°C</td><td>99.9°C</td></tr> <tr><td>13</td><td>T3</td><td>56.9°C</td><td>88.4°C</td></tr> <tr><td>14</td><td>Q70</td><td>55.1°C</td><td>86.7°C</td></tr> <tr><td>15</td><td>C56</td><td>63.0°C</td><td>94.4°C</td></tr> <tr><td>16</td><td>U1</td><td>59.5°C</td><td>90.9°C</td></tr> <tr><td>17</td><td>T1coil</td><td>72.3°C</td><td>103.7°C</td></tr> <tr><td>18</td><td>T1core</td><td>70.9°C</td><td>102.4°C</td></tr> <tr><td>19</td><td>C71</td><td>60.0°C</td><td>91.8°C</td></tr> <tr><td>20</td><td>Q100</td><td>74.9°C</td><td>105.5°C</td></tr> <tr><td>21</td><td>C106</td><td>68.8°C</td><td>98.5°C</td></tr> <tr><td>22</td><td>C107</td><td>65.9°C</td><td>96.1°C</td></tr> <tr><td>23</td><td>C113</td><td>60.1°C</td><td>89.7°C</td></tr> <tr><td>24</td><td>LF100</td><td>62.6°C</td><td>93.1°C</td></tr> <tr><td>25</td><td>U3</td><td>68.8°C</td><td>100.5°C</td></tr> <tr><td>26</td><td>R231</td><td>70.1°C</td><td>100.1°C</td></tr> <tr><td>27</td><td>U200</td><td>69.5°C</td><td>99.6°C</td></tr> <tr><td>28</td><td>R101</td><td>74.9°C</td><td>105.4°C</td></tr> <tr><td>29</td><td>C3</td><td>57.9°C</td><td>89.9°C</td></tr> </tbody> </table>	NO	Position	ROOM AMBIENT Ta= 27.8 °C	HIGH AMBIENT Ta= 60.8 °C	1	L1	46.5°C	78.0°C	2	LF2	55.7°C	87.2°C	3	RTH1	53.3°C	84.2°C	4	BD1	52.4°C	83.8°C	5	C2	52.1°C	83.3°C	6	C5	64.5°C	96.1°C	7	C6	59.5°C	90.9°C	8	Q1	61.7°C	93.2°C	9	Q2	60.5°C	91.9°C	10	Q10	55.7°C	87.2°C	11	D1	63.0°C	94.4°C	12	D3	68.2°C	99.9°C	13	T3	56.9°C	88.4°C	14	Q70	55.1°C	86.7°C	15	C56	63.0°C	94.4°C	16	U1	59.5°C	90.9°C	17	T1coil	72.3°C	103.7°C	18	T1core	70.9°C	102.4°C	19	C71	60.0°C	91.8°C	20	Q100	74.9°C	105.5°C	21	C106	68.8°C	98.5°C	22	C107	65.9°C	96.1°C	23	C113	60.1°C	89.7°C	24	LF100	62.6°C	93.1°C	25	U3	68.8°C	100.5°C	26	R231	70.1°C	100.1°C	27	U200	69.5°C	99.6°C	28	R101	74.9°C	105.4°C	29	C3	57.9°C	89.9°C
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2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )	I/P : 600 VDC O/P : 119% LOAD Ta : 25°C	TEST : OK																																																																																																																								
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 200 VDC / 1500 VDC 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 55 °C /95 %R.H NO DAMAGE	I/P : 1503 VDC O/P : FULL LOAD Ta= 60.3 °C HUMIDITY= 95 %R.H	TEST : OK																																																																																																																								



5	TEMPERATURE COEFFICIENT	$\pm 0.03\%/^{\circ}\text{C}$ (0~55 $^{\circ}\text{C}$ )	I/P : 600VDC O/P : FULL LOAD	$\pm 0.013\%/^{\circ}\text{C}$ (0~55 $^{\circ}\text{C}$ )
6	STORAGE TEMPERATURE TEST	-40~80 $^{\circ}\text{C}$	1. Thermal shock Temperature : -45 $^{\circ}\text{C}$ ~ +90 $^{\circ}\text{C}$ 2. Temperature change rate : 25 $^{\circ}\text{C}$ / 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	-30~55 $^{\circ}\text{C}$	1. Thermal shock Temperature : -35 $^{\circ}\text{C}$ ~ +60 $^{\circ}\text{C}$ 2. Temperature change rate : 25 $^{\circ}\text{C}$ / MIN 3. Dwell time low and high temperature : 30 MIN/EACH 4. Total test cycle : 16 CYCLE 5. Input/Output condition : 15cycle: 600 VDC / FULL LOAD AC ON 3sec/AC OFF 1sec TEST 1cycle: 600 VDC / FULL LOAD Burn In Test	
8	VIBRATION TEST	10 ~ 500Hz, 3G 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 $^{\circ}\text{C}$	
9	CAPACITOR LIFE CYCLE	SUPPOSE C106 IS THE MOST CRITICAL COMPONENT (1) I/P : 600VDC O/P : FULL LOAD Ta= 25 $^{\circ}\text{C}$ LIFE TIME (2) I/P : 600VDC O/P : FULL LOAD Ta= 55 $^{\circ}\text{C}$ LIFE TIME (3) I/P : 600VDC O/P : 75% LOAD Ta= 55 $^{\circ}\text{C}$ LIFE TIME (4) I/P : 600VDC O/P : 50% LOAD Ta= 55 $^{\circ}\text{C}$ LIFE TIME		(1) 280518.7HRS (2) 44077HRS (3) 106795.6HRS (4) 218237.2HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 1439.7K hrs min. Telcordia TR/SR-332 (Bellcore) ; 454.5K hrs min. MIL-HDBK-217F (25 $^{\circ}\text{C}$ )		
11	Ongoing Reliability Test	I/P : 600VDC O/P : FULL LOAD TA=50 $^{\circ}\text{C}$ Demonstration Mean Time Between Failure : 30,000 hours		

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	LIUTT		Wangdz

2018.4.30 GP-A50-F010