



Test Report: PHP-3500-380

3500W Conduction Cooling with PFC Switching 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

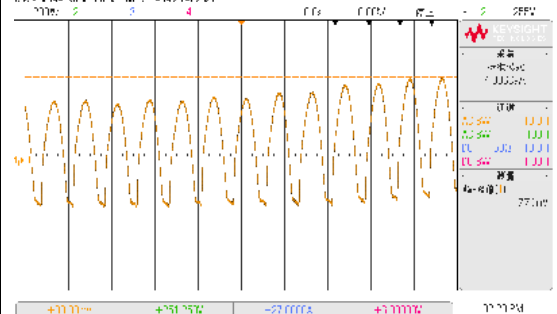
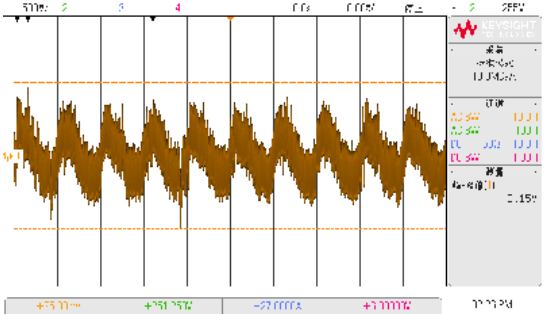
E.M.C. Test

■ RELIABILITY TEST

ENVIRONMENT TEST

DESIGN VERIFY TEST

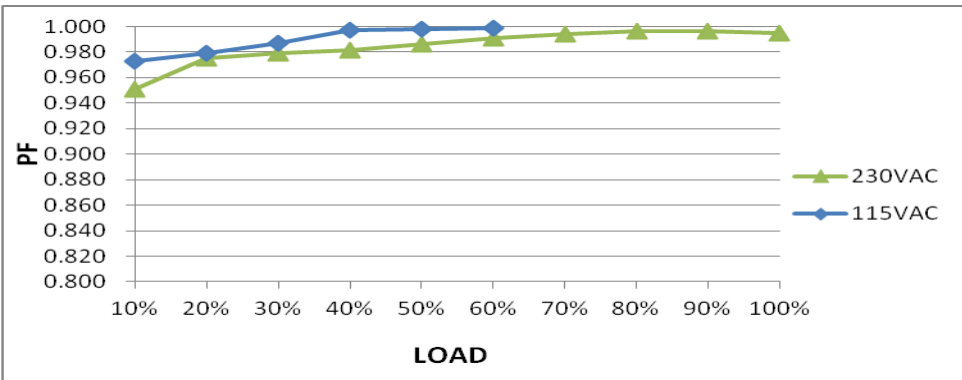
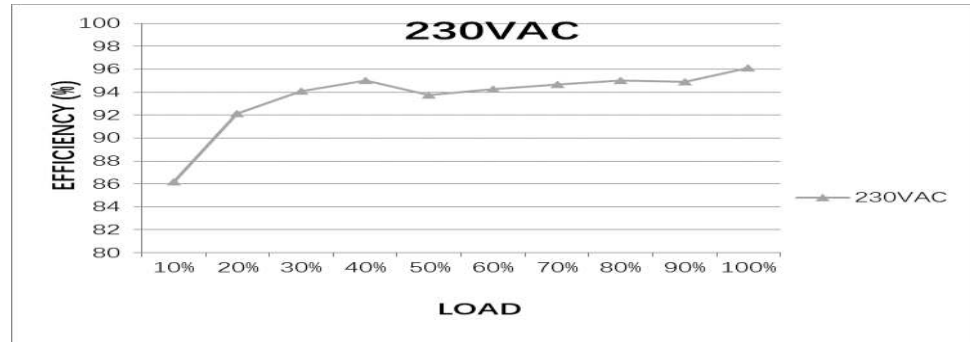
OUTPUT FUNCTION TEST

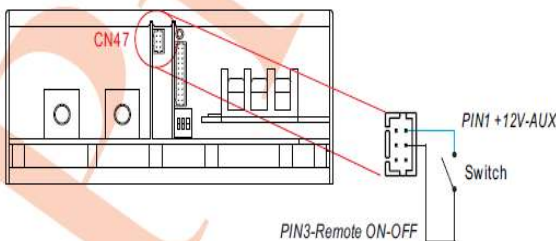
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 260V~400V	I/P : 230 VAC I/P : 115 VAC O/P : MIN LOAD Ta : 25°C	254.87V~416.39V/230VAC 254.95V~416.37V /115VAC
2	OUTPUT VOLTAGE(Max) TOLERANCE	V1: 1%~ -1 %	I/P: 90VAC /264VAC O/P:FULL/ MIN. LOAD Ta:25°C	V1:-0.202%~0.005%
3	LINE REGULATION (Max)	V1: 0.5%~-0.5 %	I/P: 180-90VAC ~ 264VAC O/P:FULL LOAD Ta:25°C	V1: -0.012%~0.028%
4	LOAD REGULATION(Max)	V1: 0.5%~ -0.5%	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25°C	V1: -0.0057%~0.1718%
5	OVER/UNDERSHOOT TEST	< ±5%	I/P: 230VAC O/P:FULL LOAD(CC) Ta:25°C	V1:1.01% (CC)
6	RIPPLE & NOISE(Max)	V1: 3800mVp-p	I/P: 230 VAC O/P:(1) FULL LOAD (2) 0%~100% LOAD Ta:25°C	(1) 2150 mVp-p (2) 2150mVp-p
high frequency :  low frequency : 				
7	SET UP TIME(Max)	230VAC/2000ms	I/P : 230 VAC O/P : FULL LOAD(CC) Ta : 25°C	230VAC/1590ms(CC)
8	RISE TIME (Max)	230VAC/60ms	I/P : 230 VAC O/P : FULL LOAD Ta : 25°C	230VAC/37ms

INPUT=230VAC/50HZ @ FULL LOAD CH2 : Output Voltage				
9	HOLD UP TIME (Typ.)	230VAC/10ms at full load 230VAC/16ms at 75% load	I/P : 230 VAC O/P : FULL LOAD/75% LOAD Ta : 25°C	230VAC/22ms /full load 230VAC/28ms/75% load
INPUT=230VAC/50HZ @ FULL LOAD CH1: Output Voltage CH2: AC Input Voltage INPUT=230VAC/60HZ @ 75% LOAD CH1 : Output Voltage CH2 : AC Input Voltage				
10	DYNAMIC LOAD	V1: 38000 mVp-p	I/P: 230VAC O/P: (1)FULL /50% LOAD 50%DUTY / 120HZ (2)FULL /50% LOAD 50%DUTY / 1KHZ Ta:25°C	3660mVp-p FULL /50% LOAD 50%DUTY / 120HZ 2490mVp-p FULL /50% LOAD 50%DUTY / 1KHZ
FULL /50% LOAD 50%DUTY / 120HZ FULL /50% LOAD 50%DUTY / 1KHZ				

INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
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1	INPUT VOLTAGE RANGE	90VAC~264VAC	I/P:TESTING O/P:FULL LOAD Ta:25℃	180V~264V full load 90V~264V 50% load																																	
			I/P: LOW-LINE-3V=177 V HIGH-LINE+15%=300 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 FREQUENCY RANGE	47HZ ~63 HZ NO DAMAGE	I/P:90 VAC ~264 VAC O/P:FULL~MIN LOAD Ta:25℃	TEST: OK																																	
3	INPUT CURRENT (Typ.)	230V/ 20 A	I/P : 230 VAC O/P : FULL LOAD Ta : 25℃	I =16.12A/ 230VAC																																	
4	LEAKAGE CURRENT	< 2mA / 240 VAC	I/P : 240 VAC O/P : Min LOAD Ta : 25℃	L-FG : 0.806 mA N-FG : 0.8231mA																																	
5	POWER FACTOR (Typ.)	0.95/ 230VAC	I/P : 230 VAC O/P : FULL LOAD Ta : 25℃	PF=0.995/230VAC																																	
P.F vs LOAD  <table><caption>P.F vs LOAD Data</caption><thead><tr><th>LOAD</th><th>230VAC</th><th>115VAC</th></tr></thead><tbody><tr><td>10%</td><td>0.945</td><td>0.975</td></tr><tr><td>20%</td><td>0.965</td><td>0.985</td></tr><tr><td>30%</td><td>0.975</td><td>0.988</td></tr><tr><td>40%</td><td>0.980</td><td>0.990</td></tr><tr><td>50%</td><td>0.982</td><td>0.992</td></tr><tr><td>60%</td><td>0.985</td><td>0.993</td></tr><tr><td>70%</td><td>0.988</td><td>0.994</td></tr><tr><td>80%</td><td>0.990</td><td>0.995</td></tr><tr><td>90%</td><td>0.992</td><td>0.995</td></tr><tr><td>100%</td><td>0.995</td><td>0.995</td></tr></tbody></table>					LOAD	230VAC	115VAC	10%	0.945	0.975	20%	0.965	0.985	30%	0.975	0.988	40%	0.980	0.990	50%	0.982	0.992	60%	0.985	0.993	70%	0.988	0.994	80%	0.990	0.995	90%	0.992	0.995	100%	0.995	0.995
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6	EFFICIENCY(Typ.)	96%	I/P:230 VAC O/P: FULL LOAD Ta:25℃	96.1%																																	
EFFICIENCY vs LOAD  <table><caption>EFFICIENCY vs LOAD Data (230VAC)</caption><thead><tr><th>LOAD</th><th>Efficiency (%)</th></tr></thead><tbody><tr><td>10%</td><td>86</td></tr><tr><td>20%</td><td>92</td></tr><tr><td>30%</td><td>94</td></tr><tr><td>40%</td><td>95</td></tr><tr><td>50%</td><td>94</td></tr><tr><td>60%</td><td>94.5</td></tr><tr><td>70%</td><td>95</td></tr><tr><td>80%</td><td>95.5</td></tr><tr><td>90%</td><td>95</td></tr><tr><td>100%</td><td>96</td></tr></tbody></table>					LOAD	Efficiency (%)	10%	86	20%	92	30%	94	40%	95	50%	94	60%	94.5	70%	95	80%	95.5	90%	95	100%	96											
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7	INRUSH CURRENT(Typ.)	230V/80A COLD START	I/P : 230 VAC O/P : FULL LOAD Ta : 25℃	I = 29.4A/ 230VAC T50=2800us/230VAC																																	

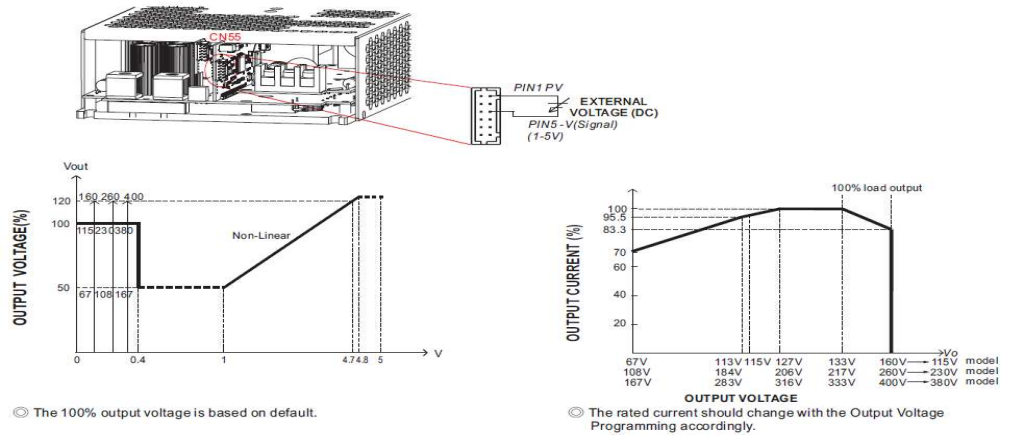
1	AUXILIARY POWER (AUX)	I/P: 230 VAC O/P:FULL LOAD Ta:25°C Test Result : <table><tr><td>AUX</td><td>TOLERANCE</td><td>RIPPLE</td><td>TEST RESULT</td></tr><tr><td>12V / 0.5A</td><td>10.8~13.2 V</td><td>150mVp-p</td><td>68mV</td></tr></table>	AUX	TOLERANCE	RIPPLE	TEST RESULT	12V / 0.5A	10.8~13.2 V	150mVp-p	68mV				
AUX	TOLERANCE	RIPPLE	TEST RESULT											
12V / 0.5A	10.8~13.2 V	150mVp-p	68mV											
2	REMOTE ON/OFF CONTROL	3.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.  <table><tr><td>Remote ON-OFF</td><td>Power Supply Status</td></tr><tr><td>Short circuit</td><td>ON</td></tr><tr><td>Open circuit</td><td>OFF</td></tr></table> I/P: 230 VAC O/P:FULL LOAD Ta:25°C Test Result : <table><tr><td>Between ON/OFF and +12V-AUX</td><td>Power Supply Status</td></tr><tr><td>SW SHORT(10.8 ~ 13.2V)</td><td>11.5V / ON</td></tr><tr><td>SW OPEN(-0.5 ~ 0.5V)</td><td>0.214V/ OFF</td></tr></table>	Remote ON-OFF	Power Supply Status	Short circuit	ON	Open circuit	OFF	Between ON/OFF and +12V-AUX	Power Supply Status	SW SHORT(10.8 ~ 13.2V)	11.5V / ON	SW OPEN(-0.5 ~ 0.5V)	0.214V/ OFF
Remote ON-OFF	Power Supply Status													
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3 OUTPUT VOLTAGE PROGRAMMABLE(PV)

FUNCTION MANUAL

1. Output Voltage Programming (or, PV / remote voltage programming / remote adjust / margin programming / dynamic voltage trim)
 ※ In addition to the adjustment via the built-in potentiometer, the output voltage can be trimmed by applying EXTERNAL VOLTAGE.

115V, 230V, 380V model

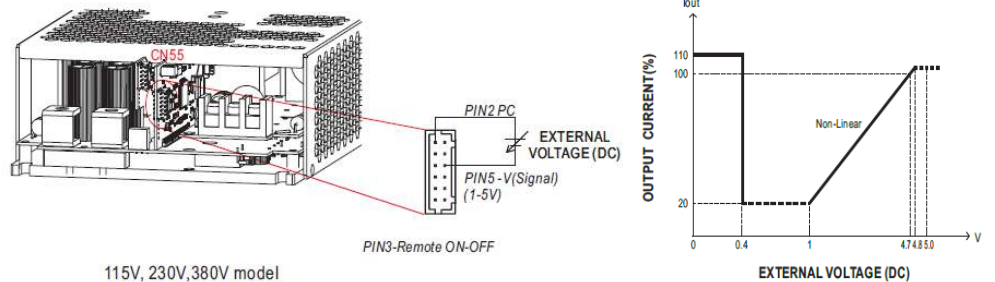


I/P: 230 VAC
 O/P: FULL LOAD
 Ta: 25°C
 TEST RESULT :

PV	0V (0~0.3V)	1V (0.45~1V)	4.7V	5V
MODEL				
SPEC	333V±5%	167V±5%	400V±5%	400V±5%
Vout	332.72V	165.67V	401.63V	407.63V

4 OUTPUT CURRENT PROGRAMMABLE (PC)

2. Output Current Programming (or, PC / remote current programming / dynamic current trim)
 ※ The output current can be trimmed to 20~100% of the rated current by applying EXTERNAL VOLTAGE.

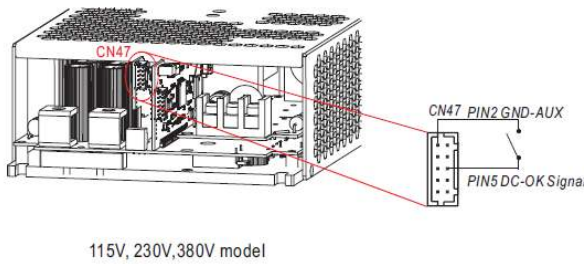


I/P: 230 VAC
 O/P: TESTING(331V /10.5A)
 Ta: 25°C

ADJ V	0V (0~0.3V)	1V (0.45~1V)	4.7V	5V
SPEC	110%±5%	20%±5%	100%±5%	100%±5%
TEST	110.72%	21.24%	101.15%	103.05%

5

DC OK CONTACT RATINGS



115V, 230V, 380V model

I/P: 230 VAC
O/P: TESTING
Ta: 25°C

DC-OK signal	Power Supply Status
"High" >3.5~5.5V	OFF
"Low" <0.5~0.5V	ON

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor (D to S) or (C to E) Peak Voltage	Q5 Rated 62 A/ 600V	AC ON/OFF 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 (7) 0%→400% Load. (8) NO LOAD (9) 200% Load I/P: Low-Line -3V = 177V 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 (9) 200% Load Ta: 25°C	VDS: (1) 465V (2) 493V (3) 469V (4) 465V (5) 465V (6) 465V (7) 489V (8) 457V (9) 485V VDS: (1) 477V (2) 485V (3) 473V (4) 473V (5) 477V (6) 473V (7) 489V (8) 453V (9) 485V

2	P.F.C Transistor (D to S) or (C to E) Peak Voltage	Q 903 Rated 34A/ 600V	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 (7) 0%→400% Load. (8) NO LOAD (9) 200% Load I/P:Low-Line -3V = 177V 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 (7) 0%→400% Load. (8) NO LOAD (9) 200% Load Ta:25°C	VDS: (1) 511V (2) 450V (3) 515V (4) 511V (5) 511V (6) 499V (7) 454V (8) 491V (9) 467V VDS: (1) 515V (2) 475V (3) 519V (4) 519V (5) 519V (6) 511V (7) 475V (8) 507V (9) 483V
3	P.F.C DIODE	D 8 Rated 20A/ 650V	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 (5) NO LOAD (6) 200% Load I/P:Low-Line -3V = 177V 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 (5) NO LOAD (6) 200% Load Ta:25°C	(1) 483V (2) 483V (3) 483V (4) 483V (5) 487V (6) 483V (1) 487V (2) 483V (3) 487V (4) 483V (5) 479V (6) 479V

4	Diode Peak Voltage	D201 Rated: 10A/1200V D204 Rated: 10A/1200V	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) 0%→400% Load. (8)NO LOAD (9) burst Mode (10) (6) 200% Load Ta:25℃	D201: (1) 893V (2) 47.5V (3) 885V (4) 893V (5) 893V (6) 901V (7) 873V (8) 881V (9) 889V (10) 47.2V D204 (1) 872V (2) 46.8V (3) 877V (4) 877V (5) 877V (6) 885V (7) 869V (8) 869V (9) 877V (10) 47V
5	Input Capacitor Voltage	C5 Rated: 470 μ / 450 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℃	(1) 443V (2) 447V (3) 449V (4) 439V
6	Control IC Voltage Test	PWM IC U1 Rated 6.5V~ 30 V PFC IC U901 Rated 4.5V~20 V PWM MCU IC U501 Rated 2.97V~ 4.6V PFC MCU IC U951 Rated 2.97V~ 4.6V	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) (6)NO/FULL LOAD (AC on) (7)NO LOAD(AC on) Ta:25℃	U1: (1) 12.6V (2) 12.6V (3) 12.6V (4) 12.6V (5) 12.6V (6) 12.6V (7) 12.6V U501: (1) 3.55V (2) 3.51V (3) 3.51V (4) 3.43V (5) 3.47V (6) 3.51V (7) 3.39V U901: (1) 12.6V (2) 12.6V (3) 12.6V (4) 12.6V (5) 12.6V (6) 12.9V (7) 12.6V U951: (1) 3.67V (2) 3.71V (3) 3.71V (4) 3.63V (5) 3.59V (6) 3.59V (7) 3.43V
8	TOP SWITCHING STAND BY POWER	U301 Rated 20 A/ 800V	AC ON/OFF I/P:High-Line +3V =267 V O/P: (1)Full Load (2)Remote On/Off I/P:Low-Line -3V =97 V O/P: (1)Full Load (2)Remote On/Off Ta:25℃	U301 (1) 621V (2) 653V (1) 661V (2) 685V

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..25KVAC/min	I/P-O/P: 3.6 KVAC/min I/P-FG: 2.4 KVAC/min O/P-FG:1.5KVAC/min Ta:25°C	I/P-O/P: 10.04mA I/P-FG:14.474mA O/P-FG:6.83m A 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°C	I/P-O/P: >9999MΩ I/P-FG: >9999MΩ O/P-FG: 2229 MΩ NO DAMAGE
3	GROUNDING CONTINUITY	FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25°C	4 mΩ

E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	HARMONIC	EN61000-3-12	I/P:230VAC/50HZ O/P:FULL LOAD Ta:25°C	PASS
2	VOLTAGE FLICKER	EN61000-3-3	I/P:230VAC/50HZ O/P:FULL LOAD Ta:25°C	PASS
3	CONDUCTION	EN55032 CLASS B	I/P : 230 VAC (50HZ) O/P : FULL/50% LOAD Ta : 25°C	PASS Test by certified Lab
4	RADIATION	EN55032 CLASS A	I/P : 230 VAC (50HZ) O/P : FULL LOAD Ta : 25°C	PASS Test by certified Lab
5	E.S.D	EN61000-4-2 INDUSTRY AIR: 8KV / Contact: 4KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA
6	E.F.T	EN61000-4-4 INDUSTRY INPUT : 2KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA
7	SURGE	IEC61000-6-2 INDUSTRY L-N : 2KV L,N-PE : 4KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA
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 : PHP-3500-380 1. ROOM AMBIENT BURN-IN : 2HRS I/P : 230VAC O/P : FULL LOAD Ta=30 °C 2. HIGH AMBIENT BURN-IN : 2HRS I/P : 230VAC O/P : FULL LOAD Ta=50.4 °C																																																																																																																																														
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2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)	I/P : 230 VAC O/P : 111.4 %LOAD Ta : 25°C	TEST : OK
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 264VAC/90VAC O/P : FULL/50% LOAD Ta= -35/-30 °C	TEST : OK
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 50 °C NO DAMAGE	I/P : 264 VAC O/P : FULL LOAD Ta= 50 °C HUMIDITY= 95 %R.H	TEST : OK
5	TEMPERATURE COEFFICIENT	$\pm 0.03 \%$ /(0°C~50°C)	I/P : 230 VAC O/P : FULL LOAD	$\pm 0.008 \%$ /°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 : 10CYCLE 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, 2G 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 : 3G (5) Test Time : 180min in each axis (X.Y.Z) (6) Ta : 25°C	
9	CAPACITOR LIFE CYCLE	SUPPOSE C111 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) 4455324HRS (2) 584603HRS (3) 637617HRS (4) 665067HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 192.1Khrs min.63.9 Khrs MIL-HDBK-217F (25°C)		
11	Ongoing Reliability Test	I/P : 230VAC O/P : FULL LOAD TA=50°C Demonstration Mean Time Between Failure : 50,000 hours		

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	WUWQ/HUANGMK	WENF	LINKX