Test Report: RSD-500C-12

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

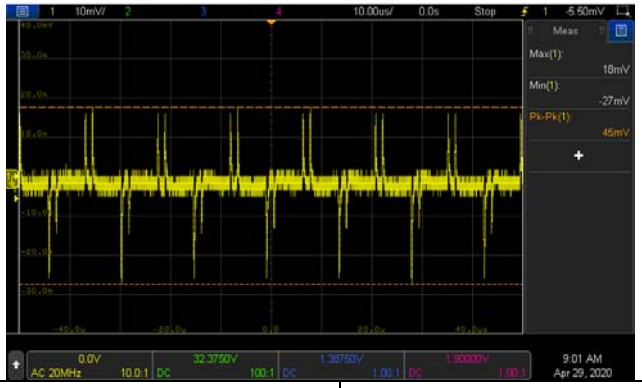
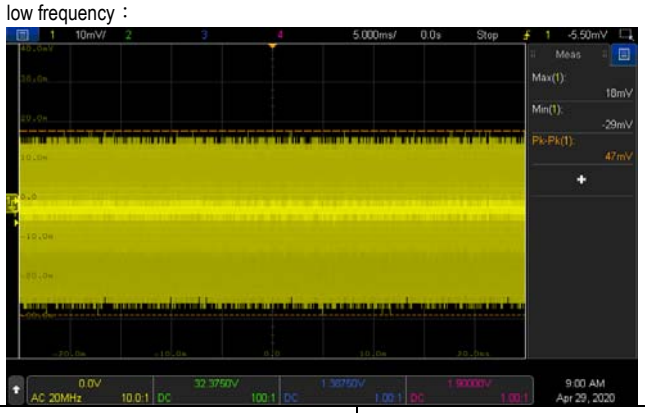
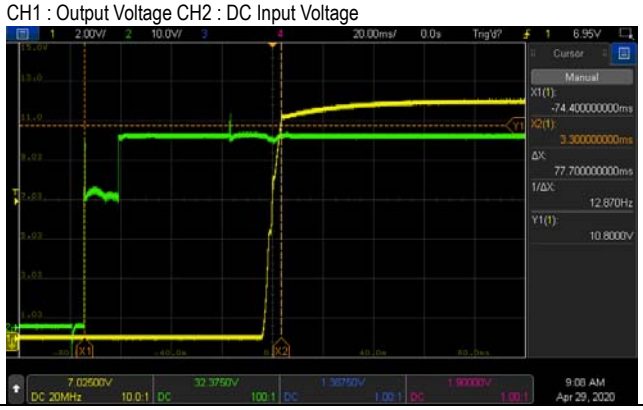
Safety Test
E.M.C. Test

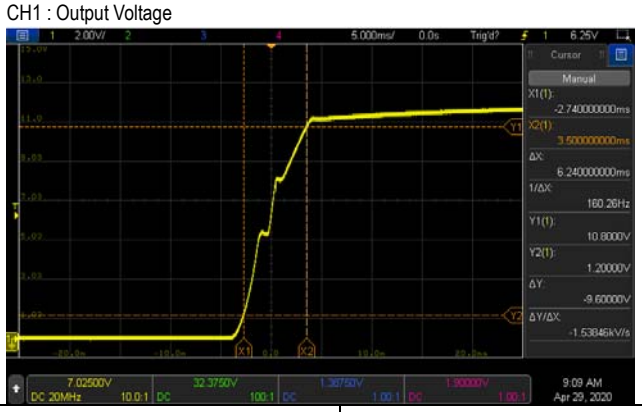
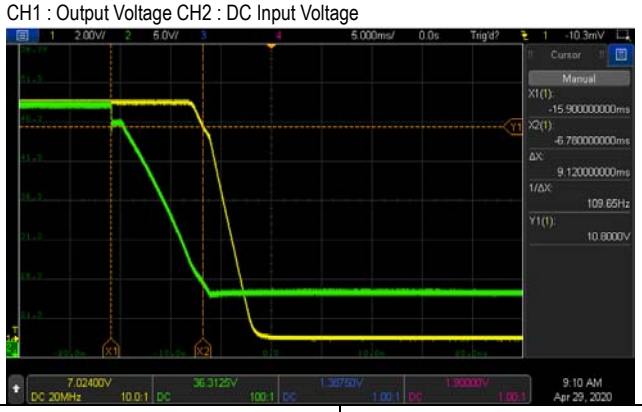
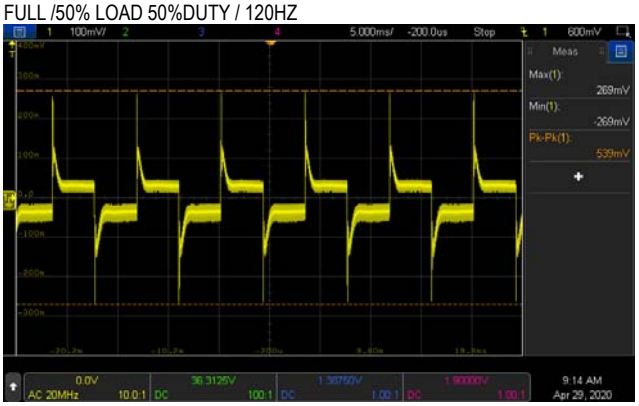
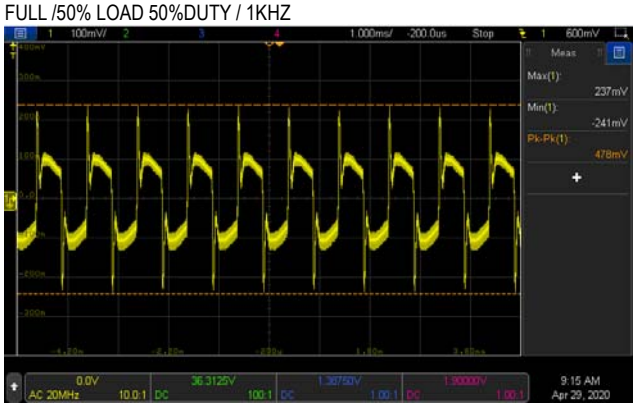
■ RELIABILITY TEST

ENVIRONMENT TEST

■ DESIGN VERIFY TEST

OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1:12V~ 14V	I/P: 48VDC O/P：MIN LOAD Ta：25℃	10.62V~14.42V
2	OUTPUT VOLTAGE TOLERANCE (Max)	V1:-1%~+1 %	I/P:33.6VDC / 67.2VDC O/P:FULL/ MIN. LOAD Ta:25℃	V1: -0.25 %~ 0.21 %
3	LINE REGULATION (Max)	V1:-0.5%~+0.5 %	I/P:33.6 VDC / 67.2 VDC O/P:FULL LOAD Ta:25℃	V1: -0.01 %~ 0.02 %
4	LOAD REGULATION (Max)	V1:-1%~ +1 %	I/P: 48VDC O/P:FULL ~MIN LOAD Ta:25℃	V1: -0.25 %~ 0.21 %
5	OVER/UNDERSHOOT TEST	< ±5%	I/P: 48VDC O/P:FULL LOAD Ta:25℃	TEST: 1.68%
6	RIPPLE & NOISE (Max)	V1:100 mVp-p	I/P: 48VDC O/P:FULL LOAD Ta:25℃	V1: 47mVp-p
	high frequency：  		low frequency：  	
7	SET UP TIME (Max)	48VDC/ 500ms	I/P: 48VDC O/P:FULL LOAD Ta:25℃	77.7ms
	INPUT= 48VDC @ FULL LOAD CH1 : Output Voltage CH2 : DC Input Voltage  			

<table>
<tr><td rowspan="2">8</td><td>RISE TIME (Max)</td><td>48VDC /60ms</td><td>I/P: 48VDC
O/P:FULL LOAD
Ta:25℃</td><td>6.24ms</td></tr>
<tr><td colspan="4">INPUT= 48VDC @ FULL LOAD
CH1 : Output Voltage
  </td></tr>
<tr><td rowspan="2">9</td><td>HOLD UP TIME (TYP)</td><td>48VDC / 3 ms</td><td>I/P: 48VDC
O/P:FULL LOAD
Ta:25℃</td><td>9.12 ms</td></tr>
<tr><td colspan="4">INPUT=48 VDC @ FULL LOAD
CH1 : Output Voltage CH2 : DC Input Voltage
  </td></tr>
<tr><td>10</td><td>TRANSIENT RECOVERY TIME</td><td>V1:1200mVp-p</td><td>I/P: 48VDC
O/P:40% LOAD CHANGE
50%DUTY/120HZ</td><td>438mVp-p</td></tr>
<tr><td rowspan="2">11</td><td>DYNAMIC LOAD</td><td>V1:1200mVp-p</td><td>I/P: 48VDC
O/P:
(1)FULL /50% LOAD 50%DUTY / 120HZ
(2)FULL /50% LOAD 50%DUTY / 1KHZ
Ta:25℃</td><td>539mVp-p
478mVp-p</td></tr>
<tr><td colspan="4">FULL /50% LOAD 50%DUTY / 120HZ
 
FULL /50% LOAD 50%DUTY / 1KHZ
  </td></tr>
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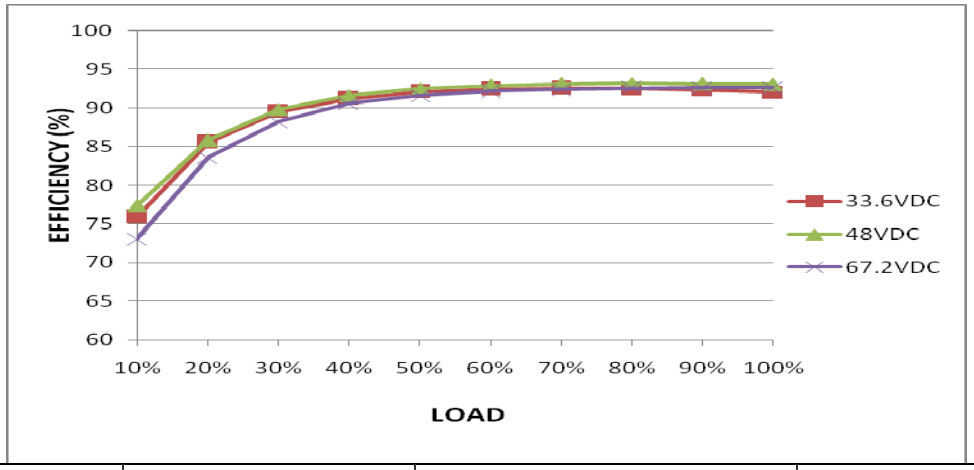
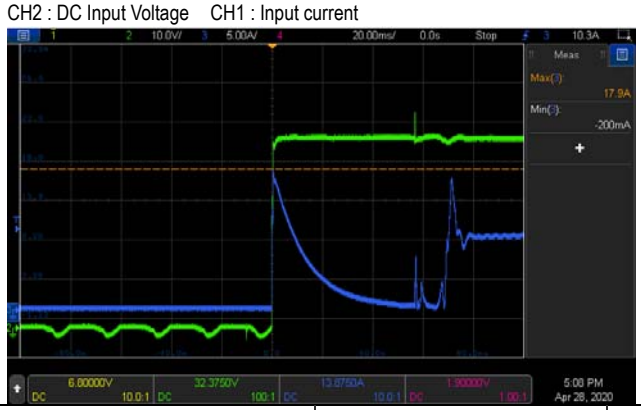
INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	33.6VDC~ 67.2VDC 28.8VDC~33.6VDC/1s	I/P:TESTING O/P:FULL LOAD Ta:25℃	（1）28.44V~ 37.2V （2）TEST:OK
			I/P: LOW-LINE-0.2= 33.4 V HIGH-LINE+3V= 70.2 V 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)	48VDC/ 11 A	I/P: 48VDC O/P:FULL LOAD Ta:25℃	I = 9.35A
3	EFFICIENCY(TYP)	93 %	I/P: 48VDC O/P:FULL LOAD Ta:25℃	93.07 %
	EFFICIENCY vs LOAD 			
4	INRUSH CURRENT(TYP)	30 A COLD START	I/P: 48VDC O/P:FULL LOAD Ta:25℃	I =17.9A
	INPUT= VDC @ FULL LOAD CH2 : DC Input Voltage CH1 : Input current 			
5	INTERRUPTION OF VOLTAGE SUPPLY	C- type comply with S2 level (10ms)@ 70% load ;	I/P: 48VDC SHORT O/P: TESTING Ta:25℃	13.1ms/70%load

PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	105 %~ 135% RATED OUTPUT POWER	I/P: 33.6 VDC I/P: 48 VDC I/P: 67.2 VDC O/P:TESTING Ta:25℃	121%/ 33.6 VDC 120.91%/ 48 VDC 120.94%/ 67.2 VDC PROTECTION TYPE： Constant current protection 105%~135% rated output power with auto-recovery .
2	OVER VOLTAGE PROTECTION	CH: 14.4 V~ 17.5 V	I/P: 33.6 VDC I/P: 48 VDC I/P: 67.2 VDC O/P:MIN LOAD Ta:25℃	15.76V/ 33.6 VDC 15.76V/ 48 VDC 15.76V/ 67.2 VDC PROTECTION TYPE： Shut down O/P voltage, re-power on to recover
3	OVER TEMPERATURE PROTECTION	SPEC: NO DAMAGE	I/P: 67.2/33.6 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: 67.2/33.6 VDC O/P: FULL LOAD Ta:25℃	NO DAMAGE PROTECTION TYPE： Constant current limiting with auto-recovery recovers automatically after fault condition is removerd
5	INPUT REVERSE	POWER OK	I/P: 67.2/33.6 VDC O/P: FULL LOAD Ta:25℃	NO DAMAGE
6	INPUT UNDER VOLTAGE PROTECTION	110 VIN (D-TYPE) : POWER ON >=33.6V POWER OFF<=33V	I/P: TESTING O/P: FULL LOAD Ta:25℃	TEST : POWER ON >= 28.44 V POWER OFF<= 25.08 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 : 65 A/ 200V	DC ON/OFF I/P:High-Line +3V =70.2V 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℃	Q10 VDS: (1) 108.4V (2) 118V (3) 144V (4) 127V (5) 131V (6) 156V (7) 159V Q21 VDS: (1) 109V (2) 118.4V (3) 135V (4) 122V (5) 120V (6) 155V (7) 166V Q12 VDS: (1) 108.4V (2) 118.9V (3) 146V (4) 12.8V (5) 130V (6) 154V (7) 165V Q23 VDS: (1) 108.8V (2) 119.6V (3) 137V (4) 123V (5) 123V (6) 155V (7) 168V
2	Clamp MOSFET (D to S) or (C to E) Peak Voltage	Q8/Q19 Rated : 34 A/ 200V	DC ON/OFF	Q8 VDS: Q19 VDS:

			I/P:High-Line +3V =70.2V 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℃	(1) 86.6V (2) 94.6V (3) 136V (4) 124.9V (5) 125.7V (6) 145V (7) 149.5V	(1) 83.6V (2) 94.9V (3) 123.8V (4) 115V (5) 112.6V (6) 115V (7) 140V
3	Diode Peak Voltage	Q100/ Q200 Rated: 100 A/ 120 V Q103/Q105 Rated : 100 A/ 120 V	DC ON/OFF I/P:High-Line +3V =70.2 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℃	Q100: VOmax: VDS: (1) 51.3V (2) 69.0V (3) 76.6V (4) 69.3V (5) 71.0V (6) 74.2V (7) 76.6V (8) 54.1V VO: (1) 55.9V Q103: VOmax: VDS: (1) 101.5V (2) 102.3V (3) 103.1V (4) 102.3V (5) 102.3V (6) 103.1V (7) 102.3V (8) 101.5V VO: (1) 99.9V	Q200: VOmax: VDS: (1) 62.1V (2) 70.1V (3) 73.4V (4) 66.1V (5) 63.7V (6) 72.6V (7) 77.4V (8) 51.7V VO: (1) 63.7V Q105: VOmax: VDS: (1) 103.1V (2) 103.1V (3) 104.7V (4) 104.7V (5) 104.7V (6) 105.5V (7) 103.9V (8) 103.1V VO: (1) 102.3V
4	Input Capacitor Voltage	C5/C35 Rated: : 820 μ/ 80 V	I/P:High-Line +3V =70.2V 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℃	C5 (1)71.5V (2)71.5V (3)71.5V (4) 71.1V	C35 (1)71.5V (2)71.5V (3)71.5V (4) 71.1V
5	Control IC Voltage Test	PWM IC U4 Rated 7.5V~ 15 V O/P U100 /U101/U102/U103 Rated -0.3V~27 V O/P U201 Rated 0V~ 32 V	DC ON/OFF I/P:High-Line +3V =70.2 V O/P(1)FULL LOAD (2) Output Short (3)O.L.P (4)O.V.P. (5)NO LOAD VRmin(LOW LINE)	U4 (1) 13.91V (2) 13.99V (3) 13.91V (4) 13.83V (5) 12.14V U100 (1) 11.33V	U201 (1) 11.58V (2) 12.14V (3) 11.58V (4) 14.95 (5) 10.53 U101 (1) 10.05V

			Ta:25℃	(2) 11.33V (3) 11.33V (4) 11.17V (5) 10.77V U102 (1) 10.85V (2) 10.85V (3) 10.85V (4) 10.85V (5) 10.77V	(2) 10.05V (3) 10.05V (4) 10.05V (5) 9.97V U103 (1) 10.13V (2) 11.13V (3) 10.21V (4) 10.05V (5) 9.97V

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℃	I/P-O/P: 0.2uA I/P-FG: 0.5uA O/P-FG: 0uA 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℃	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℃	2mΩ

E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RADIATION	EN55032 CLASS B	I/P: 48VDC O/P:FULL LOAD Ta:25℃	PASS Test by certified Lab
2	CONDUCTION	EN55032 CLASS A	I/P:48VDC O/P:FULL LOAD Ta:25℃	PASS Test by certified Lab
3	E.S.D	EN61000-4-2 □MEDICAL AIR：15KV / Contact：8KV □LIGHT INDUSTRY AIR：8KV / Contact：4KV ■INDUSTRY AIR：8KV / Contact：6KV	I/P: 48VDC O/P:FULL LOAD Ta:25℃	■CRITERIA A □CRITERIA B
4	E.F.T	EN61000-4-4 □LIGHT INDUSTRY INPUT: 0.5KV □MEDICAL ■INDUSTRY INPUT: 2KV	I/P:48VDC O/P:FULL LOAD Ta:25℃	■CRITERIA A □CRITERIA B
5	SURGE	IEC61000-4-5 ■INDUSTRY L-N :1KV L,N-PE:2KV	I/P:48VDC O/P:FULL LOAD Ta:25℃	■CRITERIA A □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-500C-24 1. ROOM AMBIENT BURN-IN：2 HRS I/P：48 VDC O/P： FULL LOAD Ta= 25 ℃ 2. HIGH AMBIENT BURN-IN：2 HRS I/P：48 VDC O/P： FULL LOAD Ta= 55 ℃		

NO	Position	ROOM AMBIENT Ta= 25 ℃	HIGH AMBIENT Ta= 55 ℃
1	Q2	58.6℃	89.3℃
2	ZNR1	52.5℃	83.2℃
3	U1	69.4℃	101.4℃
4	T3	65.3℃	95.6℃
5	T4	64.8℃	95.1℃
6	C17	62.6℃	93.1℃
7	LF1	62.0℃	93.0℃
8	D2	58.5℃	89.1℃
9	C6	64.1℃	94.3℃
10	Q19	62.3℃	93.0℃
11	Q23	66.9℃	98.7℃
12	R90	63.2℃	94.5℃
13	Q10	69.7℃	101.1℃
14	LF2	65.3℃	95.7℃
15	T5	66.5℃	97.5℃
16	U4	71.3℃	102.0℃
17	C60	56.0℃	87.0℃
18	T1	69.8℃	100.2℃
19	T6	66.5℃	97.0℃
20	T2	71.2℃	101.7℃
21	Q100	71.2℃	102.1℃
22	Q103	70.6℃	103.1℃
23	Q105	67.5℃	101.0℃
24	L101	79.0℃	110.4℃
25	L100	76.7℃	108.0℃
26	TSW1	66.6℃	97.3℃
27	C103	68.0℃	99.1℃
28	C102	65.8℃	97.1℃
29	C114	66.2℃	97.3℃
30	Q200	72.8℃	103.5℃
31	D107	61.6℃	92.4℃
32	D213	64.0℃	95.2℃
33	D106	63.3℃	94.0℃
34	Q204	66.8℃	97.5℃
35	U5	64.4℃	94.9℃
36	D204	66.2℃	96.9℃
37	Q37	61.2℃	91.6℃
38	U3	60.5℃	90.9℃
39	Q17	70.2℃	101.2℃
40	D23	65.6℃	96.6℃
41	C54	62.3℃	93.0℃

2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)	I/P：48 VDC O/P：120 % LOAD Ta：25℃	TEST：OK
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P：33.6 VDC / 67.2 VDC O/P： 100 % LOAD Ta= -45 ℃	TEST：OK
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 55 ℃ / 95 %R.H NO DAMAGE	I/P：70.2 VDC O/P：FULL LOAD Ta= 55 ℃ HUMIDITY= 95 %R.H	TEST：OK
5	TEMPERATURE COEFFICIENT	±0.03%/℃(0~55℃)	I/P：48 VDC O/P：FULL LOAD	± 0.0051%/℃(0~55℃)
6	STORAGE TEMPERATURE TEST	-40~85℃	1. Thermal shock Temperature： -45℃~ +90℃ 2. Temperature change rate ：25℃ / 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℃	1. Thermal shock Temperature： -45℃~ +60℃ 2. Temperature change rate ：25℃ / MIN 3. Dwell time low and high temperature ： 30 MIN/EACH 4. Total test cycle：16 CYCLE 5. Input/Output condition： 15cycle: 48 VDC / FULL LOAD AC ON 3sec/AC OFF 1sec TEST 1cycle: 48 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℃	
9	CAPACITOR LIFE CYCLE	SUPPOSE C103 IS THE MOST CRITICAL COMPONENT (1) I/P： 48VDC O/P：FULL LOAD Ta= 25 ℃ LIFE TIME (2) I/P： 48VDC O/P：FULL LOAD Ta= 55 ℃ LIFE TIME (3) I/P： 48VDC O/P：75% LOAD Ta= 55 ℃ LIFE TIME (4) I/P： 48VDC O/P：50% LOAD Ta= 55 ℃ LIFE TIME	(1) 213709.1HRS (2) 24752.5HRS (3) 52832.2HRS (4) 104197.1HRS	
10	MTBF	Conducted by Parts Stress Analysis Prediction 277.9K hrs min. Telcordia SR-332 (Bellcore) ; 99.1K hrs min. MIL-HDBK-217F (25℃)		
11	Ongoing Reliability Test	I/P：48VDC O/P：FULL LOAD TA=50℃ Demonstration Mean Time Between Failure : 30,000 hours		

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	LIUTT		Wangdz

2018.4.30 GP-A50-F010