



# Test Report: IRM-60-24

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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: 150mVp-p	I/P:230VAC O/P:FULL LOAD Ta:25°C	V1: 103mVp-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: -0.074%~ 0.206%	P
3	LINE REGULATION (Max)	V1: -0.5%~ 0.5%	I/P: 100VAC~ 305VAC O/P:FULL LOAD Ta:25°C	V1: -0.049%~ 0.074%	P
4	LOAD REGULATION(Max)	V1: -0.5%~ 0.5%	I/P: 230VAC O/P:FULL ~MIN LOAD Ta:25°C	V1: -0.074%~ 0.206%	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/ 410.618ms 115VAC/ 486.318ms	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/ 8.141ms 115VAC/ 12.223ms	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/ 82.216ms 115VAC/ 16.914ms	P
8	OVER/UNDERSHOOT TEST	< ±5%	I/P: 230VAC O/P:FULL LOAD Ta:25°C	< ±5%	P
9	DYNAMIC LOAD	V1: 2400mVp-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	318mVp-p 223mVp-p 178mVp-p 336mVp-p	P
10	TRANSIENT RECOVERY TIME	V1: 2400mVp-p	I/P: 230VAC O/P:40% LOAD CHANGE 50%DUTY/120HZ 1.25A/us	146 mVp-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	71.9V~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)	90%	I/P:230 VAC O/P:FULL LOAD Ta:25°C	91.63 %	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=0.5026A/ 230VAC I=0.9694A/ 115VAC I=0.4182A/ 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=46.265A/ 230VAC I=27.3A/ 115VAC	P
6	LEAKAGE CURRENT	< 0.25 mA / 277 VAC	I/P : 277 VAC O/P : Min LOAD Ta : 25°C	0.011 mA	P
7	NO LOAD CONSUMPTION	< 0.15 W	I/P : 115VAC I/P : 230VAC O/P : NO LOAD Ta : 25°C	< 0.0505 W < 0.0375 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	142.48%/ 230VAC 143.17%/115VAC Hiccup Mode	P
2	OVER VOLTAGE PROTECTION	CH:25.2V~32.4V	I/P: 230VAC I/P: 115VAC O/P:MIN LOAD Ta:25°C	30.4V 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 11A/800V	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)590V (2)564V (3)610V (4)600V (5)596V (6)608V (7)618V  (1)360V (2)273V (3)378V (4)370V (5)360V (6)374V (7)372V	P
2	Diode Peak Voltage	D100 Rated 20A/150V	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 (6)Dynamic Load 100% Load/ Min. Load 50%Duty/120Hz (7)0%→400% Load. (8).NO LOAD Ta:25°C	D100: (1)130V (2)164V (3)129V (4)130V (5)132V (6)128V (7)152V (8)120V	P
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)362V (2)364V (3)364V	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) 17.5V (2) 17.6V (3) 17.5V	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) 520 V (2) 518 V	P
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**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:1.99mA 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-60-24 1. ROOM AMBIENT BURN-IN : 1 HRS I/P : 230VAC O/P : FULL LOAD Ta=18.2°C 2. HIGH AMBIENT BURN-IN : 1 HRS I/P : 230VAC O/P : FULL LOAD Ta=51.4°C	<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta=18.2°C</th> <th>HIGH AMBIENT Ta=51.4°C</th> </tr> </thead> <tbody> <tr><td>1</td><td>LF1</td><td>51.2°C</td><td>77.0°C</td></tr> <tr><td>2</td><td>LF2</td><td>53.3°C</td><td>80.1°C</td></tr> <tr><td>3</td><td>BD1</td><td>55.5°C</td><td>82.0°C</td></tr> <tr><td>4</td><td>Q1</td><td>58.7°C</td><td>84.7°C</td></tr> <tr><td>5</td><td>C5</td><td>52.3°C</td><td>79.5°C</td></tr> <tr><td>6</td><td>C40</td><td>54.8°C</td><td>81.9°C</td></tr> <tr><td>7</td><td>D100</td><td>57.0°C</td><td>84.3°C</td></tr> <tr><td>8</td><td>C105</td><td>53.2°C</td><td>80.9°C</td></tr> <tr><td>9</td><td>T1</td><td>56.2°C</td><td>84.2°C</td></tr> <tr><td>10</td><td>D5</td><td>58.5°C</td><td>86.2°C</td></tr> <tr><td>11</td><td>R42</td><td>57.5°C</td><td>83.8°C</td></tr> <tr><td>12</td><td>U1</td><td>51.7°C</td><td>79.0°C</td></tr> <tr><td>13</td><td>D40</td><td>54.3°C</td><td>81.5°C</td></tr> </tbody> </table>	NO	Position	ROOM AMBIENT Ta=18.2°C	HIGH AMBIENT Ta=51.4°C	1	LF1	51.2°C	77.0°C	2	LF2	53.3°C	80.1°C	3	BD1	55.5°C	82.0°C	4	Q1	58.7°C	84.7°C	5	C5	52.3°C	79.5°C	6	C40	54.8°C	81.9°C	7	D100	57.0°C	84.3°C	8	C105	53.2°C	80.9°C	9	T1	56.2°C	84.2°C	10	D5	58.5°C	86.2°C	11	R42	57.5°C	83.8°C	12	U1	51.7°C	79.0°C	13	D40	54.3°C	81.5°C		P
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2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )	I/P : 230 VAC O/P : 136% 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	± 0.004%/°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																																																								



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) 274536HRS (2) 69618HRS (3) 93726HRS (4) 153381HRS	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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