



# Test Report: RSD-60L-3.3

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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

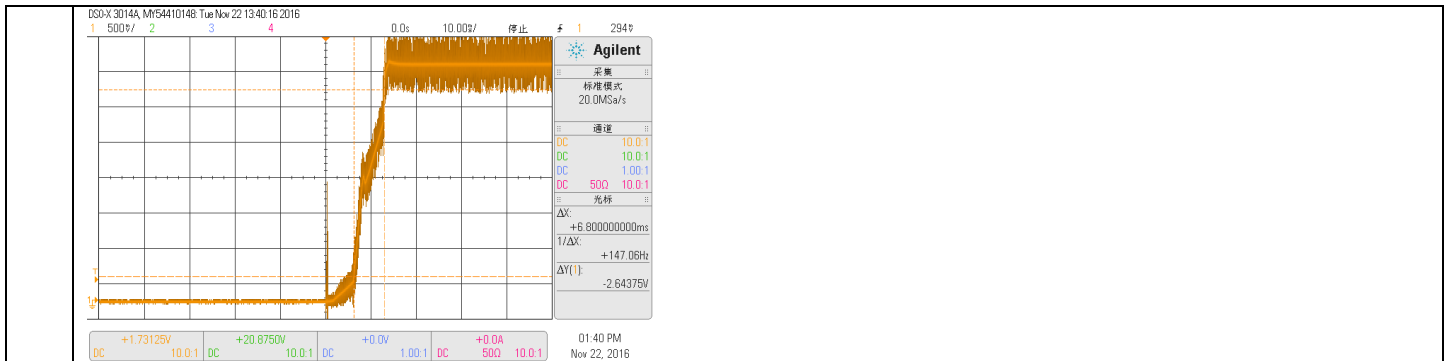
## ■ RELIABILITY TEST

ENVIRONMENT TEST

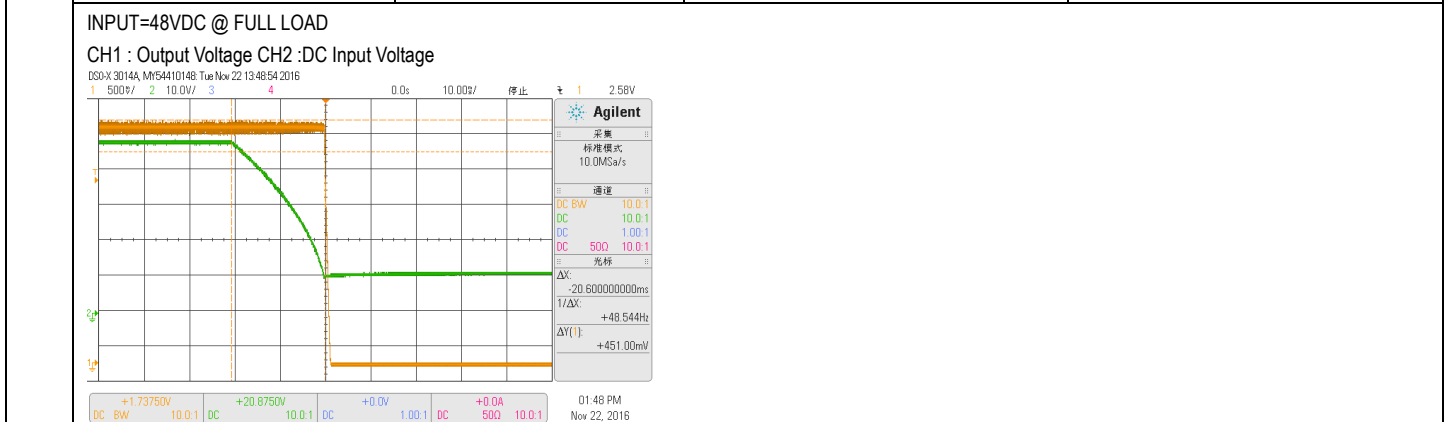
## DESIGN VERIFY TEST

### OUTPUT FUNCTION TEST

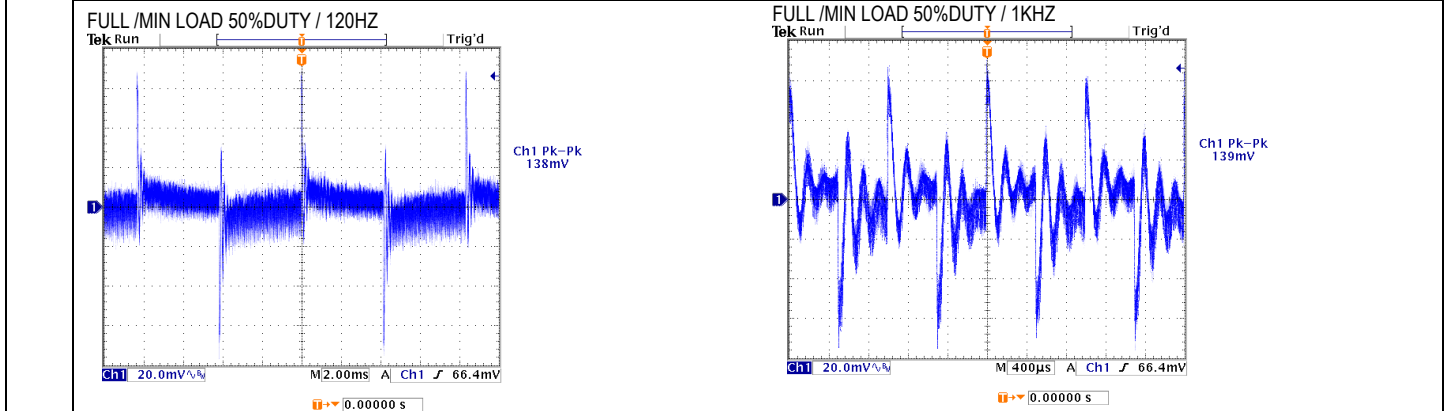
NO	TEST ITEM	SPECIFICATION	TEST CONDITION	RESULT
1	OUTPUT VOLTAGE TOLERANCE (Max)	V1: 2 %~ -2 %	I/P: 18 VDC / 72 VDC O/P:FULL/ MIN. LOAD Ta:25°C	V1: 0.724 %~1.18 %
2	LINE REGULATION (Max)	V1: 0.5 %~ -0.5 %	I/P: 18 VDC / 72 VDC O/P:FULL LOAD Ta:25°C	V1: 0%~ 0%
3	LOAD REGULATION (Max)	V1: 0.5 %~ -0.5 %	I/P: 48VDC O/P:FULL ~MIN LOAD Ta:25°C	V1: 0.228%~ -0.225%
4	OVER/UNDERSHOOT TEST	< ±15%	I/P: 48 VDC O/P:FULL LOAD Ta:25°C	TEST: 4.878%
5	RIPPLE & NOISE (Max)	V1: 60 mVp-p	I/P: 48 VDC O/P:FULL LOAD Ta:25°C	V1: 30.4mVp-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/ 15.4ms
<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/6.8ms
<p>INPUT=48VDC @ FULL LOAD</p> <p>CH1 : Output Voltage</p>				



8	HOLD UP TIME (TYP)	48VDC/ 10 ms	I/P: 48 VDC O/P: F ULL LOAD Ta:25°C	20.6ms / full load
	INPUT=48VDC @ FULL LOAD			



9	DYNAMIC LOAD	V1: 990mVp-p	I/P: 48VDC O/P: (1)FULL /MIN LOAD 50%DUTY / 120HZ (2)FULL /MIN LOAD 50%DUTY / 1KHZ Ta:25°C	138mVp-p 139mVp-p
	FULL /MIN LOAD 50%DUTY / 120HZ			



## 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	16.15V~ 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/ 0.95A	I/P: 48VDC O/P: FULL LOAD Ta: 25°C	I=0.924A/48VDC																			
3	EFFICIENCY(TYP)	88.5%	I/P: 48VDC O/P: FULL LOAD Ta: 25°C	88.89%																			
					<p>EFFICIENCY vs LOAD</p> <table border="1"> <caption>Efficiency vs Load Data (48VDC)</caption> <thead> <tr> <th>LOAD (%)</th> <th>EFFICIENCY (%)</th> </tr> </thead> <tbody> <tr><td>10%</td><td>85</td></tr> <tr><td>20%</td><td>90</td></tr> <tr><td>30%</td><td>89</td></tr> <tr><td>40%</td><td>89</td></tr> <tr><td>50%</td><td>89</td></tr> <tr><td>60%</td><td>89</td></tr> <tr><td>70%</td><td>89</td></tr> <tr><td>80%</td><td>89</td></tr> <tr><td>90%</td><td>89</td></tr> <tr><td>100%</td><td>88</td></tr> </tbody> </table>		LOAD (%)	EFFICIENCY (%)	10%	85	20%	90	30%	89	40%	89	50%	89	60%	89	70%	89	80%
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4	INRUSH CURRENT(TYP)	48VDC/ 20A COLD START	I/P: 48VDC O/P: FULL LOAD Ta: 25°C	I=14.64A/ 48VDC																			
					<p>INPUT=48VDC @ FULL LOAD</p> <p>CH1 : DC Input Voltage CH2 : Input current</p> <p>Agilent DSO-X 3014A MYS4410148 Tue Nov 22 13:17:37 2016</p> <p>1 20.0V/ 2 5.0A/ 3 0.0s 50.00μs 停止 f 2 1.08A</p> <p>采集 标准模式 2.00MS/s</p> <p>通道 DC 10.0:1 DC 100:1 DC 1.00:1 DC 50Ω 10.0:1 测量 最大电平(2): 14.64A</p> <p>+39.7500V 10.0:1 DC +6.2000A 100:1 DC +0.0V 1.00:1 DC +0.0A 50Ω 10.0:1</p> <p>01:17 PM Nov 22, 2016</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: 72VDC I/P: 48VDC I/P: 18VDC O/P: TESTING Ta:25°C	117.25% 117.25% 117.25% PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed
2	OVER VOLTAGE PROTECTION	CH: 4.3V~ 4.95 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	4.56V 4.58V 4.60V 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) 140V (2) 144V (3) 129V
2	Diode <b>Peak Voltage</b>	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°C	Q100: VDS: (1) 33.0V (2) 29.8V (3) 32.6V
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) 79.6V (2) 79.2V (3) 78.0V (4) 78.0V
4	<b>Control IC Voltage Test</b>	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°C	(1) 20.7V (2) 12.5V (3) 11.1V (4) 16.2V

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) 84.8V (2) 84.8V
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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:1.53 mA I/P-FG: 1.45mA O/P-FG: 1.62mA 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	<b>16mΩ</b>

### 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°C	PASS Test by certified Lab
2	CONDUCTION	EN55032 CLASS B	I/P: 48 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: 48 VDC O/P:FULL LOAD Ta:25°C	CRITERIA A
4	E.F.T	EN61000-4-4 LIGHT INDUSTRY INPUT: 2KV	I/P: 48 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: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℃																																																																																		
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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	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