# Test Report: LPF-16D-12

16W Single Output Switching Power Supply

## ■ 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 | VERDICT |
|---|---|---|---|---|---|
| 1 | RIPPLE & NOISE | V1 : 150 mVp-p (Max ) | I/P : 230VAC<br>O/P : FULL LOAD<br>Ta : 25℃ | V1 : 30 mVp-p (Max ) | P |
| 2 | CONSTANT CURRENT REGION | V1= 6.6V~12V | I/P : 230VAC<br>O/P : CV MODE<br>Ta : 25℃ | O/P= 6.6V : 1.370 A<br>O/P= 11V : 1.369 A | P |
| 3 | OUTPUT VOLTAGE TOLERANCE | V1 : 4 %~ -4 % (Max) | I/P : 100 VAC / 305 VAC<br>O/P : FULL/ MIN LOAD<br>Ta : 25℃ | V1 : 0.204 %~ -0.333 % | P |
| 4 | LINE REGULATION | V1 : 0.5 %~ -0.5 % (Max) | I/P : 100 VAC ~ 305 VAC<br>O/P : FULL LOAD<br>Ta : 25℃ | V1 : 0.008 %~ -0.008 % | P |
| 5 | LOAD REGULATION | V1 : 2 %~ -2 % (Max) | I/P : 230 VAC<br>O/P : FULL ~MIN LOAD<br>Ta : 25℃ | V1 : 0.167 %~ -0.167 % | P |
| 6 | SET UP TIME | 230VAC : 500 ms (Max)<br>115VAC : 1500 ms(Max) | I/P : 230 VAC<br>I/P : 115 VAC<br>O/P : FULL LOAD<br>Ta : 25℃ | 230VAC/ 323.882 ms<br>115VAC/ 287.038 ms | P |
| 7 | RISE TIME | 230VAC : 80 ms (Max)<br>115VAC : 80 ms (Max) | I/P : 230 VAC<br>I/P : 115 VAC<br>O/P : FULL LOAD<br>Ta : 25℃ | 230VAC/ 8 ms<br>115VAC/ 8 ms | P |
| 8 | HOLD UP TIME | 230VAC : 16 ms (TYP)<br>115VAC : 16 ms (TYP) | I/P : 230 VAC<br>I/P : 115 VAC<br>O/P : FULL LOAD<br>Ta : 25℃ | 230VAC/ 121 ms<br>115VAC/ 120 ms | P |
| 9 | OVER/UNDERSHOOT TEST | < ±5% | I/P : 230 VAC<br>O/P : FULL LOAD<br>Ta : 25℃ | TEST : <5 % | P |
| 10 | DYNAMIC LOAD | V1 : 1200 mVp-p | I/P : 230 VAC<br>(1).O/P : FULL /Min LOAD 90%DUTY/ 1KHZ<br>(2).O/P : FULL /Min LOAD 50%DUTY/ 120HZ<br>Ta : 25℃ | (1) 227 mVp-p<br>(2) 330 mVp-p | P |

| | | | |
|---|---|---|---|
| 11 | DIMMER TEST | SPEC:<br>*Output constant current level can be adjusted through output cable by 1 ~ 10Vdc, PWM signal or resistor between ADJ1(+) and ADJ2(-).<br>*Reference resistance value for output current adjustment (Typical) | P |

| Resistance value | 10K | 20K | 30K | 40K | 50K | 60K | 70K | 80K | 90K | 100K |
|---|---|---|---|---|---|---|---|---|---|---|
| Output current | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |

*1 ~ 10V dimming function for output current adjustment (Typical)

| Dimming value | 1V | 2V | 3V | 4V | 5V | 6V | 7V | 8V | 9V | 10V |
|---|---|---|---|---|---|---|---|---|---|---|
| Output current | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |

*10V PWM signal for output current adjustment (Typical)

| Duty value | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
|---|---|---|---|---|---|---|---|---|---|---|
| Output current | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |

TEST RESULT: I/P： 230 VAC ;Ta：25℃

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Resistance value | 10K | 20K | 30K | 40K | 50K | 60K | 70K | 80K | 90K | 100K |
| | Output current | 0.102A | 0.239A | 0.375A | 0.519A | 0.658A | 0.791A | 0.930A | 1.068A | 1.208A | 1.334A |
| | % | 7.61% | 17.84% | 27.99% | 38.73% | 49.10% | 59.03% | 69.40% | 79.70% | 90.15% | 99.55% |
| 2 | Dimming value | 1V | 2V | 3V | 4V | 5V | 6V | 7V | 8V | 9V | 10V |
| | Output current | 0.105A | 0.243A | 0.379A | 0.521A | 0.659A | 0.797A | 0.936A | 1.073A | 1.212A | 1.335A |
| | % | 7.84% | 18.15% | 28.27% | 38.87% | 49.18% | 59.48% | 69.85% | 80.07% | 90.45% | 99.66% |
| 3 | Duty value | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |
| | Output current | 0.107A | 0.244A | 0.383A | 0.522A | 0.661A | 0.799A | 0.937A | 1.077A | 1.214A | 1.339A |
| | % | 7.99% | 18.21% | 28.58% | 38.96% | 49.33% | 59.63% | 69.93% | 80.37% | 90.62% | 99.93% |

## INPUT FUNCTION TEST

| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT | VERDICT |
|---|---|---|---|---|---|
| 1 | INPUT VOLTAGE RANGE | 100VAC~305 VAC | I/P：TESTING<br>O/P：FULL LOAD<br>Ta：25℃ | 85 V~305V | P |
| | | | I/P：<br>LOW-LINE-3V=97 V<br>HIGH-LINE=305 V<br>O/P：FULL/MIN LOAD<br>ON： 30 Sec . OFF： 30 Sec 10MIN<br>( AC POWER ON/OFF NO DAMAGE ) | TEST： OK | |
| 2 | INPUT FREQUENCY RANGE | 47HZ ~63 HZ<br>NO DAMAGE OSC | I/P： 100 VAC ~ 305 VAC<br>O/P：FULL~MIN LOAD<br>Ta：25℃ | TEST： OK | P |
| 3 | POWER FACTOR | 0.95 / 230 VAC(TYP)<br>0.97 / 115 VAC(TYP)<br>0.92 / 277 VAC(TYP) | I/P： 230 VAC<br>I/P： 115 VAC<br>I/P： 277 VAC<br>O/P：FULL LOAD<br>Ta：25℃ | PF= 0.965 / 100%<br>PF= 0.995 / 100%<br>PF= 0.935 / 100% | P |
| 4 | EFFICIENCY | 83% (TYP) | I/P： 230 VAC<br>O/P：FULL LOAD<br>Ta：25℃ | 83.46 % | P |
| 5 | INPUT CURRENT | 230V/ 0.25 A (TYP)<br>115V/ 0.4 A (TYP)<br>277V/ 0.2 A (TYP) | I/P： 230 VAC<br>I/P： 115 VAC<br>I/P： 277 VAC<br>O/P：FULL LOAD<br>Ta：25℃ | I= 0.086 A/ 230 VAC<br>I= 0.170 A/ 115 VAC<br>I= 0.074 A/ 277 VAC | P |
| 6 | INRUSH CURRENT | 230V/ 50 A (TYP)<br>COLD START | I/P： 230 VAC<br>O/P：FULL LOAD<br>Ta：25℃ | I= 36.0 A/ 230 VAC | P |
| 7 | LEAKAGE CURRENT | < 0.75 mA / 240 VAC | I/P： 240 VAC<br>O/P：Min LOAD<br>Ta：25℃ | L-CASE： 0.003 mA<br>N-CASE： 0.003 mA | P |

## PROTECTION FUNCTION TEST

| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT | VERDICT |
|---|---|---|---|---|---|
| 1 | OVER LOAD PROTECTION | 95 % ~ 108 % | I/P : 230 VAC<br>I/P : 115 VAC<br>O/P : TESTING<br>Ta : 25℃ | 102.22 %/ 230 VAC<br>102.20 %/ 115 VAC<br>Constant Current Limiting ,recovers automatically after fault condition is removed. | P |
| 2 | OVER VOLTAGE PROTECTION | CH1 : 15 V ~ 18 V | I/P : 230 VAC<br>I/P : 115 VAC<br>O/P : MIN LOAD<br>Ta : 25℃ | 15.94 V/ 230 VAC<br>15.94 V/ 115 VAC<br>Shut down and latch off o/p voltage, re-power on to recover | P |
| 3 | OVER TEMPERATURE PROTECTION | SPEC :<br>TSW1 : 100± 5℃ O.T.P.<br>NO DAMAGE | I/P : 230 VAC<br>O/P : FULL LOAD | O.T.P. Active<br>Shut down o/p voltage , recovers automatically after temperature goes down | P |
| 4 | SHORT PROTECTION | SHORT EVERY OUTPUT<br>1 HOUR NO DAMAGE | I/P : 305 VAC<br>O/P : FULL LOAD<br>Ta : 25℃ | NO DAMAGE<br>Hiccup mode, recovers automatically after fault condition is removed. | P |

## COMPONENT STRESS TEST

| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT | VERDICT |
|---|---|---|---|---|---|
| 1 | Power Transistor<br>( D to S) or (C to E) Peak Voltage | U2 Rated :<br>IP7518: 700V / 2A | I/P : High-Line +3V = 308 V<br>O/P : (1)Full Load Turn on<br>(2) Output Short<br>(3)Full load continue<br>Ta : 25℃ | (1) 644 V<br>(2) 496 V<br>(3) 644 V | P |
| 2 | Diode Peak Voltage | D101 Rated :<br>PFR30L60CT: 60V / 30A | I/P : High-Line +3V = 308 V<br>O/P : (1)Full Load Turn on<br>(2)Output Short<br>(3)Full load continue<br>Ta : 25℃ | (1) 50.0 V<br>(2) 35.2 V<br>(3) 49.4 V | P |
| 3 | Input Capacitor Voltage | C5 Rated :<br>22u/450V 105℃ 16*20 RH | I/P : High-Line +3V = 308 V<br>O/P : (1)Full Load Turn on /Off<br>(2) Min load Turn on /Off<br>(3)Full Load /Min load Change<br>Ta : 25℃ | (1) 444 V<br>(2) 448 V<br>(3) 434 V | P |
| 4 | Control IC Voltage Test | U 2 Rated :<br>IP7518:30V | I/P : High-Line +3V = 308 V<br>O/P : (1)Full Load Turn on /Off<br>(2) Min load Turn on /Off<br>(3)Full Load /Min load Change<br>Ta : 25℃ | (1) 20.9 V<br>(2) 13.8 V<br>(3) 19.6 V | P |
| 5 | Power Transistor<br>( D to S) or (C to E) Peak Voltage | Q1 Rated :<br>NDF10N60ZG: 600V/ 10 A | I/P : High-Line +3V = 308 V<br>O/P : (1)Full Load Turn on<br>(2) Output Short<br>(3)Full load continue<br>Ta : 25℃ | (1) 522 V<br>(2) 434 V<br>(3) 442 V | P |

## ■ SAFETY & E.M.C. TEST

### SAFETY TEST

| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT | VERDICT |
|---|---|---|---|---|---|
| 1 | WITHSTAND VOLTAGE | I/P-O/P： 3.75 KVAC/min | I/P-O/P： 4 KVAC/min<br>Ta：25℃ | I/P-O/P： 1.437 mA<br>NO DAMAGE | P |
| 2 | ISOLATION RESISTANCE | I/P-O/P：500VDC>100MΩ | I/P-O/P： 500 VDC<br>Ta：25℃/70%RH | I/P-O/P： >9999 MΩ<br>NO DAMAGE | P |
| 3 | APPROVAL | TUV： Certificate NO ：<br>UL： File NO ： | | | N/A |

### E.M.C TEST

| NO | TEST ITEM | SPECIFICATION | TEST CONDITION | RESULT | VERDICT |
|---|---|---|---|---|---|
| 1 | HARMONIC | EN61000-3-2<br>CLASS C | I/P:230VAC/240VAC/220VAC50HZ<br>O/P:100%,75%,50%LOAD<br>CLASS C ≧ 50%<br>Ta:25℃ | PASS | P |
| 2 | CONDUCTION | EN55015 | I/P: 230 VAC (50HZ)/115V[60HZ]<br>O/P:FULL/50% LOAD<br>Ta:25℃ | PASS<br>Test by certified Lab | P |
| 3 | RADIATION | EN55015 | I/P: 230 VAC (50HZ)/115V[60HZ]<br>O/P: FULL/50% LOAD<br>Ta:25℃ | PASS<br>Test by certified Lab | P |
| 4 | E.S.D | EN61000-4-2<br>LIGHT INDUSTRY<br>AIR:8KV / Contact:4KV | I/P: 230 VAC/50HZ<br>O/P:FULL LOAD<br>Ta:25℃ | CRITERIA A | P |
| 5 | E.F.T | EN61000-4-4<br>LIGHT INDUSTRY<br>INPUT: 1KV | I/P: 230 VAC/50HZ<br>O/P:FULL LOAD<br>Ta:25℃ | CRITERIA A | P |
| 6 | SURGE | IEC61000-4-5<br>INDUSTRY<br>L-N :2KV | I/P: 230 VAC/50HZ<br>O/P:FULL LOAD<br>Ta:25℃ | CRITERIA A | P |
| 7 | 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><th>VERDICT</th></tr>
<tr><td>1</td><td>TEMPERATURE RISE TEST</td><td colspan="3">MODEL： LPF-16D-12<br>1. ROOM AMBIENT BURN-IN：2.5 HRS<br>I/P： 230VAC O/P： 95% LOAD Ta=32.2 ℃<br>2. HIGH AMBIENT BURN-IN：3.5 HRS<br>I/P： 230VAC O/P： 95% LOAD Ta=50.1 ℃
<table>
<tr><th>NO</th><th>Position</th><th>P/N</th><th>ROOM AMBIENT Ta= 32.2 ℃</th><th>HIGH AMBIENT Ta= 50.1 ℃</th></tr>
<tr><td>1</td><td>LF2</td><td>LF-802</td><td>55.6℃</td><td>72.5℃</td></tr>
<tr><td>2</td><td>BD1</td><td>UD2KB80</td><td>62.2℃</td><td>77.8℃</td></tr>
<tr><td>3</td><td>L1</td><td>TR-6102</td><td>62.3℃</td><td>78.1℃</td></tr>
<tr><td>4</td><td>Q1</td><td>NDF10N60ZG</td><td>66.6℃</td><td>82.5℃</td></tr>
<tr><td>5</td><td>D1</td><td>MUR460</td><td>69.4℃</td><td>86.1℃</td></tr>
<tr><td>6</td><td>C18</td><td>47uF/50V YXM</td><td>66.8℃</td><td>83.0℃</td></tr>
<tr><td>7</td><td>C54</td><td>22uF/50V YXM</td><td>70.2℃</td><td>87.5℃</td></tr>
<tr><td>8</td><td>C5</td><td>22uF/450V RH</td><td>68.3℃</td><td>86.2℃</td></tr>
<tr><td>9</td><td>U1</td><td>NCP1608B</td><td>68.9℃</td><td>84.8℃</td></tr>
<tr><td>10</td><td>U2</td><td>IP7518</td><td>86.8℃</td><td>104.8℃</td></tr>
<tr><td>11</td><td>T1</td><td>TF-6357</td><td>70.4℃</td><td>87.1℃</td></tr>
<tr><td>12</td><td>D101</td><td>PFR30L60CT 30A/60V</td><td>63.5℃</td><td>78.8℃</td></tr>
<tr><td>13</td><td>C105</td><td>560u/25V ZLH</td><td>59.9℃</td><td>75.9℃</td></tr>
</table></td><td>P</td></tr>
<tr><td>2</td><td>LOW TEMPERATURE<br>TURN ON TEST</td><td>TURN ON AFTER 2 HOUR</td><td>I/P： 305VAC/100VAC<br>O/P： 95 % LOAD<br>Ta= -40℃</td><td>TEST：OK</td><td>P</td></tr>
<tr><td>3</td><td>HIGH HUMIDITY<br>HIGH TEMPERATURE<br>HIGH VOLTAGE<br>TURN ON TEST</td><td>AFTER 12 HOURS<br>IN CHAMBER ON<br>CONTROL 50 ℃<br>NO DAMAGE</td><td>I/P： 305 VAC<br>O/P：95% LOAD<br>Ta= 50 ℃<br>HUMIDITY= 95 %R.H</td><td>TEST：OK</td><td>P</td></tr>
<tr><td>4</td><td>TEMPERATURE<br>COEFFICIENT</td><td>± 0.03 %(0~50℃)</td><td>I/P： 230 VAC<br>O/P：95% LOAD</td><td>± 0.002 %(0~50℃)</td><td>P</td></tr>
<tr><td>5</td><td>STORAGE TEMPERATURE TEST</td><td colspan="2">1. Thermal shock Temperature： -45℃~ +85℃<br>2. Temperature change rate ：25℃ / MIN<br>3. Dwell time low and high temperature ： 30 MIN/EACH<br>4. Total test cycle：5 CYCLE<br>5. Input/Output condition： STATIC</td><td>OK</td><td>P</td></tr>
<tr><td>6</td><td>THERMAL SHOCK TEST</td><td colspan="2">1. Thermal shock Temperature： -45℃~ +55℃<br>2. Temperature change rate ：25℃ / MIN<br>3. Dwell time low and high temperature ： 30 MIN/EACH<br>4. Total test cycle：10 CYCLE<br>5. Input/Output condition： 230VAC/Full Load AC ON/OFF TEST<br>turn on 58sec ; turn off 2sec</td><td>OK</td><td>P</td></tr>
</table>

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|---|---|---|---|---|
| 7 | VIBRATION TEST | 1 Carton & 1 Set<br>(1) Waveform： Sine Wave<br>(2) Frequency：10~500Hz<br>(3) Sweep Time：12min/sweep cycle<br>(4) Acceleration：2G<br>(5) Test Time：72min in each axis (X.Y.Z)<br>(6) Ta：25℃ | TEST：OK | P |
| 8 | CAPACITOR<br>LIFE CYCLE | LPF-16D-12:SUPPOSE C105 IS THE MOST CRITICAL COMPONENT<br>(1) I/P： 230VAC O/P：FULL LOAD Ta=25 ℃ LIFE TIME<br>(2) I/P： 230VAC O/P：FULL LOAD Ta=50 ℃ LIFE TIME<br>(3) I/P： 230VAC O/P：75% LOAD Ta=50 ℃ LIFE TIME | (1) 452611.8 HRS<br>(2) 91294.2 HRS<br>(3) 119635.2 HRS | P |
| 9 | MTBF | Conducted by Parts Stress Analysis Prediction<br>3572.8K hrs min. Telcordia SR-332 (Bellcore)； 391.6K hrs min. MIL-HDBK-217F (25℃) | | P |
| 10 | DMTBF/Accelerated Life Test | Demonstration Mean Time Between Failure(Expected Life)：<br>50,000 hours @ Tcase70℃ | | P |

| SAMPLE | TEST RESULT | TESTER | APPROVAL |
|---|---|---|---|
| PRODUCT SAMPLE | PASS | ZOULF | HOWAY |

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