



# Test Report: RSD-60H-5

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60W Reliable Railway DC-DC Converter

## ■ 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

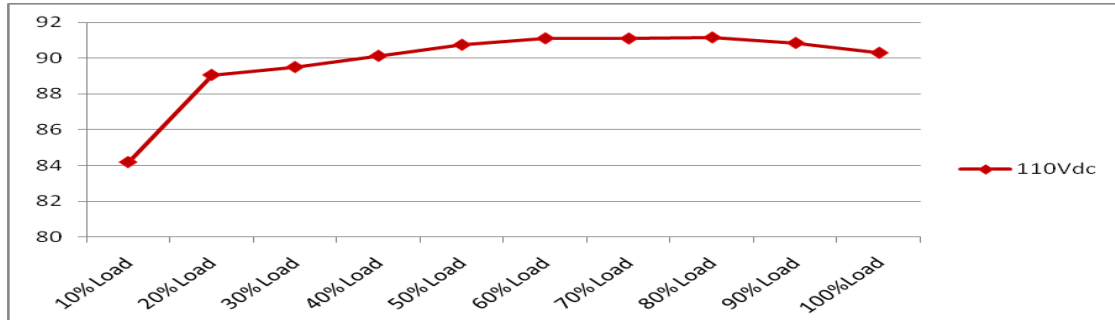
### OUTPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE TOLERANCE (Max)	V1: 2 %~ -2 %	I/P: 40 VDC / 160 VDC O/P:FULL / MIN. LOAD Ta:25°C	V1: 0.654%~0.968%
2	LINE REGULATION (Max)	V1: 0.5 %~ -0.5 %	I/P: 40 VDC / 160 VDC O/P:FULL LOAD Ta:25°C	V1: 0%~ 0%
3	LOAD REGULATION (Max)	V1: 0.5 %~ -0.5 %	I/P: 110VDC O/P:FULL ~MIN LOAD Ta:25°C	V1: -0.157%~ 0.137 %
4	OVER/UNDERSHOOT TEST	< ±10%	I/P: 110VDC O/P:FULL LOAD Ta:25°C	TEST: 1.594%
5	RIPPLE & NOISE (Max)	V1: 60mVp-p	I/P: 110VDC O/P:FULL LOAD Ta:25°C	V1: 35.2mVp-p
<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>high frequency :</p> </div> <div style="text-align: center;"> <p>low frequency :</p> </div> </div>				
6	SET UP TIME (Max)	110VDC/ 100ms	I/P: 110VDC O/P:FULL LOAD Ta:25°C	110VDC/33.2 ms
<p>INPUT=110VDC @ FULL LOAD</p> <p>CH1 : Output Voltage CH2 : DC Input Voltage</p>				
7	RISE TIME (Max)	110VDC/ 60 ms	I/P: 110VDC O/P:FULL LOAD Ta:25°C	110VDC/ 27.2ms

	<p>INPUT=110VDC @ FULL LOAD CH1 : Output Voltage</p>		
8	HOLD UP TIME (TYP)	110VDC/ 10 ms	I/P: 110VDC O/P: FULL LOAD Ta:25°C
	<p>INPUT=110VDC @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage</p>		
9	DYNAMIC LOAD	V1: 1000mVp-p	I/P: 110VDC O/P: (1)FULL /MIN LOAD 50%DUTY / 120HZ (2)FULL /MIN LOAD 50%DUTY / 1KHZ Ta:25°C
	<p>FULL /MIN LOAD 50%DUTY / 120HZ</p>		<p>FULL /MIN LOAD 50%DUTY / 1KHZ</p>

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	40 VDC / 160 VDC	I/P:TESTING O/P:FULL LOAD Ta:25°C	36V~160 V
			I/P: LOW-LINE-0.2= 39.8 V HIGH-LINE+3V= 163 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	DC CURRENT(TYP)	110VDC/ 0.62A	I/P: 110VDC O/P:FULL LOAD Ta:25°C	I=0.606A/110VDC
3	EFFICIENCY(TYP)	89%	I/P: 110VDC O/P:FULL LOAD Ta:25°C	90.3%

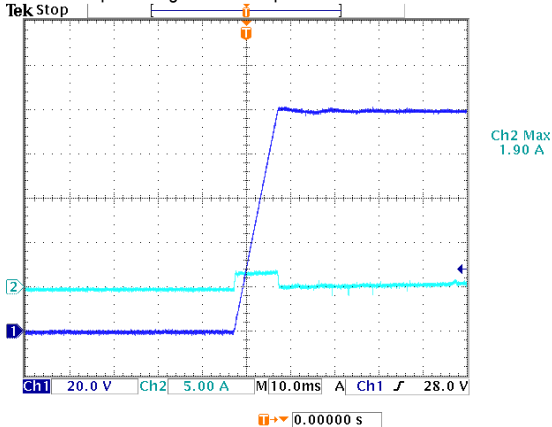
**EFFICIENCY vs LOAD**



4	INRUSH CURRENT(TYP)	110VDC/ 20A COLD START	I/P:110VDC O/P:FULL LOAD Ta:25°C	I=1.9A/110 VDC
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**INPUT=110VDC @ FULL LOAD**

CH2 : DC Input Voltage CH1 : Input current



### PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
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1	OVER LOAD PROTECTION	105%~135 %RATED OUTPUT POWER PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed	I/P: 160VDC I/P: 110VDC I/P: 40VDC O/P: TESTING Ta:25°C	117.33% 117.08% 117.33% PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	CH: 5.75V~ 7 V PROTECTION TYPE : Shut down o/p voltage, re-power on to recover	I/P: 160VDC I/P: 110VDC I/P: 40VDC O/P : NO LOAD Ta:25°C	6.37V 6.35V 6.37V PROTECTION TYPE : Shut down o/p voltage, re-power on to recover
3	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE	I/P: 110VDC O/P: FULL LOAD Ta:25°C	NO DAMAGE PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed
4.	INPUT REVERSE	POWER OK	I/P: 110 VDC O/P: NO LOAD Ta:25°C	NO DAMAGE

## COMPONENT STRESS TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	PWM Transistor ( D to S) or (C to E) <b>Peak Voltage</b>	Q3 Rated : 18 A/ 500 V	I/P:High-Line +3V =163V AC ON/OFF VDS: O/P: (1)Full Load (2)Output Short (3) Full Load Continue Ta:25°C	VDS: (1) 309V (2) 243V (3) 309V
2	Diode <b>Peak Voltage</b>	Q100 Rated : 90A/ 40 V	I/P:High-Line +3V =163V AC ON/OFF O/P: (1)Full Load (2)Output Short (3) Full Load Continue Ta:25°C	Q100: VDS: (1) 38.4V (2) 29.2V (3) 38.0V
3	<b>Input Capacitor Voltage</b>	C5 Rated: : 27 $\mu$ / 200V 105 °C	I/P:High-Line +3V =163V 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	(1) 167V (2) 167V (3) 167V (4) 167V
4	<b>Control IC Voltage Test</b>	PWM IC U1 Rated : 40 V(MAX.) -0.3V(MIN.)	I/P:High-Line +3V =163V AC ON/OFF O/P:(1)FULL LOAD (2) Output Short (3)O.L.P (4)O.V.P. Ta:25°C	(1) 22.V (2) 10.9V (3) 10.9V (4) 16.4V

5	Clamp Diode Peak Voltage	D4 Rated : 600V/3A	I/P : High-Line +3V = 163V AC ON/OFF O/P : (1) Dynamic Load 90%Duty/1KHz (2)Full load continue Ta : 25°C	(1) 175V (2) 175V
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### SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTAND VOLTAGE	EN 60950-1 I/P-O/P:4KVDC/min I/P-FG:2.5KVDC/min O/P-FG:2.5KVDC/min	I/P-O/P: 4.4KVDC/min I/P-FG: 3 KVDC/min O/P-FG:3KVDC/min Ta:25°C	I/P-O/P: 2.12mA I/P-FG: 2.58mA O/P-FG: 2.21mA NO DAMAGE
2	ISOLATION RESISTANCE	I/P-O/P:500VDC>100MΩ I/P-FG: 500VDC>100MΩ O/P-FG:500VDC>100MΩ	I/P-O/P: 500 VDC I/P-FG: 500 VDC O/P-FG: 500 VDC Ta:25°C	I/P-O/P:9999MΩ I/P-FG: 9999MΩ O/P-FG:9999MΩ NO DAMAGE
3	GROUNDING CONTINUITY	EN 60950-1 FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25°C	<b>20mΩ</b>

### E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RADIATION	BS EN/EN55032 CLASS B	I/P: 110 VDC O/P:FULL LOAD Ta:25°C	PASS Test by certified Lab
2	CONDUCTION	BS EN/EN55032 CLASS A	I/P: 110 VDC O/P:FULL LOAD Ta:25°C	PASS Test by certified Lab
3	E.S.D	BS EN/EN61000-4-2 LIGHT INDUSTRY AIR:8KV / Contact:6KV	I/P: 110 VDC O/P:FULL LOAD Ta:25°C	CRITERIA A
4	E.F.T	BS EN/EN61000-4-4 LIGHT INDUSTRY INPUT: 2KV	I/P: 110 VDC O/P:FULL LOAD Ta:25°C	CRITERIA A
5	SURGE	BS EN/EN61000-4-5 LIGHT INDUSTRY L-N :1KV L,N-PE:2KV	I/P: 110 VDC O/P:FULL LOAD Ta:25°C	CRITERIA A
6	Test by certified Lab & Test Report Prepare			

■ RELIABILITY TEST

ENVIRONMENT TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT																																																																																
2	TEMPERATURE RISE TEST	MODEL : RSD-60H-24 1. ROOM AMBIENT BURN-IN : 1HRS I/P : 110VDC O/P : FULL LOAD Ta= 22.2℃ 2. HIGH AMBIENT BURN-IN : 1HRS I/P : 110VDC O/P : FULL LOAD Ta= 52.3℃																																																																																		
				<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta=22.2℃</th> <th>HIGH AMBIENT Ta= 52.3 ℃</th> </tr> </thead> <tbody> <tr><td>1</td><td>C12</td><td>38.1℃</td><td>67.6℃</td></tr> <tr><td>2</td><td>LF1</td><td>39.6℃</td><td>68.9℃</td></tr> <tr><td>3</td><td>C5</td><td>39.5℃</td><td>68.5℃</td></tr> <tr><td>4</td><td>C6</td><td>40.0℃</td><td>69.1℃</td></tr> <tr><td>5</td><td>C40</td><td>42.4℃</td><td>71.3℃</td></tr> <tr><td>6</td><td>T2</td><td>43.6℃</td><td>73.0℃</td></tr> <tr><td>7</td><td>T1</td><td>54.0℃</td><td>82.3℃</td></tr> <tr><td>8</td><td>C110</td><td>44.2℃</td><td>73.1℃</td></tr> <tr><td>9</td><td>C105</td><td>46.1℃</td><td>74.7℃</td></tr> <tr><td>10</td><td>L100</td><td>44.0℃</td><td>72.8℃</td></tr> <tr><td>11</td><td>C108</td><td>39.2℃</td><td>68.0℃</td></tr> <tr><td>12</td><td>Q1</td><td>40.0℃</td><td>69.5℃</td></tr> <tr><td>13</td><td>Q2</td><td>40.3℃</td><td>69.7℃</td></tr> <tr><td>14</td><td>Q3</td><td>45.5℃</td><td>75.9℃</td></tr> <tr><td>15</td><td>U1</td><td>43.8℃</td><td>73.2℃</td></tr> <tr><td>16</td><td>D4</td><td>46.6℃</td><td>75.5℃</td></tr> <tr><td>17</td><td>Q100</td><td>52.9℃</td><td>81.9℃</td></tr> <tr><td>18</td><td>U101</td><td>42.6℃</td><td>71.6℃</td></tr> <tr><td>19</td><td>D1</td><td>38.8℃</td><td>68.6℃</td></tr> </tbody> </table>	NO	Position	ROOM AMBIENT Ta=22.2℃	HIGH AMBIENT Ta= 52.3 ℃	1	C12	38.1℃	67.6℃	2	LF1	39.6℃	68.9℃	3	C5	39.5℃	68.5℃	4	C6	40.0℃	69.1℃	5	C40	42.4℃	71.3℃	6	T2	43.6℃	73.0℃	7	T1	54.0℃	82.3℃	8	C110	44.2℃	73.1℃	9	C105	46.1℃	74.7℃	10	L100	44.0℃	72.8℃	11	C108	39.2℃	68.0℃	12	Q1	40.0℃	69.5℃	13	Q2	40.3℃	69.7℃	14	Q3	45.5℃	75.9℃	15	U1	43.8℃	73.2℃	16	D4	46.6℃	75.5℃	17	Q100	52.9℃	81.9℃	18	U101	42.6℃	71.6℃	19	D1	38.8℃	68.6℃
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3	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )	I/P : 110VDC O/P : 115.8 % LOAD Ta : 25℃	TEST : OK																																																																																
4	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 110VDC/ 40VDC O/P : 100 % LOAD Ta= -40 ℃	TEST : OK																																																																																
5	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 55 ℃ NO DAMAGE	I/P : 163VDC O/P : FULL LOAD Ta= 55 ℃ HUMIDITY= 95 %R.H	TEST: OK																																																																																
6	TEMPERATURE COEFFICIENT	± 0.03 %(0~50℃)	I/P : 110VDC O/P : FULL LOAD	± 0.0014 %(0~50℃)																																																																																
7	STORAGE TEMPERATURE TEST	1. Thermal shock Temperature : -40℃~ +85℃ 2. Temperature change rate : 25℃ / MIN 3. Dwell time low and high temperature : 30 MIN/EACH 4. Total test cycle : 5 CYCLE 5. Input/Output condition : STATIC		TEST : OK																																																																																



8.	THERMAL SHOCK TEST	1. Thermal shock Temperature : -45°C~+60°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 : 110VDC/Full Load DC ON/OFF TEST turn on 58sec ; turn off 2sec	TEST : OK
9	VIBRATION TEST	1 Carton & 1 Set (1) Waveform : Sine Wave (2) Frequency : 10~500Hz (3) Sweep Time : 12min/sweep cycle (4) Acceleration : 5G (5) Test Time : 60min in each axis (X.Y.Z) (6) Ta : 25°C	TEST : OK
10	CAPACITOR LIFE CYCLE	SUPPOSE C 105 IS THE MOST CRITICAL COMPONENT (1) I/P : 110VDC O/P : FULL LOAD Ta= 25°C LIFE TIME (2) I/P : 110VDC O/P : FULL LOAD Ta= 55°C LIFE TIME (3) I/P : 110VDC O/P : 75% LOAD Ta= 55°C LIFE TIME (4) I/P : 110VDC O/P : 50% LOAD Ta= 55°C LIFE TIME	(1) 697923HRS (2) 96743HRS (3) 163429HRS (4) 196525HRS
11	MTBF	2738.8K hrs min. Telcordia SR-332 (Bellcore) ; 593.9K hrs min. MIL-HDBK-217F (25°C)	
12	DMTBF/Accelerated Life Test	Demonstration Mean Time Between Failure (Expected Life): Above 30,000 hours @ TA 55°C	

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	Frank	Gesg	Wangdz

2007/3/20 A50-S014