



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

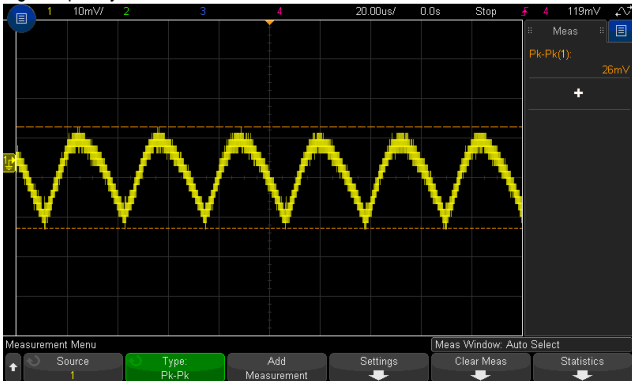
ENVIRONMENT TEST

DESIGN VERIFY TEST

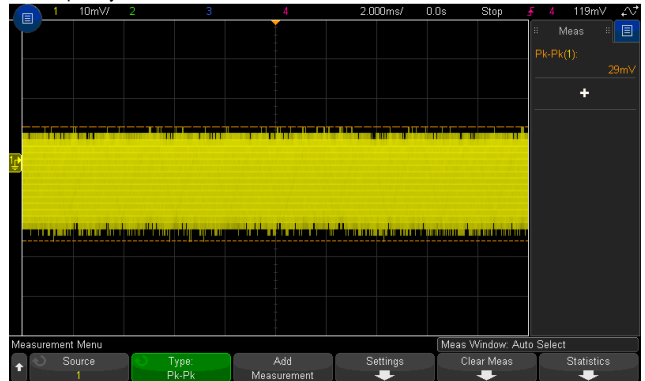
OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE ADJUST RANGE	CH1: 12V~ 15V	I/P : 1500VDC I/P : 600VDC I/P : 400VDC O/P : MIN LOAD Ta : 25°C	11.54V~15.54V/ 1500 VDC 11.54V~15.54V/ 600 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°C	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°C	V1: -0.03%~ 0.24%
4	LOAD REGULATION (Max)	V1: -0.5%~ +0.5 %	I/P: 600VDC O/P:FULL ~MIN LOAD Ta:25°C	V1: -0.27%~ 0.29 %
5	OVER/UNDERSHOOT TEST	< ±5%	I/P: 600 VDC O/P:FULL LOAD Ta:25°C	TEST: 0.8 %
6	RIPPLE & NOISE (Max)	V1: 120mVp-p	I/P: 600 VDC O/P:FULL LOAD Ta:25°C	V1: 29 mVp-p

high frequency :



low frequency :

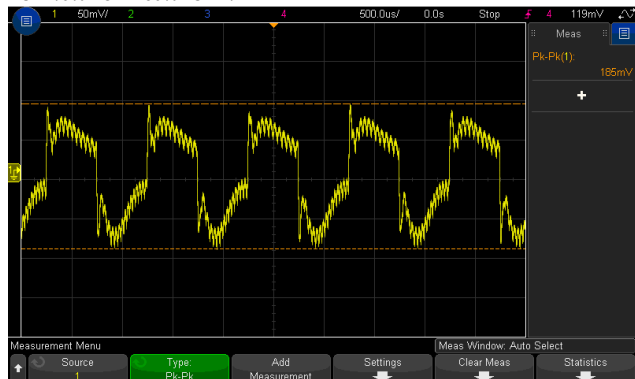


7	DYNAMIC LOAD	V1: 1200 mVp-p	I/P: 600VDC O/P: (1)FULL /0% LOAD 50%DUTY / 120HZ (2)FULL /0% LOAD 50%DUTY / 1KHZ Ta:25°C	195mVp-p 185mVp-p
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FULL /0% LOAD 50%DUTY / 120HZ



FULL /0% LOAD 50%DUTY / 1KHZ



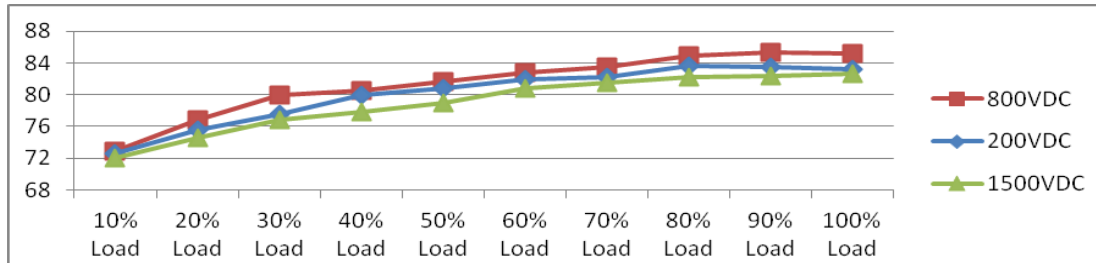


8	TRANSIENT RECOVERY TIME	V1: 1200 mVp-p	I/P: 600VDC O/P:40% LOAD CHANGE 50%DUTY/120HZ 1.25A/us	161mVp-p
9	EXERNAL CAPACITANCE LOAD(Max.)	4000uF	I/P : 600VDC O/P : FULL LOAD Ta : 25°C	OK

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°C	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 <u>OK</u>
2	EFFICIENCY(TYP)	83%/200VDC 85%/800VDC 81%/1500VDC	I/P: 200VDC I/P: 800VDC I/P: 1500VDC O/P:FULL LOAD Ta:25°C	83.2%/200VDC 85.2%/800VDC 82.6%/1500VDC

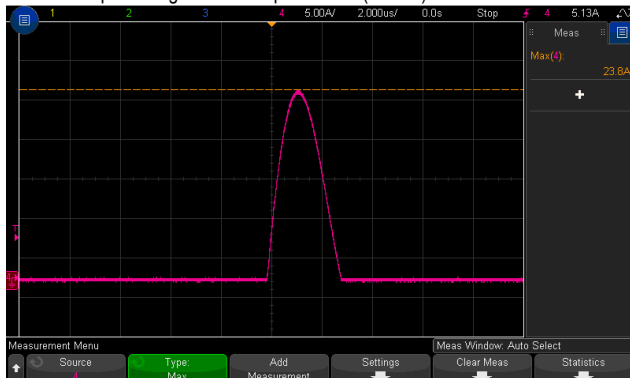
EFFICIENCY vs LOAD



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°C	I=23.8A/ 150VDC I=53.9A/ 800VDC I=106.5A/ 1500VDC
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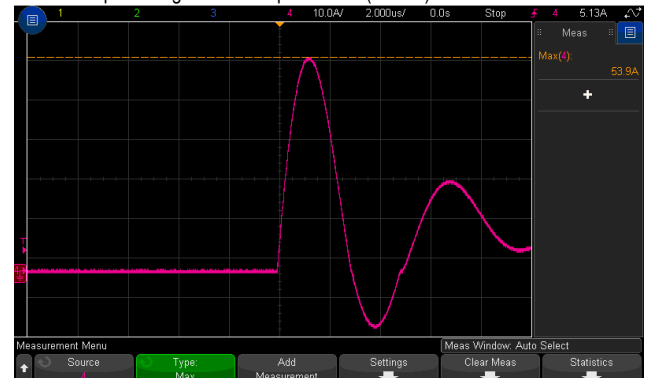
INPUT=150VDC @ FULL LOAD

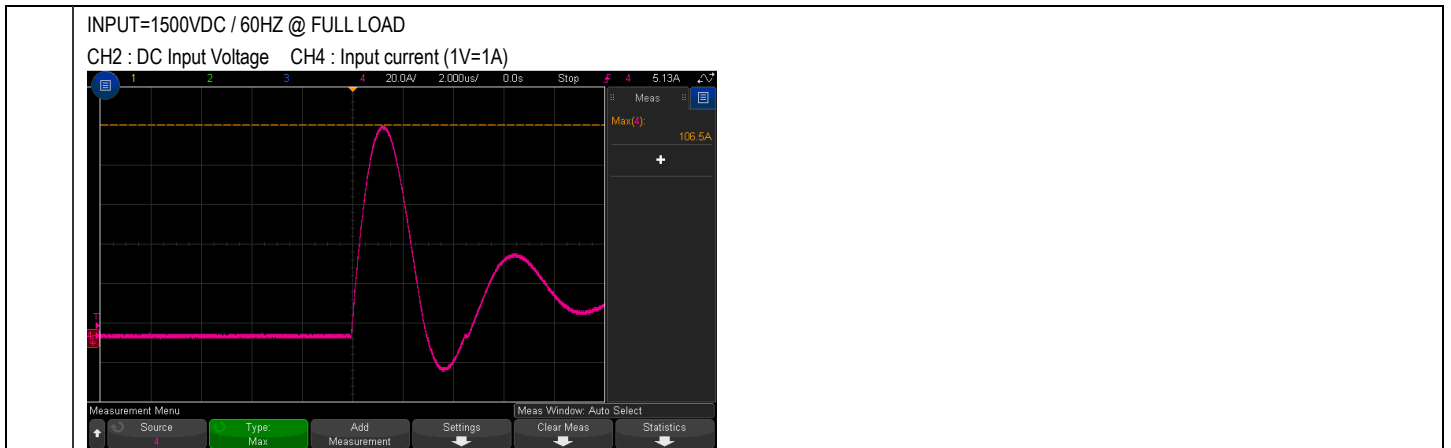
CH2 : DC Input Voltage CH4 : Input current (1V=1A)



INPUT=800VDC / 60HZ @ FULL LOAD

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





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°C	120.2%/ 200 VDC 122.0%/ 600 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 removed	I/P: 150VDC I/P: 600VDC I/P: 1500VDC O/P: MIN LOAD Ta:25°C	18.5V/ 150 VDC 18.5V/ 600 VDC 18.5V/ 1500 VDC PROTECTION TYPE : Hiccup mode , recovers automatically after fault condition is removed
3	OVER TEMPERATURE PROTECTION	PROTECTION TYPE : Hiccup mode , recovers automatically after fault condition is removed	I/P: 150VDC I/P: 1500VDC O/P: FULL LOAD	O.T.P. Active PROTECTION TYPE : Hiccup mode , recovers automatically after fault condition is removed
4	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE PROTECTION TYPE : Hiccup mode , recovers automatically after fault condition is removed	I/P: 150VDC I/P: 1500VDC O/P: FULL LOAD Ta:25°C	NO DAMAGE PROTECTION TYPE : Hiccup mode , recovers automatically after fault condition is removed
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°C	PROTECTION VOLTAGE: 127V RELEASE VOLTAGE: 142V NO DAMAGE
6.	REVERSE POLARITY	NO DAMAGE	I/P: 1500 VDC O/P: FULL LOAD Ta:25°C	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°C	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°C	Q1 VDS: (1) 761V (2) 713V (3) 761V (4) 761V (5) 761V (6) 761V (7) 753V Q2 VDS: (1) 697V (2) 663V (3) 689V (4) 697V (5) 697V (6) 697V (7) 657V Q3 VDS: (1) 721V (2) 753V (3) 721V (4) 721V (5) 713V (6) 721V (7) 721V
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°C	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°C	(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°C	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°C	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°C	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°C	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°C	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°C	PASS Test by certified Lab
2	CONDUCTION	EN55032 CLASS A	I/P: 400/800 VDC O/P:FULL LOAD Ta:25°C	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°C	<input checked="" type="checkbox"/> CRITERIA A <input type="checkbox"/> CRITERIA B
4	E.F.T	EN61000-4-4 LEVEL 3 INPUT:2KV	I/P: 400/800 VDC O/P:FULL LOAD Ta:25°C	<input checked="" type="checkbox"/> CRITERIA A <input type="checkbox"/> CRITERIA B
5	SURGE	IEC61000-4-5 LEVEL 4 Vin+~Vin-:2KV	I/P: 400/800 VDC O/P:FULL LOAD Ta:25°C	<input checked="" type="checkbox"/> CRITERIA A <input type="checkbox"/> 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-60-12 1. ROOM AMBIENT BURN-IN : 2 HRS I/P : 600 VDC O/P : FULL LOAD Ta= 27.8 °C 2. HIGH AMBIENT BURN-IN : 2 HRS I/P : 600 VDC O/P : FULL LOAD Ta= 60.8 °C																																																																																																																										
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2	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR (MIN)	I/P : 600 VDC O/P : 119% LOAD Ta : 25°C	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 °C	TEST : OK																																																																																																																								
4	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 55 °C /95 %R.H NO DAMAGE	I/P : 1503 VDC O/P : FULL LOAD Ta= 60.3 °C HUMIDITY= 95 %R.H	TEST : OK																																																																																																																								



5	TEMPERATURE COEFFICIENT	$\pm 0.03\%/^{\circ}\text{C}$ (0~55 $^{\circ}\text{C}$)	I/P : 600VDC O/P : FULL LOAD	$\pm 0.013\%/^{\circ}\text{C}$ (0~55 $^{\circ}\text{C}$)
6	STORAGE TEMPERATURE TEST	-40~80 $^{\circ}\text{C}$	1. Thermal shock Temperature : -45 $^{\circ}\text{C}$ ~ +90 $^{\circ}\text{C}$ 2. Temperature change rate : 25 $^{\circ}\text{C}$ / 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 $^{\circ}\text{C}$	1. Thermal shock Temperature : -35 $^{\circ}\text{C}$ ~ +60 $^{\circ}\text{C}$ 2. Temperature change rate : 25 $^{\circ}\text{C}$ / 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 $^{\circ}\text{C}$	
9	CAPACITOR LIFE CYCLE	SUPPOSE C106 IS THE MOST CRITICAL COMPONENT (1) I/P : 600VDC O/P : FULL LOAD Ta= 25 $^{\circ}\text{C}$ LIFE TIME (2) I/P : 600VDC O/P : FULL LOAD Ta= 55 $^{\circ}\text{C}$ LIFE TIME (3) I/P : 600VDC O/P : 75% LOAD Ta= 55 $^{\circ}\text{C}$ LIFE TIME (4) I/P : 600VDC O/P : 50% LOAD Ta= 55 $^{\circ}\text{C}$ LIFE TIME		(1) 280518.7HRS (2) 44077HRS (3) 106795.6HRS (4) 218237.2HRS
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 $^{\circ}\text{C}$)		
11	Ongoing Reliability Test	I/P : 600VDC O/P : FULL LOAD TA=50 $^{\circ}\text{C}$ Demonstration Mean Time Between Failure : 30,000 hours		

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	LIUTT		Wangdz

2018.4.30 GP-A50-F010