Test Report: RSD-60L-5

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

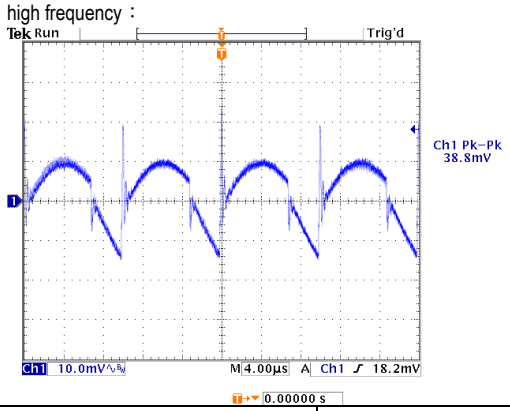
ENVIRONMENT TEST

■ DESIGN VERIFY TEST

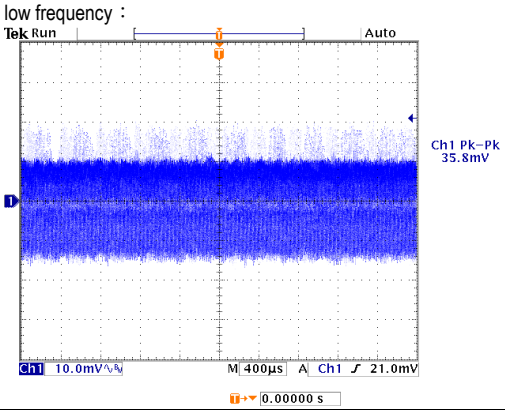
OUTPUT FUNCTION TEST

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℃	V1: 0.568%~0.854%
2	LINE REGULATION (Max)	V1: 0.5 %~ -0.5 %	I/P: 18 VDC / 72 VDC O/P:FULL LOAD Ta:25℃	V1: 0%~ 0%
3	LOAD REGULATION (Max)	V1: 0.5 %~ -0.5 %	I/P: 48VDC O/P:FULL ~MIN LOAD Ta:25℃	V1: -0.1367 %~ 0.1563%
4	OVER/UNDERSHOOT TEST	＜±10%	I/P: 48 VDC O/P:FULL LOAD Ta:25℃	TEST:3.26%
5	RIPPLE & NOISE (Max)	V1: 60mVp-p	I/P: 48 VDC O/P:FULL LOAD Ta:25℃	V1: 38.8mVp-p

high frequency：



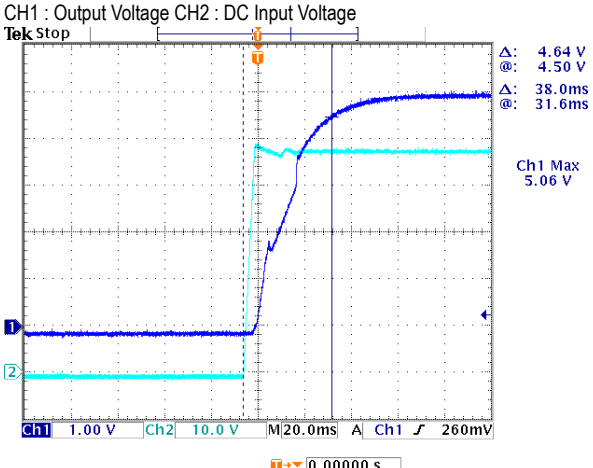
low frequency：



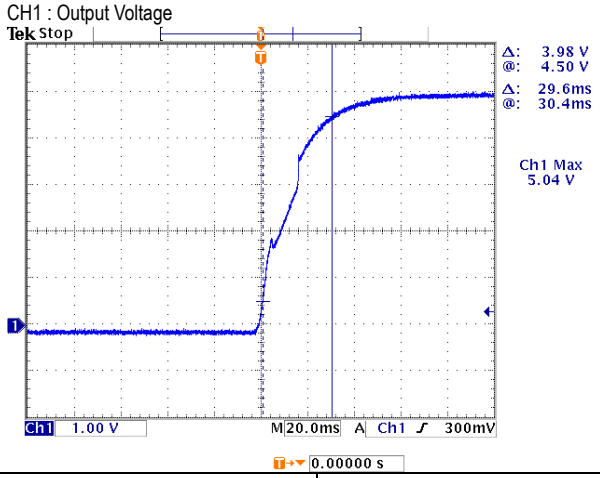
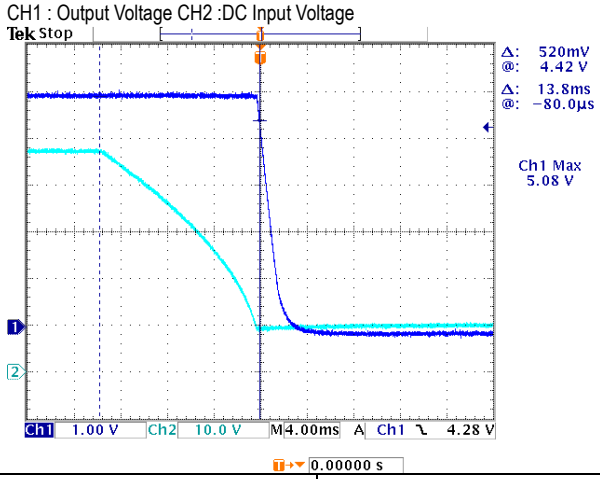
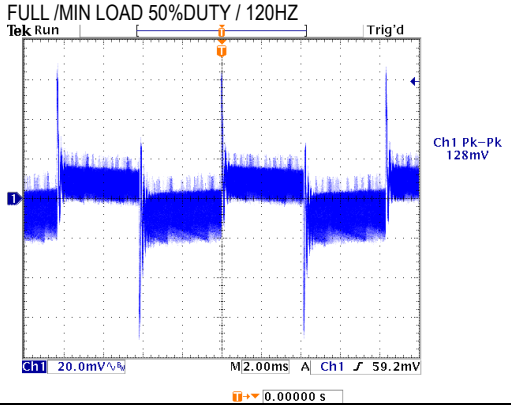
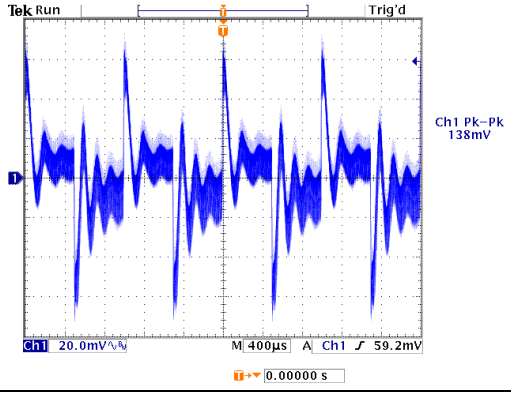
6	SET UP TIME (Max)	48VDC/ 100ms	I/P: 48VDC O/P:FULL LOAD Ta:25℃	48VDC/ 38ms

INPUT=48VDC @ FULL LOAD

CH1 : Output Voltage CH2 : DC Input Voltage



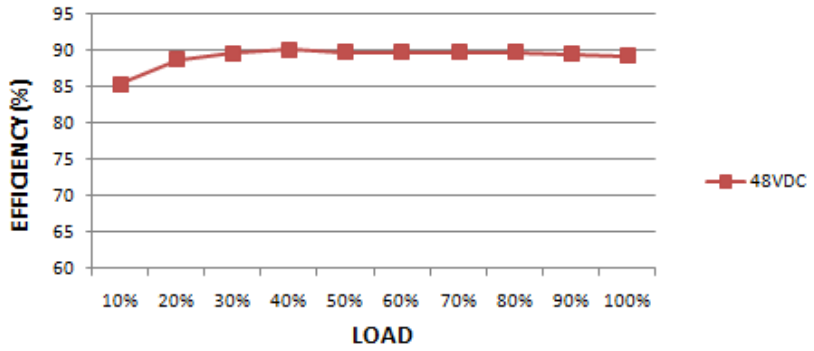
7	RISE TIME (Max)	48VDC/ 60 ms	I/P: 48 VDC O/P:FULL LOAD Ta:25℃	48VDC/29.6ms

	INPUT=48VDC @ FULL LOAD CH1 : Output Voltage 			
8	HOLD UP TIME (TYP)	48VDC/ 10 ms	I/P: 48 VDC O/P:F ULL LOAD Ta:25℃	13.8ms / full load
	INPUT=48VDC @ FULL LOAD CH1 : Output Voltage CH2 :DC Input Voltage 			
9	DYNAMIC LOAD	V1: 1000mVp-p	I/P: 48VDC O/P: (1)FULL /MIN LOAD 50%DUTY / 120HZ (2)FULL /MIN LOAD 50%DUTY / 1KHZ Ta:25℃	 128mVp-p 138mVp-p
	FULL /MIN LOAD 50%DUTY / 120HZ 		FULL /50% LOAD 50%DUTY / 1KHZ 	

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℃	12.8V~ 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℃	I =1.399A/48VDC
3	EFFICIENCY(TYP)	89%	I/P: 48VDC O/P:FULL LOAD Ta:25℃	89.53%

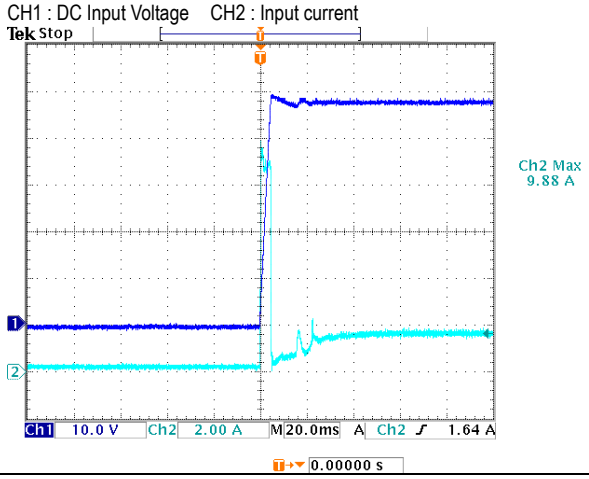
EFFICIENCY vs LOAD



NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
4	INRUSH CURRENT(TYP)	48VDC/ 20A COLD START	I/P:48VDC O/P:FULL LOAD Ta:25℃	I =9.88A/ 48VDC

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℃	119.0% 119.0% 119.0% 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: 72VDC I/P: 48VDC I/P: 18VDC O/P：NO LOAD Ta:25℃	6.34V 6.35V 6.34V 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℃	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℃	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 :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℃	 VDS: (1) 143V (2) 119V (3) 135V
2	Diode Peak **Voltage**	Q100 Rated : 90A/ 40 V	I/P:High-Line +3V =75V AC ON/OFF O/P: (1)Full Load (2)Output Short (3) Full Load Continue Ta:25℃	Q100: VDS: (1) 38.8V (2) 27.2V (3) 37.6V
3	**Input Capacitor Voltage**	C5 Rated: :120 μ/80 V 105℃s	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℃	(1) 76V (2) 75.8V (3) 74.8V (4) 74.8V
4	**Control IC Voltage Test**	PWM IC U1 Rated : 40 V 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℃	(1) 22.2V (2) 10.8V (3) 10.9V (4) 15.8V

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℃	(1) 88.8V (2) 88.8V

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℃	I/P-O/P: 1.31mA I/P-FG: 2.54mA O/P-FG: 2.23mA 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℃	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℃	**16mΩ**

E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RADIATION	EN55032 CLASS B	I/P: 48 VDC O/P:FULL LOAD Ta:25℃	PASS Test by certified Lab
2	CONDUCTION	EN55032 CLASS B	I/P: 48 VDC O/P:FULL LOAD Ta:25℃	PASS Test by certified Lab
3	E.S.D	EN61000-4-2 LIGHT INDUSTRY AIR:8KV / Contact:6KV	I/P: 48 VDC O/P:FULL LOAD Ta:25℃	CRITERIA A
4	E.F.T	EN61000-4-4 LIGHT INDUSTRY INPUT: 2KV	I/P: 48 VDC O/P:FULL LOAD Ta:25℃	CRITERIA A
5	SURGE	IEC61000-4-5 LIGHT INDUSTRY L-N :1KV L,N-PE:2KV	I/P:48 VDC O/P:FULL LOAD Ta:25℃	CRITERIA A
6	Test by certified Lab & Test Report Prepare			

■ RELIABILITY TEST

ENVIRONMENT TEST

<table>
<tr><th>NO</th><th>TEST ITEM</th><th>SPECIFICATION</th><th>TEST CONDITION</th><th>RESULT</th></tr>
<tr><td>2</td><td>TEMPERATURE RISE TEST</td><td colspan="3">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>
<tr><th>NO</th><th>Position</th><th>ROOM AMBIENT Ta= 23.4 ℃</th><th>HIGH AMBIENT Ta= 53.2 ℃</th></tr>
<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>
</table></td></tr>
<tr><td>3</td><td>OVER LOAD BURN-IN TEST</td><td>NO DAMAGE
1 HOUR (MIN)</td><td>I/P： 48VDC
O/P：116.8 % LOAD
Ta：25℃</td><td>TEST：OK</td></tr>
<tr><td>4</td><td>LOW TEMPERATURE
TURN ON TEST</td><td>TURN ON AFTER 2 HOUR</td><td>I/P： 72VDC/ 18VDC
O/P： 100 % LOAD
Ta= -40 ℃</td><td>TEST：OK</td></tr>
<tr><td>5</td><td>HIGH HUMIDITY
HIGH TEMPERATURE
HIGH VOLTAGE
TURN ON TEST</td><td>AFTER 12 HOURS
IN CHAMBER ON
CONTROL 55 ℃
NO DAMAGE</td><td>I/P： 75VDC
O/P：FULL LOAD
Ta= 55 ℃
HUMIDITY= 95 %R.H</td><td>TEST：OK</td></tr>
<tr><td>6</td><td>TEMPERATURE
COEFFICIENT</td><td>± 0.03 %(0~50℃)</td><td>I/P： 48VDC
O/P：FULL LOAD</td><td>± 0.0028 %(0~50℃)</td></tr>
<tr><td>7</td><td>STORAGE TEMPERATURE TEST</td><td colspan="2">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</td><td>TEST：OK</td></tr>
</table>

8.	THERMAL SHOCK TEST	1. Thermal shock Temperature： -45℃~ +60℃ 2. Temperature change rate ：25℃ / 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℃	TEST：OK
10	CAPACITOR LIFE CYCLE	SUPPOSE C 105 IS THE MOST CRITICAL COMPONENT (1) I/P： 48VDC O/P：FULL LOAD Ta= 25℃ LIFE TIME (2) I/P： 48VDC O/P：FULL LOAD Ta= 55℃ LIFE TIME (3) I/P： 48VDC O/P：75% LOAD Ta= 55℃ LIFE TIME (4) I/P： 48VDC O/P：50% LOAD Ta= 55℃ LIFE TIME	 (1) 866977HRS (2) 113760HRS (3) 175576HRS (4) 251932HRS
11	MTBF	Conducted by Parts Stress Analysis Prediction 593.8K hrs min. MIL-HDBK-217F (25℃)	
12	DMTBF/Accelerated Life Test	Demonstration Mean Time Between Failure (Expected Life): Above 30,000 hours @ TA 55℃	

TEST RESULT	TESTER	REVIEW	APPROVAL
PASS	**Frank**	**Gesg**	**Wangdz**

2007/3/20 A50-S014