



# Test Report: RSD-60G-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: 9 VDC /36 VDC O/P:FULL/ MIN. LOAD Ta:25°C	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°C	V1:0%~0%
3	LOAD REGULATION(Max)	V1:0.3%~ -0.3 %	I/P: 24VDC O/P:FULL ~MIN LOAD Ta:25°C	V1: -0.0326%~ -0.0245%
4	OVER/UNDERSHOOT TEST	<±5%	I/P: 24 VDC O/P:FULL LOAD Ta:25°C	TEST:2.04%
5	RIPPLE & NOISE(Max)	V1: 50 mVp-p	I/P: 24 VDC O/P:FULL LOAD Ta:25°C	V1:19.8mVp-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/100ms	I/P: 24VDC O/P:FULL LOAD Ta:25°C	24VDC/17.6ms
<p>INPUT=24VDC @ FULL LOAD</p> <p>CH1 : Output Voltage CH2 : DC Input Voltage</p>				
7	RISE TIME (Max)	24VDC/60ms	I/P: 24VDC O/P:FULL LOAD Ta:25°C	24VDC/7.2ms

<p>INPUT=24VDC @ FULL LOAD CH1 : Output Voltage</p> <p>Ch1 Max 12.6 V</p>			
8	<p>HOLD UP TIME (TYP)</p> <p>24VDC / 3 ms 24VDC / 10 ms</p>	<p>I/P: 24VDC O/P: FULL LOAD / 50% LOAD Ta:25°C</p>	<p>7.6ms / full load 15.8ms / 50% load</p>
<p>INPUT=24VDC @ FULL LOAD CH1 : Output Voltage CH2 : DC Input Voltage</p> <p>Ch1 Max 12.4 V</p>		<p>INPUT=24VDC @ 50% LOAD CH1 : Output Voltage CH2 : DC Input Voltage</p> <p>Ch1 Max 12.4 V</p>	
9	<p>DYNAMIC LOAD</p> <p>V1: 1200 mVp-p</p>	<p>I/P: 24VDC O/P: (1) FULL / MIN LOAD 50% DUTY / 120HZ (2) FULL / MIN LOAD 50% DUTY / 1KHZ Ta:25°C</p>	<p>155mVp-p 144mVp-p</p>
<p>FULL / MIN LOAD 50% DUTY / 120HZ</p> <p>Ch1 Pk-Pk 155mV</p>		<p>FULL / MIN LOAD 50% DUTY / 1KHZ</p> <p>Ch1 Pk-Pk 144mV</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	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°C	I =2.7088A/24VDC																						
3	EFFICIENCY(TYP)	92%	I/P: 24VDC O/P:FULL LOAD Ta:25°C	92.73%																						
<p>EFFICIENCY vs LOAD</p> <table border="1"> <caption>Efficiency vs Load Data (Approximate)</caption> <thead> <tr> <th>LOAD (%)</th> <th>EFFICIENCY (%)</th> </tr> </thead> <tbody> <tr><td>10%</td><td>89</td></tr> <tr><td>20%</td><td>91</td></tr> <tr><td>30%</td><td>92</td></tr> <tr><td>40%</td><td>92.5</td></tr> <tr><td>50%</td><td>93</td></tr> <tr><td>60%</td><td>92.5</td></tr> <tr><td>70%</td><td>92.5</td></tr> <tr><td>80%</td><td>92.5</td></tr> <tr><td>90%</td><td>92.5</td></tr> <tr><td>100%</td><td>92</td></tr> </tbody> </table>					LOAD (%)	EFFICIENCY (%)	10%	89	20%	91	30%	92	40%	92.5	50%	93	60%	92.5	70%	92.5	80%	92.5	90%	92.5	100%	92
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4	INRUSH CURRENT(TYP)	24VDC/20A COLD START	I/P:24VDC O/P:FULL LOAD Ta:25°C	I =8.36A/24 VDC																						
<p>INPUT=24VDC @ FULL LOAD CH2 : DC Input VoltageCH4 : Input current (1V=1A)</p> <p>Ch2 Max 8.36 A</p> <p>0.00000 s</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: 36VDC I/P: 24VDC I/P: 9VDC O/P: TESTING Ta:25°C	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°C	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°C	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°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)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°C	Q100: VDS: (1)88.0V (2)70.0V (3)87.6V
3	Input Capacitor Voltage	C5 Rated: :220 $\mu$ / 50V 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)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°C	(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°C	(1)49.8V (2)49.2V
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### 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°C	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°C	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°C	<b>20mΩ</b>

### 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°C	PASS Test by certified Lab
2	CONDUCTION	EN55032 CLASS B	I/P: 24 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: 24 VDC O/P:FULL LOAD Ta:25°C	CRITERIA A
4	E.F.T	EN61000-4-4 LIGHT INDUSTRY INPUT: 2KV	I/P: 24 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: 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℃ 2. HIGH AMBIENT BURN-IN : 1HRS I/P : 24VDC O/P : FULL LOAD Ta= 53.2℃																																																																																		
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3	OVER LOAD BURN-IN TEST	NO DAMAGE 1 HOUR ( MIN )	I/P : 24VDC O/P : 114 % LOAD Ta : 25℃	TEST : OK																																																																																
4	LOW TEMPERATURE TURN ON TEST	TURN ON AFTER 2 HOUR	I/P : 36VDC/ 9VDC 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 : 39VDC O/P : FULL LOAD Ta= 55 ℃ HUMIDITY= 95 %R.H	TEST: OK																																																																																
6	TEMPERATURE COEFFICIENT	± 0.03 %(0~50℃)	I/P : 24VDC O/P : FULL LOAD	± 0.0066 %(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 : 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	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