



# Test Report: IRM-60-5

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60W AC-DC PCB-Mount Green Power Module

## ■ DESIGN VERIFY TEST

Output Function Test

Input Function Test

Protection 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	VERDICT
1	RIPPLE & NOISE(Max)	V1: 80mVp-p	I/P:230VAC O/P:FULL LOAD Ta:25°C	V1: 47.8 mVp-p	P
2	OUTPUT VOLTAGE(Max) TOLERANCE	V1: -2.5%~ 2.5%	I/P: 85VAC /305VAC O/P:FULL/ MIN. LOAD Ta:25°C	V1: -0.618%~ 0.498%	P
3	LINE REGULATION (Max)	V1: -0.5%~ 0.5%	I/P: 100VAC~ 305VAC O/P:FULL LOAD Ta:25°C	V1: -0.12%~ 0%	P
4	LOAD REGULATION(Max)	V1: -1%~ 1%	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25°C	V1: -0.618%~ 0.498%	P
5	SET UP TIME(Max)	230VAC/1000ms 115VAC/2000ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 466.436ms 115VAC/ 570.495ms	P
6	RISE TIME (Max)	230VAC/30ms 115VAC/30ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 10.600ms 115VAC/ 11.081ms	P
7	HOLD UP TIME(Typ)	230VAC/50ms 115VAC/12ms	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	230VAC/ 92.400ms 115VAC/ 18.221ms	P
8	OVER/UNDERSHOOT TEST	< ±5%	I/P: 230VAC O/P:FULL LOAD Ta:25°C	< ±5%	P
9	DYNAMIC LOAD	V1: 1000mVp-p	I/P: 230VAC O/P(1)FULL /Min LOAD 90%DUTY / 1KHZ (2) (1)FULL /Min LOAD 90%DUTY / 3KHZ (3)FULL /Min LOAD 90%DUTY / 5KHZ (4)FULL /Min LOAD 50%DUTY / 120HZ Ta:25°C	376mVp-p 386mVp-p 378mVp-p 374mVp-p	P
10	TRANSIENT RECOVERY TIME	V1: 1000mVp-p	I/P: 230VAC O/P:40% LOAD CHANGE 50%DUTY/120HZ 1.25A/us	172mVp-p	P



**INPUT FUNCTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	INPUT VOLTAGE RANGE	85VAC~305VAC	I/P:TESTING O/P:FULL LOAD Ta:25°C	71.8V~305V	P
			I/P: (1)LOW-LINE-3V=97 V HIGH-LINE=305 V O/P:FULL/MIN LOAD 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 ~440 HZ NO DAMAGE	I/P:85 VAC ~305 VAC O/P:FULL~MIN LOAD Ta:25°C	TEST: OK	P
3	EFFICIENCY(TYP)	84%	I/P:230 VAC O/P:FULL LOAD Ta:25°C	85.24%	P
4	INPUT CURRENT (Typ)	230V/ 1A 115V/ 1.8A 277V/ 0.9A	I/P : 230 VAC/115 VAC/277VAC O/P : FULL LOAD Ta : 25°C	I=0.483A/ 230VAC I=0.918A/ 115VAC I=0.403A/ 277VAC	P
5	INRUSH CURRENT(Typ)	230V/60A 115V/30A COLD START	I/P : 230 VAC I/P : 115 VAC O/P : FULL LOAD Ta : 25°C	I=49.218A/ 230VAC I=28.1A/ 115VAC	P
6	LEAKAGE CURRENT	< 0.25 mA / 277 VAC	I/P : 277 VAC O/P : Min LOAD Ta : 25°C	0.011mA	P
7	NO LOAD CONSUMPTION	< 0.15 W	I/P : 115VAC I/P : 230VAC O/P : NO LOAD Ta : 25°C	< 0.0465 W < 0.0625 W	P



**PROTECTION FUNCTION TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	OVER LOAD PROTECTION	115%~ 160%	I/P: 230VAC I/P: 115VAC O/P: TESTING Ta:25°C	138.24%/ 230VAC 138.04%/115VAC Hiccup Mode	P
2	OVER VOLTAGE PROTECTION	CH:5.25V-6.75V	I/P: 230VAC I/P: 115VAC O/P: MIN LOAD Ta:25°C	6.3V shut off o/p voltage, clamping by zener diode	P
3	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE	I/P: 305VAC O/P: FULL LOAD Ta:25°C	NO DAMAGE Hiccup Mode	P

**COMPONENT STRESS TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	PWM Transistor ( D to S) or (C to E) Peak Voltage	Q1 Rated 13A/650V	I/P: High-Line =305V AC ON/OFF 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. I/P: Low-Line -3V = 97V 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	(1)566V (2)580V (3)564V (4)560V (5)562V (6)558V (7)588V  (1)428V (2)420V (3)418V (4)406V (5)410V (6)422V (7)430V	P
2	Diode Peak Voltage	D101 Rated 30A/45V	I/P: High-Line =305V 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	Q101: (1)39.2V (2)34.6V (3)40V (4)40.6V (5)40.6V (6)38.8V (7) 37.6V (8)37.4V	P



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			(6)Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz (7)0%→400% Load. (8).NO LOAD Ta:25°C		
3	Input Capacitor Voltage	C5 Rated: : 120μ/ 450V	I/P: High-Line =305V O/P: (1)Full Load input on/off (2) Min load input on /Off (3)Full Load /Min load Change Ta:25°C	(1)366V (2)368V (3)366V	P
4	Control IC Voltage Test	PWM IC U1 Rated : 10V~27V	I/P: High-Line =305V AC ON/OFF O/P:(1)FULL LOAD (2) Output Short (3)O.L.P Ta:25°C	(1) 19.8V (2) 17.8V (3) 21.0V	P
5	Clamp Diode Peak Voltage	D 5 Rated : 2A/800V	I/P : High-Line =305V AC ON/OFF O/P : (1) Dynamic Load 90%Duty/1KHz (2)Full load continue Ta : 25°C	(1) 472 V (2) 472 V	P

**SAFETY TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	WITHSTAND VOLTAGE	I/P-O/P: 4KVAC/min	I/P-O/P: 4.4 KVAC/min Ta:25°C	I/P-O/P:1.88mA NO DAMAGE	P
2	ISOLATION RESISTANCE	I/P-O/P:500VDC>100MΩ	I/P-O/P: 500 VDC Ta:25°C	I/P-O/P: 9999MΩ NO DAMAGE	P

**E.M.C TEST**

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT
1	HARMONIC	BS EN/EN61000-3-2 CLASS A	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	PASS	P
2	CONDUCTION	BS EN/EN55032(CISPR32) CNS13438 CLASS B	I/P : 230 VAC (50HZ) O/P : FULL/50% LOAD Ta : 25°C	PASS Test by certified Lab	P
3	RADIATION	BS EN/EN55032(CISPR32) CNS13438 CLASS B	I/P : 230 VAC (50HZ) O/P : FULL LOAD Ta : 25°C	PASS Test by certified Lab	P
4	E.S.D	BS EN/EN61000-4-2 AIR : 8KV / Contact : 4KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A	P
5	E.F.T	BS EN/EN61000-4-4 INPUT : 2KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A	P
6	SURGE	BS EN/EN61000-4-5 L-N : 2KV	I/P : 230 VAC/50HZ O/P : FULL LOAD Ta : 25°C	CRITERIA A	P
7	Test by certified Lab & Test Report Prepare				



■ RELIABILITY TEST

ENVIRONMENT TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT	VERDICT																																																												
1	TEMPERATURE RISE TEST	MODEL : IRM-60-12 1. ROOM AMBIENT BURN-IN : 1 HRS I/P : 230VAC O/P : FULL LOAD Ta=32.9°C 2. HIGH AMBIENT BURN-IN : 1 HRS I/P : 230VAC O/P : FULL LOAD Ta=50.5°C	<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta=32.9°C</th> <th>HIGH AMBIENT Ta=50.5°C</th> </tr> </thead> <tbody> <tr><td>1</td><td>R42</td><td>75.5°C</td><td>94.4°C</td></tr> <tr><td>2</td><td>LF1</td><td>69.9°C</td><td>86.7°C</td></tr> <tr><td>3</td><td>BD1</td><td>74.4°C</td><td>93.2°C</td></tr> <tr><td>4</td><td>C5</td><td>73.6°C</td><td>92.0°C</td></tr> <tr><td>5</td><td>D40</td><td>73.2°C</td><td>92.3°C</td></tr> <tr><td>6</td><td>U1</td><td>71.1°C</td><td>89.5°C</td></tr> <tr><td>7</td><td>D100</td><td>78.0°C</td><td>96.5°C</td></tr> <tr><td>8</td><td>LF2</td><td>68.8°C</td><td>86.8°C</td></tr> <tr><td>9</td><td>T1</td><td>78.8°C</td><td>98.1°C</td></tr> <tr><td>10</td><td>C105</td><td>74.9°C</td><td>90.5°C</td></tr> <tr><td>11</td><td>C40</td><td>74.9°C</td><td>93.4°C</td></tr> <tr><td>12</td><td>L100</td><td>69.4°C</td><td>88.1°C</td></tr> <tr><td>13</td><td>Q1</td><td>78.9°C</td><td>98.7°C</td></tr> <tr><td>14</td><td>D5</td><td>78.6°C</td><td>98.5°C</td></tr> </tbody> </table>	NO	Position	ROOM AMBIENT Ta=32.9°C	HIGH AMBIENT Ta=50.5°C	1	R42	75.5°C	94.4°C	2	LF1	69.9°C	86.7°C	3	BD1	74.4°C	93.2°C	4	C5	73.6°C	92.0°C	5	D40	73.2°C	92.3°C	6	U1	71.1°C	89.5°C	7	D100	78.0°C	96.5°C	8	LF2	68.8°C	86.8°C	9	T1	78.8°C	98.1°C	10	C105	74.9°C	90.5°C	11	C40	74.9°C	93.4°C	12	L100	69.4°C	88.1°C	13	Q1	78.9°C	98.7°C	14	D5	78.6°C	98.5°C		P
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2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )	I/P : 230 VAC O/P : 140% LOAD Ta : 25°C	TEST : OK	P																																																												
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 305VAC/100VAC O/P : 100 % LOAD Ta=-30°C	TEST : OK	P																																																												
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 50°C NO DAMAGE	I/P : 305 VAC O/P : FULL LOAD Ta=50°C HUMIDITY= 95 %R.H	TEST : OK	P																																																												
5	TEMPERATURE COEFFICIENT	± 0.03 %/°C (0~50°C)	I/P : 230 VAC O/P : FULL LOAD	± 0.018%/°C (0~50°C)	P																																																												
6	STORAGE TEMPERATURE TEST	1. Thermal shock Temperature : -40°C~ +85°C 2. Temperature change rate : 25°C / MIN 3. Dwell time low and high temperature : 30 MIN/EACH 4. Total test cycle : 5 CYCLE 5. Input/Output condition : STATIC		OK	P																																																												
7	THERMAL SHOCK TEST	1. Thermal shock Temperature : -30°C~ +50°C 2. Temperature change rate : 25°C / MIN 3. Dwell time low and high temperature : 30 MIN/EACH 4. Total test cycle : 10 CYCLE 5. Input/Output condition : 230VAC/Full Load AC ON/OFF TEST turn on 58sec ; turn off 2sec		OK	P																																																												



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8	VIBRATION TEST	1 Carton & 1 Set (1) Waveform : Sine Wave (2) Frequency : 10~500Hz (3) Sweep Time : 12min/sweep cycle (4) Acceleration : 2G (Blank) /5G (ST) (5) Test Time : 60min in each axis (X.Y.Z) (6) Ta : 25°C	TEST : OK	P
9	CAPACITOR LIFE CYCLE	SUPPOSE C105 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) 158105.5HRS (2) 32120.5HRS (3) 62425HRS (4) 108733HRS	P
10	MTBF	6433.3K hrs min. Telcordia SR-332 (Bellcore) ; 1226.3K hrs min. MIL-HDBK-217F (25°C)		P
11	DMTBF/Accelerated Life Test	Demonstration Mean Time Between Failure (Expected Life): Above 30,000 hours @ TA 50°C		P

TEST RESULT	TESTER	APPROVAL
PASS	Frank	WANGDZ

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