TEST REPORT: MFM-20-15

20W High Reliable Green Medical On Board Type

■ 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

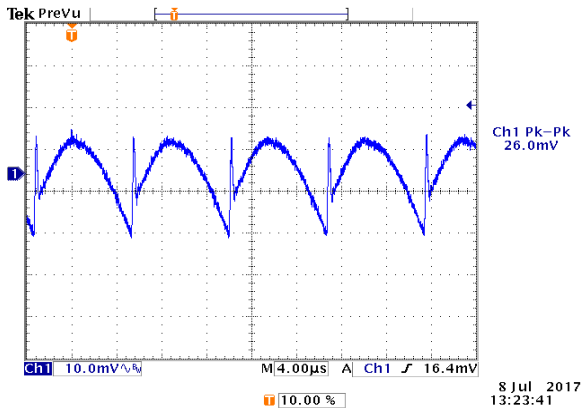
■ RELIABILITY TEST

- ENVIRONMENT TEST

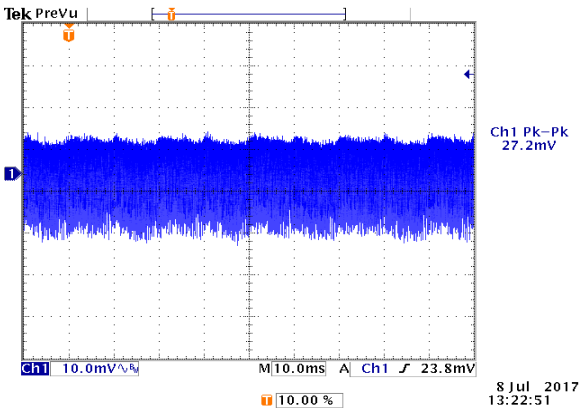
■ DESIGN VERIFY TEST
OUTPUT FUNCTION

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE TOLERANCE (Max)	V1 : 2.0% ~ -2.0%	I/P : 80VAC / 264VAC O/P: FULL / MINLOAD TA= 25℃	V1: 0.98% ~ -0.91%
2	LINE REGULATION (MAX.)	V1 : 0.3% ~ -0.3%	I/P : 80VAC / 264VAC O/P: FULL LOAD TA : 25℃	V1: 0.00% ~ -0.07%
3	LOAD REGULATION(MAX.)	V1 : 0.5% ~ -0.5%	I/P : 230VAC O/P: MIN LOAD ~ FULL LOAD TA : 25℃	V1: 0.07% ~ -0.07%
4	OVER/UNDERSHOOT TEST	< ±5%	I/P : 230VAC O/P: FULL LOAD TA : 25℃	TEST< 2.0 %
5	RIPPLE & NOISE(Max)	V1 : 180 mVp-p	I/P : 230VAC O/P: FULL LOAD TA : 25℃	V1 : 27.2 mVp-p

high frequency:

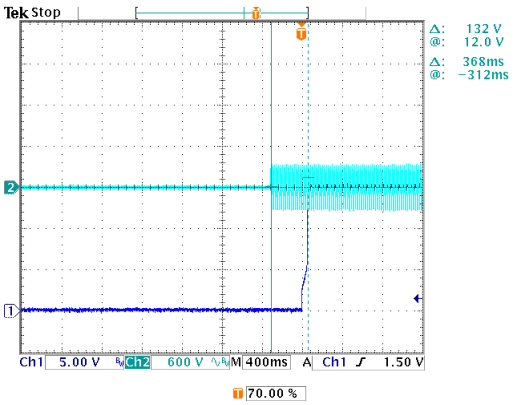


low frequency:

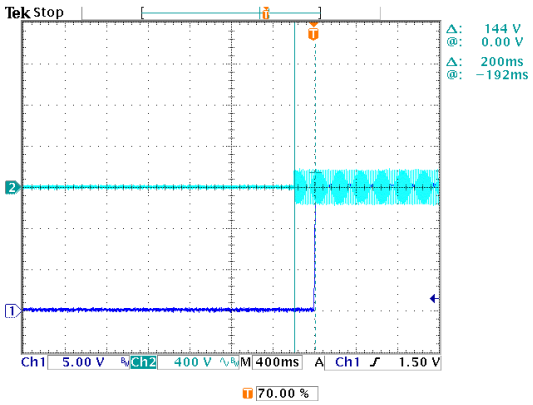


NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
6	SET UP TIME (MAX.)	230VAC : 1500ms 115VAC : 1500ms	I/P : 230VAC I/P : 115VAC O/P: FULL LOAD TA : 25℃	230VAC : 368ms 115VAC : 200ms

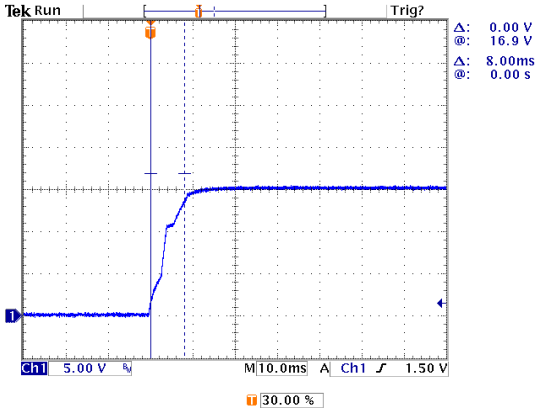
INPUT=230VAC/50HZ @ FULL LOAD
CH1 : Output Voltage CH2 : AC Input Voltage

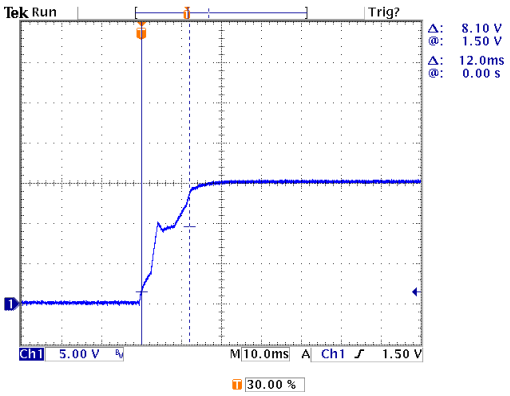


INPUT=115VAC/60HZ @ FULL LOAD
CH1 : Output Voltage CH2 : AC Input Voltage

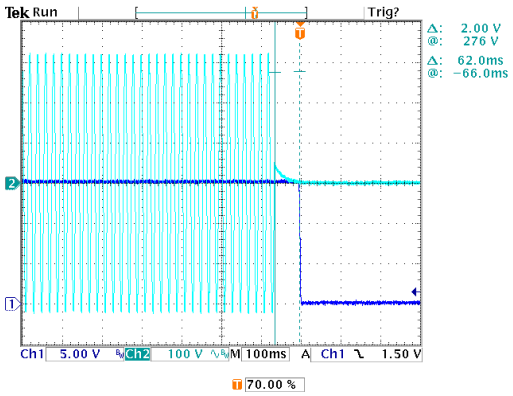


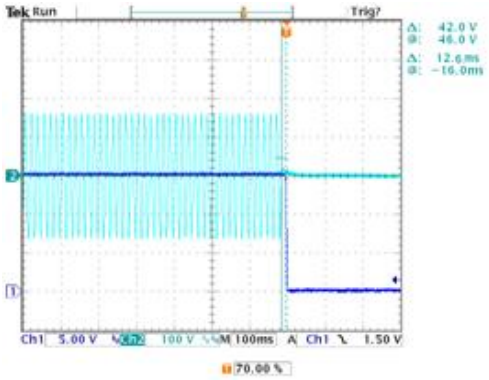
7	RISE TIME (MAX.)	230VAC : 30ms 115VAC : 30ms	I/P : 230VAC I/P : 115VAC O/P: FULL LOAD TA : 25℃	230VAC : 8.0ms 115VAC : 12.0ms	
	INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage		INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage		



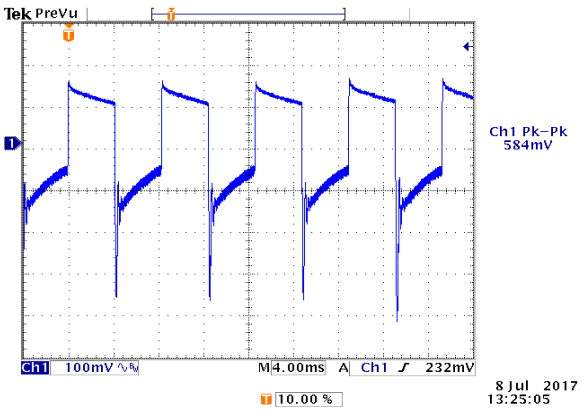


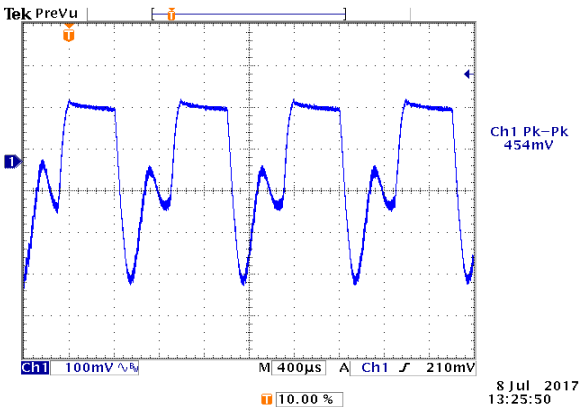
8	HOLD UP TIME (TYP.)	230VAC : 40ms 115VAC : 10ms	I/P : 230VAC I/P : 115VAC O/P: FULL LOAD TA : 25℃	230VAC : 62.0ms 115VAC : 12.6ms	
	INPUT=230VAC/50HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage		INPUT=115VAC/60HZ @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage		





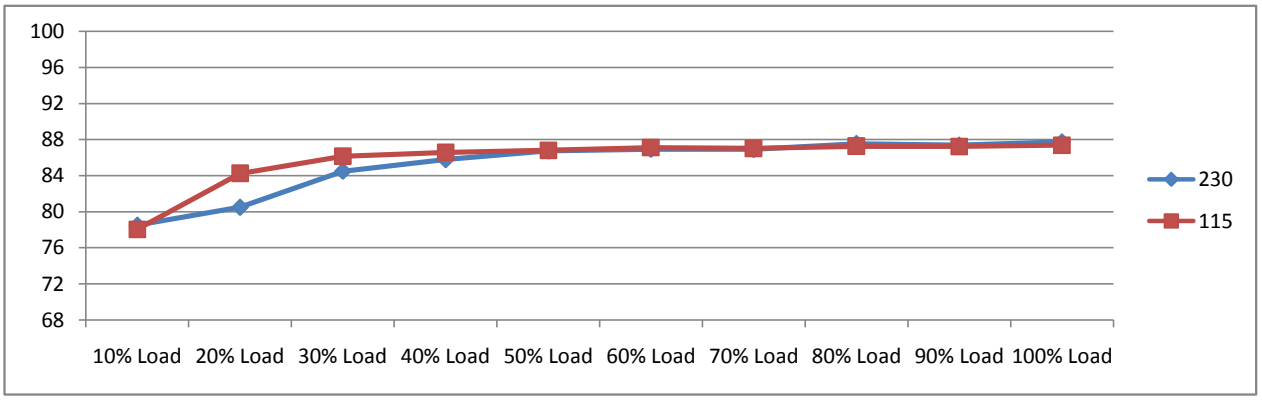
9	DYNAMIC LOAD	V1 : 1500 mVp-p	I/P : 230VAC O/P: (1)Full/Min load 50%duty/120HZ (2)Full/Min load 50%duty/1KHZ TA : 25℃	(1). (2). unit:mVp-p V1: 584mv 454mv	
	FULL /MIN LOAD 50%DUTY / 120HZ		FULL /MIN% LOAD 50%DUTY / 1KHZ		





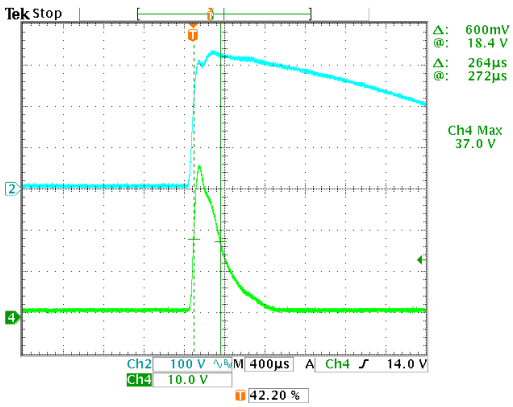
INPUT FUNCTION TEST

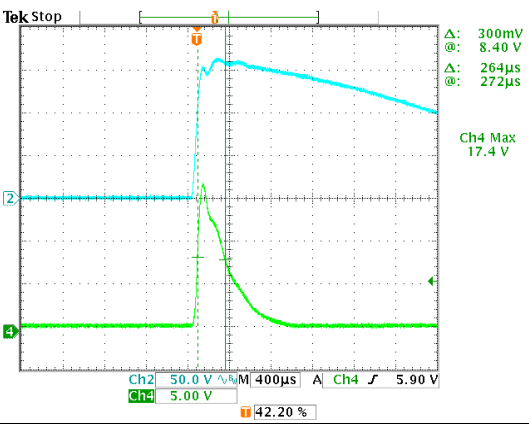
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	80VAC ~ 264VAC	I/P : TESTING O/P : FULL LOAD Ta : 25℃	72.0VAC ~ 264VAC
			I/P : LOW-LINE = 97VAC HIGH-LINE = 300VAC O/P : FULL/MIN LOAD ON:30 Sec ; OFF:30 Sec 10MIN (POWER ON/OFF NO DAMAGE)	TEST : OK
2	INPUT FREQUENCY RANGE	47HZ ~ 440HZ NO DAMAGE	I/P : 80VAC ~ 264VAC O/P : FULL~MIN LOAD Ta : 25℃	TEST : OK
3	INPUT CURRENT (TYP.)	0.5 / 230VAC 0.75 / 115VAC	I/P : 230VAC I/P : 115VAC O/P: FULL LOAD TA : 25℃	I= 0.19 / 230VAC I= 0.323 / 115VAC
4	LEAKAGE CURRENT	< 80.00μA	I/P : 264VAC O/P: MIN LOAD TA : 25℃	Touch current 49.2 μA
5	NO LOAD POWER CONSUMPTION	< 0.1W	I/P : 230VAC O/P: MIN LOAD TA : 25℃	< 0.062 W
6	EFFICIENCY (TYP.)	87.0%	I/P : 230VAC O/P: FULL LOAD TA : 25℃	87.8 %



NO				
7	INRUSH CURRENT (TYP.)	45A / 230VAC 20A / 115VAC twidth= 555 us measured at 50% Ipeak COLD START	I/P : 230VAC I/P : 115VAC O/P: FULL LOAD TA : 25℃	I= 37.0A / 230VAC I= 17.4A / 115VAC T50= 264.0us / 230VAC

INPUT=230VAC/50HZ @ FULL LOAD	INPUT=115VAC/50HZ @ FULL LOAD
CH2 : AC Input Voltage CH4 : Input current (1V=1A)	CH2 : AC Input Voltage CH4 : Input current (1V=1A)





PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	110% ~ 150%	I/P: 264VAC I/P: 230VAC I/P: 100VAC O/P: TESTING TA : 25℃	146.57% 264VAC 142.85% 230VAC 128.35% 100VAC Hiccup Mode
2	OVER VOLTAGE PROTECTION	17.30V ~ 20.30V	I/P: 80VAC/230VAC/264VAC O/P: MIN LOAD TA : 25℃	18.9V 264VAC 18.9V 230VAC 18.9V 80VAC Shut off o/p voltage, clamping by zener diode
3	OVER TEMPERATURE PROTECTION	Shut down o/p voltage，recovers automatically after temperature goes down	I/P: 264VAC I/P: 80VAC O/P: FULL LOAD	O.T.P. Active Shut down o/p voltage，recovers automatically after temperature goes down
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE	I/P: 264VAC I/P: 80VAC O/P: FULL LOAD Ta: 25℃	NO DAMAGE Hiccup Mode

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Power Transistor	U1 Rated： 800V 11.5A	I/P： 267VAC VDS： O/P： (1)Full Load Turn on (2) Output Short (3)Fulll load continue Ta： 25℃	VIN: 267VAC VDS: (1). 486.00V (2). 444.00V (3). 484.00V
2	O/P MOSFET	Q100 Rated： 100V 10.0A	I/P： 267VAC VDS： O/P： (1)Full Load Turn on (2) Output Short (3)Fulll load continue Ta： 25℃	Q100 VDS： (1). 69.60V (2). 61.20V (3). 70.00V
3	Input Capacitor	C5 Rated： 33uf 400V	I/P： 267VAC O/P： (1)Full Load Turn on /Off (2)Min load Turn on /Off (3)Full Load /Min load Change (4)Full Load Continue Ta： 25℃	(1). 364.00V (2). 366.00V (3). 366.00V (4). 364.00V
4	Control IC	U1 Rated： 27V (max) -0.3 (min)	I/P： 267VAC O/P： (1)Full Load (2)Output Short (3)O.L.P (4)Low Line No Load Vo(min) Ta： 25℃	U1 (1). 20.00V (2). 16.40V (3). 20.00V (4). 17.20V
9	Clamp Diode	D1 Rated： 1000V 1.0A	I/P： 267VAC O/P： (1)Dynamic Load Full/Min Load (2)Fulll load continue Ta： 25℃	(1). 456.00V (2). 454.00V

■SAFETY & E.M.C. TEST

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P： 4.000KVAC /min	I/P-O/P: 4.400KVAC /min Ta： 25℃	I/P-O/P: 0.73mA NO DAMAGE
2	ISOLATION RESISTANCE	I/P-O/P： 500VDC>100MΩ	I/P-O/P: 500VDC Ta： 25℃/70%RH	I/P-O/P: 9999.0MΩ NO DAMAGE

E.M.C. TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	HARMONIC	EN61000-3-2 CLASS A	I/P： 230VAC /50HZ O/P： FULL LOAD Ta： 25℃	PASS

2	CONDUCTION	EN55011 CLASS B	I/P : 230VAC /50HZ O/P : FULL LOAD / 50% LOAD Ta : 25℃	PASS Test by certified Lab
3	RADIATION	EN55011 CLASS B	I/P : 230VAC /50HZ O/P : FULL LOAD Ta : 25℃	PASS Test by certified Lab
4	E.S.D	EN61000-4-2 MEDICAL AIR：15KV / Contact：8KV	I/P : 230VAC /50HZ O/P : FULL LOAD Ta : 25℃	CRITERIA A
5	E.F.T	EN61000-4-4 MEDICAL INPUT：2KV	I/P : 230VAC /50HZ O/P : FULL LOAD Ta : 25℃	CRITERIA A
6	SURGE	EN61000-4-5 MEDICAL L-N:1KV	I/P : 230VAC /50HZ O/P : FULL LOAD Ta : 25℃	CRITERIA A

RELIABILITY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	TEMPERATURE RISE TEST	MODEL : MFM-20-24 1. ROOM AMBIENT BURN-IN : 1.0hrs IP: 230VAC O/P: 100% LOAD TA= 23.1℃ 2. HIGH AMBIENT BURN-IN : 1.0hrs IP: 230VAC O/P: 100% LOAD TA= 50.0℃		
2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)	I/P : 230VAC O/P : 130.00% LOAD Ta : 25℃	TEST : OK
3	LOW TEMPERATURE TURN ON TEST	NO DAMAGE 1 HOUR (MIN)	I/P : 264VAC / 100VAC O/P : FULL LOAD Ta : -35.0℃	TEST : OK
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 50℃ NO DAMAGE	I/P : 272VAC O/P : FULL LOAD Ta : 50℃ HUMIDITY= 95.0% RH	TEST : OK
5	TEMPERATURE COEFFICIENT	±0.03% /(0℃~50℃)	I/P : 230VAC O/P : FULL LOAD	±0.0091% /(0℃~50℃)
6	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		TEST : OK
7	THERMAL SHOCK TEST	1. Thermal shock Temperature : -40℃ ~ +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 : 230VAC Full Load AC ON/OFF test turn on 3sec ; turn off 1sec @ 15CYCLE 230VAC Full Load AC ON turn on continue @ 1CYCLE		TEST : OK

NO.	Position	ROOM AMBIENT 23.1℃	HIGH AMBIENT Ta: 50.0℃
1	LF1	56.6℃	80.1℃
2	C6	69.6℃	91.8℃
3	C5	65.4℃	100.5℃
4	U1	99.3℃	115.5℃
5	T1	78.3℃	106.6℃
6	C105	48.3℃	89.4℃
7	Q100	84.9℃	117.5℃
8	BD1	29.6℃	98.7℃
9	C1	41.5℃	73.0℃
10	L100	63.9℃	88.0℃
60	TA	23.1℃	50.0℃

8	VIBRATION TEST	1 Carton & 1 Set (1) Waveform： Sine Wave (2) Frequency：10~500Hz (4) Acceleration： 5G (5) Test Time： 60 min in each axis (X.Y.Z) (6) Ta：25℃	TEST：OK
9	CAPACITOR LIFE CYCLE	MFM-20-24 :SUPPOSE C105 IS THE MOST CRITICAL COMPONENT (1) I/P： 230VAC O/P：FULL LOAD Ta= 25.0℃ LIFE TIME (2) I/P： 230VAC O/P：FULL LOAD Ta= 50.0℃ LIFE TIME (3) I/P： 230VAC O/P：75% LOAD Ta= 50.0℃ LIFE TIME (4) I/P： 230VAC O/P：50% LOAD Ta= 50.0℃ LIFE TIME	(1). 357486.3 HRS (2). 33401.7 HRS (3). 57708 HRS (4). 70981 HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 1210K hrs min. MIL-HDBK-217F (25℃)	
11	DMTBF /Accelerated Life test	Demonstration Mean Time Between Failure (Expected Life): Above 30000HRS @ TA 50℃	

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	LIUTT		WANGDZ