Test Report: DDRH-60-24

60W Ultra Wide Input DIN Rail Type DC-DC Converter

■ DESIGN VERIFY TEST

Output Function Test
Input Function Test
Protection Function Test
Control Function Test
Component Stress Test

■ SAFETY & E.M.C. TEST

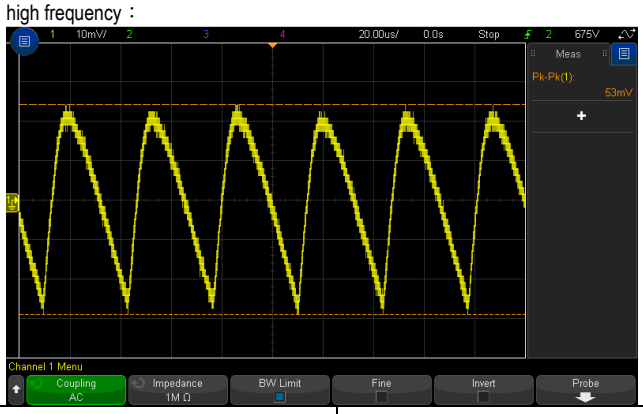
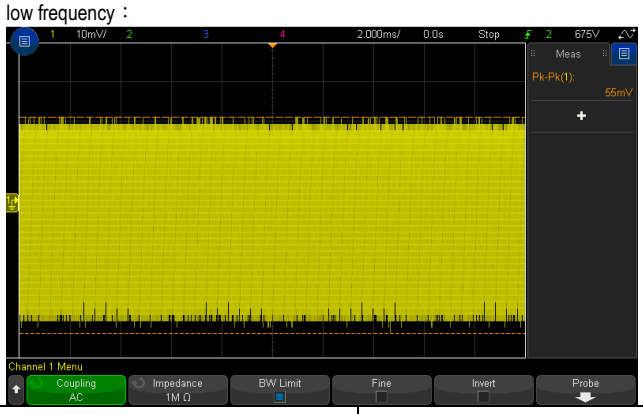
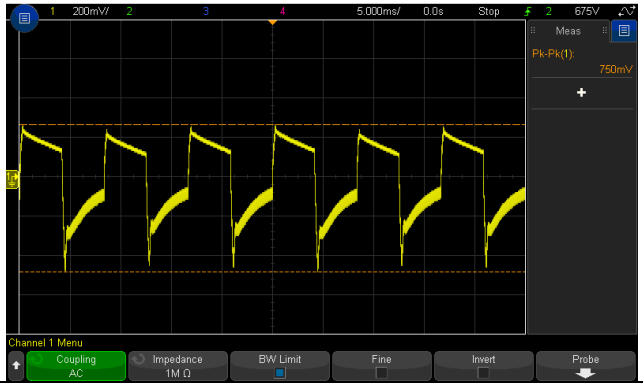
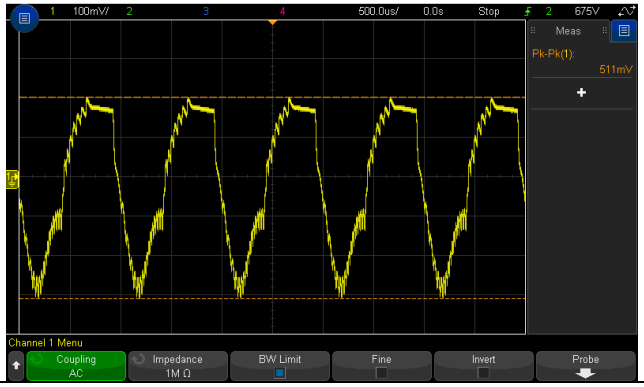
Safety Test
E.M.C. Test

■ RELIABILITY TEST

ENVIRONMENT TEST

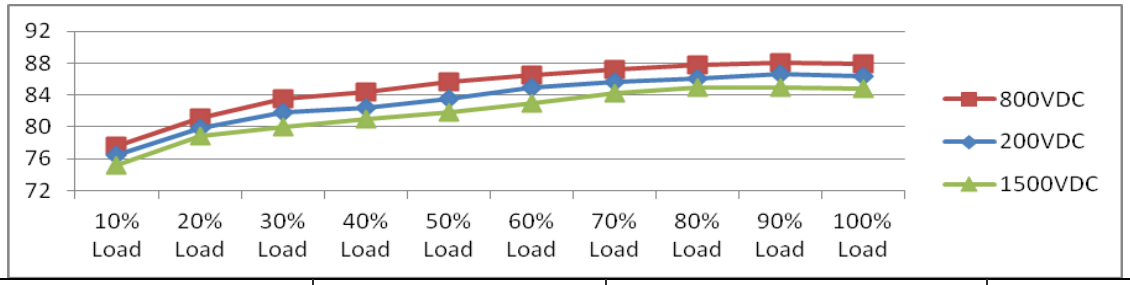
■ DESIGN VERIFY TEST

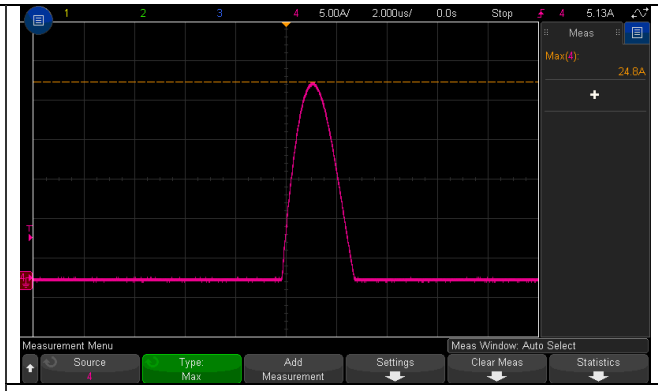
OUTPUT FUNCTION TEST

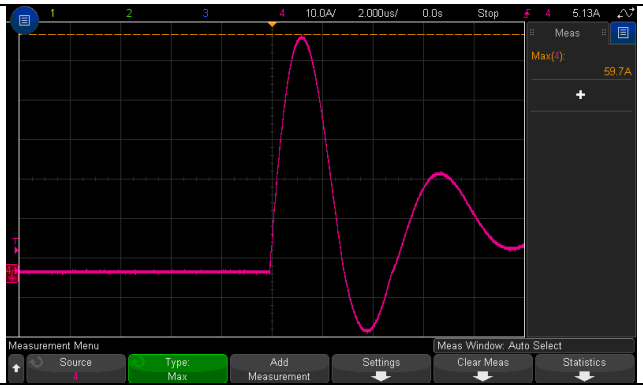
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 24 V~ 29 V	I/P： 1500VDC I/P： 600VDC I/P： 400VDC O/P：MIN LOAD Ta：25℃	23.29V~30.08V/ 1500 VDC 23.29V~30.08V/ 600 VDC 23.28V~30.08V/ 400 VDC
2	OUTPUT VOLTAGE TOLERANCE (Max)	V1: -1.0%~+1.0 %	I/P: 150 VDC~1500 VDC O/P:FULL/ MIN. LOAD Ta:25℃	V1: -0.14%~ 0.17%
3	LINE REGULATION (Max)	V1: -0.5%~+0.5 %	I/P: 150 VDC~1500 VDC O/P:FULL LOAD Ta:25℃	V1:-0.01%~ 0.16 %
4	LOAD REGULATION (Max)	V1: -0.5%~ +0.5 %	I/P: 600VDC O/P:FULL ~MIN LOAD Ta:25℃	V1: -0.14%~ 0.17%
5	OVER/UNDERSHOOT TEST	< ±5%	I/P: 600 VDC O/P:FULL LOAD Ta:25℃	TEST: 1.3%
6	RIPPLE & NOISE (Max)	V1: 150mVp-p	I/P: 600 VDC O/P:FULL LOAD Ta:25℃	V1: 55mVp-p
	high frequency： 		low frequency： 	
7	DYNAMIC LOAD	V1: 2400 mVp-p	I/P: 600VDC O/P: (1)FULL /0% LOAD 50%DUTY / 120HZ (2)FULL /0% LOAD 50%DUTY / 1KHZ Ta:25℃	750mVp-p 511mVp-p
	FULL /0% LOAD 50%DUTY / 120HZ 		FULL /0% LOAD 50%DUTY / 1KHZ 	

8	TRANSIENT RECOVERY TIME	V1: 2400 mVp-p	I/P: 600VDC O/P:40% LOAD CHANGE 50%DUTY/120HZ 1.25A/us	197mVp-p
9	EXERNAL CAPACITANCE LOAD(Max.)	2500uF	I/P：600VDC O/P：NO LOAD Ta：25℃	OK

INPUT FUNCTION TEST

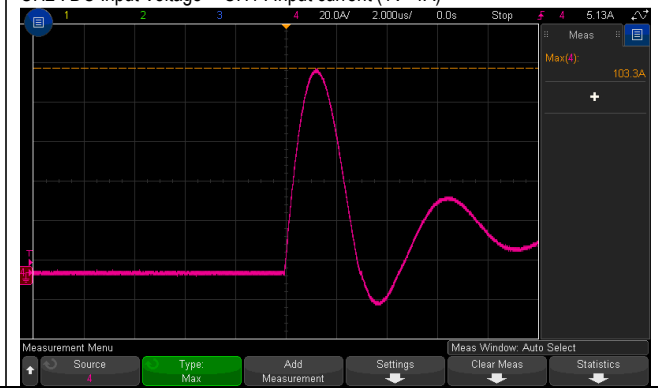
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	150VDC~ 1500 VDC	I/P:TESTING O/P:FULL LOAD Ta:25℃	141V~ 1500 V
			I/P: LOW-LINE-0.2= 198.2 V HIGH-LINE+3V= 1503 V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON: 30 Sec . OFF: 30 Sec 10MIN (POWER ON/OFF NO DAMAGE)	TEST__OK____
2	EFFICIENCY(TYP)	86%/200VDC 87%/800VDC 84%/1500VDC	I/P: 200VDC I/P: 800VDC I/P: 1500VDC O/P:FULL LOAD Ta:25℃	86.4%/200VDC 87.9%/800VDC 84.8%/1500VDC
	EFFICIENCY vs LOAD			
3	INRUSH CURRENT(TYP)	30A/150VDC 80A/800VDC 120A/1500VDC COLD START	I/P: 150VDC I/P: 800VDC I/P: 1500VDC O/P:FULL LOAD Ta:25℃	I =24.8A/ 150VDC I =59.7A/ 800VDC I =103.3A/ 1500VDC
	INPUT=150VDC @ FULL LOAD CH2 : DC Input Voltage CH4 : Input current (1V=1A)		INPUT=800VDC / 50HZ @ FULL LOAD CH2 :DC Input Voltage CH4 : Input current (1V=1A)	





INPUT=1500VDC / 50HZ @ FULL LOAD

CH2 : DC Input Voltage CH4 : Input current (1V=1A)



PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOAD PROTECTION	105 %~ 135 % RATED OUTPUT POWER	I/P: 200VDC I/P: 600VDC I/P: 1500VDC O/P:TESTING Ta:25℃	117.6%/ 200 VDC 120.0%/ 600 VDC 118.0%/ 1500 VDC PROTECTION TYPE：Hiccup mode when output voltage< 55%,recovers automatically after fault condition is remove; constant current limiting within 55-100% rated output voltage，recovers automatically after fault condition is remove。
2	OVER VOLTAGE PROTECTION	CH: 30 V~ 38 V PROTECTION TYPE： Hiccup mode , recovers automatically after fault condition is removerd	I/P: 150VDC I/P: 600VDC I/P: 1500VDC O/P:MIN LOAD Ta:25℃	34.6V/ 150 VDC 34.6V/ 600 VDC 34.6V/ 1500 VDC PROTECTION TYPE： Hiccup mode , recovers automatically after fault condition is removerd
3	OVER TEMPERATURE PROTECTION	PROTECTION TYPE： Hiccup mode , recovers automatically after fault condition is removerd	I/P: 150VDC I/P: 1500VDC O/P:FULL LOAD	O.T.P. Active PROTECTION TYPE： Hiccup mode , recovers automatically after fault condition is removerd
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE PROTECTION TYPE： Hiccup mode , recovers automatically after fault condition is removerd	I/P: 150VDC I/P: 1500VDC O/P: FULL LOAD Ta:25℃	NO DAMAGE PROTECTION TYPE： Hiccup mode , recovers automatically after fault condition is removerd

5	INPUT UNDER VOLTAGE	PROTECTION RANGE: 120 V~ 130 V RELEASE RANGE: 130 V~146.5 V NO DAMAGE	INPUT: 130 V~ 140 V O/P:MIN LOAD Ta:25℃	PROTECTION VOLTAGE: 128V RELEASE VOLTAGE: 141V NO DAMAGE
6.	REVERSE POLARITY	NO DAMAGE	I/P: 1500 VDC O/P: FULL LOAD Ta:25℃	NO DAMAGE

CONTROL FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
7	DC OK SIGNAL	30VDC/1A RESISTIVE LOAD	I/P:600VDC O/P:FULL LOAD Ta:25℃	TEST : OK

COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor (D to S) or (C to E) Peak Voltage	Q1 /Q2/Q3 Rated : 8A/ 950 V	DC ON/OFF I/P:High-Line +3V =1503V 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. Ta:25℃	Q1 VDS: (1) 665V (2) 894V (3) 665V (4) 665V (5) 665V (6) 673V (7) 690V Q3 VDS: (1) 690V (2) 883V (3) 690V (4) 690V (5) 681V (6) 690V (7) 762V Q2 VDS: (1) 665V (2) 826V (3) 673V (4) 665V (5) 665V (6) 665V (7) 673V
4	Diode Peak Voltage	Q100 Rated : 10 A/ 600 V	DC ON/OFF I/P:High-Line +3V =1503 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	VDS: (1) 365V (2) 378V (3) 353V (4) 349V (5) 378V (6) 369V (7) 333V (8) 309VV

			Ta:25℃	
5	Diode Peak Voltage	Q10 Rated : 0.1A/ 1500 V	DC ON/OFF I/P:High-Line +3V =1503 V O/P: (1)Full Load (2)Output Short (3) NO LOAD Ta:25℃	(1) 1.196KV (2)1.212 KV (3) 1.196KV
6	Input Capacitor Voltage	C5 / C6/ C7 Rated: : 22 μ/ 550 V	I/P:High-Line +3V =1503V 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℃	C5 (1) 498V (2) 498V (3) 498V (4) 498V C6 (1) 502V (2) 498V (3) 502V (4) 502V C7 (1) 502V (2) 506V (3) 506V (4) 502V
7	Control IC Voltage Test	PWM IC U1 Rated -0.3V~ 28 V O/P IC U200 Rated -0.3 V~ 38 V	DC ON/OFF I/P:High-Line +3V =1503V O/P(1)FULL LOAD (2) Output Short (3)O.L.P (4)O.V.P. (5)NO LOAD VRmin(LOW LINE) Ta:25℃	U1 (1) 17.1V (2) 17.1V (3) 17.3V (4) 17.1V (5) 17.1V U200 (1) 24.1V (2) 24.3V (3) 24.3V (4) 34.4V (5) 23.9V
8	Clamp Diode Peak Voltage	D1 / D2 / D3 Rated： 1000V / 1 A	I/P：High-Line +3V =1503 V DC ON/OFF O/P： (1) Dynamic Load 90%Duty/1KHz (2)Full load continue Ta：25℃	D1 (1) 594V (2)590 V D2 (1)582 V (2) 582V D3 (1)590V (2) 590V

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	I/P-O/P:4KVAC/min O/P-DC OK:0.5KVAC/min	I/P-O/P: 4.4 KVAC/min O/P-DC OK:0.6KVAC/min Ta:25℃	I/P-O/P: 5.44mA O/P-DC OK: 0.005mA NO DAMAGE
2	ISOLATION RESISTANCE	I/P-O/P:500VDC>100MΩ	I/P-O/P: 600 VDC Ta:25℃	I/P-O/P: 9999MΩ NO DAMAGE

E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RADIATION	EN55032 CLASS A	I/P: 400/800 VDC O/P:FULL LOAD Ta:25℃	PASS Test by certified Lab

2	CONDUCTION	EN55032 CLASS A	I/P: 400/800 VDC O/P:FULL LOAD Ta:25℃	PASS Test by certified Lab
3	E.S.D	EN61000-4-2 LEVEL 3 AIR：8KV / Contact：4KV	I/P: 400/800 VDC O/P:FULL LOAD Ta:25℃	☑CRITERIA A ☐CRITERIA B
4	E.F.T	EN61000-4-4 LEVEL 3 INPUT:2KV	I/P: 400/800 VDC O/P:FULL LOAD Ta:25℃	☑CRITERIA A ☐CRITERIA B
5	SURGE	IEC61000-4-5 LEVEL 4 Vin+~Vin-:2KV	I/P: 400/800 VDC O/P:FULL LOAD Ta:25℃	☑CRITERIA A ☐CRITERIA B
6	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：DDRH-60-24 1. ROOM AMBIENT BURN-IN：2 HRS I/P：600 VDC O/P： FULL LOAD Ta= 25.4 ℃ 2. HIGH AMBIENT BURN-IN：2 HRS I/P：600 VDC O/P： FULL LOAD Ta= 60.7 ℃		

NO	Position	ROOM AMBIENT Ta= 25.4 ℃	HIGH AMBIENT Ta= 60.7 ℃
1	L1	41.8℃	75.9℃
2	RTH1	46.9℃	80.1℃
3	C2	46.3℃	79.9℃
4	LF2	49.0℃	82.6℃
5	BD1	47.5℃	81.3℃
6	Q10	50.2℃	83.0℃
7	C5	57.1℃	89.9℃
8	C6	53.8℃	86.7℃
9	Q1	55.1℃	88.3℃
10	Q3	53.8℃	86.8℃
11	D1	54.9℃	88.2℃
12	D3	59.0℃	94.9℃
13	T3	51.4℃	84.3℃
14	Q70	49.8℃	82.5℃
15	C56	55.9℃	88.9℃
16	U1	53.0℃	86.3℃
17	T1coil	62.3℃	95.1℃
18	T1core	60.7℃	94.0℃
19	Q100	61.1℃	93.7℃
20	C71	53.5℃	86.9℃
21	C106	55.1℃	87.7℃
22	C107	53.8℃	86.5℃

			NO	Position	ROOM AMBIENT Ta= 25.4 ℃ / HIGH AMBIENT Ta= 60.7 ℃
			23	C113	48.2℃ / 80.9℃
			24	LF100	49.5℃ / 81.8℃
			25	U2	54.9℃ / 87.6℃
			26	U200	55.0℃ / 87.2℃
			27	D10	56.7℃ / 89.5℃
			28	C3	51.5℃ / 84.1℃
2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)	I/P：600 VDC O/P：121% LOAD Ta：25℃	TEST：OK	
3	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P：200 VDC / 1500 VDC O/P：100 % LOAD Ta= -30 ℃	TEST：OK	
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 55 ℃ / 95 %R.H NO DAMAGE	I/P：1503 VDC O/P：FULL LOAD Ta= 60.7 ℃ HUMIDITY= 95 %R.H	TEST：OK	
5	TEMPERATURE COEFFICIENT	±0.03%/℃(0~55℃)	I/P： 600VDC O/P：FULL LOAD	± 0.012%/℃(0~55℃)	
6	STORAGE TEMPERATURE TEST	-40~80℃	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		
7	THERMAL SHOCK TEST	-30~55℃	1. Thermal shock Temperature： -35℃~ +60℃ 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: 600 VDC / FULL LOAD AC ON 3sec/AC OFF 1sec TEST 1cycle: 600 VDC / FULL LOAD Burn In Test		
8	VIBRATION TEST	10 ~ 500Hz, 3G 10min./1cycle, 60min. each along X, Y, Z axes	1 Carton & 1 Set (1) Waveform： Sine Wave (2) Frequency：10~500Hz (3) Sweep Time：10min/sweep cycle (4) Acceleration：3G (5) Test Time：180min in each axis (X.Y.Z) (6) Ta：25℃		
9	CAPACITOR LIFE CYCLE	SUPPOSE C106 IS THE MOST CRITICAL COMPONENT (1) I/P： 600VDC O/P：FULL LOAD Ta= 25 ℃ LIFE TIME (2) I/P： 600VDC O/P：FULL LOAD Ta= 55 ℃ LIFE TIME (3) I/P： 600VDC O/P：75% LOAD Ta= 55 ℃ LIFE TIME (4) I/P： 600VDC O/P：50% LOAD Ta= 55 ℃ LIFE TIME		(1) 232495.8HRS (2) 35043.2HRS (3) 50896.2HRS (4) 71189.8HRS	
10	MTBF	Conducted by Parts Stress Analysis Prediction 1439.7K hrs min. Telcordia TR/SR-332 (Bellcore) ; 454.5K hrs min. MIL-HDBK-217F (25℃)			
11	Ongoing Reliability Test	I/P：600VDC O/P：FULL LOAD TA=50℃ Demonstration Mean Time Between Failure : 30,000 hours			

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	LIUTT		Wangdz

2018.4.30 GP-A50-F010