



# Test Report: RSD-60H-24

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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	V1:0.717 %~ 0.767 %
2	LINE REGULATION (Max)	V1: 0.2 %~ -0.2 %	I/P: 40 VDC / 160 VDC O/P:FULL LOAD Ta:25°C	V1: 0%~ 0%
3	LOAD REGULATION (Max)	V1: 0.2 %~ -0.2 %	I/P: 110VDC O/P:FULL ~MIN LOAD Ta:25°C	V1: 0%~ 0%
4	OVER/UNDERSHOOT TEST	< ±5%	I/P: 110VDC O/P:FULL LOAD Ta:25°C	TEST: 1.245%
5	RIPPLE & NOISE (Max)	V1: 50mVp-p	I/P: 110VDC O/P:FULL LOAD Ta:25°C	V1: 21.4mVp-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/ 65.2ms
<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/48.4 ms

	<p>INPUT=110VDC @ FULL LOAD CH1 : Output Voltage</p>		
8	HOLD UP TIME (TYP)	110VDC/ 10 ms	I/P: 110VDC O/P: F FULL LOAD Ta:25°C 18ms / full load
	<p>INPUT=110VDC @ FULL LOAD CH1 : Output Voltage CH2 : AC Input Voltage</p>		
9	DYNAMIC LOAD	V1: 2400mVp-p	I/P: 110VDC O/P: (1)FULL /MIN LOAD 50%DUTY / 120HZ (2)FULL /MIN LOAD 50%DUTY / 1KHZ Ta:25°C 106mVp-p 98.0mVp-p
	<p>FULL /MIN LOAD 50%DUTY / 120HZ</p>		
	<p>FULL /MIN LOAD 50%DUTY / 1KHZ</p>		

### INPUT FUNCTION TEST

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	37.47V~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 = 0.588A/110VDC																			
3	EFFICIENCY(TYP)	91.5%	I/P: 110VDC O/P: FULL LOAD Ta: 25°C	92.8%																			
			<p>EFFICIENCY vs LOAD</p> <table border="1"> <caption>Efficiency vs Load Data (110VDC)</caption> <thead> <tr> <th>Load (%)</th> <th>Efficiency (%)</th> </tr> </thead> <tbody> <tr><td>10%</td><td>84</td></tr> <tr><td>20%</td><td>89</td></tr> <tr><td>30%</td><td>91</td></tr> <tr><td>40%</td><td>92</td></tr> <tr><td>50%</td><td>92</td></tr> <tr><td>60%</td><td>93</td></tr> <tr><td>70%</td><td>93</td></tr> <tr><td>80%</td><td>93</td></tr> <tr><td>90%</td><td>93</td></tr> <tr><td>100%</td><td>93</td></tr> </tbody> </table>		Load (%)	Efficiency (%)	10%	84	20%	89	30%	91	40%	92	50%	92	60%	93	70%	93	80%	93	90%
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4	INRUSH CURRENT(TYP)	110VDC/ 20A COLD START	I/P: 110VDC O/P: FULL LOAD Ta: 25°C	I = 18.6A/110 VDC																			
			<p>INPUT=110VDC @ FULL LOAD CH2 : DC Input Voltage CH1 : Input current</p> <p>Ch2 Max 18.6 A</p> <p>Ch1 36.4 V</p>																				

### PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
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	118.0% 118.0% 118.0% PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	CH: 27.6V~ 32.4 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	29.33V 29.33V 29.37V PROTECTION TYPE : Shut down o/p voltage, re-power on to recover
3	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE	I/P: 160VDC 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) Peak Voltage	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) 305V (2) 231V (3) 296V
2	Diode Peak Voltage	Q100 Rated : 10A/ 150 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) 123V (2) 105V (3) 91.2V
3	Input Capacitor Voltage	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) 168V (2) 167V (3) 168V (4) 167V
4	Control IC Voltage Test	PWM IC U1 Rated : 35 V 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) 21.3V (2) 10.6V (3) 10.8V (4) 24.1V

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) 217V (2) 218V
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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: 2.13mA ] I/P-FG:2.56 mA O/P-FG:1.32mA 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>18mΩ</b>

### E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RADIATION	EN55032 CLASS B	I/P: 110 VDC O/P:FULL LOAD Ta:25°C	PASS Test by certified Lab
2	CONDUCTION	EN55032 CLASS A	I/P: 110 VDC O/P:FULL LOAD Ta:25°C	PASS Test by certified Lab
3	E.S.D	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	EN61000-4-4 LIGHT INDUSTRY INPUT: 2KV	I/P: 110 VDC O/P:FULL LOAD Ta:25°C	CRITERIA A
5	SURGE	IEC61000-4-5 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℃																																																																																		
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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	Conducted by Parts Stress Analysis Prediction 593.8K 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