



# Test Report: RSD-60L-12

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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

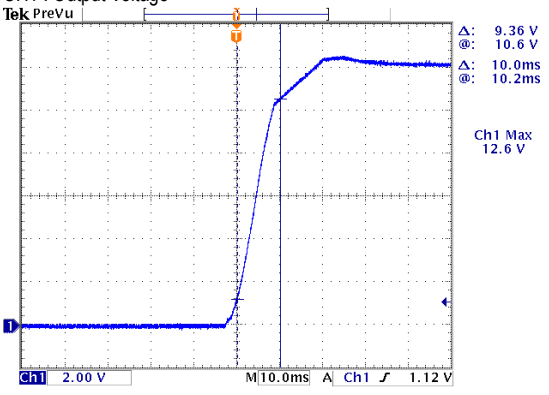
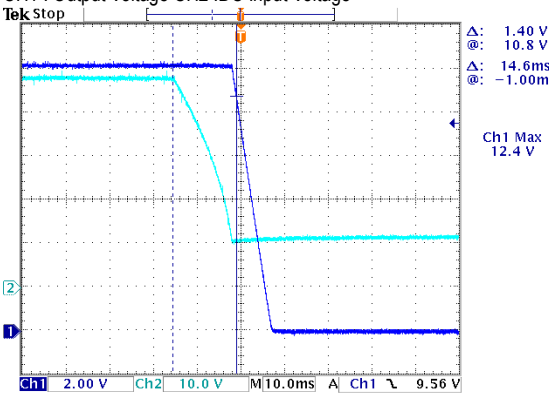
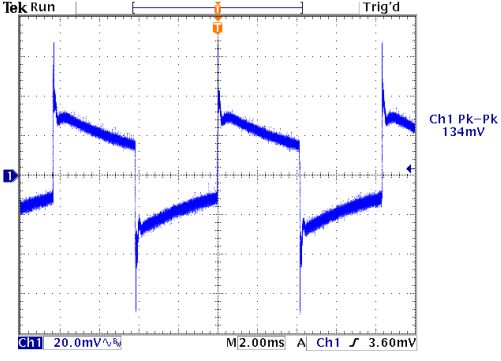
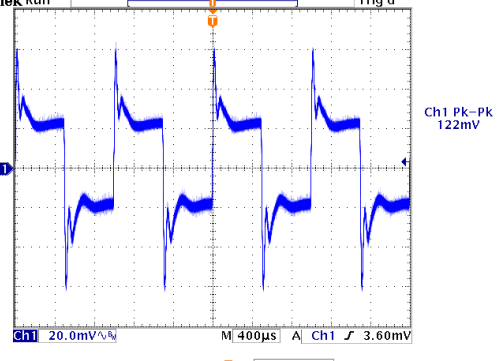
## ■ RELIABILITY TEST

ENVIRONMENT TEST

## DESIGN VERIFY TEST

### OUTPUT FUNCTION TEST

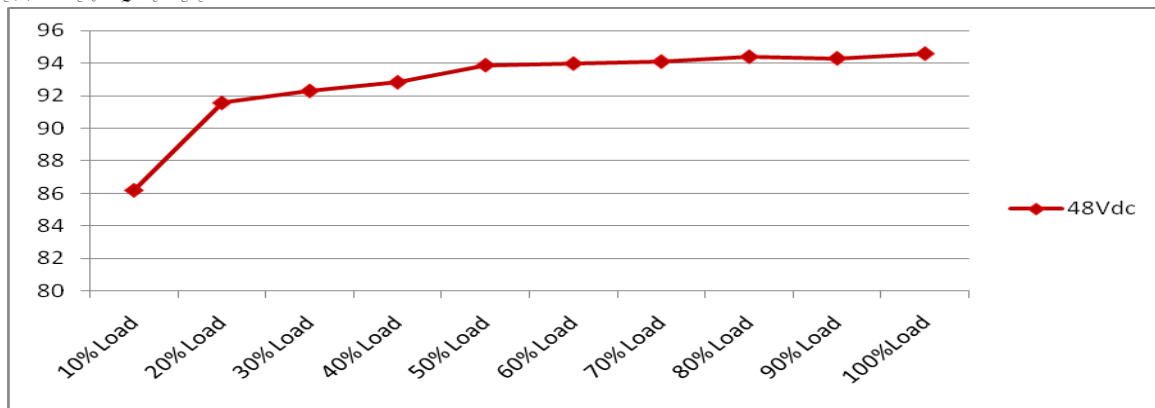
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE TOLERANCE (Max)	V1: 2 %~ -2 %	I/P: 18 VDC / 72 VDC O/P:FULL/ MIN. LOAD Ta:25°C	V1:0.817%~0.875%
2	LINE REGULATION (Max)	V1: 0.3 %~ -0.3 %	I/P: 18 VDC / 72 VDC O/P:FULL LOAD Ta:25°C	V1: 0%~ 0%
3	LOAD REGULATION (Max)	V1: 0.3 %~ -0.3 %	I/P: 48VDC O/P:FULL ~MIN LOAD Ta:25°C	V1: -0.24%~ 0.24 %
4	OVER/UNDERSHOOT TEST	< ±5%	I/P: 48 VDC O/P:FULL LOAD Ta:25°C	TEST: 4.0%
5	RIPPLE & NOISE (Max)	V1: 50 mVp-p	I/P: 48 VDC O/P:FULL LOAD Ta:25°C	V1: 11.6mVp-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)	48VDC/ 100ms	I/P: 48VDC O/P:FULL LOAD Ta:25°C	48VDC/ 24ms
<p>INPUT=48VDC @ FULL LOAD</p> <p>CH1 : Output Voltage CH2 : DC Input Voltage</p>				
7	RISE TIME (Max)	48VDC/ 60 ms	I/P: 48 VDC O/P:FULL LOAD Ta:25°C	48VDC/10ms

	<p>INPUT=48VDC @ FULL LOAD CH1 : Output Voltage</p>  <p>Δ: 9.36 V @: 10.6 V Δ: 10.0ms @: 10.2ms Ch1 Max 12.6 V</p> <p>2.00 V 10.0ms 1.12 V</p>			
8	HOLD UP TIME (TYP)	48VDC / 10 ms	I/P: 48 VDC O/P: FULL LOAD Ta:25°C	14.6 ms / full load
	<p>INPUT=48VDC @ FULL LOAD CH1 : Output Voltage CH2 :DC Input Voltage</p>  <p>Δ: 1.40 V @: 10.8 V Δ: 14.6ms @: -1.00ms Ch1 Max 12.4 V</p> <p>2.00 V 10.0 V 10.0ms 9.56 V</p>			
9	DYNAMIC LOAD	V1: 1200mVp-p	I/P: 48VDC O/P: (1)FULL /MIN LOAD 50%DUTY / 120HZ (2)FULL /MIN LOAD 50%DUTY / 1KHZ Ta:25°C	134mVp-p 122mVp-p
	<p>FULL /50% LOAD 50%DUTY / 120HZ</p>  <p>Ch1 Pk-Pk 134mV</p> <p>20.0mV 2.00ms 3.60mV</p>		<p>FULL /50% LOAD 50%DUTY / 1KHZ</p>  <p>Ch1 Pk-Pk 122mV</p> <p>20.0mV 400µs 3.60mV</p>	

INPUT FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	INPUT VOLTAGE RANGE	18 VDC / 72 VDC	I/P:TESTING O/P:FULL LOAD Ta:25°C	16.03V~ 72 V
			I/P: LOW-LINE-0.2= 17.8 V HIGH-LINE+3V= 75 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)	48VDC/ 1.5A	I/P: 48VDC O/P:FULL LOAD Ta:25°C	I =1.325A/48VDC
3	EFFICIENCY(TYP)	93%	I/P: 48VDC O/P:FULL LOAD Ta:25°C	94.59%

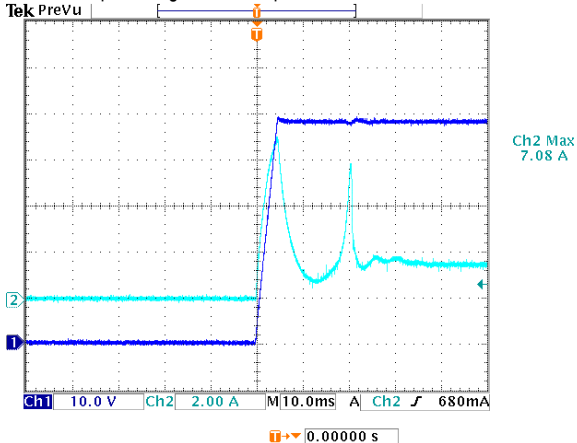
EFFICIENCY vs LOAD



4	INRUSH CURRENT(TYP)	48VDC/ 20A COLD START	I/P:48VDC O/P:FULL LOAD Ta:25°C	I =7.08A/ 48VDC
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INPUT=48VDC @ FULL LOAD

CH1 : DC Input Voltage CH2 : Input current



**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: 72VDC I/P: 48VDC I/P: 18VDC O/P:TESTING Ta:25°C	116.8% 116.8% 116.8% PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	CH: 13.8V~ 16.2 V PROTECTION TYPE : Shut down o/p voltage, re-power on to recover	I/P: 72VDC I/P: 48VDC I/P: 18VDC O/P : NO LOAD Ta:25°C	15.18V 15.14V 15.11V PROTECTION TYPE : Shut down o/p voltage, re-power on to recover
3	SHORT PROTECTION	SHORT EVERY OUTPUT 1 HOUR NO DAMAGE	I/P: 72VDC 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: 72 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 :33 A/ 150V	I/P:High-Line +3V =75V AC ON/OFF VDS: O/P: (1)Full Load (2)Output Short (3) Full Load Continue Ta:25°C	VDS: (1) 148V (2) 146V (3) 140V
2	Diode <b>Peak Voltage</b>	Q100 Rated : 70A/ 100 V	I/P:High-Line +3V =75V AC ON/OFF O/P: (1)Full Load (2)Output Short (3) Full Load Continue Ta:25°C	Q100: VDS: (1) 83.5V (2) 62.0V (3) 83.5V
3	<b>Input Capacitor Voltage</b>	C5 Rated: :120 $\mu$ /80 V 105°C	I/P:High-Line +3V =75V 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) 76.0V (2) 76.0V (3) 74.0V (4) 74.0V
4	<b>Control IC Voltage Test</b>	PWM IC U1 Rated : V(MAX.) 40V V(MIN.) -0.3V	I/P:High-Line +3V =75V AC ON/OFF O/P(1)FULL LOAD (2) Output Short (3)O.L.P (4)O.V.P. Ta:25°C	(1) 15.4V (2) 10.6V (3) 10.4V (4) 18.4V

5	Clamp Diode Peak Voltage	D4 Rated : 600 V / 3 A	I/P : High-Line +3V = 75V AC ON/OFF O/P : (1) Dynamic Load 90%Duty/1KHz (2)Full load continue Ta : 25°C	(1) 98.4V (2) 97.2V
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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: 2.32mA I/P-FG: 2.56mA O/P-FG: 1.23mA 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	18mΩ

### E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RADIATION	BS EN/EN55032 CLASS B	I/P: 48 VDC O/P:FULL LOAD Ta:25°C	PASS Test by certified Lab
2	CONDUCTION	BS EN/EN55032 CLASS B	I/P: 48 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: 48 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: 48 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:48 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-60L-12 1. ROOM AMBIENT BURN-IN : 1HRS I/P : 48VDC O/P : FULL LOAD Ta= 23.4℃ 2. HIGH AMBIENT BURN-IN : 1HRS I/P : 48VDC O/P : FULL LOAD Ta= 53.2℃																																																																																		
				<table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta= 23.4 ℃</th> <th>HIGH AMBIENT Ta= 53.2 ℃</th> </tr> </thead> <tbody> <tr><td>1</td><td>C12</td><td>36.3℃</td><td>65.6℃</td></tr> <tr><td>2</td><td>LF1</td><td>37.6℃</td><td>67.1℃</td></tr> <tr><td>3</td><td>C5</td><td>37.1℃</td><td>66.3℃</td></tr> <tr><td>4</td><td>C6</td><td>37.6℃</td><td>66.9℃</td></tr> <tr><td>5</td><td>C40</td><td>39.8℃</td><td>68.9℃</td></tr> <tr><td>6</td><td>T2</td><td>42.0℃</td><td>71.5℃</td></tr> <tr><td>7</td><td>T1</td><td>49.6℃</td><td>70.1℃</td></tr> <tr><td>8</td><td>C110</td><td>41.1℃</td><td>70.1℃</td></tr> <tr><td>9</td><td>C105</td><td>42.4℃</td><td>71.5℃</td></tr> <tr><td>10</td><td>L100</td><td>41.0℃</td><td>70.2℃</td></tr> <tr><td>11</td><td>C108</td><td>36.4℃</td><td>65.4℃</td></tr> <tr><td>12</td><td>Q1</td><td>37.4℃</td><td>66.9℃</td></tr> <tr><td>13</td><td>Q2</td><td>37.9℃</td><td>67.3℃</td></tr> <tr><td>14</td><td>Q3</td><td>45.5℃</td><td>75.4℃</td></tr> <tr><td>15</td><td>U1</td><td>40.9℃</td><td>70.4℃</td></tr> <tr><td>16</td><td>D4</td><td>45.7℃</td><td>75.4℃</td></tr> <tr><td>17</td><td>Q100</td><td>44.8℃</td><td>74.3℃</td></tr> <tr><td>18</td><td>U100</td><td>38.3℃</td><td>67.4℃</td></tr> <tr><td>19</td><td>D1</td><td>36.7℃</td><td>66.1℃</td></tr> </tbody> </table>	NO	Position	ROOM AMBIENT Ta= 23.4 ℃	HIGH AMBIENT Ta= 53.2 ℃	1	C12	36.3℃	65.6℃	2	LF1	37.6℃	67.1℃	3	C5	37.1℃	66.3℃	4	C6	37.6℃	66.9℃	5	C40	39.8℃	68.9℃	6	T2	42.0℃	71.5℃	7	T1	49.6℃	70.1℃	8	C110	41.1℃	70.1℃	9	C105	42.4℃	71.5℃	10	L100	41.0℃	70.2℃	11	C108	36.4℃	65.4℃	12	Q1	37.4℃	66.9℃	13	Q2	37.9℃	67.3℃	14	Q3	45.5℃	75.4℃	15	U1	40.9℃	70.4℃	16	D4	45.7℃	75.4℃	17	Q100	44.8℃	74.3℃	18	U100	38.3℃	67.4℃	19	D1	36.7℃	66.1℃
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3	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )	I/P : 48VDC O/P : 116.8 % LOAD Ta : 25℃	TEST : OK																																																																																
4	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 72VDC/ 18VDC 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 : 75VDC O/P : FULL LOAD Ta= 55 ℃ HUMIDITY= 95 %R.H	TEST: OK																																																																																
6	TEMPERATURE COEFFICIENT	± 0.03 %(0~50℃)	I/P : 48VDC O/P : FULL LOAD	± 0.0028 %(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 : 48VDC/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 : 48VDC O/P : FULL LOAD Ta= 25°C LIFE TIME (2) I/P : 48VDC O/P : FULL LOAD Ta= 55°C LIFE TIME (3) I/P : 48VDC O/P : 75% LOAD Ta= 55°C LIFE TIME (4) I/P : 48VDC O/P : 50% LOAD Ta= 55°C LIFE TIME	(1) 866977HRS (2) 113760HRS (3) 175576HRS (4) 251932HRS
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