Test Report: DBU -3200-24

3200W Intelligent Single Output Battery Charger

■ 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

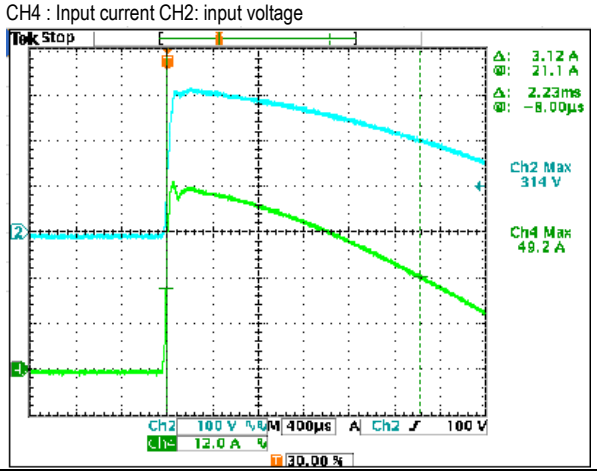
■ DESIGN VERIFY TEST

OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	BOOST CHARGE VOLTAGE	Default, programmable 28.8V±0.24V	I/P: 230 VAC O/P: CV MODE Ta:25℃	28.764V
2	FLOAT CHARGE VOLTAGE	Default, programmable 27.6V±0.24V	I/P: 230 VAC O/P: CV MODE Ta:25℃	27.57V
3	OUTPUT CURRENT	110A±3%	I/P: 230 VAC O/P:CV MODE-2V Ta:25℃	110 A
4	VOLTAGE ADJ. RANGE	23.5V~30V	I/P: 230 VAC O/P:NO LOAD Ta:25℃	23.112V~ 31.38V/230VAC 23.113V~ 31.38V/115VAC
5	LEAKAGE CURRENT FROM BATTERY (Typ.)	<1.5mA	I/P: AC OFF O/P:BATTERY 24v Ta:25℃	1.1mA

INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	90VAC~264VAC	I/P:TESTING O/P:FULL LOAD Ta:25℃	180V~264V/ FULL LOAD 76V~264 /HALF LOAD
			I/P: (1)LOW-LINE-3V=87 V HIGH-LINE+15%=300 V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON: 30 Sec OFF: 30 Sec 10MIN (2)230Vac ON: 0.5 Sec OFF: 0.5 Sec 20MIN (3)230Vac ON:3Sec OFF:3Sec 12HOURS (POWER ON/OFF NO DAMAGE)	TEST:OK
2	INPUT FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE	I/P:180 VAC ~264 VAC O/P:FULL~MIN LOAD Ta:25℃	TEST: OK
3	INPUT CURRENT (Typ.)	230V/ 17A	I/P ： 230 VAC O/P ：FULL LOAD Ta ：25℃	I =13.8 A/ 230VAC
4	LEAKAGE CURRENT	<2 mA / 230 VAC	I/P ： 230 VAC O/P ：Min LOAD Ta ：25℃	L-FG ：0.85 mA N-FG ：0.85 mA
5	POWER FACTOR (Typ.)	0.97 / 230VAC	I/P ： 230 VAC O/P ：FULL LOAD Ta ：25℃	PF= 0.997 /230VAC
6	EFFICIENCY(Typ.)	93.5%	I/P:230 VAC O/P:FULL LOAD Ta:25℃	93.55%

7	INRUSH CURRENT(Typ.)	230V/55 A COLD START	I/P： 230 VAC O/P：FULL LOAD Ta：25℃	I =49.2A/ 230VAC T50=2230 us/230V
	INPUT=230VAC/50HZ @ FULL LOAD CH4 : Input current CH2: input voltage 			

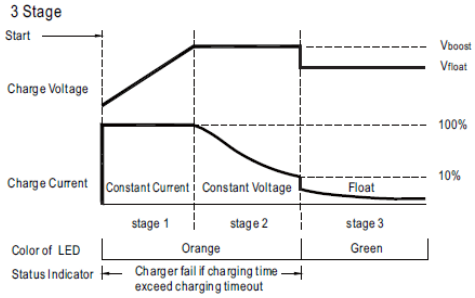
PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER VOLTAGE PROTECTION	31.5 V~ 37.5 V PROTECTION TYPE： Shut down o/p voltage, re-power on to recover	I/P: 264VAC I/P: 230VAC I/P: 90VAC O/P:MIN LOAD Ta:25℃	33.25V/ 264VAC 33.3V/ 230VAC 33.37V/ 90VAC PROTECTION TYPE： Shut down o/p voltage, re-power on to recover
2	OVER TEMPERATURE PROTECTION	NO DAMAGE PROTECTION TYPE： Shut down o/p voltage, recovers automatically after temperature goes down	I/P: 264VAC I/P: 90VAC O/P:FULL LOAD	O.T.P. Active PROTECTION TYPE： Shut down o/p voltage, recovers automatically after temperature goes down

CONTROL FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PMBus Communication Interface	DBU-3200 supports PMBus Rev. 1.1 with maximum 100KHz bus speed, allowing information reading, status monitoring, output trimming, etc. For details, please refer to the Installation Manual. TEST RESULT : OK		
2	Charging Curve	※ By factory default, this charger performs the default curve which can be programmed via PMBus. ※ To disable / enable the charging curve, change to a 2 stage curve, a different curve frequently used for certain types of batteries in the industry, and so on, please refer to the Installation Manual.		

◎ Default 3 stage charging curve

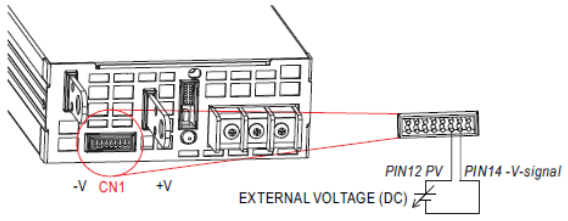


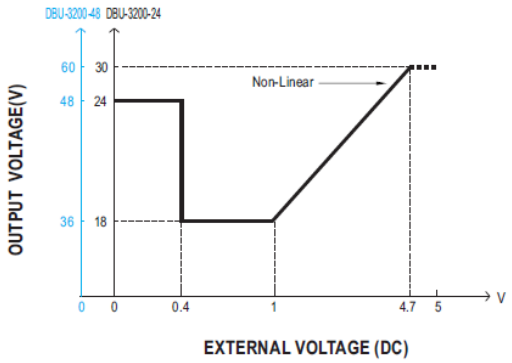
◎ Suitable for lead-acid batteries (flooded, Gel and AGM) and Li-ion batteries (lithium iron and lithium manganese).

◎ Embedded 3 stage charging curve

MODEL	Description	Vboost	Vfloat	CC(default)
24V	Default, programmable	28.8	27.6	110A
	Pre-defined, gel batter	28	27.2	
	Pre-defined, flooded battery	28.4	26.8	
	Pre-defined, AGM battery	29	27	
48V	Default, programmable	57.6	55.2	55A
	Pre-defined, gel batter	56	54.4	
	Pre-defined, flooded battery	56.8	53.6	
	Pre-defined, AGM battery	58	54	

Note:
When using this charger unit, please configured the system with recommended battery capacity by specification defined. Should battery capacity in use be much smaller so that user needs to set a low current for charging, under such condition it might cause higher current ripple.

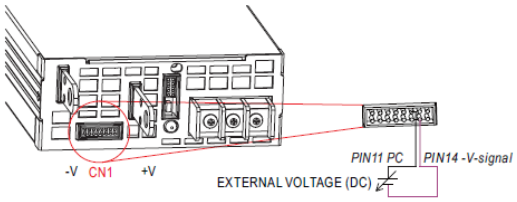
<table>
<tr><td></td><td></td><td>I/P: 230 VAC
O/P:TESTING
Ta:25℃
TEST RESULT：OK</td></tr>
<tr><td>3</td><td>Front Panel LED Indicators & Corresponding Signal at Function Pins</td><td>
<table>
<tr><th>LED</th><th>Description</th></tr>
<tr><td>Green</td><td>Float (stage 3)</td></tr>
<tr><td>Orange</td><td>Charging (stage 1 or stage 2)</td></tr>
<tr><td>Red</td><td>Abnormal status (OTP, OLP, Fan Fail, Charging timeout.)</td></tr>
</table>
I/P: 230 VAC
O/P:TESTING
Ta:25℃
TEST RESULT：OK</td></tr>
<tr><td>4</td><td>OUTPUT VOLTAGE PROGRAMMABLE(PV)</td><td>※ In addition to the adjustment via the built-in potentiometer, the output voltage can be trimmed by applying EXTERNAL VOLTAGE.
 

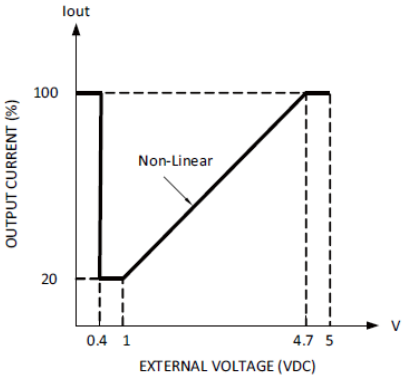


I/P: 230 VAC
O/P:FULL LOAD
Ta:25℃
TEST RESULT：
<table>
<tr><th>PV / MODEL</th><th><0.4V</th><th>1V</th><th>4.7V</th><th>5V</th></tr>
<tr><td>SPEC</td><td>24V±5%</td><td>18V±5%</td><td>30V±5%</td><td>30V±5%</td></tr>
<tr><td>Vout</td><td>24.08V</td><td>17.8V</td><td>30.84V</td><td>31.37V</td></tr>
</table>
</td></tr>
</table>

5 OUTPUT CURRENT PROGRAMMABLE (PC)

※ The output current can be trimmed to 20~100% of the rated current by applying EXTERNAL VOLTAGE.



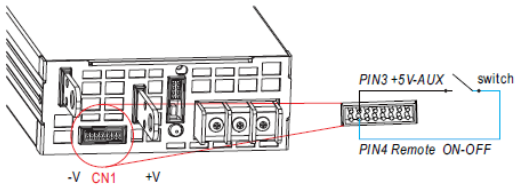


I/P: 230 VAC
O/P:TESTING
Ta:25℃
TEST RESULT：

ADJ V	<0.4V	1V	4.7V	5V
SPEC	100%±10%	20%±10%	100%±10%	100%±10%
Io	112A	20.7A	112A	112A

6 REMOTE ON/OFF CONTROL

The power supply can be turned ON/OFF individually or along with other units in parallel by using the "Remote ON-OFF" function.

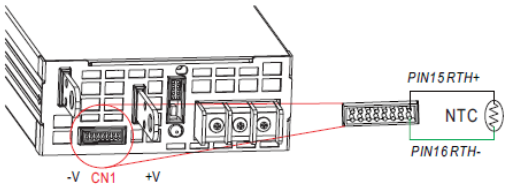


Between Remote ON-OFF and +5V-AUX	Power Supply Status
Switch Short	ON
Switch Open	OFF

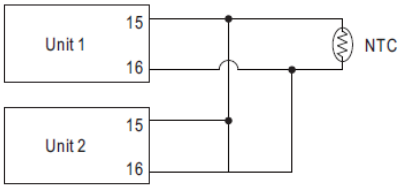
I/P: 230 VAC
O/P:FULL LOAD
Ta:25℃
Test Result：

Between ON/OFF and +5V-AUX	OUTPUT
SW SHORT	ON
SW OPEN	OFF

7 Temperature Compensation



◎ To exploit the temperature compensation function, please attach the temperature sensor, NTC, which is enclosed with the charger, to the battery or the battery's vicinity.
◎ The charger is able to work normally without the NTC.



When multiple chargers are connected in parallel, please configure with the NTC as exhibited in the diagram .
If the temperature compensation is not required, RTH+ (PIN15) and RTH- (PIN16) from each unit still need to be connected.

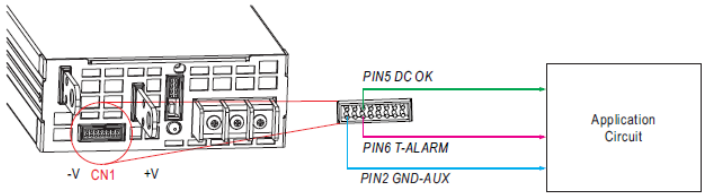
I/P: 230 VAC
O/P:FULL LOAD
Ta:25℃
Test Result：

TEMP	Voltage compensation	Temperature compensation

			BEFORE	AFTER
		(Ta=0℃)	28.8V = +0.90V ±0.24V	27.593	28.516
		(Ta=25℃)	28.8V = 0V ±0.24V	27.593	27.593
		(Ta=50℃)	28.8V = -0.90V ±0.24V	27.593	26.695

8 ALARM SIGNAL

※ There are 2 alarm signals, DC OK and T-ALARM, in TTL signal form, on CN1. These signals are isolated from output. The maximum sink current is 10mA.



1. DC OK SIGNAL
High (4.5 ~ 5.5V) : When the Vout≦ 16V±1V.
Low (-0.1 ~ 0.5V) : When Vout≧ 16V±1V.
The maximum sourcing current is 10mA and only for output.
I/P: 230 VAC
O/P:FULL LOAD
Ta:25℃
Test Result：

Vout	DC OK SIGNAL
Vout≦ 15V	4.72v
Vout≧ 17V	-0.065V

2. T-ALARM
High (4.5 ~ 5.5V) : When the internal temperature exceeds the limit of temperature alarm, or when Fan fails.
Low (-0.1 ~ 0.5V) : When the internal temperature is normal, and when Fan works normally.
The maximum sourcing current is 10mA and only for output(Note.2)
I/P: 230 VAC
O/P:FULL LOAD
Ta:25℃
Test Result：

P.SU STATUS	T-ALARM
NORMAL	-0.065V
OTP OR FAN LOCK	4.71V

9 Current Sharing with Remote Sensing

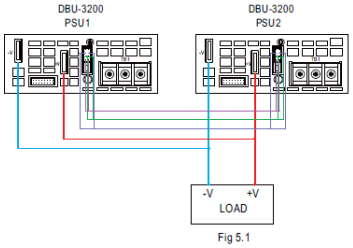
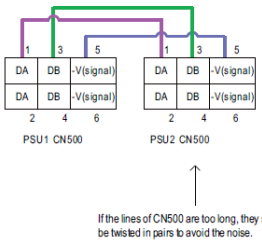
DBU-3200 has the built-in active current sharing function and can be connected in parallel, up to 2 units, to provide higher output power as exhibited below :
※ The power supplies should be paralleled using short and large diameter wiring and then connected to the load.
※ Difference of output voltages among parallel units should be less than 0.2V.
※ The total output current must not exceed the value determined by the following equation:
Maximum output current at parallel operation=(Rated current per unit)×(Number of unit)×0.9
※ When the total output current is less than 5% of the total rated current, or say (5% of Rated current per unit)×(Number of unit) the current shared among units may not be balanced.
※ CN500/SW1 Function pin connection

Parallel	PSU1		PSU2	
	CN500	SW1	CN500	SW1
1 unit	X	ON	—	—
2 unit	V	ON	V	ON

I/P： 230 VAC
O/P：396A/160A
Ta：25℃

O/P：396A
PSU1：98.3A
PSU2：98.5 A
PSU3：98.4 A
PSU4：98.6 A

O/P：160A
PSU1：38.9 A
PSU2：40.4 A
PSU3：39.5 A
PSU4：39.2 A

		(V : CN500 connected ; X : CN500 not connected.)  Fig 5.1  	
10	AUXILIARY POWER (AUX)	a.+12V Auxiliary voltage output, 10.8~13.2V, referenced to GND-AUX (pin 2). The maximum load current is 0.8A. This output has the built-in "Oring diodes" and is not controlled by the Remote ON/OFF control b.+5V Auxiliary voltage output, 4.5~5.5V, referenced to GND-AUX (pin 2). The maximum load current is 0.3A. This output has the built-in "Oring diodes" and is not controlled by the Remote ON/OFF control I/P: 230 VAC O/P:FULL LOAD Ta:25℃ Test Result：	

AUX	TOLERANCE	RIPPLE	TEST RESULT
12V / 0.8A	10.6~13.2 V	450mVp-p	12.1V/130mv
5V / 0.3A	4.5 ~ 5.5V	150mVp-p	4.7V/110mv

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor (D to S) or (C to E) **Peak Voltage**	Q1 Rated 52A/600V Q3 Rated 52A/600V	I/P:High-Line +3V =267V AC ON/OFF VDS: O/P: (1)Full Load	Q1: VDS: (1)477 V Q3 VDS: (1)493 V
2	P.F.C Transistor (D to S) or (C to E) **Peak Voltage**	Q 900 Rated 52 A/600V Q 902 Rated 52 A/600V	I/P:High-Line +3V =267 V AC ON/OFF VDS: O/P: (1)Full Load	Q900: VDS: (1)505V Q902: VDS: (1)493V
3	P.F.C DIODE	D8 Rated 16 A/600V	I/P:High-Line +3V =267 V AC ON/OFF O/P: (1)Full Load Ta:25℃	(1) 441V
4	Diode Peak Voltage	Q101 Rated 100 A/100 V Q104 Rated 100 A/100 V Q107 Rated 100 A/100 V Q110 Rated	I/P:High-Line +3V =267 V AC ON/OFF VDS: O/P: (1)Full Load	Q101: VDS: (1)85.7V Q104: VDS: (1)72.1V Q107: VDS: Q110: VDS:

		100 A/100 V		(1)77.7V (1)80.2V
5	Input Capacitor Voltage	C5 Rated: 330μ/ 450V 105 ℃	I/P:High-Line +3V =267V O/P: (1)Full Load input on/off Ta:25℃	(1)432V
6	Control IC Voltage Test	PWM IC U201 Rated 6.5 V~30V PFC IC U900 Rated 4.5V~20 V	I/P:High-Line +3V =267 V AC ON/OFF O/P(1)FULL LOAD Ta:25℃	U201 U900 (1) 14.9V (1) 13.9V
7	TOP SWITCHING STAND BY POWER	U71 Rate 20 A/ 800V	I/P:High-Line +3V =267 V AC ON/OFF O/P: (1)Full Load (2)Remote On/Off Ta:25℃	(1) 645V (2) 645V

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P: 3KVAC/min I/P-FG :2KVAC/min O/P-FG:1.5KVAC/min	I/P-O/P: 3.6 KVAC/min I/P-FG: 2.4 KVAC/min O/P-FG:1.8 KVAC/min Ta:25℃	I/P-O/P: 11.76mA I/P-FG: 13.32 mA O/P-FG: 18.98 mA 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: 500 VDC I/P-FG: 500 VDC O/P-FG: 500 VDC Ta:25℃	I/P-O/P: 13 GΩ I/P-FG: 2.86GΩ O/P-FG: 5 GΩ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25℃	25mΩ

E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	CONDUCTION	EN55032 (CISPR32) / EN55011 (CISPR11) CLASS B	I/P： 230 VAC (50HZ) O/P：FULL/50% LOAD Ta：25℃	Test by certified Lab
2	RADIATION	EN55032 (CISPR32) / EN55011 (CISPR11) CLASS A	I/P： 230 VAC (50HZ) O/P：FULL LOAD Ta：25℃	Test by certified Lab
3	HARMONIC	EN61000-3-2 CLASS A	I/P:230VAC/50HZ O/P:100% LOAD Ta:25℃	Test by certified Lab
4	E.S.D	EN61000-4-2 INDUSTRY AIR：8KV / Contact：4KV	I/P： 230 VAC/50HZ O/P：FULL LOAD Ta：25℃	CRITERIA A
5	E.F.T	EN61000-4-4 INDUSTRY INPUT： 2KV	I/P： 230 VAC/50HZ O/P：FULL LOAD Ta：25℃	CRITERIA A
6	SURGE	IEC61000-6-2 INDUSTRY L-N ：2KV L,N-PE：4KV	I/P： 230 VAC/50HZ O/P：FULL LOAD Ta：25℃	CRITERIA A
7	Test by certified Lab & Test Report Prepare			

■ RELIABILITY TEST

ENVIRONMENT TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	TEMPERATURE RISE TEST	MODEL： DBU-3200-24 1. ROOM AMBIENT BURN-IN：1 HRS I/P： 230VAC O/P： FULL LOAD 2. HIGH AMBIENT BURN-IN： 1 HRS I/P： 230VAC O/P： FULL LOAD		

NO	Position	ROOM AMBIENT Ta= 25℃	HIGH AMBIENT Ta= 50℃
1	BD1	71.0℃	97.3℃
2	RY1	36.7℃	62.6℃
3	D7	71.0℃	98.2℃
4	D8	68.9℃	96.3℃
5	T3	47.2℃	73.3℃
6	U900	39.8℃	66.3℃
7	Q900	58.8℃	86.1℃
8	Q902	69.0℃	96.9℃
9	C5	52.9℃	81.7℃
10	U902	43.4℃	70.5℃
11	Q1	71.3℃	101.7℃
12	Q3	74.1℃	104.9℃
13	T1-2	70.0℃	99.3℃
14	T1-1	71.7℃	100.9℃
15	T2-2	81.8℃	112.2℃
16	T2-1	83.8℃	114.9℃
17	T301	58.0℃	85.3℃
18	U71	77.7℃	107.4℃
19	U201	60.0℃	89.6℃
20	C111	28.4℃	52.9℃
21	C121	41.0℃	66.8℃
22	C115	33.4℃	58.7℃
23	C116	39.0℃	64.8℃
24	Q401	53.5℃	80.2℃
25	Q411	41.7℃	67.2℃
26	Q101	54.2℃	82.2℃
27	Q108	75.3℃	105.0℃
28	U425	49.9℃	77.3℃
29	RT90	56.1℃	83.3℃
30	U903	51.5℃	78.6℃
31	RG76	51.5℃	77.3℃
32	U501	35.2℃	60.2℃
33	L1	53.0℃	79.9℃
34	L3	77.7℃	104.7℃
35	R900	46.4℃	72.6℃
36	ZR2	31.4℃	57.1℃
37	LF1	41.0℃	67.8℃
38	C2	31.4℃	57.1℃
39	C10	31.2℃	57.1℃
40	ZR1	28.0℃	53.4℃
41	RT1	31.7℃	57.3℃
42	Q104	65.9℃	94.2℃
43	RG75	43.6℃	68.6℃
44	RG91	51.4℃	78.0℃
45	D52	50.9℃	79.2℃

2	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P：230VAC /180VAC O/P：100 % LOAD Ta= -30℃/-25℃	TEST：OK
3	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 50 ℃ NO DAMAGE	I/P： 272 VAC O/P：FULL LOAD Ta= 50℃ HUMIDITY= 95 %R.H	TEST：OK

4	TEMPERATURE COEFFICIENT	± 0.03 %/℃(0~50℃)	I/P： 230 VAC O/P：FULL LOAD	± 0 %/℃(0~50℃)
5	STORAGE TEMPERATURE TEST	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		OK
6	THERMAL SHOCK TEST	1. Thermal shock Temperature： -35℃~ +55℃ 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:230V/ FULL LOAD AC ON 3sec/AC OFF 1sec TEST 1cycle:230V/ FULL LOAD Burn In Test		OK
7	VIBRATION TEST	1 Carton & 1 Set (1) Waveform： Sine Wave (2) Frequency：10~500Hz (3) Sweep Time：12min/sweep cycle (4) Acceleration：2G (5) Test Time：60min in each axis (X.Y.Z) (6) Ta：25℃		TEST：OK
8	CAPACITOR LIFE CYCLE	SUPPOSE C121 IS THE MOST CRITICAL COMPONENT (1) I/P： 230VAC O/P：FULL LOAD Ta= 25 ℃ LIFE TIME (2) I/P： 230VAC O/P：FULL LOAD Ta= 50 ℃ LIFE TIME (3) I/P： 230VAC O/P：75% LOAD Ta= 50 ℃ LIFE TIME (4) I/P： 230VAC O/P：50% LOAD Ta= 50 ℃ LIFE TIME		(1) 284793HRS (2) 49666HRS (3) 186482HRS (4) 374724HRS
9	MTBF	Conducted by Parts Stress Analysis Prediction 494.2K hrs min. Telcordia SR-332 (Bellcore) ; 44.8K hrs min. MIL-HDBK-217F (25℃)		
10	DMTBF/Accelerated Life Test	Demonstration Mean Time Between Failure (Expected Life): Above 50,000 hours @ TA 50℃		

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	**DANIEL GAO**	**SANFORD SU**	**VINCENT TSENG**

2018.4.30 GP-A50-F010