Test Report: DDRH-60-12

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

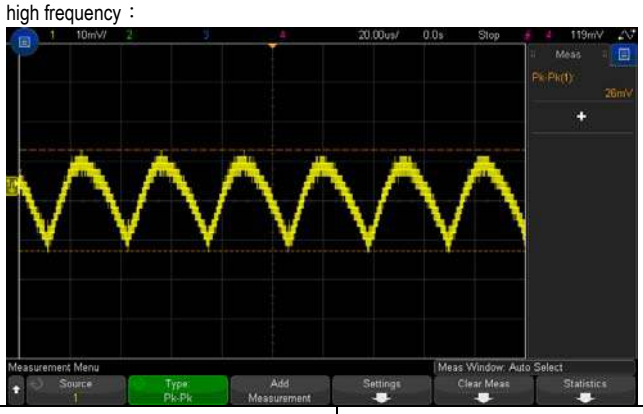
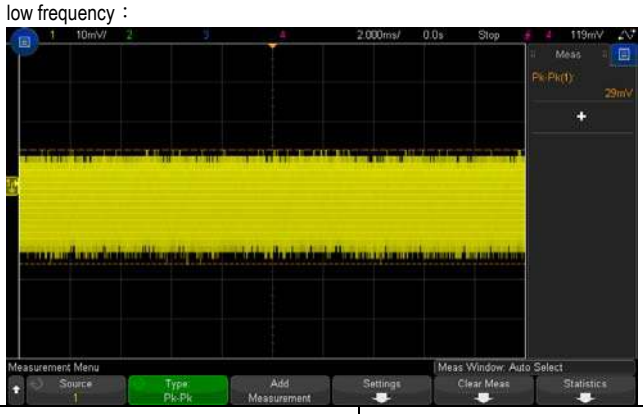
Safety Test
E.M.C. Test

■ RELIABILITY TEST

ENVIRONMENT TEST

■ DESIGN VERIFY TEST

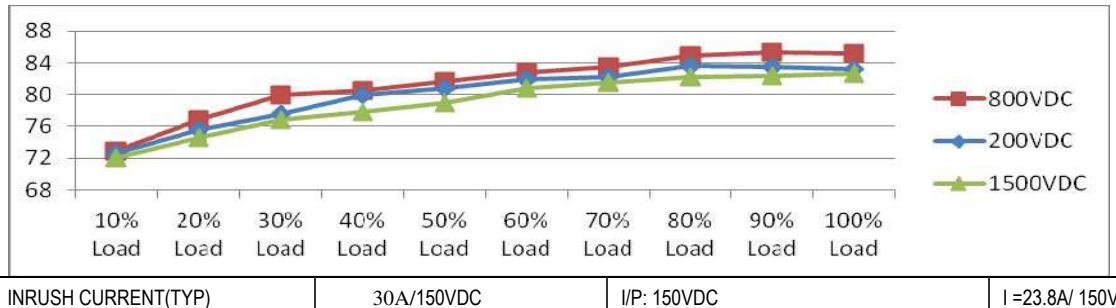
OUTPUT FUNCTION TEST

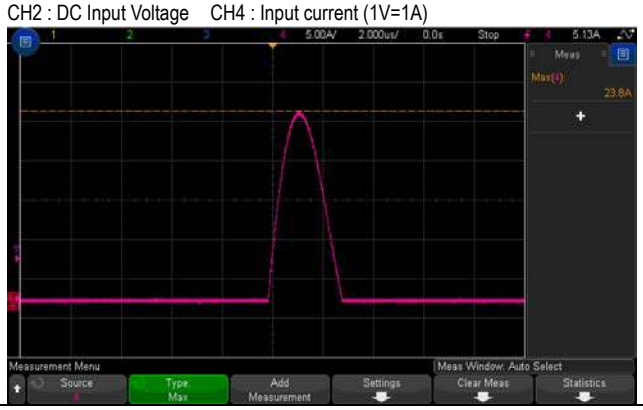
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 12V~ 15 V	I/P： 1500VDC I/P： 800VDC I/P： 400VDC O/P：MIN LOAD Ta：25℃	11.54V~15.54V/ 1500 VDC 11.54V~15.54V/ 800 VDC 11.54V~15.54V/ 400 VDC
2	OUTPUT VOLTAGE TOLERANCE (Max)	V1: -1.5%~+1.5 %	I/P: 150 VDC~1500 VDC O/P:FULL/ MIN. LOAD Ta:25℃	V1: -0.27%~ 0.29 %
3	LINE REGULATION (Max)	V1: -0.5%~+0.5 %	I/P: 150 VDC~1500 VDC O/P:FULL LOAD Ta:25℃	V1: -0.03%~ 0.24%
4	LOAD REGULATION (Max)	V1: -0.5%~ +0.5 %	I/P: 800VDC O/P:FULL ~MIN LOAD Ta:25℃	V1: -0.27%~ 0.29 %
5	OVER/UNDERSHOOT TEST	< ±5%	I/P: 800 VDC O/P:FULL LOAD Ta:25℃	TEST: 0.8 %
6	RIPPLE & NOISE (Max)	V1: 120mVp-p	I/P: 800 VDC O/P:FULL LOAD Ta:25℃	V1: 29 mVp-p
	high frequency： 		low frequency： 	
7	DYNAMIC LOAD	V1: 1200 mVp-p	I/P: 800VDC O/P: (1)FULL /0% LOAD 50%DUTY / 120HZ (2)FULL /0% LOAD 50%DUTY / 1KHZ Ta:25℃	195mVp-p 185mVp-p
	FULL /0% LOAD 50%DUTY / 120HZ 		FULL /0% LOAD 50%DUTY / 1KHZ 	

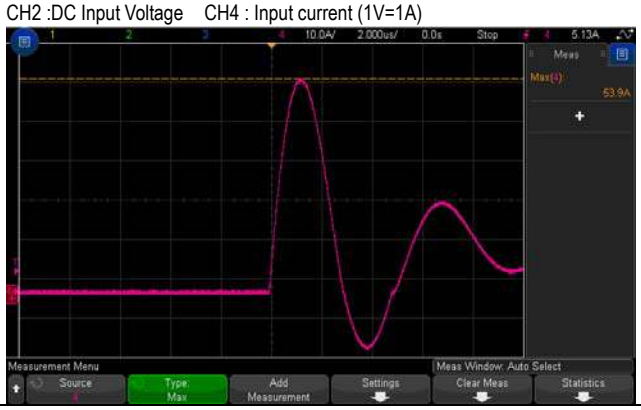
8	TRANSIENT RECOVERY TIME	V1: 1200 mVp-p	I/P: 800VDC O/P:40% LOAD CHANGE 50%DUTY/120HZ 1.25A/us	161mVp-p
9	EXERNAL CAPACITANCE LOAD(Max.)	4000uF	I/P：800VDC O/P：FULL LOAD Ta：25℃	OK

INPUT FUNCTION TEST

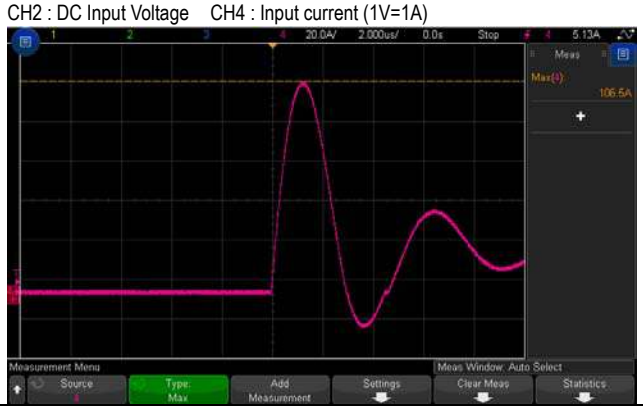
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	150VDC~ 1500 VDC	I/P:TESTING O/P:FULL LOAD Ta:25℃	140V~ 1500 V
			I/P: LOW-LINE-0.2= 198.2 V HIGH-LINE+3V= 1503 V O/P:FULL/MIN LOAD (PLEASE CHECK DERATING CURVE) ON: 30 Sec . OFF: 30 Sec 10MIN (POWER ON/OFF NO DAMAGE)	TEST OK
2	EFFICIENCY(TYP)	83%/200VDC 85%/800VDC 81%/1500VDC	I/P: 200VDC I/P: 800VDC I/P: 1500VDC O/P:FULL LOAD Ta:25℃	83.2%/200VDC 85.2%/800VDC 82.6%/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 =23.8A/ 150VDC I =53.9A/ 800VDC I =106.5A/ 1500VDC
	INPUT=150VDC @ FULL LOAD CH2 : DC Input Voltage CH4 : Input current (1V=1A)			INPUT=800VDC / 60HZ @ FULL LOAD CH2 :DC Input Voltage CH4 : Input current (1V=1A)







INPUT=1500VDC / 60HZ @ 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: 800VDC I/P: 1500VDC O/P:TESTING Ta:25℃	120.2%/ 200 VDC 122.0%/ 800 VDC 122.0%/ 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: 16.5 V~ 21 V PROTECTION TYPE： Hiccup mode , recovers automatically after fault condition is removerd	I/P: 150VDC I/P: 800VDC I/P: 1500VDC O/P:MIN LOAD Ta:25℃	18.5V/ 150 VDC 18.5V/ 800 VDC 18.5V/ 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: 127V RELEASE VOLTAGE: 142V 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:800VDC 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) 761V (2) 713V (3) 761V (4) 761V (5) 761V (6) 761V (7) 753V Q3 VDS: (1) 721V (2) 753V (3) 721V (4) 721V (5) 713V (6) 721V (7) 721V Q2 VDS: (1) 697V (2) 663V (3) 689V (4) 697V (5) 697V (6) 697V (7) 657V
4	Diode Peak Voltage	Q100 Rated : 20 A/ 300 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 Ta:25℃	Q101: VDS: (1) 222V (2) 182V (3) 184V (4) 184V (5) 184V (6) 184V (7) 184V (8) 184V
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) 1.208KV (2) 1.208KV (3) 1.2KV
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) 502V (2) 498V (3) 498V (4) 498V C7 (1) 506V (2) 506V (3) 506V (4) 506V

				C6 (1) 506V (2) 498V (3) 506V (4) 506V	
7	Control IC Voltage Test	PWM IC U1 Rated -0.3V~ 28 V MCU 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) 17.3V (2) 17.3V (3) 17.3V (4) 15.1V (5) 17.3V	U200 (1) 12.0V (2) 11.8V (3) 11.8V (4) 18.9V (5) 11.8V
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) 642V (2) 634V D2 (1) 626V (2) 626V	D3 (1) 634 V (2) 634V

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: 0.006 mA 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: 800 VDC O/P:FULL LOAD Ta:25℃	PASS Test by certified Lab
2	CONDUCTION	EN55032 CLASS A	I/P: 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: 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: 800 VDC O/P:FULL LOAD Ta:25℃	☑CRITERIA A ☐CRITERIA B
5	SURGE	IEC61000-4-5 LEVEL 4 Vin+~Vin-:2KV	I/P: 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

<table>
<tr><th>NO</th><th>TEST ITEM</th><th>SPECIFICATION</th><th>TEST CONDITION</th><th>RESULT</th></tr>
<tr><td>1</td><td>TEMPERATURE RISE TEST</td><td colspan="3">MODEL：DDRH-60-12
1. ROOM AMBIENT　BURN-IN：2 HRS
I/P：800 VDC　O/P：　FULL LOAD　Ta= 27.8 ℃
2. HIGH AMBIENT　BURN-IN：2 HRS
I/P：800 VDC　O/P：　FULL LOAD　Ta= 60.8 ℃</td></tr>
<tr><td>2</td><td>OVER LOAD BURN-IN TEST</td><td>NO DAMAGE
1 HOUR (MIN)</td><td>I/P：800 VDC
O/P：119% LOAD
Ta：25℃</td><td>TEST：OK</td></tr>
<tr><td>3</td><td>LOW TEMPERATURE
TURN ON TEST</td><td>TURN ON AFTER　2　HOUR</td><td>I/P：200 VDC / 1500 VDC
O/P：100 % LOAD
Ta= -30 ℃</td><td>TEST：OK</td></tr>
<tr><td>4</td><td>HIGH HUMIDITY
HIGH TEMPERATURE
HIGH VOLTAGE
TURN ON TEST</td><td>AFTER 12　HOURS
IN CHAMBER ON
CONTROL　55 ℃ / 95 %R.H
NO DAMAGE</td><td>I/P：1503 VDC
O/P：FULL LOAD
Ta= 60.3 ℃
HUMIDITY=　95 %R.H</td><td>TEST：OK</td></tr>
</table>

NO	Position	ROOM AMBIENT Ta= 27.8 ℃	HIGH AMBIENT Ta= 60.8 ℃
1	L1	46.5℃	78.0℃
2	LF2	55.7℃	87.2℃
3	RTH1	53.3℃	84.2℃
4	BD1	52.4℃	83.8℃
5	C2	52.1℃	83.3℃
6	C5	64.5℃	96.1℃
7	C6	59.5℃	90.9℃
8	Q1	61.7℃	93.2℃
9	Q2	60.5℃	91.9℃
10	Q10	55.7℃	87.2℃
11	D1	63.0℃	94.4℃
12	D3	68.2℃	99.9℃
13	T3	56.9℃	88.4℃
14	Q70	55.1℃	86.7℃
15	C56	63.0℃	94.4℃
16	U1	59.5℃	90.9℃
17	T1coil	72.3℃	103.7℃
18	T1core	70.9℃	102.4℃
19	C71	60.0℃	91.8℃
20	Q100	74.9℃	105.5℃
21	C106	68.8℃	98.5℃
22	C107	65.9℃	96.1℃
23	C113	60.1℃	89.7℃
24	LF100	62.6℃	93.1℃
25	U3	68.8℃	100.5℃
26	R231	70.1℃	100.1℃
27	U200	69.5℃	99.6℃
28	R101	74.9℃	105.4℃
29	C3	57.9℃	89.9℃

5	TEMPERATURE COEFFICIENT	±0.03%/℃(0~55℃)	I/P： 800VDC O/P：FULL LOAD	± 0.013%/℃(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: 800 VDC / FULL LOAD AC ON 3sec/AC OFF 1sec TEST 1cycle: 800 VDC / 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：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： 800VDC O/P：FULL LOAD Ta= 25 ℃ LIFE TIME (2) I/P： 800VDC O/P：FULL LOAD Ta= 55 ℃ LIFE TIME (3) I/P： 800VDC O/P：75% LOAD Ta= 55 ℃ LIFE TIME (4) I/P： 800VDC O/P：50% LOAD Ta= 55 ℃ LIFE TIME		(1) 280518.7HRS (2) 44077HRS (3) 106795.6HRS (4) 218237.2HRS
10	MTBF	Conducted by Parts Stress Analysis Prediction 503K hrs min. Telcordia TR/SR-332 (Bellcore) ; 454.5K hrs min. MIL-HDBK-217F (25℃)		
11	Ongoing Reliability Test	I/P：800VDC 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