



# Test Report: RSD-500D-48

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500W Enclosed Type Reliable Railway 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

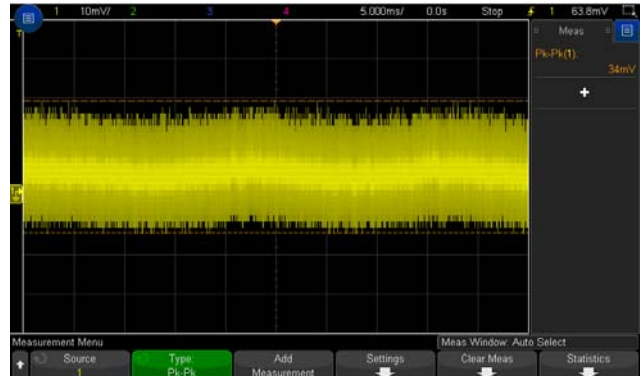
### OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 48V~ 56V	I/P: 110VDC O/P : MIN LOAD Ta : 25°C	45.69V~ 57.49V
2	OUTPUT VOLTAGE TOLERANCE (Max)	V1: -1%~+1 %	I/P: 67.2 VDC / 154 VDC O/P:FULL/ MIN. LOAD Ta:25°C	V1: -0.11 %~ 0.13 %
3	LINE REGULATION (Max)	V1:-0.5%~+0.5 %	I/P: 67.2 VDC / 154 VDC O/P:FULL LOAD Ta:25°C	V1: -0.11 %~ 0.02 %
4	LOAD REGULATION (Max)	V1:-1%~ +1 %	I/P: 110VDC O/P:FULL ~MIN LOAD Ta:25°C	V1: -0.01%~ 0.13%
5	OVER/UNDERSHOOT TEST	< ±5%	I/P: 110VDC O/P:FULL LOAD Ta:25°C	TEST: 1.3%
6	RIPPLE & NOISE (Max)	V1:150mVp-p	I/P: 110VDC O/P:FULL LOAD Ta:25°C	V1: 34mVp-p

high frequency :



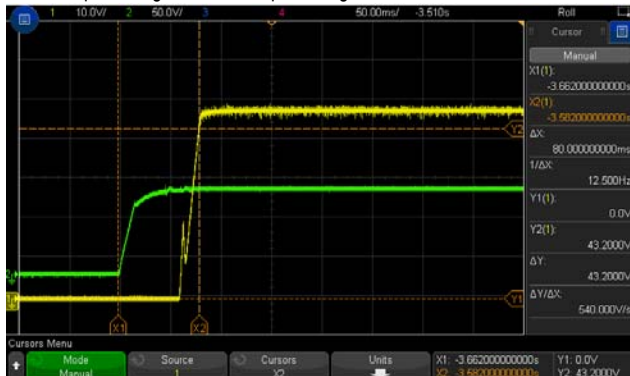
low frequency :

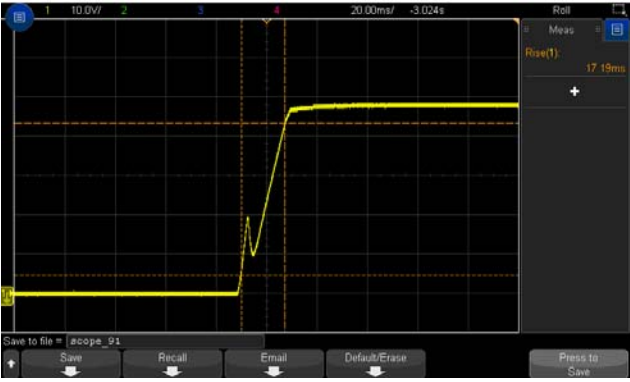
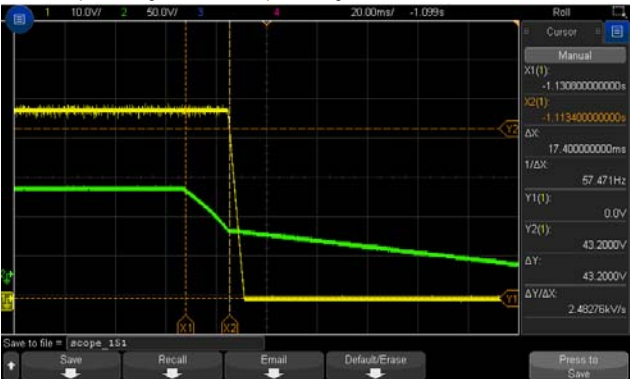

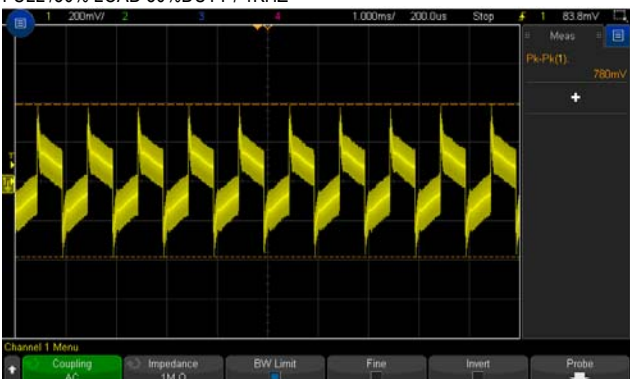


7	SET UP TIME (Max)	110VDC/ 500ms	I/P: 110VDC O/P:FULL LOAD Ta:25°C	80ms
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INPUT= 110VDC @ FULL LOAD

CH1 : Output Voltage CH2 : DC Input Voltage



8	RISE TIME (Max)	110VDC /60ms	I/P: 110VDC O/P:FULL LOAD Ta:25°C	17.19ms
<p>INPUT=110 VDC @ FULL LOAD CH1 : Output Voltage</p> 				
9	HOLD UP TIME (TYP)	110VDC /10 ms	I/P: 110VDC O/P:FULL LOAD Ta:25°C	17.4ms
<p>INPUT= 110VDC @ FULL LOAD CH1 : Output Voltage CH2 : DC Input Voltage</p> 				
10	TRANSIENT RECOVERY TIME	V1:4800mVp-p	I/P: 110VDC O/P:40% LOAD CHANGE 50%DUTY/120HZ	700mVp-p
11	DYNAMIC LOAD	V1: 4800mVp-p	I/P: 110VDC O/P: (1)FULL /50% LOAD 50%DUTY / 120HZ (2)FULL /50% LOAD 50%DUTY / 1KHZ Ta:25°C	840mVp-p 780mVp-p
<p>FULL /50% LOAD 50%DUTY / 120HZ</p>  <p>FULL /50% LOAD 50%DUTY / 1KHZ</p> 				

INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT																																												
1	INPUT VOLTAGE RANGE	67.2VDC~154VDC 57.6 VDC~ 67.2 VDC/100ms	I/P:TESTING O/P:FULL LOAD Ta:25°C	(1) 59.8V~154 V (2) TEST:OK																																												
			I/P: LOW-LINE-0.2= 67V HIGH-LINE+3V=157V 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 CURRENT(TYP)	110VDC/ 5A	I/P: 110VDC O/P:FULL LOAD Ta:25°C	I = 4.86A																																												
3	EFFICIENCY(TYP)	93%	I/P: 110VDC O/P:FULL LOAD Ta:25°C	93.57%																																												
<p>EFFICIENCY vs LOAD</p> <table border="1"> <caption>Efficiency vs Load Data</caption> <thead> <tr> <th>LOAD (%)</th> <th>67.2VDC (%)</th> <th>110VDC (%)</th> <th>154VDC (%)</th> </tr> </thead> <tbody> <tr><td>10%</td><td>87</td><td>85</td><td>83</td></tr> <tr><td>20%</td><td>92</td><td>90</td><td>88</td></tr> <tr><td>30%</td><td>93</td><td>91</td><td>89</td></tr> <tr><td>40%</td><td>93.5</td><td>92</td><td>90</td></tr> <tr><td>50%</td><td>93.5</td><td>92.5</td><td>91</td></tr> <tr><td>60%</td><td>93.5</td><td>93</td><td>91.5</td></tr> <tr><td>70%</td><td>93.5</td><td>93</td><td>92</td></tr> <tr><td>80%</td><td>93.5</td><td>93</td><td>92.5</td></tr> <tr><td>90%</td><td>93.5</td><td>93</td><td>93</td></tr> <tr><td>100%</td><td>93.5</td><td>93</td><td>93</td></tr> </tbody> </table>					LOAD (%)	67.2VDC (%)	110VDC (%)	154VDC (%)	10%	87	85	83	20%	92	90	88	30%	93	91	89	40%	93.5	92	90	50%	93.5	92.5	91	60%	93.5	93	91.5	70%	93.5	93	92	80%	93.5	93	92.5	90%	93.5	93	93	100%	93.5	93	93
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100%	93.5	93	93																																													
4	INRUSH CURRENT(TYP)	30A COLD START	I/P: 110VDC O/P:FULL LOAD Ta:25°C	I = 18.8 A																																												
<p>INPUT= VDC @ FULL LOAD CH2 : DC Input Voltage CH4 : Input current</p>																																																
5	INTERRUPTION OF VOLTAGE SUPPLY	D-type comply with S2 level (10ms)@ full load	I/P: 110VDC SHORT O/P: TESTING Ta:25°C	17.9ms/full load																																												

**PROTECTION FUNCTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	105%~ 135% RATED OUTPUT POWER	I/P: 67.2VDC I/P: 110VDC I/P: 154VDC O/P: TESTING Ta:25°C	119.2%/ 67.2 VDC 119.52%/ 110 VDC 120.82%/ 154 VDC PROTECTION TYPE : Constant current limiting 105%~135% rated output power with auto-recovery .
2	OVER VOLTAGE PROTECTION	CH: 57.6V~ 65V	I/P: 67.2VDC I/P: 110VDC I/P: 154VDC O/P: MIN LOAD Ta:25°C	62.5V/ 67.2 VDC 62.5V/ 110 VDC 62.5V/ 154 VDC PROTECTION TYPE : Shut down O/P voltage, re-power on to recover
3	OVER TEMPERATURE PROTECTION	SPEC: NO DAMAGE	I/P: 154/67.2 VDC O/P: FULL LOAD	O.T.P. Active PROTECTION TYPE : Shut down O/P voltage, re-power on to recover
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE	I/P: 154/67.2VDC O/P: FULL LOAD Ta:25°C	NO DAMAGE PROTECTION TYPE : Constant current limiting with auto-recovery recovers automatically after fault condition is removed
5	INPUT REVERSE	POWER OK	I/P: 154/67.2VDC O/P: FULL LOAD Ta:25°C	NO DAMAGE
6	INPUT UNDER VOLTAGE PROTECTION	110 VIN (D-TYPE) : POWER ON >=67.2V POWER OFF <=65V	I/P: TESTING O/P: FULL LOAD Ta:25°C	TEST : POWER ON >= 60.1V POWER OFF <= 57.38 V

**COMPONENT STRESS TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT																																				
1	PWM Transistor ( D to S) or (C to E) Peak Voltage	Q 10/Q12/ Q21/Q23 Rated : 26 A/400V	DC ON/OFF  I/P: High-Line +3V =157V 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. Ta:25°C	<table border="0"> <tr> <td><b>Q10</b></td> <td><b>Q12</b></td> </tr> <tr> <td>VDS:</td> <td>VDS:</td> </tr> <tr> <td>(1) 209V</td> <td>(1) 210V</td> </tr> <tr> <td>(2) 247V</td> <td>(2) 248V</td> </tr> <tr> <td>(3) 304V</td> <td>(3) 295V</td> </tr> <tr> <td>(4) 286V</td> <td>(4) 272V</td> </tr> <tr> <td>(5) 290V</td> <td>(5) 292V</td> </tr> <tr> <td>(6) 286V</td> <td>(6) 290V</td> </tr> <tr> <td>(7) 336V</td> <td>(7) 336V</td> </tr> <tr> <td><b>Q21</b></td> <td><b>Q23</b></td> </tr> <tr> <td>VDS:</td> <td>VDS:</td> </tr> <tr> <td>(1) 216V</td> <td>(1) 211V</td> </tr> <tr> <td>(2) 260V</td> <td>(2) 260V</td> </tr> <tr> <td>(3) 308V</td> <td>(3) 302V</td> </tr> <tr> <td>(4) 296V</td> <td>(4) 278V</td> </tr> <tr> <td>(5) 282V</td> <td>(5) 270V</td> </tr> <tr> <td>(6) 280V</td> <td>(6) 284V</td> </tr> <tr> <td>(7) 328V</td> <td>(7) 332V</td> </tr> </table>	<b>Q10</b>	<b>Q12</b>	VDS:	VDS:	(1) 209V	(1) 210V	(2) 247V	(2) 248V	(3) 304V	(3) 295V	(4) 286V	(4) 272V	(5) 290V	(5) 292V	(6) 286V	(6) 290V	(7) 336V	(7) 336V	<b>Q21</b>	<b>Q23</b>	VDS:	VDS:	(1) 216V	(1) 211V	(2) 260V	(2) 260V	(3) 308V	(3) 302V	(4) 296V	(4) 278V	(5) 282V	(5) 270V	(6) 280V	(6) 284V	(7) 328V	(7) 332V
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	Clamp MOSFET ( D to S) or (C to E) Peak Voltage	Q8/Q19 Rated : 26 A/ 400V	DC ON/OFF I/P:High-Line +3V =157V 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. Ta:25°C	Q8 VDS: (1) 193V (2) 237V (3) 294V (4) 264V (5) 262V (6) 255V (7) 300V	Q19 VDS: (1) 191V (2) 242V (3) 314V (4) 266V (5) 255V (6) 253V (7) 296V
2	Diode Peak Voltage	Q100/Q200 Rated : 20A/400V  Q103/ Q104 Rated : 20A/400V	DC ON/OFF I/P:High-Line +3V =157 V VOmax: 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  VO: O/P: (1)Full Load  Ta:25°C	Q100: VOmax: VDS: (1) 272V (2) 276V (3) 373V (4) 359V (5) 351V (6) 351V (7) 204V (8) 157V VO: (1) 238V  Q103: VOmax: VDS: (1) 363V (2) 375V (3) 363V (4) 367V (5) 363V (6) 363V (7) 367V (8) 355V VO: (1) 355V	Q200: VOmax: VDS: (1) 222V (2) 230V (3) 367V (4) 363V (5) 355V (6) 347V (7) 202V (8) 155V VO: (1) 240V  Q104: VOmax: VDS: (1) 367V (2) 379V (3) 371V (4) 367V (5) 367V (6) 371V (7) 375V (8) 363V VO: (1) 363V
3	Input Capacitor Voltage	C5/C35 Rated: : 270 $\mu$ / 160 V	I/P:High-Line +3V =157V 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) 158V (2) 158V (3) 156V (4) 154V	C35 (1) 158V (2) 158V (3) 156V (4) 154V
4	Control IC Voltage Test	PWM IC U4 Rated 7.5V~ 15 V O/P U201 Rated 0V~ 32 V	DC ON/OFF I/P:High-Line +3V =157 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	U4 (1) 14.15V (2) 14.32V (3) 14.32V (4) 14.3V (5) 12.39V	U201 (1) 13.35V (2) 13.35V (3) 13..03V (4) 28.3V (5) 10.78V

**SAFETY TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	EN 60950-1 I/P-O/P:4KVDC/min I/P-FG:2.5 KVDC/min O/P-FG:2.5KVDC/min	I/P-O/P: 4.4KVDC/min I/P-FG: 3 KVDC/min O/P-FG:3KVDC/min Ta:25°C	I/P-O/P: 0.5 uA I/P-FG: 0.2uA O/P-FG: 0 uA NO DAMAGE
2	ISOLATION RESISTANCE	I/P-O/P:500VDC>100MΩ I/P-FG: 500VDC>100MΩ O/P-FG:500VDC>100MΩ	I/P-O/P: 600 VDC I/P-FG: 600 VDC O/P-FG: 600 VDC Ta:25°C	I/P-O/P: 9999MΩ I/P-FG: 9999MΩ O/P-FG: 9999MΩ NO DAMAGE
3	GROUNDING CONTINUITY	EN 60950-1 FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25°C	4mΩ

**E.M.C TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RADIATION	EN55032 CLASS B	I/P: 110VDC O/P:FULL LOAD Ta:25°C	PASS Test by certified Lab
2	CONDUCTION	EN55032 CLASS A	I/P:110VDC O/P:FULL LOAD Ta:25°C	PASS Test by certified Lab
3	E.S.D	EN61000-4-2 <input type="checkbox"/> MEDICAL AIR: 15KV / Contact: 8KV <input type="checkbox"/> LIGHT INDUSTRY AIR: 8KV / Contact: 4KV <input checked="" type="checkbox"/> INDUSTRY AIR: 8KV / Contact: 6KV	I/P: 110VDC 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 <input type="checkbox"/> LIGHT INDUSTRY INPUT: 0.5KV <input type="checkbox"/> MEDICAL <input checked="" type="checkbox"/> INDUSTRY INPUT: 2KV	I/P:110VDC O/P:FULL LOAD Ta:25°C	<input checked="" type="checkbox"/> CRITERIA A <input type="checkbox"/> CRITERIA B
5	SURGE	IEC61000-4-5 <input checked="" type="checkbox"/> INDUSTRY L-N :1KV L,N-PE:2KV	I/P: 110VDC 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 : RSD-500D-12 1. ROOM AMBIENT BURN-IN : 2 HRS I/P : 110 VDC O/P : FULL LOAD Ta= 25 °C 2. HIGH AMBIENT BURN-IN : 2 HRS I/P : 110 VDC O/P : FULL LOAD Ta= 55 °C		

		NO	Position	ROOM AMBIENT Ta= 25 °C	HIGH AMBIENT Ta= 55 °C
		1	LF1	55.9°C	86.1°C
		2	LF2	58.6°C	83.3°C
		3	C17	57.2°C	84.3°C
		4	Q1	56.9°C	84.7°C
		5	C5	58.8°C	85.9°C
		6	T3	60.8°C	88.3°C
		7	T5	64.5°C	90.9°C
		8	U4	65.8°C	92.7°C
		9	Q8	61.7°C	88.4°C
		10	ZNR1	50.6°C	78.3°C
		11	D2	58.2°C	84.3°C
		12	Q35	58.0°C	85.1°C
		13	U1	60.4°C	87.4°C
		14	C35	59.9°C	87.0°C
		15	Q23	63.2°C	90.2°C
		16	T4	61.1°C	88.5°C
		17	T6	64.7°C	91.5°C
		18	T2	69.6°C	97.2°C
		19	TSW1	69.3°C	95.2°C
		20	T1	71.3°C	96.2°C
		21	Q100	71.8°C	102.1°C
		22	Q103	72.6°C	101.8°C
		23	L100	76.8°C	104.5°C
		24	C114	74.0°C	101.2°C
		25	C115	75.5°C	102.2°C
		26	LF100	70.9°C	98.5°C
		27	Q200	72.6°C	102.0°C
		28	Q105	76.3°C	105.0°C
		29	R202	67.4°C	94.9°C
		30	L101	75.1°C	103.9°C
		31	C103	73.4°C	101.7°C
		32	D213	66.3°C	93.7°C
		33	U101	70.0°C	96.4°C
		34	D107	94.9°C	95.1°C
		35	D106	66.3°C	93.2°C
		36	Q204	72.1°C	98.4°C
		37	Q37	59.2°C	85.9°C
		38	U3	58.5°C	85.3°C
		39	D17	60.0°C	87.6°C
		40	Q17	71.9°C	100.3°C
		41	U5	65.3°C	92.7°C
2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )		I/P : 110 VDC O/P : 118% LOAD Ta : 25°C	TEST : OK
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR		I/P : 67.2 VDC / 154 VDC O/P : 100 % LOAD Ta= -45 °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 : 157 VDC O/P : FULL LOAD Ta= 55 °C HUMIDITY= 95 %R.H	TEST : OK





5	TEMPERATURE COEFFICIENT	$\pm 0.03\%/^{\circ}\text{C}$ (0~55 $^{\circ}\text{C}$ )	I/P : 110 VDC O/P : FULL LOAD	$\pm 0.0081\%/^{\circ}\text{C}$ (0~55 $^{\circ}\text{C}$ )
6	STORAGE TEMPERATURE TEST	-40~85 $^{\circ}\text{C}$	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	-40~55 $^{\circ}\text{C}$	1. Thermal shock Temperature : -45 $^{\circ}\text{C}$ ~ +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: 110 VDC / FULL LOAD AC ON 3sec/AC OFF 1sec TEST 1cycle: 110 VDC / 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 : 10min/sweep cycle (4) Acceleration : 6G (5) Test Time : 180min in each axis (X.Y.Z) (6) Ta : 25 $^{\circ}\text{C}$	
9	CAPACITOR LIFE CYCLE	SUPPOSE C115 IS THE MOST CRITICAL COMPONENT (1) I/P : 110VDC O/P : FULL LOAD Ta= 25 $^{\circ}\text{C}$ LIFE TIME (2) I/P : 110VDC O/P : FULL LOAD Ta= 55 $^{\circ}\text{C}$ LIFE TIME (3) I/P : 110VDC O/P : 75% LOAD Ta= 55 $^{\circ}\text{C}$ LIFE TIME (4) I/P : 110VDC O/P : 50% LOAD Ta= 55 $^{\circ}\text{C}$ LIFE TIME		(1) 187973.8 HRS (2) 39791.5 HRS (3) 93165.4 HRS (4) 211552.1 HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 277.9K hrs min. Telcordia SR-332 (Bellcore) ; 99.1K hrs min. MIL-HDBK-217F (25 $^{\circ}\text{C}$ )		
11	Ongoing Reliability Test	I/P : 110VDC 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