



# Test Report: RSD-60G-3.3

---

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

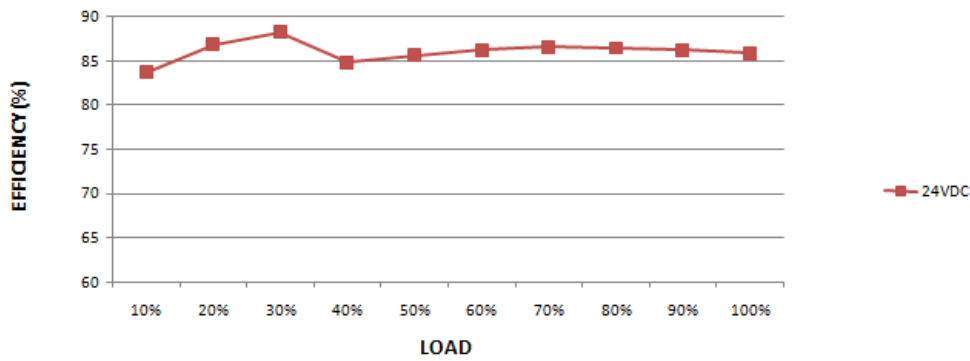
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE TOLERANCE (Max)	V1: 2 %~ -2 %	I/P: 9 VDC / 36 VDC O/P: FULL / MIN. LOAD Ta: 25°C	V1: 0.5545%~ -0.9788%
2	LINE REGULATION (Max)	V1: 0.5 %~ -0.5 %	I/P: 9 VDC / 36 VDC O/P: FULL LOAD Ta: 25°C	V1: 0 %~ 0 %
3	LOAD REGULATION (Max)	V1: 0.5 %~ -0.5 %	I/P: 24VDC O/P: FULL ~MIN LOAD Ta: 25°C	V1: -0.207%~ -0.207%
4	OVER/UNDERSHOOT TEST	< ±15%	I/P: 24 VDC O/P: FULL LOAD Ta: 25°C	TEST: 9.091%
5	RIPPLE & NOISE (Max)	V1: 60 mVp-p	I/P: 24 VDC O/P: FULL LOAD Ta: 25°C	V1: 28.8mVp-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)	24VDC/ 100 ms	I/P: 24VDC O/P: FULL LOAD Ta: 25°C	24VDC/ 28.4ms
<p>INPUT=24VDC @ FULL LOAD</p> <p>CH1 : Output Voltage CH2 : DC Input Voltage</p>				
7	RISE TIME (Max)	24VDC/ 60 ms	I/P: 24 VDC O/P: FULL LOAD Ta: 25°C	24VDC/ 10.6 ms

<p>INPUT=24VDC @ FULL LOAD</p> <p>CH1 : Output Voltage</p>			
8	<p>HOLD UP TIME (TYP)</p> <p>24VDC / 3 ms 24VDC / 10 ms</p>	<p>I/P: 24 VDC</p> <p>O/P: FULL LOAD / 50% LOAD</p> <p>Ta:25°C</p>	<p>9.6 ms / full load</p> <p>19 ms / 50% load</p>
<p>INPUT=24VDC @ FULL LOAD</p> <p>CH1 : Output Voltage CH2 : DC Input Voltage</p>		<p>INPUT=24VDC @ 50% LOAD</p> <p>CH1 : Output Voltage CH2 : DC Input Voltage</p>	
9	<p>DYNAMIC LOAD</p> <p>V1: 990 mVp-p</p>	<p>I/P: 24VDC</p> <p>O/P:</p> <p>(1) FULL / MIN LOAD 50%DUTY / 120HZ</p> <p>(2) FULL / MIN LOAD 50%DUTY / 1KHZ</p> <p>Ta:25°C</p>	<p>132mVp-p</p> <p>137mVp-p</p>
<p>FULL /50% LOAD 50%DUTY / 120HZ</p>		<p>FULL /50% LOAD 50%DUTY / 1KHZ</p>	

### INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	9VDC~ 36 VDC	I/P:TESTING O/P:FULL LOAD Ta:25°C	8.148V~ 36 V
			I/P: LOW-LINE-0.2= 8.8 V HIGH-LINE+3V= 39 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)	24VDC/ 2.1A	I/P: 24VDC O/P:FULL LOAD Ta:25°C	I=1.884A/24VDC
3	EFFICIENCY(TYP)	86.5%	I/P: 24VDC O/P:FULL LOAD Ta:25°C	87.1%

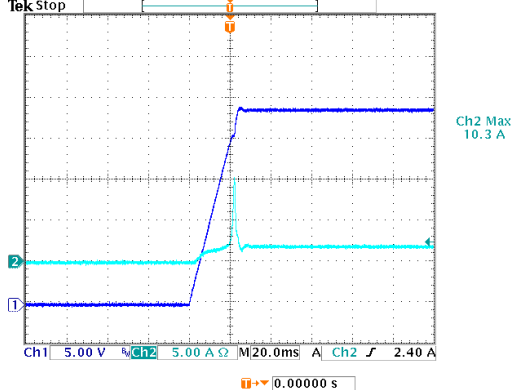
**EFFICIENCY vs LOAD**



4	INRUSH CURRENT(TYP)	24VDC/ 20A COLD START	I/P:24VDC O/P:FULL LOAD Ta:25°C	I=10.3A/24 VDC
---	---------------------	--------------------------	---------------------------------------	----------------

**INPUT=24VDC @ 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 PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed	I/P: 36VDC I/P: 24VDC I/P: 9VDC O/P:TESTING Ta:25°C	117.42% 117.42% 117.25% PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	CH: 4.3V~ 5.3 V PROTECTION TYPE : Shut down o/p voltage, re-power on to recover	I/P: 36 VDC I/P: 24VDC I/P: 9VDC O/P : NO LOAD Ta:25°C	4.69V 4.64V 4.70V PROTECTION TYPE : Shut down o/p voltage, re-power on to recover
3	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE	I/P: 36VDC O/P: FULL LOAD Ta:25°C	NO DAMAGE PROTECTION TYPE :
4.	INPUT REVERSE	POWER OK	I/P: 36 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 :70 A/ 100V	I/P:High-Line +3V =39V AC ON/OFF VDS: O/P: (1)Full Load (2)Output Short (3) Full Load Continue Ta:25°C	VDS: (1) 98.5V (2) 92.4V (3) 88.8V
2	Diode Peak Voltage	Q100 Rated :90 A/ 40V	I/P:High-Line +3V =39V AC ON/OFF O/P: (1)Full Load (2)Output Short (3) Full Load Continue Ta:25°C	Q100: VDS: (1) 35.4V (2) 29.2V (3) 35.0V
3	Input Capacitor Voltage	C5 Rated: :220 $\mu$ / 50 V 100°C	I/P:High-Line +3V =39V 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) 40.6V (2) 40.6V (3) 40.6V (4) 40.6V
4	Control IC Voltage Test	PWM IC U1 Rated : 40 V V(MIN.) -0.3 V	I/P:High-Line +3V =39V AC ON/OFF O/P(1)FULL LOAD (2) Output Short (3)O.L.P (4)O.V.P. Ta:25°C	(1) 17.8V (2) 12.0V (3) 12.0V (4) 16.6V

5	Clamp Diode Peak Voltage	D4 Rated : 600 V / 3 A	I/P : High-Line +3V = 39V AC ON/OFF O/P : (1) Dynamic Load 90%Duty/1KHz (2) Full load continue Ta : 25°C	(1) 39.0V (2) 30.4V
---	--------------------------	---------------------------	---	------------------------

### 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: 1.49mA I/P- FG: 1.23mA O/P-FG: 1.54mA 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: 9999 MΩ I/P- FG: 9999 MΩ O/P - FG: 9999 MΩ NO DAMAGE
3	GROUNDING CONTINUITY	EN 60950-1 FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25°C	25mΩ

### E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RADIATION	BS EN/EN55032 CLASS B	I/P: 24 VDC O/P:FULL LOAD Ta:25°C	PASS Test by certified Lab
2	CONDUCTION	BS EN/EN55032 CLASS B	I/P: 24 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: 24 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: 24 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: 24 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-60G-5 1. ROOM AMBIENT BURN-IN : 1HRS I/P : 24VDC O/P : FULL LOAD Ta= 23.4°C 2. HIGH AMBIENT BURN-IN : 1HRS I/P : 24VDC O/P : FULL LOAD Ta= 53.2°C																																																																																		
				<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta= 23.4 °C</th> <th>HIGH AMBIENT Ta= 53.2 °C</th> </tr> </thead> <tbody> <tr><td>1</td><td>C12</td><td>47.8°C</td><td>76.7°C</td></tr> <tr><td>2</td><td>LF1</td><td>50.6°C</td><td>80.1°C</td></tr> <tr><td>3</td><td>C5</td><td>48.8°C</td><td>77.9°C</td></tr> <tr><td>4</td><td>C6</td><td>50.5°C</td><td>79.7°C</td></tr> <tr><td>5</td><td>C40</td><td>52.7°C</td><td>81.9°C</td></tr> <tr><td>6</td><td>T2</td><td>59.5°C</td><td>89.0°C</td></tr> <tr><td>7</td><td>T1</td><td>65.7°C</td><td>95.3°C</td></tr> <tr><td>8</td><td>C110</td><td>56.5°C</td><td>86.0°C</td></tr> <tr><td>9</td><td>C105</td><td>59.8°C</td><td>89.6°C</td></tr> <tr><td>10</td><td>L100</td><td>55.5°C</td><td>85.0°C</td></tr> <tr><td>11</td><td>C108</td><td>47.8°C</td><td>76.5°C</td></tr> <tr><td>12</td><td>Q1</td><td>49.1°C</td><td>78.3°C</td></tr> <tr><td>13</td><td>Q2</td><td>50.1°C</td><td>79.4°C</td></tr> <tr><td>14</td><td>Q3</td><td>67.5°C</td><td>98.3°C</td></tr> <tr><td>15</td><td>U1</td><td>55.7°C</td><td>84.8°C</td></tr> <tr><td>16</td><td>D4</td><td>66.3°C</td><td>95.4°C</td></tr> <tr><td>17</td><td>Q100</td><td>60.5°C</td><td>90.4°C</td></tr> <tr><td>18</td><td>U100</td><td>50.0°C</td><td>79.0°C</td></tr> <tr><td>19</td><td>D1</td><td>47.9°C</td><td>77.1°C</td></tr> </tbody> </table>	NO	Position	ROOM AMBIENT Ta= 23.4 °C	HIGH AMBIENT Ta= 53.2 °C	1	C12	47.8°C	76.7°C	2	LF1	50.6°C	80.1°C	3	C5	48.8°C	77.9°C	4	C6	50.5°C	79.7°C	5	C40	52.7°C	81.9°C	6	T2	59.5°C	89.0°C	7	T1	65.7°C	95.3°C	8	C110	56.5°C	86.0°C	9	C105	59.8°C	89.6°C	10	L100	55.5°C	85.0°C	11	C108	47.8°C	76.5°C	12	Q1	49.1°C	78.3°C	13	Q2	50.1°C	79.4°C	14	Q3	67.5°C	98.3°C	15	U1	55.7°C	84.8°C	16	D4	66.3°C	95.4°C	17	Q100	60.5°C	90.4°C	18	U100	50.0°C	79.0°C	19	D1	47.9°C	77.1°C
NO	Position	ROOM AMBIENT Ta= 23.4 °C	HIGH AMBIENT Ta= 53.2 °C																																																																																	
1	C12	47.8°C	76.7°C																																																																																	
2	LF1	50.6°C	80.1°C																																																																																	
3	C5	48.8°C	77.9°C																																																																																	
4	C6	50.5°C	79.7°C																																																																																	
5	C40	52.7°C	81.9°C																																																																																	
6	T2	59.5°C	89.0°C																																																																																	
7	T1	65.7°C	95.3°C																																																																																	
8	C110	56.5°C	86.0°C																																																																																	
9	C105	59.8°C	89.6°C																																																																																	
10	L100	55.5°C	85.0°C																																																																																	
11	C108	47.8°C	76.5°C																																																																																	
12	Q1	49.1°C	78.3°C																																																																																	
13	Q2	50.1°C	79.4°C																																																																																	
14	Q3	67.5°C	98.3°C																																																																																	
15	U1	55.7°C	84.8°C																																																																																	
16	D4	66.3°C	95.4°C																																																																																	
17	Q100	60.5°C	90.4°C																																																																																	
18	U100	50.0°C	79.0°C																																																																																	
19	D1	47.9°C	77.1°C																																																																																	
3	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )	I/P : 24VDC O/P : 114 % LOAD Ta : 25°C	TEST : OK																																																																																
4	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 36VDC/ 9VDC O/P : 100 % LOAD Ta= -40 °C	TEST : OK																																																																																
5	HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST	AFTER 12 HOURS IN CHAMBER ON CONTROL 55 °C NO DAMAGE	I/P : 39VDC O/P : FULL LOAD Ta= 55 °C HUMIDITY= 95 %R.H	TEST: OK																																																																																
6	TEMPERATURE COEFFICIENT	± 0.03 %(0~50°C)	I/P : 24VDC O/P : FULL LOAD	± 0.0066 %(0~50°C)																																																																																
7	STORAGE TEMPERATURE TEST	1. Thermal shock Temperature : -40°C~ +85°C 2. Temperature change rate : 25°C / 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 : 36VDC/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 C105 IS THE MOST CRITICAL COMPONENT (1) I/P : 24VDC O/P : FULL LOAD Ta= 25°C LIFE TIME (2) I/P : 24VDC O/P : FULL LOAD Ta= 55°C LIFE TIME (3) I/P : 24VDC O/P : 75% LOAD Ta= 55°C LIFE TIME (4) I/P : 24VDC O/P : 50% LOAD Ta= 55°C LIFE TIME	(1) 158118HRS (2) 25053HRS (3) 88914HRS (4) 158118HRS
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