



Test Report: RSD-30G-3.3

30W 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

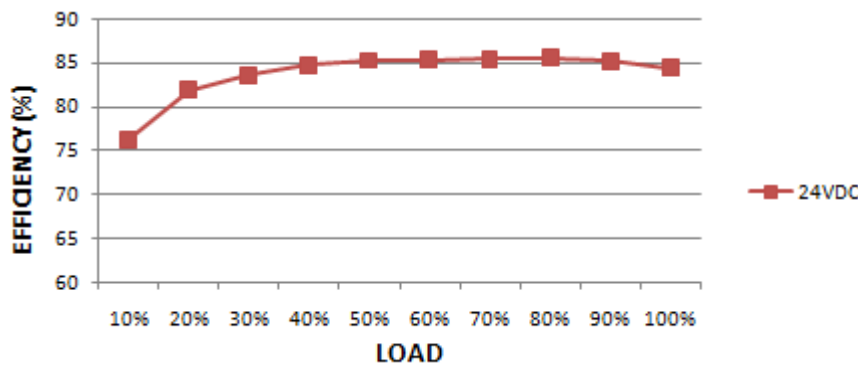
| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT |
|---|--------------------------------|-------------------|---|----------------------|
| 1 | OUTPUT VOLTAGE TOLERANCE (Max) | V1: 2 %~ -2 % | I/P: 9 VDC / 36 VDC O/P:FULL/ MIN. LOAD Ta:25°C | V1: -0.085%~ 0.094% |
| 2 | LINE REGULATION (Max) | V1: 0.5 %~ -0.5 % | I/P: 9 VDC / 36 VDC O/P:FULL LOAD Ta:25°C | V1: 0 %~ 0 % |
| 3 | LOAD REGULATION (Max) | V1: 0.5 %~ -0.5 % | I/P: 24VDC O/P:FULL ~MIN LOAD Ta:25°C | V1: -0.085 %~ -0.09% |
| 4 | OVER/UNDERSHOOT TEST | $\leq \pm 15\%$ | I/P: 24 VDC O/P:FULL LOAD Ta:25°C | TEST: 4.878% |
| 5 | RIPPLE & NOISE (Max) | V1:70 mVp-p | I/P: 24 VDC O/P:FULL LOAD Ta:25°C | V1: 46.2mVp-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/ 120 ms | I/P: 24VDC O/P:FULL LOAD Ta:25°C | 24VDC/27.8ms |
| <p>INPUT=24VDC @ FULL LOAD</p> <p>CH1 : Output Voltage CH2 : DC Input Voltage</p> | | | | |
| 7 | RISE TIME (Max) | 24VDC/ 85 ms | I/P: 24 VDC O/P:FULL LOAD Ta:25°C | 24VDC/9.84ms |

| | | | |
|---|---|---|---|
| <p>INPUT=24VDC @ FULL LOAD</p> <p>CH1 : Output Voltage</p> | | | |
| 8 | <p>HOLD UP TIME (TYP)</p> <p>24VDC / 3 ms 24VDC / 10 ms</p> | <p>I/P: 24 VDC O/P: FULL LOAD / 80% LOAD Ta:25°C</p> | <p>10.4ms / full load 20ms / 80% load</p> |
| <p>INPUT=24VDC @ FULL LOAD</p> <p>CH1 : Output Voltage CH2 : DC Input Voltage</p> | | <p>INPUT=24VDC @ 80% LOAD</p> <p>CH1 : Output Voltage CH2 :DC Input Voltage</p> | |
| 9 | <p>DYNAMIC LOAD</p> <p>V1: 990 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>444mVp-p 578mVp-p</p> |
| <p>FULL /MIN LOAD 50%DUTY / 120HZ</p> <p>Ch1 Pk-Pk 444mV</p> | | <p>FULL /MIN LOAD 50%DUTY / 1KHZ</p> <p>Ch1 Pk-Pk 578mV</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 | 7.9V~ 36 V |
| | | | I/P: LOW-LINE-0.2= 8.8 V HIGH-LINE+3V= 39 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) | 24VDC/ 1.1A | I/P: 24VDC O/P:FULL LOAD Ta:25°C | I=0.9695A/24VDC |
| 3 | EFFICIENCY(TYP) | 84% | I/P: 24VDC O/P:FULL LOAD Ta:25°C | 84.8% |

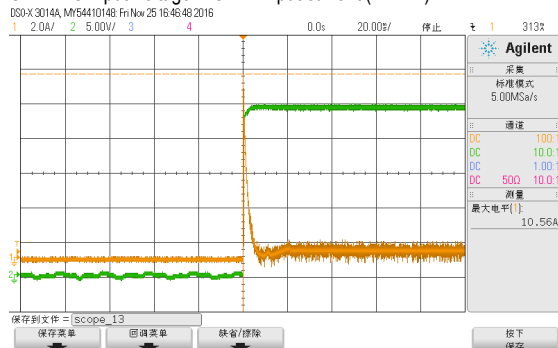
EFFICIENCY vs LOAD



| | | | | |
|---|---------------------|--------------------------|---------------------------------------|-----------------|
| 4 | INRUSH CURRENT(TYP) | 24VDC/ 20A COLD START | I/P:24VDC O/P:FULL LOAD Ta:25°C | I=10.56A/ 24VDC |
|---|---------------------|--------------------------|---------------------------------------|-----------------|

INPUT=24VDC @ FULL LOAD

CH2 : DC Input Voltage CH4 : Input current (1V=1A)



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 | 118%/36V 118%/24V 118%/9V PROTECTION TYPE : Constant current limiting, recovers automatically after fault condition is removed |
| 2 | OVER VOLTAGE PROTECTION | CH: 3.8V~ 4.5 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 | 4.23V 4.22V 4.22V 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 70A/100 V | I/P: High-Line +3V =39V DC ON/OFF VDS: O/P: (1) Full Load (2) Output Short (3) Full Load Continue Ta:25°C | VDS: (1) 72.8V (2) 66.8V (3) 70.4V |
| 2 | Diode Peak Voltage | Q100 Rated 120 A/ 40 V | I/P: High-Line +3V =39V DC ON/OFF VDS: O/P: (1) Full Load (2) Output Short (3) Full Load Continue Ta:25°C | VDS: (1) 32.0V (2) 22.8V (3) 31.6V |
| 3 | Input Capacitor Voltage | C5 Rated: : 220 μ / 50 V 105 °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) 39.4V (2) 39.4V (3) 39.4V (4) 39.4V |
| 4 | Control IC Voltage Test | PWM IC U1 Rated 35V 3.9V(MIN.) | I/P: High-Line +3V =39V DC ON/OFF O/P: (1) FULL LOAD (2) Output Short (3) O.L.P (4) O.V.P. Ta:25°C | (1) 13.4V (2) 10.1V (3) 10.1V (4) 12.1V |

| | | | | |
|---|--------------------------|-----------------------|---|------------------------|
| 5 | Clamp Diode Peak Voltage | D4 Rated : 3A/100V | I/P : High-Line +3V = 39V DC ON/OFF O/P : (1) Dynamic Load 90%Duty/1KHz (2) Full load continue Ta : 25°C | (1) 39.8V (2) 39.2V |
|---|--------------------------|-----------------------|---|------------------------|

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: 1.02mA I/P-FG:0.58mA O/P-FG: 0.52mA 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:9999 MΩ NO DAMAGE |
| 3 | GROUNDING CONTINUITY | EN 60950-1 FG(PE) TO CHASSIS OR TRACE < 100 mΩ | 40A / 2min Ta:25°C | 20mΩ |

E.M.C TEST

| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT |
|----|---|---|---|-------------------------------|
| 1 | RADIATION | BS EN/EN55032 CLASS B | I/P: 24 VDC O/P:FULL LOAD Ta:25°C | PASS Test by certified Lab |
| 2 | CONDUCTION | BS EN/EN55032 CLASS A | 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 | BS EN/EN61000-4-2 LIGHT INDUSTRY INPUT: 2KV | I/P: 24 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: 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-30G-5 1. ROOM AMBIENT BURN-IN : 1HRS I/P : 24VDC O/P : FULL LOAD Ta= 19.0°C 2. HIGH AMBIENT BURN-IN : 1HRS I/P : 24VDC O/P : FULL LOAD Ta= 54.1°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | <table border="1"> <thead> <tr> <th>NO</th> <th>Position</th> <th>ROOM AMBIENT Ta= 19.0 °C</th> <th>HIGH AMBIENT Ta= 54.1 °C</th> </tr> </thead> <tbody> <tr><td>1</td><td>LF1</td><td>37.5°C</td><td>70.3°C</td></tr> <tr><td>2</td><td>C5</td><td>40.2°C</td><td>73.0°C</td></tr> <tr><td>3</td><td>C12</td><td>35.3°C</td><td>68.0°C</td></tr> <tr><td>4</td><td>D4</td><td>45.9°C</td><td>79.4°C</td></tr> <tr><td>5</td><td>T1</td><td>45.5°C</td><td>77.8°C</td></tr> <tr><td>6</td><td>C40</td><td>41.5°C</td><td>73.8°C</td></tr> <tr><td>7</td><td>C112</td><td>41.1°C</td><td>73.7°C</td></tr> <tr><td>8</td><td>C105</td><td>41.4°C</td><td>74.3°C</td></tr> <tr><td>9</td><td>L100</td><td>39.8°C</td><td>73.2°C</td></tr> <tr><td>10</td><td>Q100</td><td>42.4°C</td><td>75.5°C</td></tr> <tr><td>11</td><td>U101</td><td>36.6°C</td><td>69.5°C</td></tr> <tr><td>12</td><td>Q3</td><td>46.5°C</td><td>80.8°C</td></tr> <tr><td>13</td><td>Q2</td><td>36.8°C</td><td>69.6°C</td></tr> <tr><td>14</td><td>Q1</td><td>35.6°C</td><td>69.0°C</td></tr> <tr><td>15</td><td>U1</td><td>36.2°C</td><td>69.1°C</td></tr> </tbody> </table> | NO | Position | ROOM AMBIENT Ta= 19.0 °C | HIGH AMBIENT Ta= 54.1 °C | 1 | LF1 | 37.5°C | 70.3°C | 2 | C5 | 40.2°C | 73.0°C | 3 | C12 | 35.3°C | 68.0°C | 4 | D4 | 45.9°C | 79.4°C | 5 | T1 | 45.5°C | 77.8°C | 6 | C40 | 41.5°C | 73.8°C | 7 | C112 | 41.1°C | 73.7°C | 8 | C105 | 41.4°C | 74.3°C | 9 | L100 | 39.8°C | 73.2°C | 10 | Q100 | 42.4°C | 75.5°C | 11 | U101 | 36.6°C | 69.5°C | 12 | Q3 | 46.5°C | 80.8°C | 13 | Q2 | 36.8°C | 69.6°C | 14 | Q1 | 35.6°C | 69.0°C | 15 | U1 | 36.2°C | 69.1°C |
| NO | Position | ROOM AMBIENT Ta= 19.0 °C | HIGH AMBIENT Ta= 54.1 °C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 | LF1 | 37.5°C | 70.3°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 2 | C5 | 40.2°C | 73.0°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | C12 | 35.3°C | 68.0°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | D4 | 45.9°C | 79.4°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | T1 | 45.5°C | 77.8°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | C40 | 41.5°C | 73.8°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | C112 | 41.1°C | 73.7°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 8 | C105 | 41.4°C | 74.3°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 9 | L100 | 39.8°C | 73.2°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 10 | Q100 | 42.4°C | 75.5°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 11 | U101 | 36.6°C | 69.5°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 12 | Q3 | 46.5°C | 80.8°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 13 | Q2 | 36.8°C | 69.6°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 14 | Q1 | 35.6°C | 69.0°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 15 | U1 | 36.2°C | 69.1°C | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 3 | OVER LOAD BURN-IN TEST | NO DAMAGE 1 HOUR (MIN) | I/P : 24VDC O/P : 114 % LOAD Ta : 25°C | TEST : OK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 4 | LOW TEMPERATURE TURN ON TEST | TURN ON AFTER 2 HOUR | I/P : 36VDC/ 9VDC O/P : 100 % LOAD Ta= -40 °C | TEST : OK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 5 | HIGH HUMIDITY HIGH TEMPERATURE HIGH VOLTAGE TURN ON TEST | AFTER 12 HOURS IN CHAMBER ON CONTROL 55 °C NO DAMAGE | I/P : 39VDC O/P : FULL LOAD Ta= 55 °C HUMIDITY= 95 %R.H | TEST: OK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 6 | TEMPERATURE COEFFICIENT | ± 0.03 %(0~50°C) | I/P : 24VDC O/P : FULL LOAD | ± 0.0057 %(0~50°C) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 7 | STORAGE TEMPERATURE TEST | 1. Thermal shock Temperature : -40°C~ +85°C 2. Temperature change rate : 25°C / 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |



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|----|-----------------------------|--|---|
| 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 : 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) 455629.5HRS (2) 66339.1HRS (3) 112533.2HRS (4) 159487.7HRS |
| 11 | MTBF | 3093.5K hrs min. Telcordia SR-332 (Bellcore) ; 396.9K 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