Test Report: RSD-60G-12

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

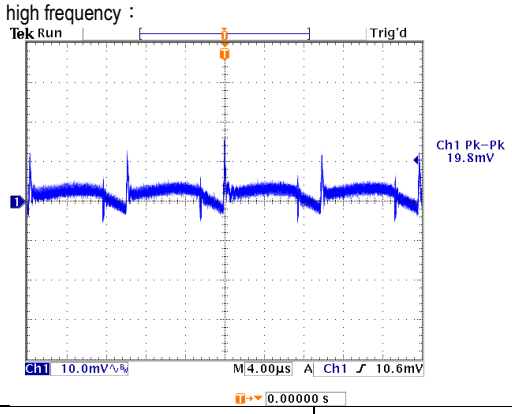
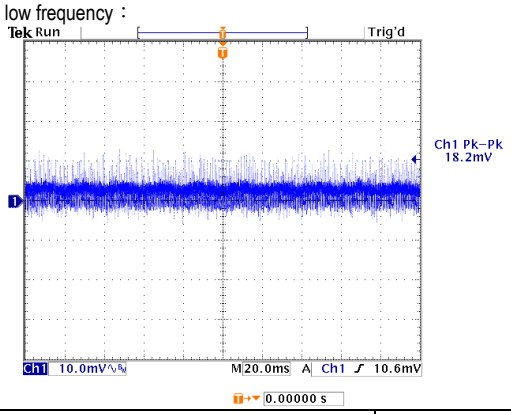
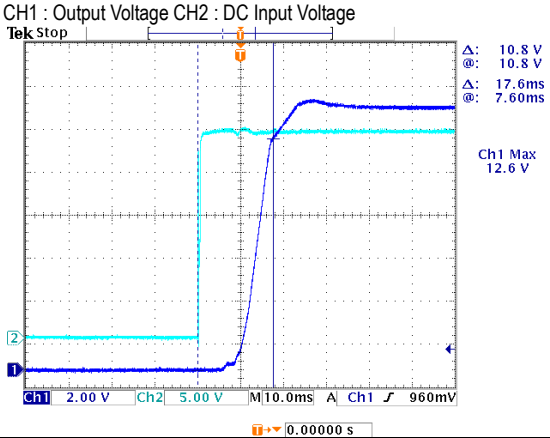
Safety Test
E.M.C. Test

■ RELIABILITY TEST

ENVIRONMENT TEST

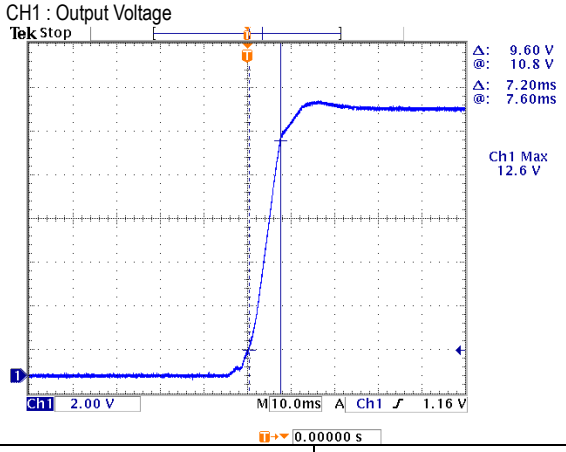
■ DESIGN VERIFY TEST

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℃	V1: 0.458%~0.508%
2	LINE REGULATION(Max)	V1: 0.3%~ -0.3%	I/P: 9 VDC /36 VDC O/P:FULL LOAD Ta:25℃	V1:0%~0%
3	LOAD REGULATION(Max)	V1:0.3%~-0.3 %	I/P: 24VDC O/P:FULL ~MIN LOAD Ta:25℃	V1: -0.0326%~0.0245%
4	OVER/UNDERSHOOT TEST	<±5%	I/P: 24 VDC O/P:FULL LOAD Ta:25℃	TEST:2.04%
5	RIPPLE & NOISE(Max)	V1: 50 mVp-p	I/P: 24 VDC O/P:FULL LOAD Ta:25℃	V1:19.8mVp-p
	high frequency： 		low frequency： 	
6	SET UP TIME(Max)	24VDC/100ms	I/P: 24VDC O/P:FULL LOAD Ta:25℃	24VDC/17.6ms
	INPUT=24VDC @ FULL LOAD CH1 : Output Voltage CH2 : DC Input Voltage 			
7	RISE TIME (Max)	24VDC/60ms	I/P: 24VDC O/P:FULL LOAD Ta:25℃	24VDC/7.2ms

INPUT=24VDC @ FULL LOAD

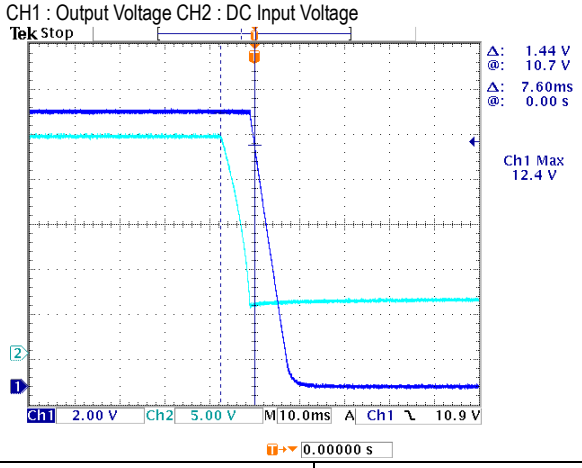
CH1 : Output Voltage



8	HOLD UP TIME (TYP)	24VDC/ 3 ms 24VDC/ 10 ms	I/P: 24VDC O/P:FULL LOAD / 50% LOAD Ta:25℃	7.6ms / full load 15.8ms / 50% load

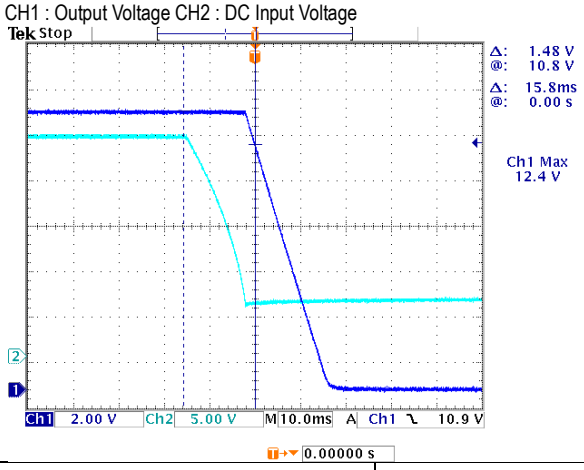
INPUT=24VDC @ FULL LOAD

CH1 : Output Voltage CH2 : DC Input Voltage



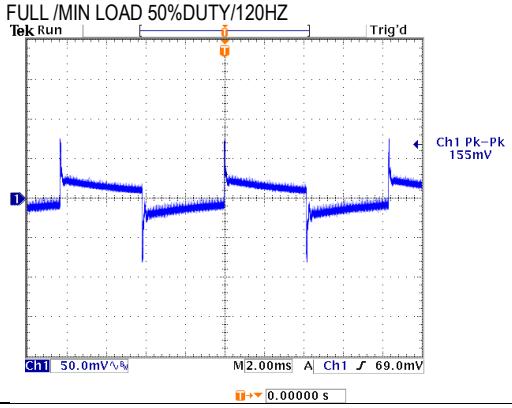
INPUT=24VDC @ 50% LOAD

CH1 : Output Voltage CH2 : DC Input Voltage

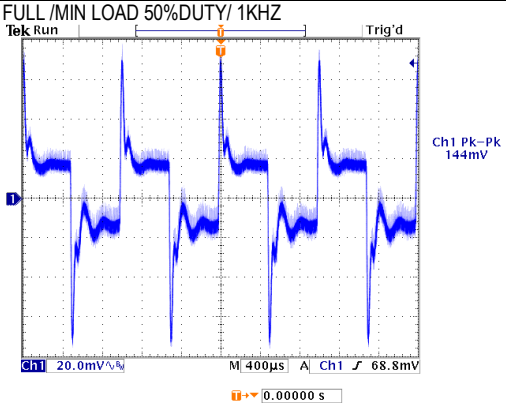


9	DYNAMIC LOAD	V1: 1200 mVp-p	I/P: 24VDC O/P: (1)FULL /MIN LOAD 50%DUTY/120HZ (2)FULL /MIN LOAD 50%DUTY/ 1KHZ Ta:25℃	 155mVp-p 144mVp-p

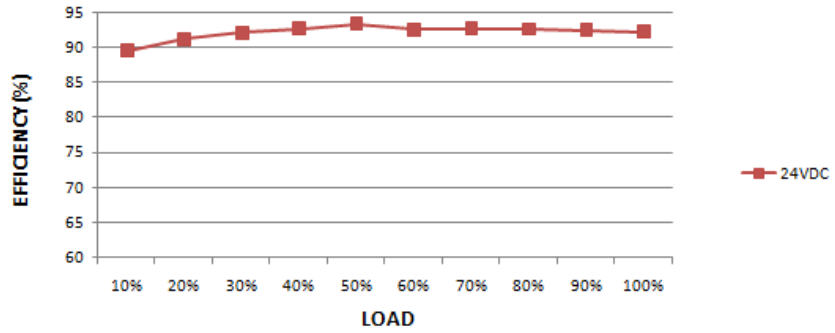
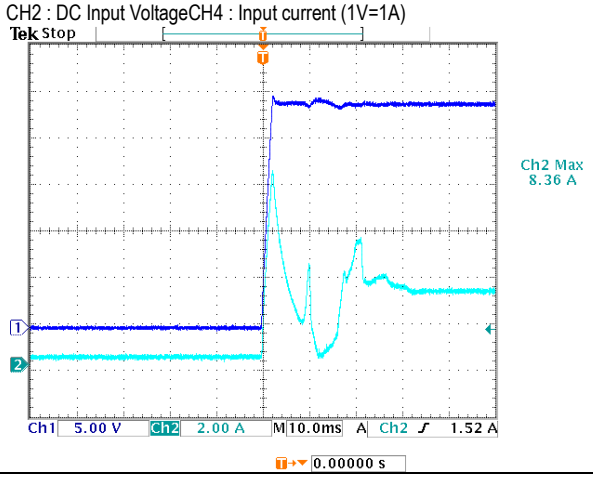
FULL /MIN LOAD 50%DUTY/120HZ



FULL /MIN LOAD 50%DUTY/ 1KHZ



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℃	6.73V~ 36 V
			I/P: LOW-LINE-0.2=8.8 V HIGH-LINE+3V= 39V 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/3A	I/P: 24VDC O/P:FULL LOAD Ta:25℃	I =2.7088A/24VDC
3	EFFICIENCY(TYP)	92%	I/P: 24VDC O/P:FULL LOAD Ta:25℃	92.73%
	EFFICIENCY vs LOAD  			
4	INRUSH CURRENT(TYP)	24VDC/20A COLD START	I/P:24VDC O/P:FULL LOAD Ta:25℃	I =8.36A/24 VDC
	INPUT=24VDC @ FULL LOAD CH2 : DC Input VoltageCH4 : Input current (1V=1A)  			

PROTECTION FUNCTION TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OVER LOADPROTECTION	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℃	119.4% 119.4% 119.4% 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: 36 VDC I/P: 24VDC I/P: 9VDC O/P：NO LOAD Ta:25℃	15.14V 15.14V 15.14V 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℃	NO DAMAGE PROTECTION TYPE：Constant current limiting, recovers automatically after fault condition is removed
4.	INPUT REVERSE	POWER OK	I/P: 36 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 :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℃	 VDS: (1)98.5V (2)91.2V (3) 89.2V
2	Diode Peak**Voltage**	Q100 Rated :70A/ 100 V	I/P:High-Line +3V =39V AC ON/OFF O/P: (1)Full Load (2)Output Short (3) Full Load Continue Ta:25℃	Q100: VDS: (1)88.0V (2)70.0V (3)87.6V
3	**Input Capacitor Voltage**	C5 Rated: :220 μ / 50V 100℃	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℃	(1)41.2V (2)41.2V (3)40.8V (4)40.8V
4	**Control IC Voltage Test**	PWM IC U1 Rated MP3910:35V V(MIN.)0.5 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℃	(1)15.2V (2)11.5V (3)11.4V (4)18.2V

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℃	(1)49.8V (2)49.2V

SAFETY TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	WITHSTANDVOLTAGE	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:2.21mA I/P- FG: 1.53mA O/P-FG: 1.12mA NO DAMAGE
2	ISOLATIONRESISTANCE	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	GROUNDINGCONTINUITY	EN 60950-1 FG(PE) TO CHASSIS OR TRACE < 100 mΩ	40A / 2min Ta:25℃	**20mΩ**

E.M.C TEST

NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	RADIATION	EN55032 CLASS B	I/P: 24 VDC O/P:FULL LOAD Ta:25℃	PASS Test by certified Lab
2	CONDUCTION	EN55032 CLASS B	I/P: 24 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: 24 VDC O/P:FULL LOAD Ta:25℃	CRITERIA A
4	E.F.T	EN61000-4-4 LIGHT INDUSTRY INPUT: 2KV	I/P: 24 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: 24 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-30G-5
1. ROOM AMBIENT BURN-IN： 1HRS
I/P： 36VDC O/P： FULL LOAD Ta= 23.4℃
2. HIGH AMBIENT BURN-IN： 1HRS
I/P： 36VDC 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>47.8℃</td><td>76.7℃</td></tr>
<tr><td>2</td><td>LF1</td><td>50.6℃</td><td>80.1℃</td></tr>
<tr><td>3</td><td>C5</td><td>48.8℃</td><td>77.9℃</td></tr>
<tr><td>4</td><td>C6</td><td>50.5℃</td><td>79.7℃</td></tr>
<tr><td>5</td><td>C40</td><td>52.7℃</td><td>81.9℃</td></tr>
<tr><td>6</td><td>T2</td><td>59.5℃</td><td>89.0℃</td></tr>
<tr><td>7</td><td>T1</td><td>65.7℃</td><td>95.3℃</td></tr>
<tr><td>8</td><td>C110</td><td>56.5℃</td><td>86.0℃</td></tr>
<tr><td>9</td><td>C105</td><td>59.8℃</td><td>89.6℃</td></tr>
<tr><td>10</td><td>L100</td><td>55.5℃</td><td>85.0℃</td></tr>
<tr><td>11</td><td>C108</td><td>47.8℃</td><td>76.5℃</td></tr>
<tr><td>12</td><td>Q1</td><td>49.1℃</td><td>78.3℃</td></tr>
<tr><td>13</td><td>Q2</td><td>50.1℃</td><td>79.4℃</td></tr>
<tr><td>14</td><td>Q3</td><td>67.5℃</td><td>98.3℃</td></tr>
<tr><td>15</td><td>U1</td><td>55.7℃</td><td>84.8℃</td></tr>
<tr><td>16</td><td>D4</td><td>66.3℃</td><td>95.4℃</td></tr>
<tr><td>17</td><td>Q100</td><td>60.5℃</td><td>90.4℃</td></tr>
<tr><td>18</td><td>U100</td><td>50.0℃</td><td>79.0℃</td></tr>
<tr><td>19</td><td>D1</td><td>47.9℃</td><td>77.1℃</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： 24VDC
O/P：114 % 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： 36VDC/ 9VDC
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： 39VDC
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： 24VDC
O/P：FULL LOAD</td><td>± 0.0066 %(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： 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℃	TEST：OK
10	CAPACITOR LIFE CYCLE	SUPPOSE C105 IS THE MOST CRITICAL COMPONENT (1) I/P： 230VAC O/P：FULL LOAD Ta= 55℃ LIFE TIME (2) I/P： 230VAC O/P：FULL LOAD Ta= 55℃ LIFE TIME (3) I/P： 230VAC O/P：75% LOAD Ta= 55℃ LIFE TIME (4) I/P： 230VAC O/P：50% LOAD Ta= 55℃ LIFE TIME	(1) 158118HRS (2) 25053HRS (3) 88914HRS (4) 158118HRS
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

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