
CE Report RoHS 5 year Warranty

EN62368-1

## FEATURES

- Universal 85 - 305VAC or 120 - 430VDC Input voltage
- Output voltage adjustable
- Wide operating temperature range: -40℃ to +100℃ Base plate
- Input under-voltage protection, output over-voltage/ short circuit/over-current protection, over-temperature protection
- Active PFC, PFC value up to 0.98
- Integrated parallel current sharing, status indication, remote control, auxiliary power supply, remote compensation function.
- High I/O isolation test voltage up to 3000VAC
- Operating up to 5000m altitude
- 5 years warranty
- Safety according to IEC/UL 62368, GB4943

*LBF1000-13Bxx-NS is one of Mornsun's potting ultra-thin bricks AC-DC switching power supply, it is suitable for industrial and outdoor occasions where the application environment is relatively harsh. It features universal AC input and at the same time accepts DC input voltage, cost-effective, high efficiency, high reliability and double or reinforced insulation. These converters offer excellent EMC performance and meet IEC/UL/EN 62368, GB4943 standards and they are widely used in areas of industrial, LED, street light control, electricity, security, telecommunications, smart home, etc.*

## Selection Guide

| Certification | Part No. | Rated Output Power (W)* | Nominal Output Voltage and Current (Vo/Io) | Output Voltage Adjustable Range (V) | Efficiency at 230VAC (%) Typ.* | Room Temperature Max. Capacitive Load (μF) | Low Temperature Max. Capacitive Load (μF) |
|---|---|---|---|---|---|---|---|
| EN | LBF1000-13B28-NS | 1008 | 28V/36A | 14.0 - 33.6 | 91.5 | 5000 | 5000 |
| -- | LBF1000-13B48-NS | 1008 | 48V/21A | 24.0 - 55.1 | 92.5 | 5000 | 5000 |

Note: 1.*Under any conditions, the total power of the product should not exceed the rated output power, and the output current should not exceed the rated output current;
2.*Due to different working modes, the efficiency difference between 0.5% and 0.7% is normal.

## Input Specifications

| Item | Operating Conditions | | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|---|
| Input Voltage Range | AC input | | | 85 | -- | 305 | VAC |
| | DC input | | | 120 | -- | 430 | VDC |
| Input Voltage Frequency | | | | 47 | -- | 63 | Hz |
| Input Current | 115VAC | | | -- | -- | 10.8 | A |
| | 230VAC | | | -- | -- | 5.3 | |
| Inrush Current | Built-in inrush current suppression circuit, external 10Ω resistor | 115VAC | Cold start | -- | 20 | 23 | |
| | | 230VAC | | -- | 40 | 46 | |
| Input Under-voltage Protection | Protection start | | | 50 | -- | 75 | VAC |
| | Protection release | | | 75 | -- | 85 | |
| Leakage Current | 277VAC | | | <0.75 mA | | | |
| Power Factor | 115VAC | Normal temperature, full load | | PF ⩾ 0.98 | | | |
| | 230VAC | | | PF ⩾0.96 | | | |
| Total Harmonic Ratio Of Input Current (THD) | Normal temperature, full load | | | ⩽10% | | | |
| Hot Plug | | | | Unavailable | | | |

## Output Specifications*

| Item | Operating Conditions | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Output Voltage Accuracy* | Full load range | | -- | -- | ±2 | % |
| Line Regulation | Rated load | | -- | -- | ±1 | |
| Load Regulation | 0% - 100% load | | -- | -- | ±2 | |
| Ripple & Noise* | 25℃, 20MHz bandwidth (peak-to-peak value) | LBF1000-13B28-NS | -- | -- | 150 | mV |
| | | LBF1000-13B48-NS | -- | -- | 350 | |
| Hold-up Time | 115/230VAC (output voltage 28V, main bus with external electrolytic capacitor, >1500uF) | | 20 | 30 | -- | ms |
| Output Over Voltage Protection | LBF1000-13B28-NS | | Vo≤40.6VDC (hiccup, clamp or shutdown) | | | |
| | LBF1000-13B48-NS | | Vo≤60VDC (hiccup, clamp or shutdown) | | | |
| Short Circuit Protection | Recover time <5s after the short circuit disappear | | Hiccup, continuous, self-recover | | | |
| Over-current Protection | LBF1000-13B28-NS | Output voltage 14VDC-19VDC, output hiccup and constant current protection | 42 | -- | 47 | A |
| | | Output voltage 19VDC-25VDC, output constant current protection | 42 | -- | 47 | |
| | | Output voltage 25VDC-33.6VDC, output constant current protection | 31 | -- | 47 | |
| | LBF1000-13B48-NS | Output voltage 24VDC-33VDC, output hiccup and constant current protection | 24 | -- | 28 | A |
| | | Output voltage 33VDC-43VDC, output constant current protection | 24 | -- | 28 | |
| | | Output voltage 43VDC-55.1VDC, output constant current protection | 18 | -- | 28 | |
| Over-temperature Protection | Input voltage 85VAC-170VAC Rated load (base plate temperature) | Protect start | 95 | -- | 125 | ℃ |
| | | Protect release | 85 | -- | 115 | |
| | Input voltage 170VAC-305VAC Rated load (base plate temperature) | Protect start | 110 | -- | 140 | |
| | | Protect release | 100 | -- | 130 | |

Note:1.*For all the above test items, please refer to our company standard "AC-DC Black Box Test Specification" for specific test specifications and methods;
2.*Output Voltage Accuracy: including setting error, line regulation, load regulation;
3.*The "Tip and barrel method" is used for ripple and noise test, output parallel 47uF electrolytic capacitor and 0.1uF ceramic capacitor, please refer to Enclosed Switching Power Supply Application Notes for specific information.

## General Specifications

| Item | | Operating Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Isolation Test | Input - ⏚ | Electric test for 1min, leakage current <10mA (recommended external circuit 3) | 2500 | -- | -- | VAC |
| | Input - output | | 3000 | -- | -- | |
| | Output - ⏚ | | 1500 | -- | -- | |
| Insulation Resistance | Input - ⏚ | Environment temperature: 25±5℃ Relative humidity: <95%RH, non-condensing Testing voltage: 500VDC | 100 | -- | -- | MΩ |
| | Input - output | | 100 | -- | -- | |
| | Output - ⏚ | | 100 | -- | -- | |
| Operating Temperature* | | The max temperature refer to the Aluminun base of PCB | -40 | -- | 100 | ℃ |
| Storage Temperature* | | | -40 | -- | 85 | |
| Operating Humidity | | Non-condensing | 20 | -- | 90 | %RH |
| Storage Humidity | | | 10 | -- | 95 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Power Derating | Operating temperature derating | | -- | -- | -- | %/℃ |
| | Input voltage derating* | 85VAC<Vin≤170VAC | -- | -- | 85 | ℃ |
| | | 170VAC<Vin≤305VAC | -- | -- | 100 | |
| | Altitude derating | 2000m-5000m | 6.67 | -- | -- | ℃/Km |
| | Output voltage derating | LBF1000-13B28-NS 14VDC-28VDC | Maximum output power Po=Vo*36 | | | |
| | | LBF1000-13B28-NS 28VDC-33.6VDC | Maximum output power 1008W | | | |
| | | LBF1000-13B48-NS 24VDC-48VDC | Maximum output power Po=Vo*21 | | | |
| | | LBF1000-13B48-NS 48VDC-55.1VDC | Maximum output power 1008W | | | |
| Parallel Operation* | PC (2-6 PCS of the same product in parallel) maximum current ≥50%Io | | 5 | -- | 10 | % |
| Remote Switch* | -ON/OFF, +ON/OFF, end use recommendation | Power on | 2 | -- | 10 | mA |
| | | Power off | -- | -- | 0.15 | mA |
| TRIM Output Voltage Adjustable Range* | LBF1000-13B28-NS | 230VAC input, full load range | 14 | -- | 33.6 | V |
| | LBF1000-13B48-NS | | 24 | -- | 55.1 | V |
| Remote Compensation | -S, +S | | Compensation voltage should within the range of the voltage adjustable range. | | | |
| Status Indication | IOG/ENA (maximum sink current 5mA, maximum source voltage 35V) | Normal state | L | | | |
| | | Fault state | H | | | |
| Safety Standard | | | Design refer to IEC/UL/EN 62368-1, GB4943.1 | | | |
| Safety Class | | | CLASS I | | | |
| MTBF | MIL-HDBK-217F@25℃ | | ≥500,000 h | | | |
| Pollution Degree | 1 | | | | | |
| Warranty | Aluminum substrate temperature: <100℃ | | 5 years | | | |

Note: 1.*In order to optimize the heat dissipation performance, should add a heat sink for heat dissipation, The surface of the heat sink must be coated with thermal grease;
2.*The max temperature is the base plate temperature;
3.* Parallel current sharing needs to adjust the output voltage of the product within ±2% accuracy through the trim pin. When 2-3pcs of the same product are paralleled, they can output at most 90% of the rated output current, current sharing accuracy can reach within 5%; 4-6pcs (same product) can output up to 85% of the rated output current when they are paralleled, and the current sharing accuracy can reach within 10%;
4.*Pay attention when the remote control is used with an external power supply. This module has a built-in MAX0.25W4.7K resistor. For details, see the schematic diagram in the application manual.
5.*The TRIM pin is pulled up to 3.3V by a built-in 1K resistor. When the external adjustment method is used, the input voltage between TRIM and COM should be greater than 0V and less than 3.3V.

## Mechanical Specifications

| | |
|---|---|
| Case Material | Aluminum substrate+black Plastic(SABIC PC945) |
| Dimensions | 160.00mm x 100.00mm x 13.40mm |
| Weight | 545g (Typ.) |
| Cooling Method* | Conduction heat dissipation, it is necessary to ensure that the product aluminum substrate surface temperature lower than 100℃. |

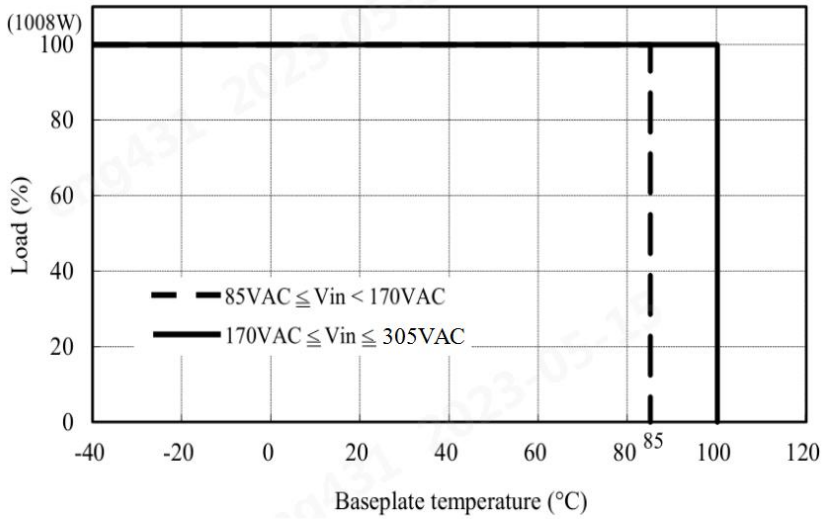
Note: *Cooling method refer to the Product Characteristic Curve.

## Electromagnetic Compatibility (EMC)

| | | | |
|---|---|---|---|
| Emissions | CE | CISPR32/EN55032 CLASS A (Recommended external circuit 1) | |
| | | GJB151B , CE102 (Recommended external circuit 2) | |
| | RE | CISPR32/EN55032 CLASS A (Recommended external circuit 1) | |
| | Harmonic current | IEC/EN61000-3-2 CLASS A (Recommended external circuit 1) | |
| Immunity | ESD | IEC/EN61000-4-2 Contact ±6KV /Air ±8KV (Recommended external circuit 1) | perf. Criteria B |
| | RS | IEC/EN61000-4-3 10V/m (Recommended external circuit 1) | perf. Criteria A |
| | EFT (Input port) | IEC/EN61000-4-4 ±2KV (Recommended external circuit 1) | perf. Criteria B |
| | Surge (Input port) | IEC/EN61000-4-5 line to line ±2KV/line to ground ±4KV (Recommended external circuit 1) | perf. Criteria B |
| | CS | IEC/EN61000-4-6 10Vr.m.s (Recommended external circuit 1) | perf. Criteria A |

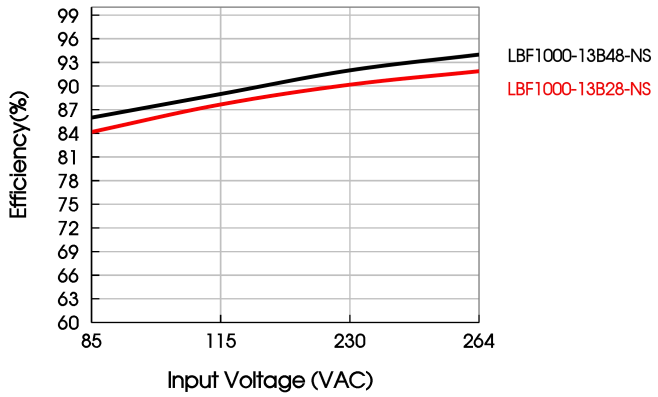
| | | | |
|---|---|---|---|
| | Voltage dips, short interruptions and voltage variations immunity | IEC/EN61000-4-11 0%, 70% (Recommended external circuit 1) | perf. Criteria B |
| | Intercom interference test | MS-SOP-DQC-007 (Recommended external circuit 1) | perf. Criteria B |

## Product Characteristic Curve

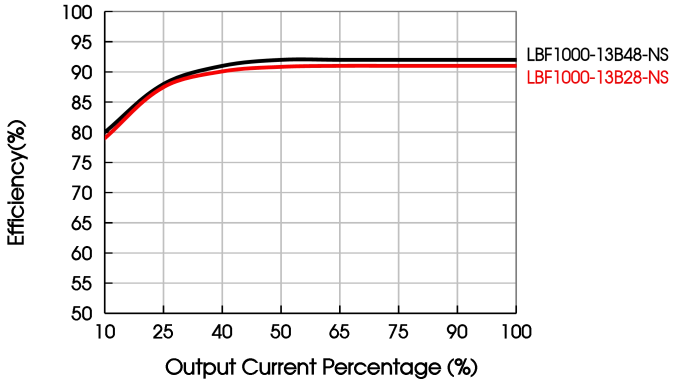


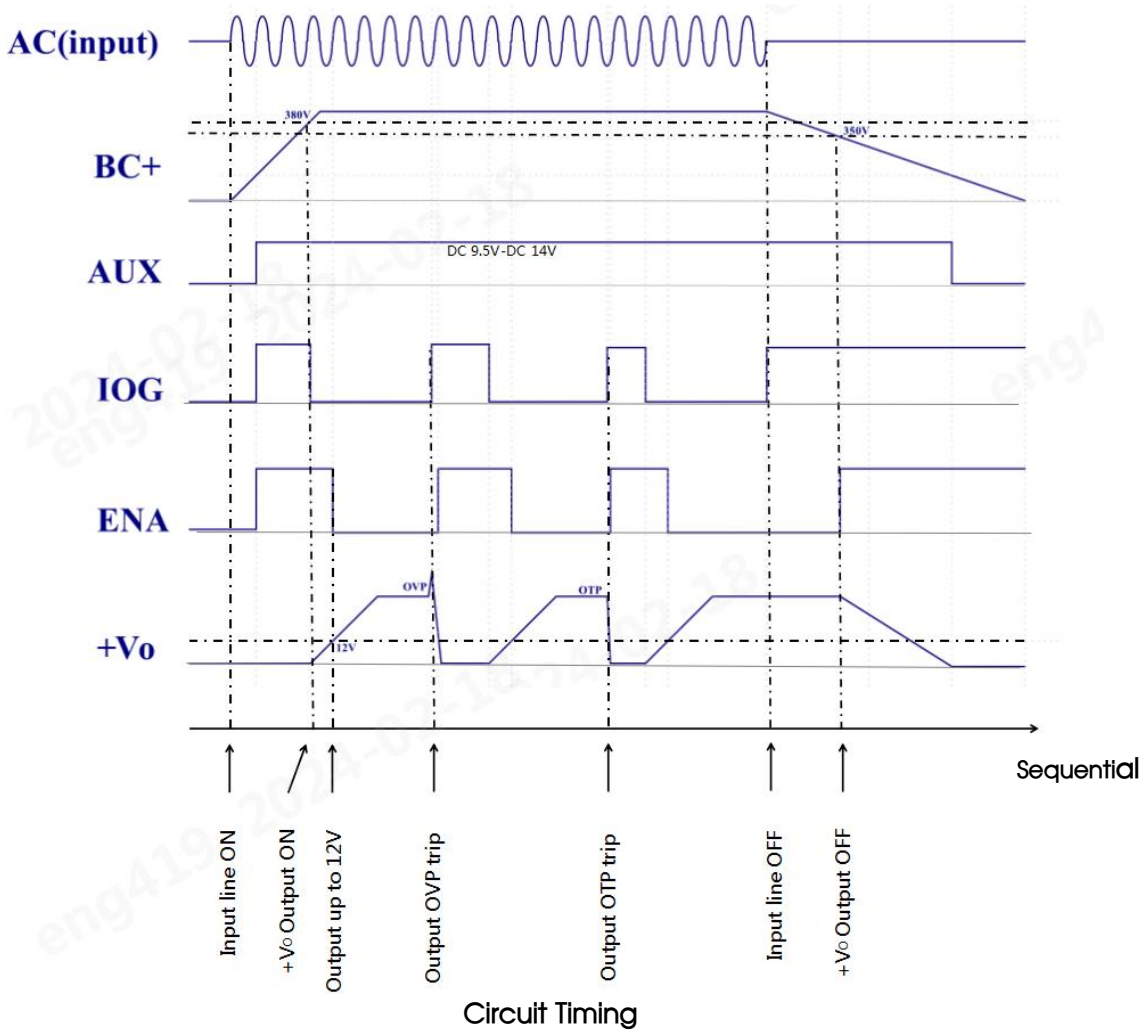

Note: This product is suitable for applications using in good conduction heat dissipation conditon, for applications in closed environment please consult Mornsun FAE.

Efficiency Vs Input Voltage (Full Load)



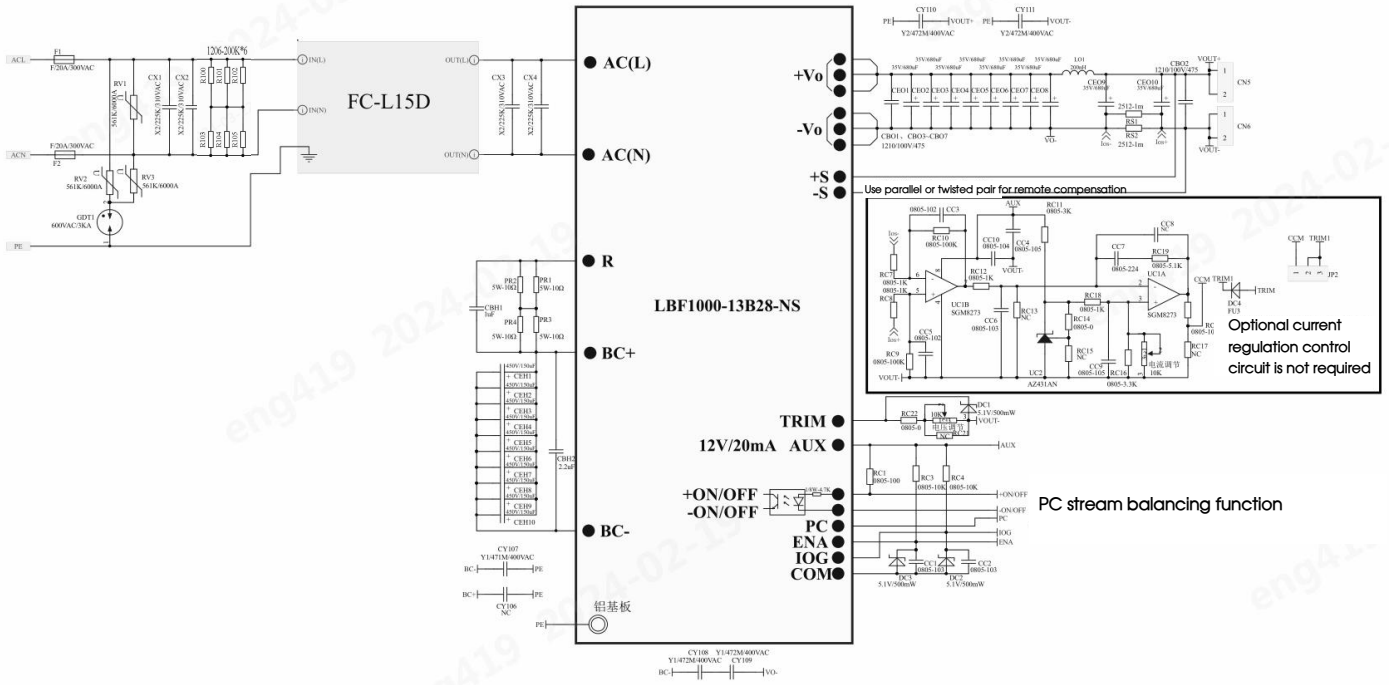

Efficiency Vs Output Load (Vin=230VAC)



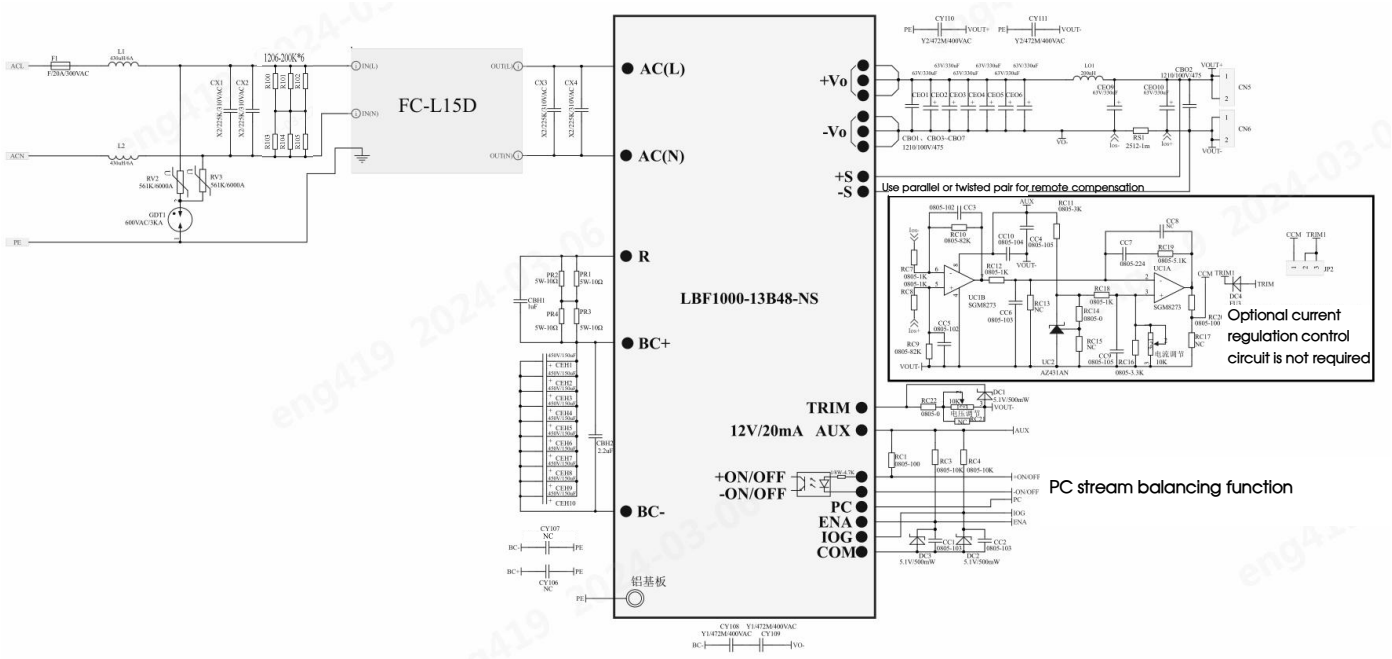



Circuit Timing

## Recommended External Circuit



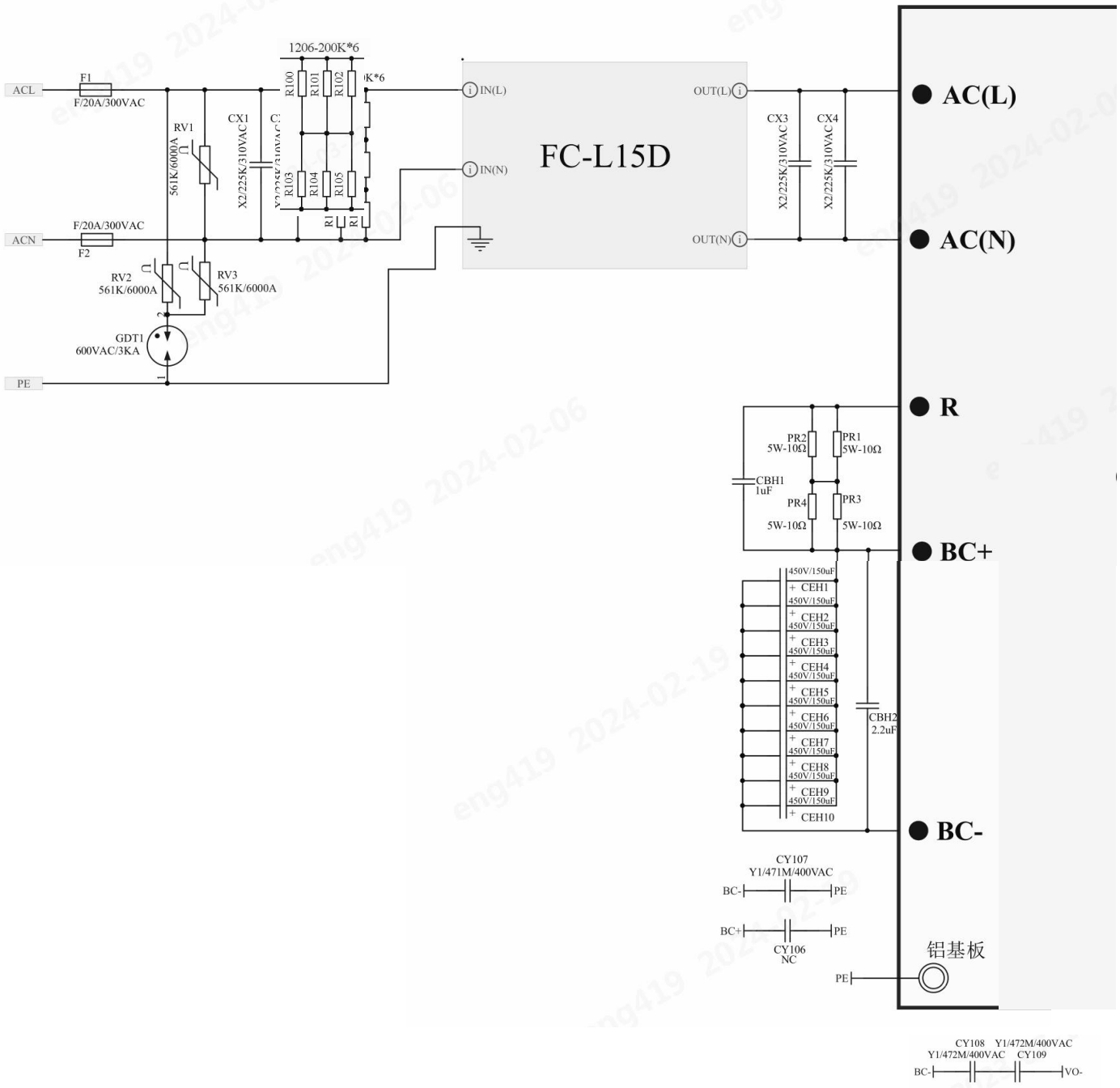

LBF1000-13B28NS

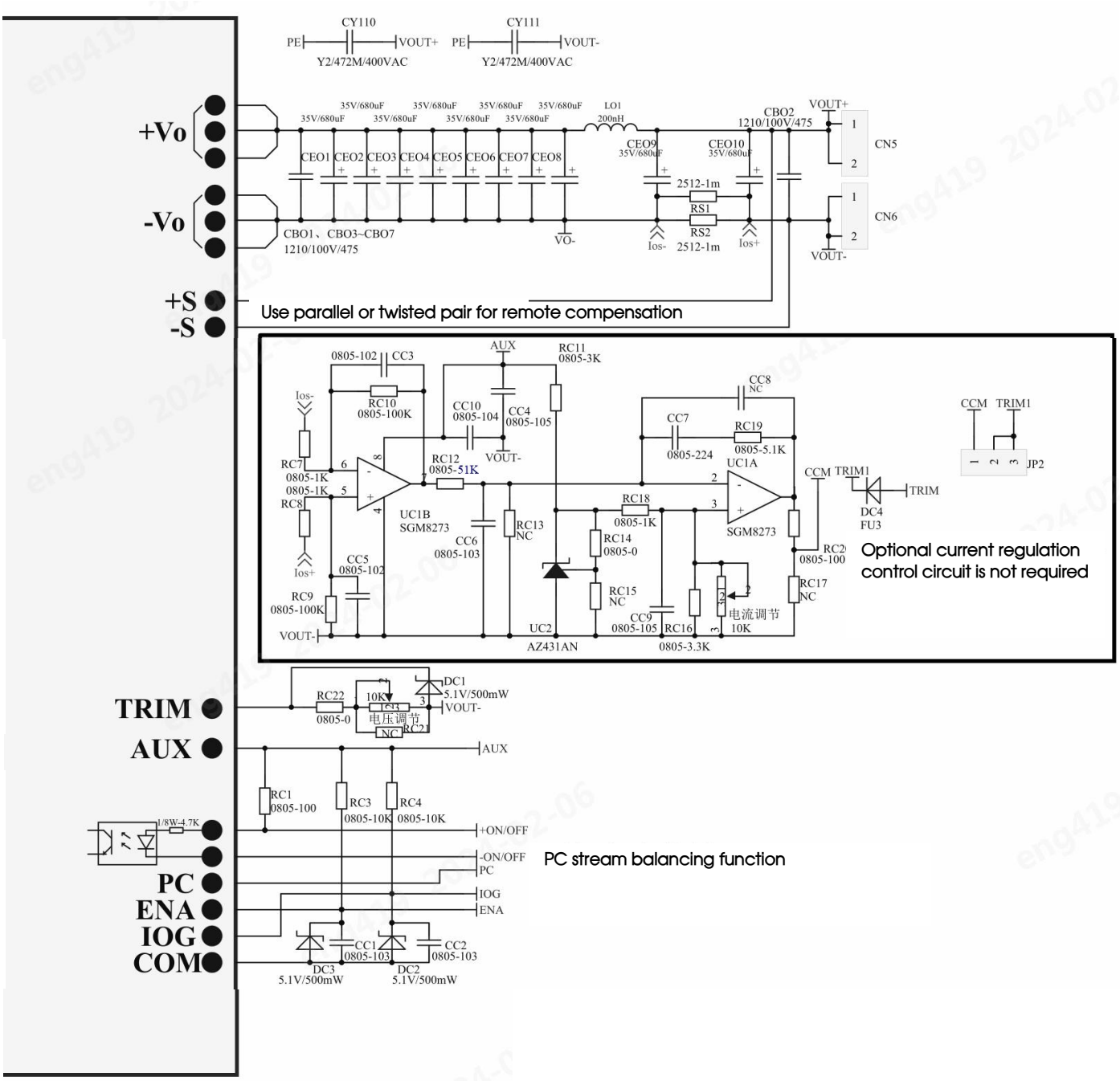



LBF1000-13B48NS

## Recommended External Circuit 1

Note: The breakdown chart is as follows.





LBF1000-13B28-NS the recommended device selection list is as follows:：

| Component type | Recommended value |
|---|---|
| F1 | 300VAC/25A slow-blow |
| PR1/PR2/PR3/RP4 | 10Ω/5W/wire-round resistor |
| RV2/RV3 | 14D561K/6000A |
| CX1/CX2/CX3/CX4 | X2/225K/310VAC |
| R100/R101/R102/R103/R104/R105 | 200K/1206 |
| FC-L15D | FC-L15D |
| GDT1 | 600V/5KA |
| GDT5/GDT8 | 300V/1KA |
| CBH1 | 105K/630VDC(Film Capacitor) |
| CBH2 | 225K/630VDC((Film Capacitor) |
| CEH1/CEH2/CEH3/CEH4/CEH5/CEH6 CEH7/CEH8/CEH9/CEH10 | 150uF/450V (electrolytic capacitor) |
| CEH1/CEH2/CEH3/CEH4/CEH5/CEH6 CEH7/CEH8 | 470uF/35V (electrolytic capacitor) |
| CEO1/CEO2/CEO3/CE04/CEO5/CEO6 CEO7/CEO8/CEO9/CEO10 | 680uF/35V(electrolytic capacitor) |
| CY107 | Y2/471K/250VAC |
| CY108/CY109/CY110/CY111 | Y2/472M/250VAC |
| RS1/RS2 | 1mΩ/2W/2512 |
| LO1 | 0.4uH/1.2mΩ/80A |
| CBO1/CBO2/CBO3/CBO4/CBO5/CBO6/CBO7 | 475K/100V/1210 |

LBF1000-13B48-NS the recommended device selection list is as follows:：

| Component type | Recommended value |
|---|---|
| F1 | 300VAC/25A slow-blow |
| PR1/PR2/PR3/RP4 | 10Ω/5W/wire-round resistor |
| RV2/RV3 | 14D561K/6000A |
| CX1/CX2/CX3/CX4 | X2/225K/310VAC |
| R100/R101/R102/R103/R104/R105 | 200K/1206 |
| FC-L15D | FC-L15D |
| GDT1 | 600V/5KA |
| GDT5/GDT8 | 300V/1KA |
| CBH1 | 105K/630VDC(Film Capacitor) |
| CBH2 | 225K/630VDC((Film Capacitor) |
| CEH1/CEH2/CEH3/CEH4/CEH5/CEH6 CEH7/CEH8/CEH9/CEH10 | 150uF/450V (electrolytic capacitor) |
| CEO1/CEO2/CEO3/CE04/CEO5/CEO6 CEO9/CEO10 | 330uF/63V(electrolytic capacitor) |
| CY108/CY109/CY110/CY111 | Y2/472M/250VAC |

| | |
|---|---|
| RS1 | 1mΩ/2W/2512 |
| LO1 | 0.4uH/1.2mΩ/80A |
| CBO1/CBO2/CBO3/CBO4/CBO5/CBO6/CBO7 | 475K/100V/1210 |

LBF1000-13B28-NS Optional current regulation control circuit is not required, the recommended device selection list is as follows:

| Component type | Recommended value |
|---|---|
| RC7, RC8,RC18 | 1KΩ/0805 |
| RC9, RC10 | 100KΩ/0805 |
| CC10 | 104K/50V/0805/X7R |
| CC1, CC2, CC6 | 103K/100V/0805/X7R |
| CC3, CC5 | 102K/250V/0805/X7R |
| CC4, CC9 | 105K/50V/0805/X7R |
| CC7 | 224K/50V/0805/X7R |
| RC12 | 51 |
| RC14 | 0Ω/0805 |
| RC1 | 100Ω/0805 |
| RC20 | 10Ω/0805 |
| RC3, RC4 | 10KΩ/0805 |
| RC11 | 3KΩ/0805 |
| RC16 | 3.3KΩ/0805 |
| RC19 | 5.1KΩ/0805 |
| RS1, RS2 | 1mΩ/2512 |
| Voltage regulation, current regulation | 10KΩ/1/2W |
| DC2, DC3 | 5.1V/200mW/SOD-323 |
| DC4 | 40V/2A/SOD-123FL |
| UC1 | SGM8273-2XS8G/TR/SOP-8 (same specification dual channel low noise high-precision operational amplifier can also be used) |
| UC2 | TPR432B-S3TR/SOT-23 (devices with the same specification of2.5V reference can also be used) |

LBF1000-13B48-NS Optional current regulation control circuit is not required, the recommended device selection list is as follows:

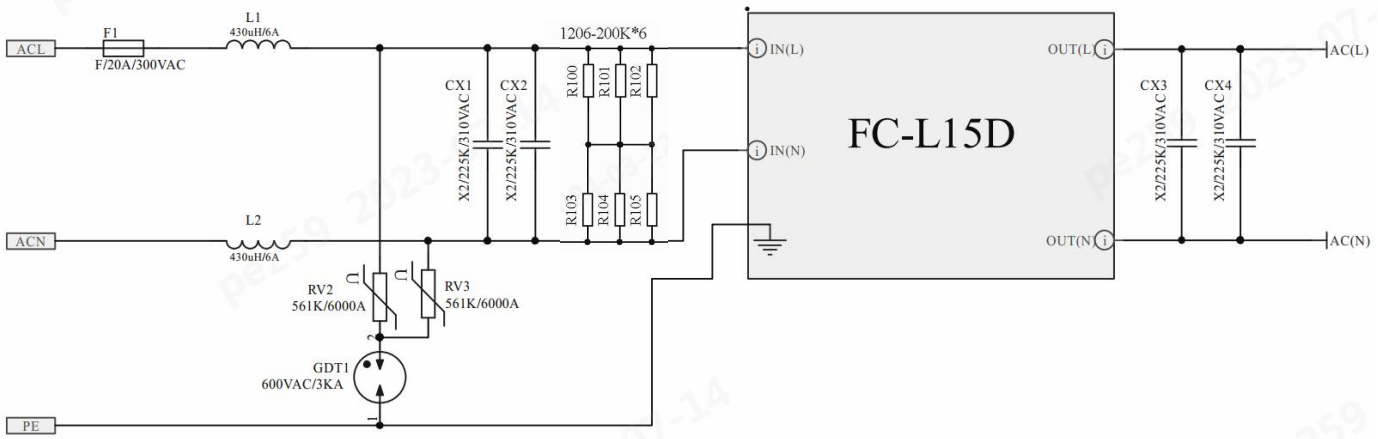
| Component type | Recommended value |
|---|---|
| RC7, RC8, RC12, RC18 | 1KΩ/0805 |
| RC9, RC10 | 82KΩ/0805 |
| CC10 | 104K/50V/0805/X7R |
| CC1, CC2, CC6 | 103K/100V/0805/X7R |
| CC3, CC5 | 102K/250V/0805/X7R |
| CC4, CC9 | 105K/50V/0805/X7R |
| CC7 | 224K/50V/0805/X7R |
| RC14 | 0Ω/0805 |
| RC1 | 100Ω/0805 |

| | |
|---|---|
| RC20 | 10Ω/0805 |
| RC3, RC4 | 10KΩ/0805 |
| RC11 | 3KΩ/0805 |
| RC16 | 3.3KΩ/0805 |
| RC19 | 5.1KΩ/0805 |
| RS1 | 1mΩ/2512 |
| Voltage regulation, current regulation | 10KΩ/1/2W |
| DC2, DC3 | 5.1V/200mW/SOD-323 |
| DC4 | 40V/2A/SOD-123FL |
| UC1 | SGM8273-2XS8G/TR/SOP-8 (same specification dual channel low noise high-precision operational amplifier can also be used) |
| UC2 | TPR432B-S3TR/SOT-23 (devices with the same specification of 2.5V reference can also be used) |

Note:JP2 in the schematic diagram is equivalent to using a jumper switch, when using a current regulation control circuit, it is necessary to short circuit CCM toTRIM1, if this function is not used, please disconnect CCM from TRIM1.

Note: 1. The no-load ripple voltage of the product will slightly exceed the specification (150mV) after switching from load to no-load, which can be improved by connecting a dummy load (resistance value ≤ 1.4KΩ) in parallel with the external circuit.

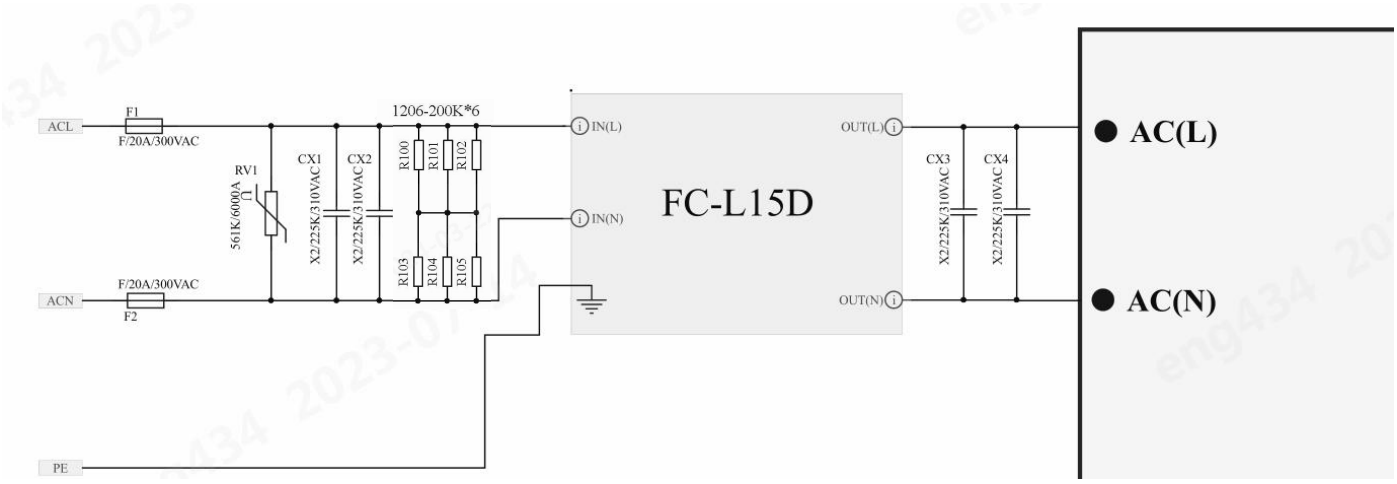
2. If there is a strict requirements on the output ripple voltage rms value, the single capacity of CEH1-CEH8 electrolytic capacitor should be increased to at least 470 uF (For routine use of CEH1-CEH10, use 150uF).




Recommended External Circuit 2

| | |
|---|---|
| L1/L2 | FD2D -60-431 |
| Note: 1. The rest of devices are same as above recommended external circuit 1.<br>2. L1 and L2 have been added to meet the conduction disturbance performance of low frequency conduction in the range of 9KHz -10MHz. | |

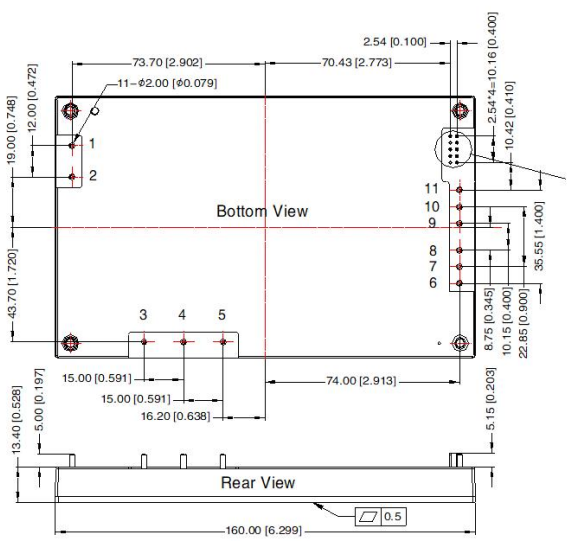
Note: Customer can choose MORNSUN filter module FC-L15D and FD2D-60-431 to replace the part of EMC circuit in the Recommended External Circuit, For more details, please consult the MORNSUN FAE.

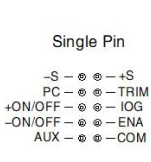


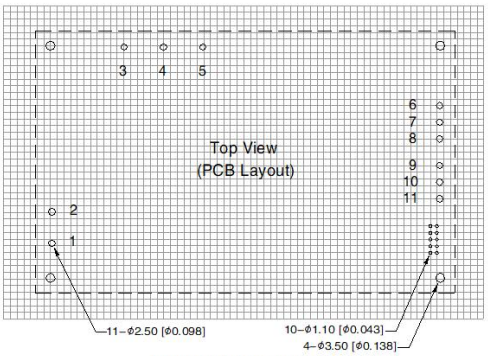

Recommended External Circuit 3

Note:
1.The rest of devices are same as above recommended external circuit 1.
2.Gas is removed from this circuit, and the discharge tube GDT1 is used to meet the needs of isolated voltage resistance.

## Dimensions and Recommended Layout

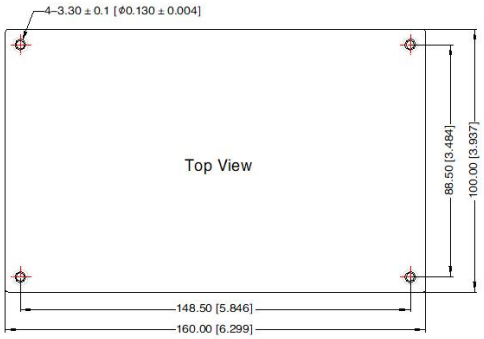


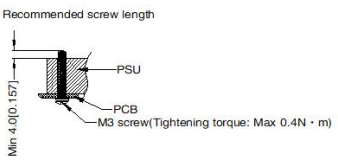




THIRD ANGLE PROJECTION

Note: Grid 2.54*2.54mm




| Pin-Out | | | |
|---|---|---|---|
| Pin | Mark | Pin | Mark |
| 1 | AC(N) | 7 | +Vo |
| 2 | AC(L) | 8 | +Vo |
| 3 | R | 9 | -Vo |
| 4 | +BC | 10 | -Vo |
| 5 | -BC | 11 | -Vo |
| 6 | +Vo | | |




Note:
Unit: mm[inch]
Pin1~11 diameter: φ2.00[0.079]
Single pin dimension: 0.64*0.64[0.025]
Pin diameter tolerances: ± 0.10[ ± 0.004]
General tolerances: ± 0.50[ ± 0.020]

Note:

1. For additional information on Product Packaging please refer to www.mornsun-power.com. Packaging bag number: 58210313;
2. Unless otherwise specified, parameters in this datasheet were measured under the conditions of Ta=25℃, humidity<75%RH with nominal input voltage and rated output load;
3. All index testing methods in this datasheet are based on our company corporate standards;
4. In order to improve the efficiency, there will be audible noise generated when work at light load, but it does not affect product performance and reliability;
5. We can provide product customization service, please contact our technicians directly for specific information;
6. Products are related to laws and regulations: see "Features" and "EMC";
7. The out case needs to be connected to PE (⏚) of system when the terminal equipment in operating;
8. Our products shall be classified according to ISO14001 and related environmental laws and regulations, and shall be handled by qualified units;
9. The power supply is considered a component which will be installed into a terminal equipment. All EMC tests should be confirmed with the final equipment. Please consult our FAE for EMC test operation instructions.

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# LBF1000-13Bxx-NS Power Supply Application Manual

# Content

# 1. Performance characteristics and appearance pin definition


Figure1: Appearance Pin

Appearance Pin (Port) Definition:

| | | | |
|---|---|---|---|
| 1 | Input N line | -S | -Remote sensing terminal |
| 2 | Input L line | +S | +Remote sensing terminal |
| 3 | External inrush current limiting resister terminal (R) | PC | Output current balance terminal |
| 4 | +Boosted voltage terminal (+BC) | TRIM | Output voltage trimming terminal |
| 5 | -Boosted voltage terminal (-BC) | +ON/OFF | +ON/OFF control terminal |
| 6, 7, 8 | +Output voltage (+Vo) | -ON/OFF | -ON/OFF control terminal |
| 9, 10, 11 | -Output voltage (-Vo) | IOG | Output status indicating terminal |
| COM | Common ground terminal | ENA | Power on signal terminal |
| AUX | Auxiliary power supply terminal for external circuits | | |

# 2. Instructions for use

## 2.1 Input requirements

The AC input voltage and DC input voltage must be within the defined voltage range (refer to datasheet), otherwise the power supply may not work properly or even malfunction. There is no fuse inside the power module. For better protection, it is recommended that customers use a circuit breaker not greater than 20A.

To ensure the reliability of the product, hot plugging is prohibited.

## 2.2 Output requirements

At any voltage value, the maximum output current and power must not exceed the rated value.

## 2.3 Remote compensation (+S, -S terminals)

As shown in Figure 2, the +S and -S terminals are respectively connected to the load terminal (VOUT+ and VOUT-) through twisted-pair signal cables or differential signal cables (+S and -S) to compensate the line voltage drop between the module and the load. If the remote compensation connection is not required, the +S and -S terminals can be floating.

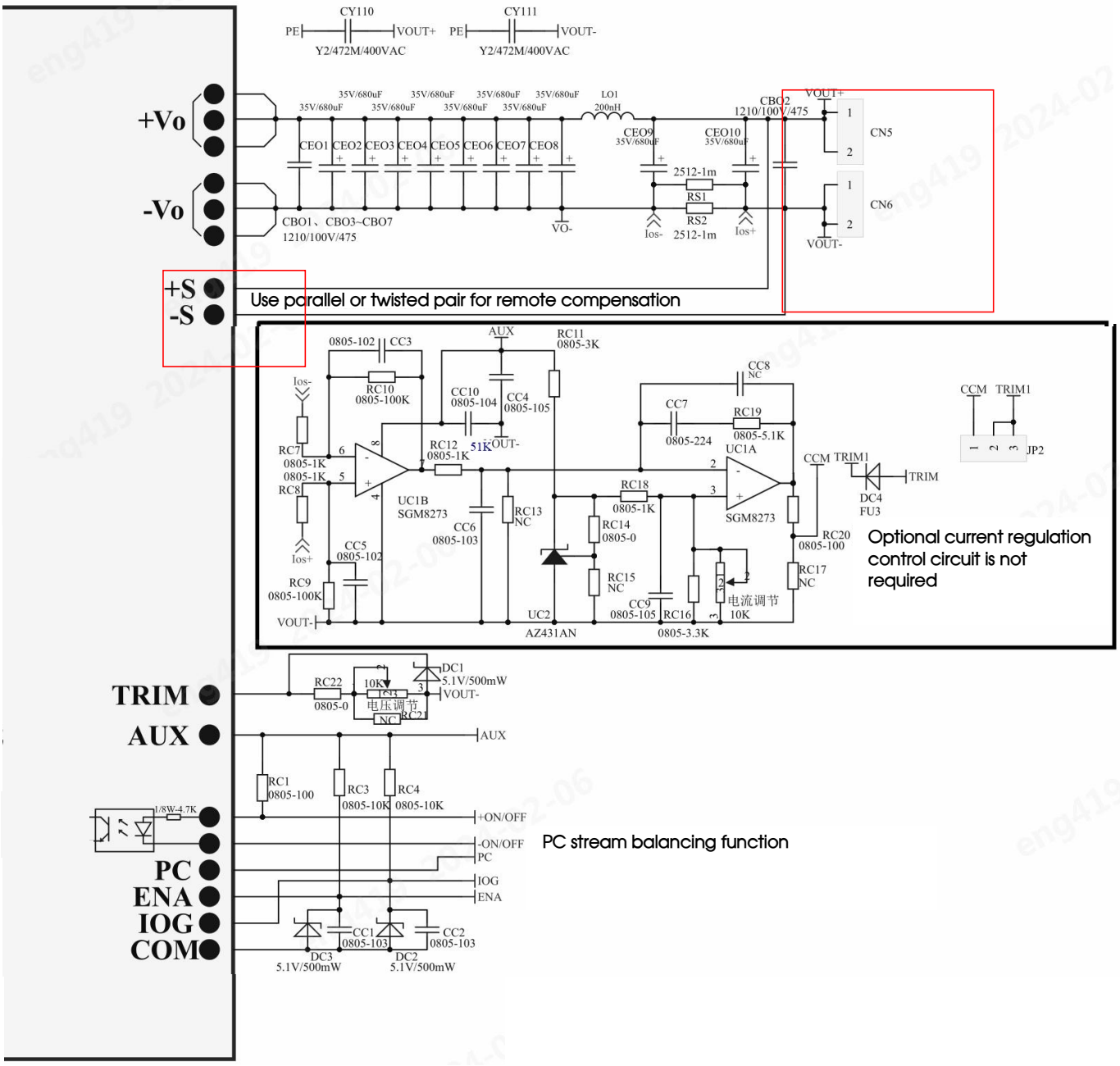



Figure 2: Schematic diagram of the remote compensation connection

Note: In the case of parallel machines or hot and cold backup, the remote compensation function cannot be used, otherwise the voltage anti backflow function will fail, and there may even be a risk of damage to the product.

## 2.4 Output voltage adjustment (TRIM terminal)

As shown in the wiring diagram in the red box in Figure 3, the output voltage of the LBF1000-13B28NS module can be adjusted voltage from 14V to 33.6V by connecting the external 10K adjustable resistor with TRIM and VOUT terminals；the output voltage of the LBF1000-13B48NS module can be adjusted voltage from 24V to 55.1V by connecting the external 10K adjustable resistor with TRIM and VOUT terminals. When the output voltage is higher than the adjustable range, it may cause output over-voltage protection. When the output voltage increases, reduce the output current to ensure that the maximum output power of the module stays within the specified range. When the output voltage is lowered, the maximum output current remains unchanged.

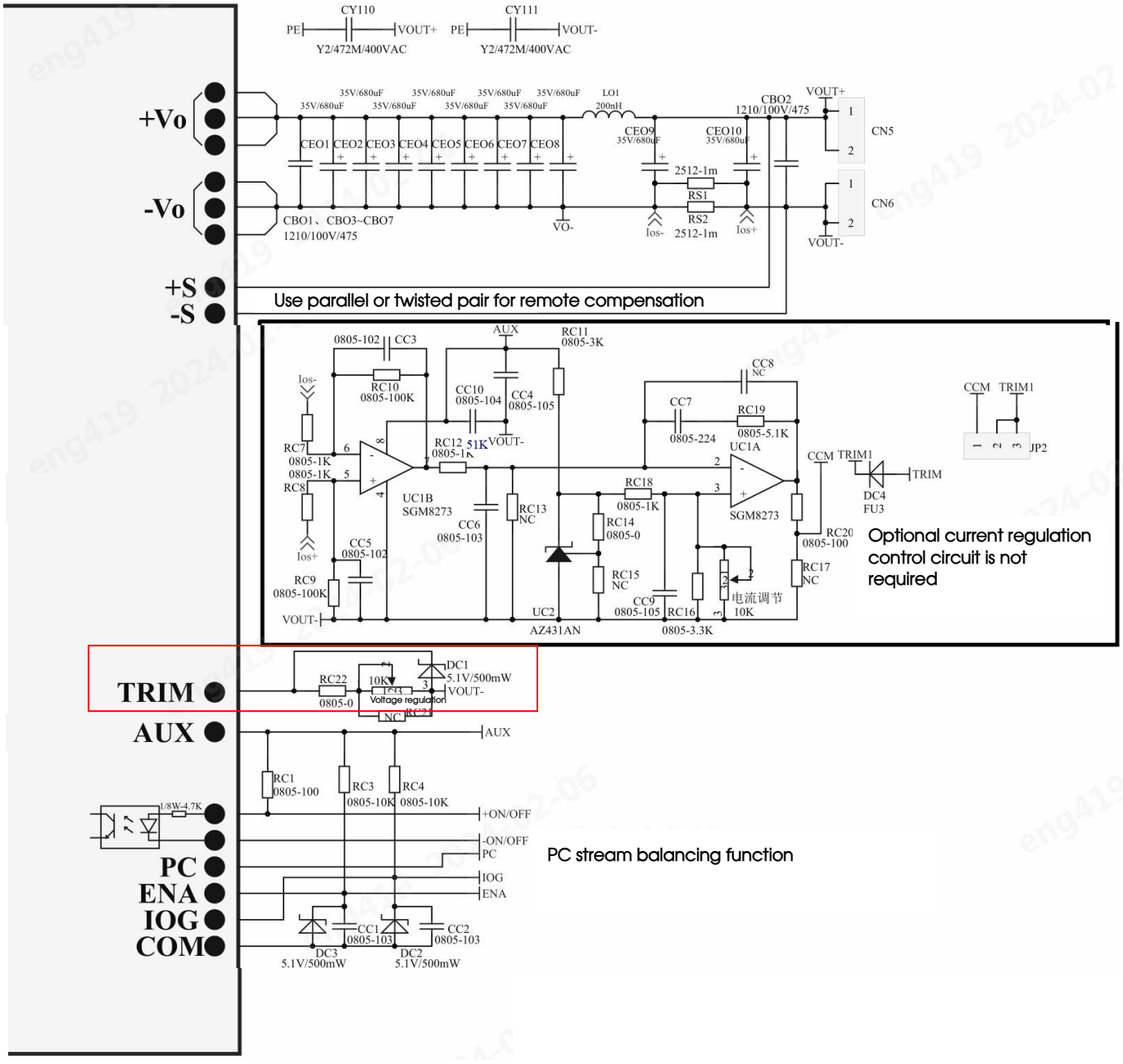


Figure 3: Schematic diagram of the output voltage regulation connection

when using adjustable resistors to adjust voltage, curve diagram of the corresponding relationship between power module TRIM pin terminal voltage and output voltage is shown in figure 4:

$$Vtrim = 3.3 \times \frac{RC22 + R_{Adjustable\ resistor}}{RC22 + R_{Adjustable\ resistor} + RU} = 3.3 \times \frac{RC22 + R_{Adjustable\ resistor}}{RC22 + R_{Adjustable\ resistor} + 1K\Omega}$$

$$Vout = (Vtrim - 0.3) \times \frac{Voutmax - Voutmin}{3 - 0.3} + Voutmin$$

Note: RU is internal resistance of the module, 3.3 is internal power supply

Recommended value of Trim resistor (adjustable slip $R_{voltage\ regulation}$ to achieve upper and lower output voltage regulation):

| Vout | RC22 | Rvoltage regulation |
|---|---|---|
| LBF1000-13B28NS | 0Ω/0805 | Sliding rheostat with adjustable range of 0-10kΩ |
| LBF1000-13B48NS | 0Ω/0805 | Sliding rheostat with adjustable range of 0-10kΩ |
| Note: When the sliding rheostat adjustment resistance exceeds the recommended adjustable range too much, the module will enter over-voltage protection. | | |

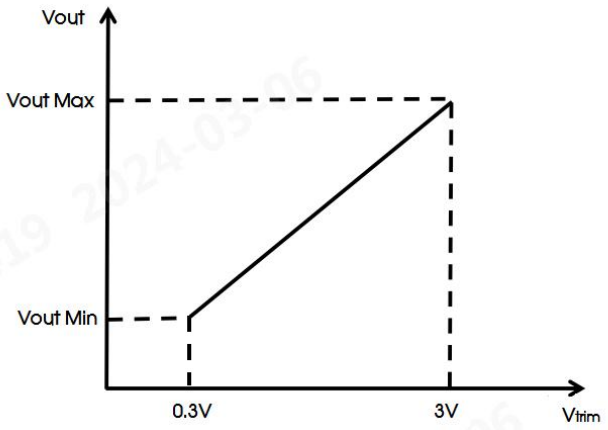



Figure 4: curve diagram of the corresponding relationship between Vtrim and Vout

| Part No. | Vout max | Vout min |
|---|---|---|
| LBF1000-13B28NS | 34.1V | 13.5V |
| LBF1000-13B48NS | 55.6V | 23.5V |

when the output is fixed, and no need for adjustment resistance, fixed resistor (RC22) can be directly connected, adapt the required output voltage by selecting the appropriate resistance value, power module TRIM pin terminal circuit connection diagram is shown in figure 5, TRIM pin terminal voltage relationship:

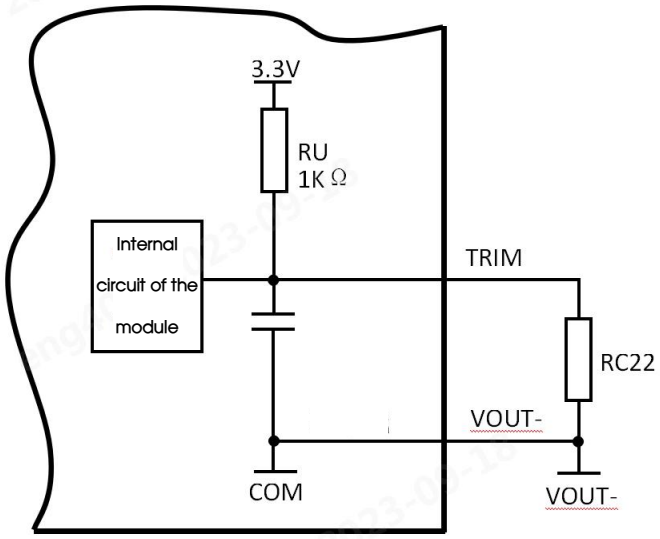



Figure 5: power module TRIM pin terminal circuit connection diagram

$$Vout = (Vtrim - 0.3) \times \frac{Voutmax - Voutmin}{3 - 0.3} + Voutmin$$

$$Vtrim = 3.3 \times \frac{RC22}{RC22 + RU} = 3.3 \times \frac{RC22}{RC22 + 1K\Omega}$$

LBF1000-13B28NS: Typical output voltage 28Vcorresponds to a fixed resistance (RC22) value of around 2K, if the Trim PIN is suspended, the output voltage is around 34.5V.

LBF1000-13B48NS: Typical output voltage 48Vcorresponds to a fixed resistance (RC22) value of around 2.52K, if the Trim PIN is suspended, the output voltage is around 55.6V.

LBF1000-13B28NS: When the output voltage is between 25.5V and 27.5V, he working mode of the power module exists in PWM mode and PFM mode; When the output voltage is above 27.5V, the working mode of the power module is PFM mode; When the output voltage is below 25.5V, the working mode of the power module is PWM mode; LBF1000-13B48NS: When the output voltage is between 45V and 47V, the working mode of the power module exists in PWM mode and PFM mode; When the output voltage is above 47V, the working mode of the power module is PFM mode; When the output voltage is below45V, the working mode of the power module is PWM mode, the efficiency of power supply operating in PWM mode is slightly lower by 0.5%-0.7% compared to operating in PFM mode.

## 2.5 Remote control switch (ON/OFF terminal)

The product with built-in remote control switch function. This function enables switching of the output to be controlled while the input voltage on. As shown in Figure 6, the remote control function shielding

connection diagram, the ON/OFF signal terminal of this product with built-in isolation optocoupler in the power supply. If this function is not used, the customer can supply power to the +ON/OFF terminal via the AUX terminal through the current limiting resistor RC1. - The ON/OFF terminal is connected to the COM pin; if you need to use the ON/OFF function to achieve electrical isolation control, you can refer to the schematic diagram of the remote switch connection in Figure 7, and use the ON/OFF control signal isolated from the power supply to provide power supply connections for the ON/OFF terminal (The control signal cannot be reversed).

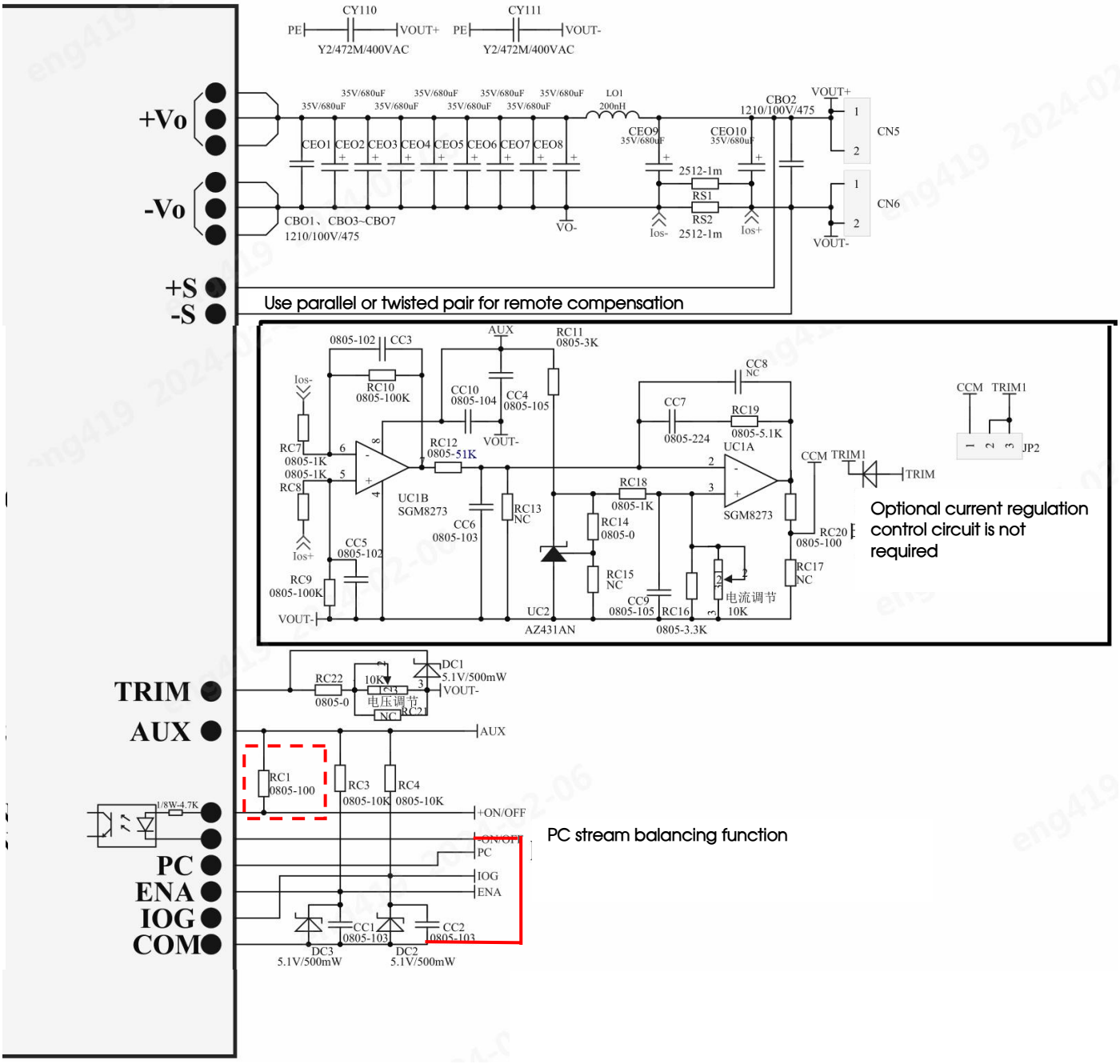



Figure 6: Remote function shielding connection diagram

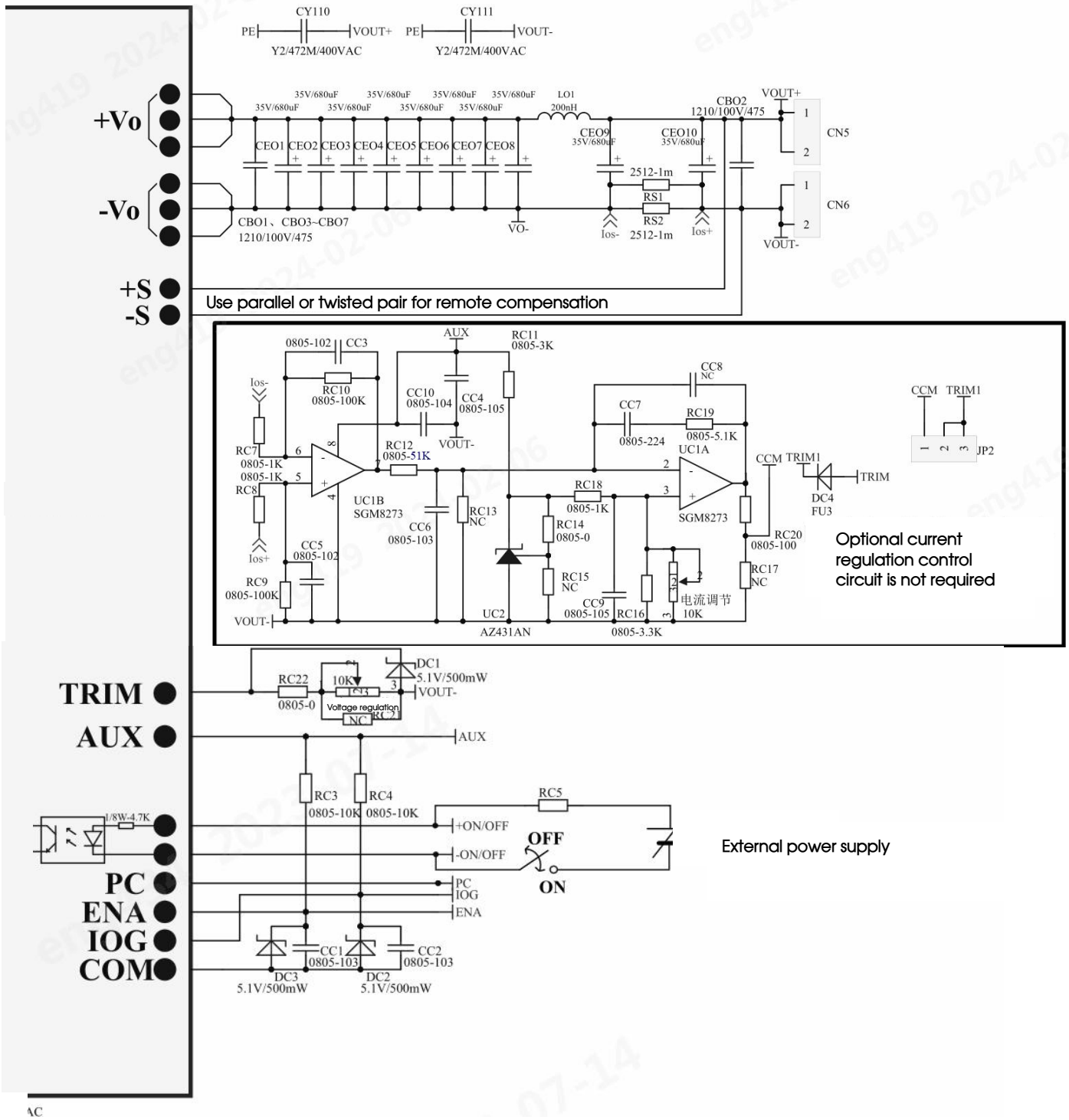



Figure 7: Schematic diagram of remote switch connection

Select the external voltage and external resistance, as the ON/OFF terminals current is shown below.

Table 1 Recommended ON/OFF terminal current

| ON/OFF terminal current | Output Voltage |
|---|---|
| 2-10mA | ON |
| <0.15mA | OFF |

## 2.6 Parallel operation (PC terminal)

The PC terminal is a parallel current sharing bus. Parallel-connect the PC and COM terminals of each power module to equalize the output current between modules. At the output end of the power supply, the output cable width and length of each module should be as consistent as possible, and the line impedance should be as similar as possible. After the output filtering of a single module, a load bus is drawn from the load end. After the output filtering, each module accesses the load bus nearby through the load line of the same specification and length, and themobility is optimal.

Power modules support 2-6 parallel redundancy. Set the accuracy of the output voltage within ±2% precision when adjust the output voltage for parallel operation.

When the system is used in parallel, the maximum load current cannot exceed the maximum output current of a single power module; otherwise, the entire parallel power system cannot start properly.

Table 2 Condition for parallel operation

| Parallel units | Maximum output current |
|---|---|
| 2-3 units | 90% of nominal output current |
| 4-6 units | 85% of nominal output current |

## 2.7 Auxiliary power supply for external signals (AUX terminal)

The AUX terminal output voltage ranges from DC9.5V to DC14V, The AUX terminal keep current constant and reduce voltage when the output current is over 20mA. AUX terminal reference position COM terminal. Do not short-circuit the AUX terminal to a terminal other than the ON/OFF terminal. Otherwise, the power module may be damaged.

## 2.8 Status indicator (IOG terminal)

This signal is located at the secondary output side and is an open drain output. the reference ground is the COM terminal. By monitoring the signal from IOG terminal to COM terminal, you can check whether the power module is working properly. Low level when working normally, high level when working abnormally.

Note: Normal output is "low", when a fault occurs, the output is "high" (maximum pull-down current is 5mA, maximum applied voltage is 35V).

## 2.9 Power ON signal (ENA terminal)

This signal is located at the secondary output side and is an open drain output. the reference ground is the COM terminal. When output voltage goes over Typ. Output voltage threshold level 12V at start up, Power ON signal is "low level". "high level" when working abnormally.

Note: Normal output is "low", when a fault occurs, the output is "high" (maximum pull-down current is 5mA, maximum applied voltage is 35V).

## 2.10 Input under-voltage protection (UVP)

When the input voltage is lower than the under-voltage protection set value, the module output is closed; When the input voltage is higher than the under-voltage protection power-on set value, the module output is normal. The under-voltage protection has a return difference, that is, the shutdown setting value is lower than the start-up setting value, so as to prevent the module from being affected by external interference or the transient drop of input voltage when starting itself and working normally.

## 2.11 Output over-voltage protection (OVP)

When the output end of the module is over-voltage, the output voltage hiccup or clamped at a fixed value. After the fault is rectified, the module output automatically recovers to normal.

## 2.12 Over-current circuit protection (OCP)

This module is designed with over-current/short circuit protection circuit, which can withstand over-current or short circuit at the output end. After the over-current and short circuit faults are eliminated, the module output automatically recovers to normal.

LBF1000-13B28NS：When the output voltage setting value less than 25V, Typ. constant current value is 45A; When the output voltage setting value between 25V-34.1V, Typ. constant current value decreasing as the output voltage setting value increases, the relationship diagram is shown in Figure 8.

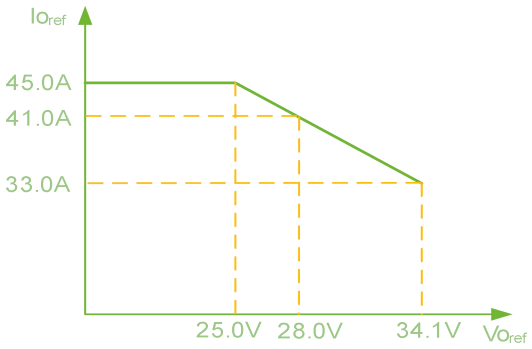



Figure 8: the relationship diagram between output voltage setting value and Typ. constant current value.

When the output voltage setting value less than 17V, OCP mode is hiccup mode Typ. 1s at work, 4s at rest; When the output voltage setting value more than 19V, OCP mode is Constant current mode; When the output voltage setting value between 17V and 19V, both states may exist.

LBF1000-13B48NS：When the output voltage setting value less than 43V, Typ. constant current value is 26A; When the output voltage setting value between 43V-55.6V, Typ. constant current value decreasing as the output voltage setting value increases, the relationship diagram is shown in Figure 9.

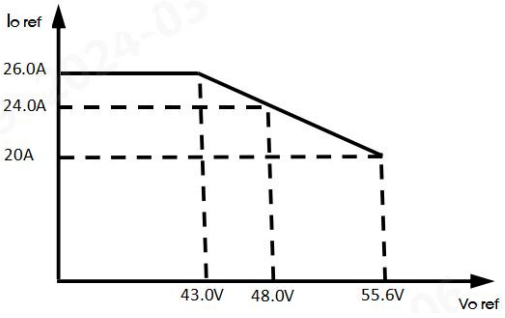



Figure 9: the relationship diagram between output voltage setting value and Typ. constant current value.

When the output voltage setting value less than 31V, OCP mode is hiccup mode Typ. 1s at work, 4s at rest; When the output voltage setting value more than 33V, OCP mode is Constant current mode; When the output voltage setting value between 31V and 33V, both states may exist.

Note: that continuous short circuit or overload condition, might result in power module damage.

## 2.13 Over-temperature protection (OTP)

The built-in over-temperature protection circuit of the module prevents the module from being damaged due to excessive temperature rise such as overload and short circuit. When the temperature of the module shell exceeds the set value of over-temperature protection, the output of the module automatically closes. You need to power off and reset to restore the system.

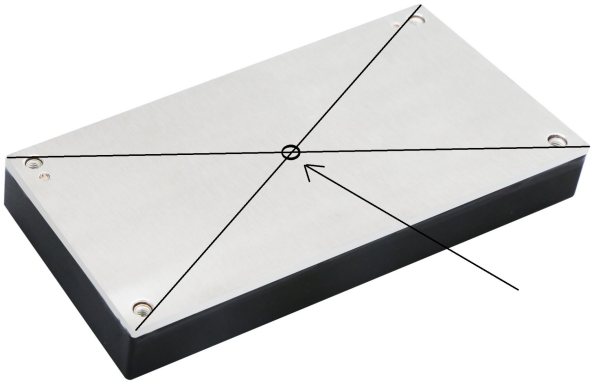


Figure 10: AL-Substrate temperature test point

## 2.14.External current regulating and controlling circuits

The internal constant current point of the module is fixed,if needed use an external current regulating control circuit to adjust the constant current point,then can refer to the following recommendations for debugging,output constant current control output current feedback error amplifier， As shown in recommended peripheral circuit diagram 1,since the output current sampling operation amplifier has a maximum output voltage signal is 1.8V,in order to ensure the value range of the normal operating reference voltage（ *Iadj* ）is 0-2Vdc,RC18（recommende1KΩ) and CC9(recommend 1μF) is a filter circuit for reference voltage to ensure that the circuit to provide a stable reference voltage.CC7(recommend 10nF～1μF)与 RC19(recommend3KΩ～10KΩ)以及 CC8(usually unnecessary) is to compensate the loop of current feedback error amplifier，RC20 与 DC4 is coupled circuit(necessary），It can prevents the damage of operational amplifier and power module,when the output of the operational amplifier is higher than the Trim of power module,DC1 is the 5.1V voltage regulator,It also can can prevents the damage of operational amplifier and power module,when the output of the operational amplifier is higher than the Trim of power module,CC9(recommend 1nF～4.7μF) is the capacitance of the current feedback error amplifier and also is the current feedback error amplifier's output compensates for one of the response frequency poles,it can effectively improved the stability of feedback loop in feedback loop debugging,the effect of RC22 is very important,it determines the upper limit of the output voltage.

External loop output constant current control circuit topology link,set the upper limit of the output voltage(Vout set) of the power module:

$$\text{Vout set} = (\text{Vtrim} - 0.3) \times \frac{\text{Voutmax} - \text{Voutmin}}{3 - 0.3} + \text{Voutmin}$$

$$\text{Vtrim} = 3.3 \times \frac{\text{RC22}}{\text{RC22} + \text{RU}} = 3.3 \times \frac{\text{RC22}}{\text{RC22} + 1\text{K}\Omega}$$

| 型号 | V out max | V out min |
|---|---|---|
| LBF1000-13B28NS | 34.1V | 13.5V |
| LBF1000-13B48NS | 55.6V | 23.5V |

Special version:when the output voltage(or charging voltage) of the power module is lower than 19V,the power supply can be burped constant current mode output.

1)The external output constant current control circuit has constant current setting:

$$Io_{set} = \frac{V_{OPin}}{Rs}$$

$Io_{set}$ :Module output current

$V_{OPin}$ :The input voltage signal amplitude of the amplifier

Rs :Module power output current sampling resistance

2)Amplifier output voltage signal

$$V_{OPin} = \frac{V_{OPout}}{\beta}$$

$V_{OPout}$ :The output signal amplitude of the amplifier

β :The multiple of output current sampling operational amplifier

$V_{OPin}$ :The input signal amplitude of the amplifier.

3)The relationship between the current adjustable resistance and amplifier's output voltage signal

$$V_{OPout} = \frac{Vref}{RC18 + \frac{RC16 * R_{Adjustable\ current}}{RC16 + R_{Adjustable\ curren}}}$$

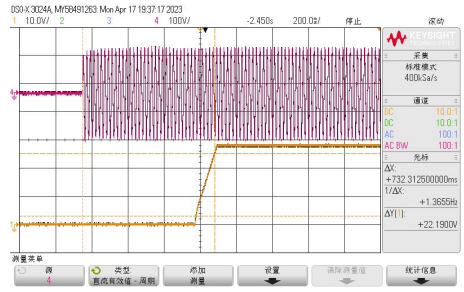
Note:1. IOS+ and IOS- need separate leads from the sampling resistor to the control circuit.

2. when use external current regulation control circuit,CCM and TRIM1 need connect in the picture.

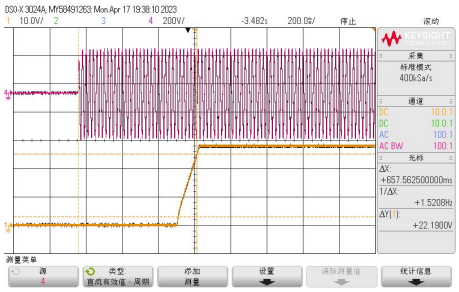
# 3. Test waveform

## 3.1 Startup and shutdown

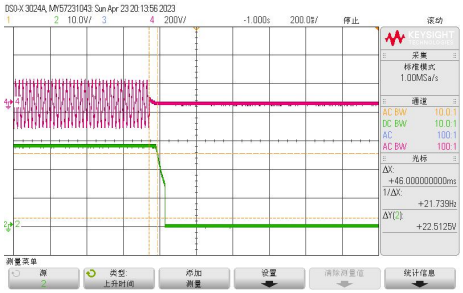
Test conditions: Tc=25℃, LBF1000-13B28-NS products are tested based on recommended circuit 1, CEH1-CEH10=1500uF.



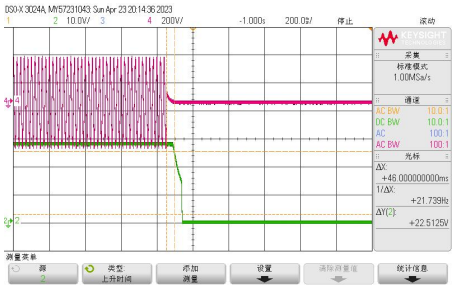
Vin=115VAC Full load start (start delay 732ms)



Vin=230VAC Full load start (start delay 657ms)

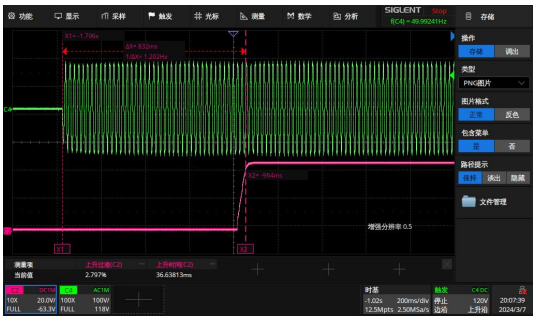


Vin=115VAC Full load shutdown (46ms)

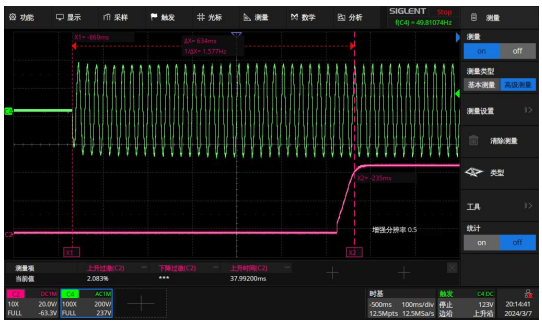


Vin=230VAC Full load shutdown (46ms)

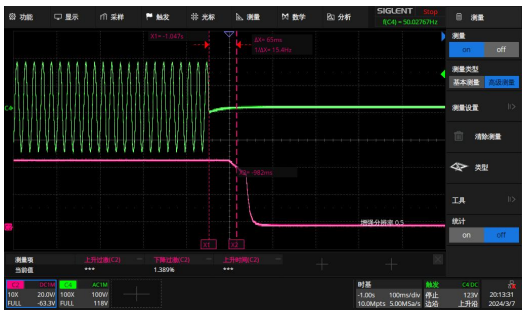
Test conditions: Tc=25℃, LBF1000-13B48-NS products are tested based on recommended circuit 1, CEH1-CEH10=1500uF.



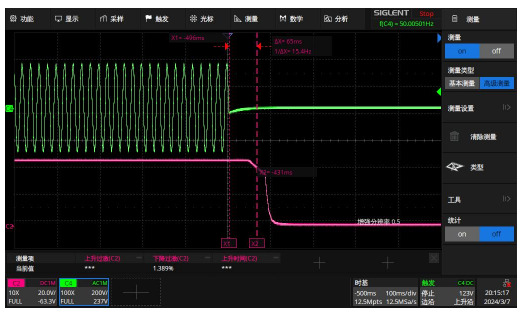
Vin=115VAC Full load start (start delay 832ms)



Vin=230VAC Full load start (start delay 634ms)



Vin=115VAC Full load shutdown (65ms)



Vin=230VAC Full load shutdown (65ms)

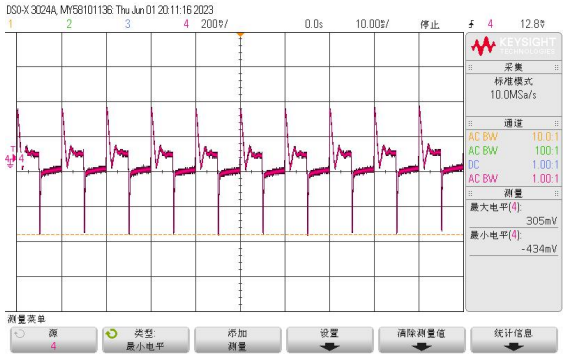
Note: The power OFF hold-up time is related to the CEH capacitance, and can be adjusted with reference to the following formula:

$$t = \frac{0.5 \cdot C_{EH} \cdot (U_1^{\,2} - U_2^{\,2})}{P_o}$$

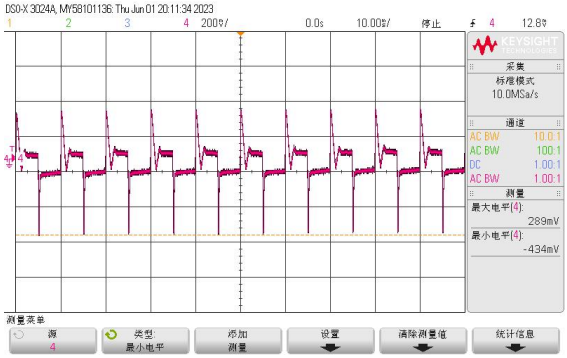
U1=410VDC, U2=325VDC, Po=1008W (based on actual power output).

## 3.2 Dynamic response

Test conditions: Tc=25℃, current rate slope 0.1A/us, LBF1000-13B28-NS products are tested based on recommended circuit 1.



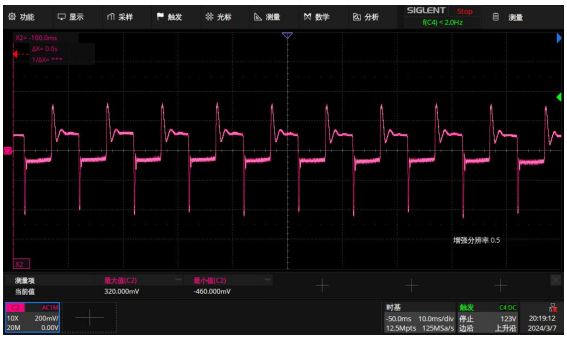
Vin=115VAC 10%-100% dynamic



Vin=230VAC 10%-100% dynamic

Test conditions: Tc=25℃, current rate slope 0.1A/us, LBF1000-13B48-NS products are tested based on recommended circuit 1.

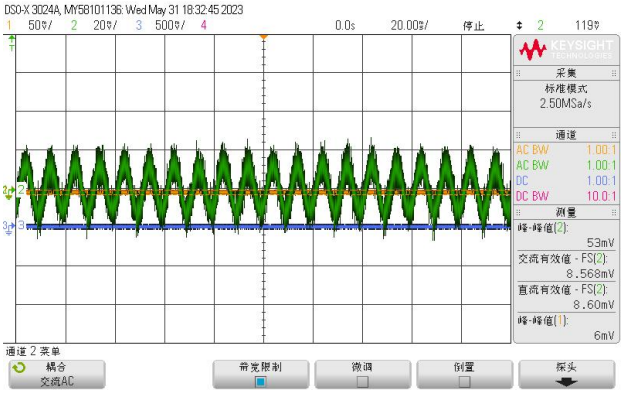
Vin=115VAC 10%-100% dynamic



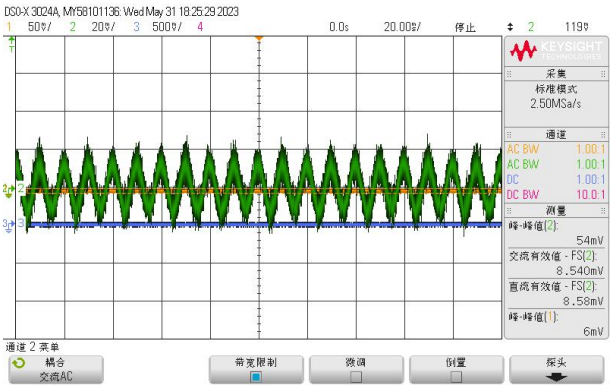
Vin=230VAC 10%-100% dynamic

## 3.3 Output ripple and noise

Test conditions: Tc=25℃, 20M bandwidth (peak to peak value) LBF1000-13B28-NS products are tested based on recommended circuit 4.

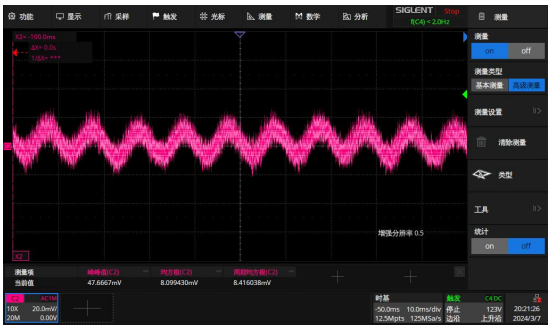



Vin=115VAC full load ripple noise (53mV)/ripple RMS value (8.5mV)

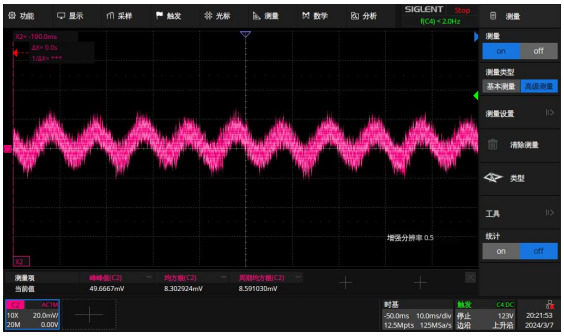



Vin=230VAC full load ripple noise (54mV)/ripple RMS value (8.5mV)

Test conditions: Tc=25℃, 20M bandwidth (peak to peak value) LBF1000-13B48-NS products are tested based on recommended circuit 4.



Vin=115VAC full load ripple noise (48mV)/ripple RMS value (8.1mV)



Vin=230VAC full load ripple noise (50mV)/ripple RMS value (8.6mV)

## 3.4 Conductive and radiation

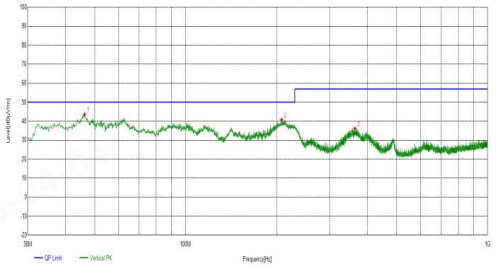
(1) Radiation (RE)

LBF1000-13B28-NS products Safety specifications: CISPR32/EN55032 CLASS A

RE Tc=25℃, Vin=115VAC, Pout=1008W, based on recommended circuit 1 test

| Suspected List | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency [MHz] | Polarity | Factor [dB] | Reading [dBμV/m] | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Detector | Height [cm] | Angle deg | Pass/Fail |
| 46.2976 | Vertical | 14.24 | 29.29 | 43.53 | 50.00 | 6.47 | PK | 100 | 234 | PASS |
| 207.9158 | Vertical | 11.77 | 28.98 | 40.75 | 50.00 | 9.25 | PK | 100 | 82 | PASS |
| 363.4223 | Vertical | 16.84 | 19.39 | 36.23 | 57.00 | 20.77 | PK | 100 | 227 | PASS |

TRACE

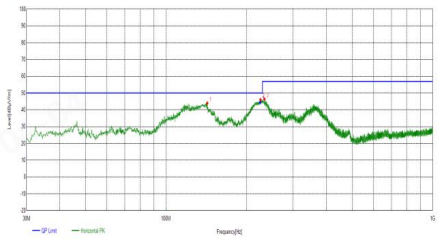


Vertical waveform and reading point

| Suspected List | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency [MHz] | Polarity | Factor [dB] | Reading [dBμV/m] | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Detector | Height [cm] | Angle deg | Pass/Fail |
| 142.8223 | Horizontal | 13.98 | 30.05 | 44.03 | 50.00 | 5.97 | PK | 100 | 67 | PASS |
| 225.9596 | Horizontal | 12.41 | 33.67 | 46.08 | 50.00 | 3.92 | PK | 100 | 82 | PASS |
| 234.1084 | Horizontal | 12.70 | 33.69 | 46.39 | 57.00 | 10.61 | PK | 100 | 97 | PASS |

| Final Data List | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Frequency [MHz] | Polarity | Factor [dB] | QP Value [dBμV/m] | QP Limit [dBμV/m] | QP Margin [dB] | Height [cm] | Angle [°] | Pass/Fail |
| 225.5476 | Horizontal | 12.40 | 44.43 | 50.00 | 5.57 | 110 | 82 | PASS |

TRACE

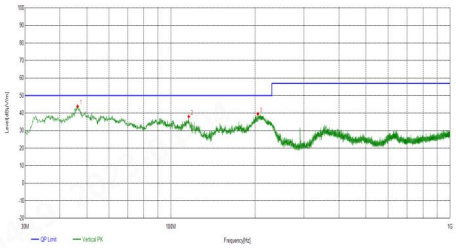


Horizontal waveform and reading point

RE Tc=25℃, Vin=230VAC, Pout=1008W, based on recommended circuit 1 test

| Suspected List | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency [MHz] | Polarity | Factor [dB] | Reading [dBμV/m] | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Detector | Height [cm] | Angle deg | Pass/Fail |
| 46.2976 | Vertical | 14.24 | 29.59 | 43.83 | 50.00 | 6.17 | PK | 100 | 125 | PASS |
| 115.8536 | Vertical | 12.02 | 26.04 | 38.06 | 50.00 | 11.94 | PK | 100 | 208 | PASS |
| 204.9085 | Vertical | 11.66 | 27.83 | 39.49 | 50.00 | 10.51 | PK | 100 | 48 | PASS |

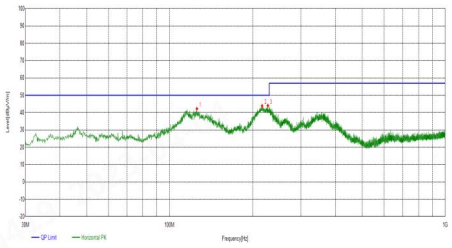
TRACE



Vertical waveform and reading point

| Suspected List | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency [MHz] | Polarity | Factor [dB] | Reading [dBμV/m] | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Detector | Height [cm] | Angle deg | Pass/Fail |
| 125.6516 | Horizontal | 12.63 | 29.59 | 42.22 | 50.00 | 7.78 | PK | 100 | 189 | PASS |
| 216.5497 | Horizontal | 12.08 | 31.82 | 43.90 | 50.00 | 6.10 | PK | 100 | 21 | PASS |
| 227.3177 | Horizontal | 12.46 | 31.58 | 44.04 | 50.00 | 5.96 | PK | 100 | 74 | PASS |

TRACE



Horizontal waveform and reading point

The test results meet CLASS A standards

LBF1000-13B48-NS products Safety specifications: CISPR32/EN55032 CLASS A

RE Tc=25℃, Vin=115VAC, Pout=1008W, based on recommended circuit 1 test

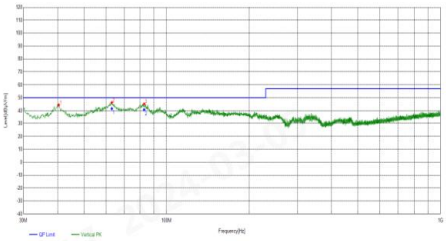
Suspected List

| Frequency [MHz] | Polarity | Factor [dB] | Reading [dBμV/m] | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Detector | Height [cm] | Angle deg | Pass/Fail |
|---|---|---|---|---|---|---|---|---|---|---|
| 40.38 | Vertical | 19.92 | 24.46 | 44.38 | 50.00 | 5.62 | PK | 100 | 105 | PASS |
| 63.0803 | Vertical | 19.37 | 26.82 | 46.19 | 50.00 | 3.81 | PK | 100 | 14 | PASS |
| 82.7733 | Vertical | 15.75 | 29.40 | 45.15 | 50.00 | 4.85 | PK | 100 | 214 | PASS |

Final Data List

| Frequency [MHz] | Polarity | Factor [dB] | QP Value [dBμV/m] | QP Limit [dBμV/m] | QP Margin [dB] | Height [cm] | Angle [°] | Pass/Fail |
|---|---|---|---|---|---|---|---|---|
| 63.0807 | Vertical | 19.37 | 41.49 | 50.00 | 8.51 | 350 | 14 | PASS |
| 82.7724 | Vertical | 15.75 | 40.68 | 50.00 | 9.32 | 200 | 214 | PASS |

TRACE



Vertical waveform and reading point

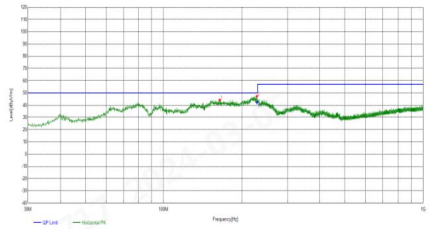
Suspected List

| Frequency [MHz] | Polarity | Factor [dB] | Reading [dBμV/m] | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Detector | Height [cm] | Angle deg | Pass/Fail |
|---|---|---|---|---|---|---|---|---|---|---|
| 164.4554 | Horizontal | 20.70 | 23.55 | 44.25 | 50.00 | 5.75 | PK | 100 | 105 | PASS |
| 228.6759 | Horizontal | 18.51 | 28.68 | 47.19 | 50.00 | 2.81 | PK | 100 | 136 | PASS |

Final Data List

| Frequency [MHz] | Polarity | Factor [dB] | QP Value [dBμV/m] | QP Limit [dBμV/m] | QP Margin [dB] | Height [cm] | Angle [°] | Pass/Fail |
|---|---|---|---|---|---|---|---|---|
| 228.6871 | Horizontal | 18.51 | 42.28 | 50.00 | 7.72 | 120 | 136 | PASS |

TRACE



Horizontal waveform and reading point

RE Tc=25℃, Vin=230VAC, Pout=1008W, based on recommended circuit 1 test

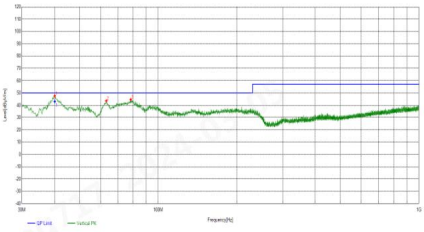
Suspected List

| Frequency [MHz] | Polarity | Factor [dB] | Reading [dBμV/m] | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Detector | Height [cm] | Angle deg | Pass/Fail |
|---|---|---|---|---|---|---|---|---|---|---|
| 40.089 | Vertical | 19.90 | 27.69 | 47.59 | 50.00 | 2.41 | PK | 100 | 117 | PASS |
| 63.1773 | Vertical | 19.37 | 24.15 | 43.52 | 50.00 | 6.48 | PK | 100 | 2 | PASS |
| 78.4078 | Vertical | 16.48 | 28.08 | 44.56 | 50.00 | 5.44 | PK | 100 | 187 | PASS |

Final Data List

| Frequency [MHz] | Polarity | Factor [dB] | QP Value [dBμV/m] | QP Limit [dBμV/m] | QP Margin [dB] | Height [cm] | Angle [°] | Pass/Fail |
|---|---|---|---|---|---|---|---|---|
| 40.0878 | Vertical | 19.90 | 43.03 | 50.00 | 6.97 | 117 | 117 | PASS |

TRACE

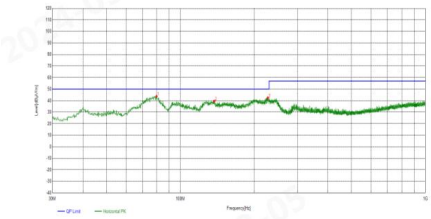


Vertical waveform and reading point

Suspected List

| Frequency [MHz] | Polarity | Factor [dB] | Reading [dBμV/m] | Level [dBμV/m] | Limit [dBμV/m] | Margin [dB] | Detector | Height [cm] | Angle deg | Pass/Fail |
|---|---|---|---|---|---|---|---|---|---|---|
| 79.863 | Horizontal | 16.17 | 27.67 | 43.84 | 50.00 | 6.16 | PK | 100 | 224 | PASS |
| 137.3897 | Horizontal | 19.85 | 19.75 | 39.60 | 50.00 | 10.40 | PK | 100 | 262 | PASS |
| 227.4147 | Horizontal | 18.46 | 24.03 | 42.49 | 50.00 | 7.51 | PK | 100 | 132 | PASS |

TRACE



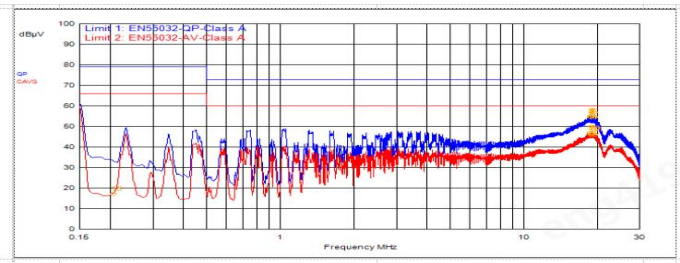
Horizontal waveform and reading point

The test results meet CLASS A standards

(2) Conductive (CE)

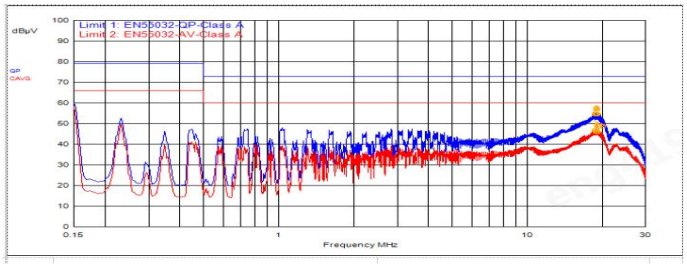
LBF1000-13B28-NS products Safety specifications: CISPR32/EN55032 CLASS A

CE Tc=25℃, Vin=115VAC, Pout=1008W, based on recommended circuit 1 test




| ID | Frequency | Probe | Cable | Atten. | Detector | Meter Read | Meas Level | Limit | Limit Dist. |
|---|---|---|---|---|---|---|---|---|---|
| 14 | 150.000kHz | 0.1 | 0.2 | 10.0 | C_AVG | 49.6 | 59.9 | 66.0 | -6.1 |
| 7 | 19.074MHz | 1.0 | 0.2 | 10.0 | C_AVG | 35.7 | 46.9 | 60.0 | -13.1 |
| 9 | 18.780MHz | 1.0 | 0.2 | 10.0 | C_AVG | 35.7 | 46.8 | 60.0 | -13.2 |
| 8 | 19.365MHz | 1.0 | 0.2 | 10.0 | C_AVG | 35.6 | 46.7 | 60.0 | -13.3 |
| 10 | 18.945MHz | 1.0 | 0.2 | 10.0 | C_AVG | 35.3 | 46.5 | 60.0 | -13.5 |
| 12 | 19.002MHz | 1.0 | 0.2 | 10.0 | C_AVG | 34.8 | 46.0 | 60.0 | -14.0 |
| 11 | 19.656MHz | 1.0 | 0.2 | 10.0 | C_AVG | 34.7 | 45.9 | 60.0 | -14.1 |
| 1 | 19.074MHz | 1.0 | 0.2 | 10.0 | QPeak | 44.0 | 55.1 | 73.0 | -17.9 |
| 2 | 19.365MHz | 1.0 | 0.2 | 10.0 | QPeak | 43.9 | 55.1 | 73.0 | -17.9 |
| 3 | 18.780MHz | 1.0 | 0.2 | 10.0 | QPeak | 43.8 | 54.9 | 73.0 | -18.1 |
| 4 | 18.945MHz | 1.0 | 0.2 | 10.0 | QPeak | 43.5 | 54.7 | 73.0 | -18.3 |
| 5 | 19.656MHz | 1.0 | 0.2 | 10.0 | QPeak | 43.5 | 54.7 | 73.0 | -18.3 |
| 6 | 19.002MHz | 1.0 | 0.2 | 10.0 | QPeak | 43.5 | 54.7 | 73.0 | -18.3 |

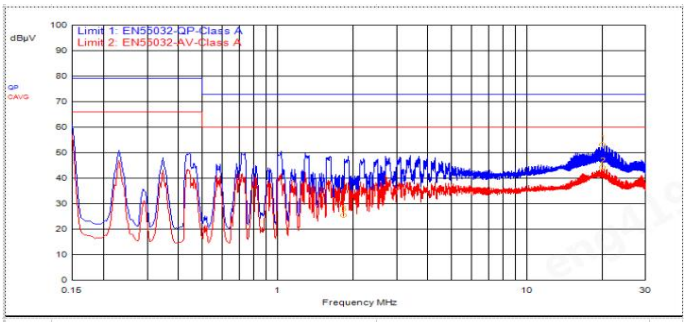
L line




| ID | Frequency | Probe | Cable | Atten. | Detector | Meter Read | Meas Level | Limit | Limit Dist. |
|---|---|---|---|---|---|---|---|---|---|
| 13 | 150.000kHz | 0.1 | 0.2 | 10.0 | C_AVG | 48.0 | 58.3 | 66.0 | -7.7 |
| 7 | 19.020MHz | 1.0 | 0.2 | 10.0 | C_AVG | 35.9 | 47.1 | 60.0 | -12.9 |
| 11 | 18.729MHz | 1.0 | 0.2 | 10.0 | C_AVG | 35.4 | 46.5 | 60.0 | -13.5 |
| 8 | 18.891MHz | 1.0 | 0.2 | 10.0 | C_AVG | 35.3 | 46.5 | 60.0 | -13.5 |
| 10 | 19.077MHz | 1.0 | 0.2 | 10.0 | C_AVG | 34.9 | 46.1 | 60.0 | -13.9 |
| 9 | 19.311MHz | 1.0 | 0.2 | 10.0 | C_AVG | 34.9 | 46.0 | 60.0 | -14.0 |
| 12 | 18.948MHz | 1.0 | 0.2 | 10.0 | C_AVG | 34.7 | 45.9 | 60.0 | -14.1 |
| 1 | 19.020MHz | 1.0 | 0.2 | 10.0 | QPeak | 43.9 | 55.1 | 73.0 | -17.9 |
| 2 | 18.891MHz | 1.0 | 0.2 | 10.0 | QPeak | 43.5 | 54.7 | 73.0 | -18.3 |
| 3 | 19.311MHz | 1.0 | 0.2 | 10.0 | QPeak | 43.4 | 54.6 | 73.0 | -18.4 |
| 4 | 19.077MHz | 1.0 | 0.2 | 10.0 | QPeak | 43.4 | 54.6 | 73.0 | -18.4 |
| 5 | 18.729MHz | 1.0 | 0.2 | 10.0 | QPeak | 43.4 | 54.5 | 73.0 | -18.5 |
| 6 | 18.948MHz | 1.0 | 0.2 | 10.0 | QPeak | 43.3 | 54.5 | 73.0 | -18.5 |

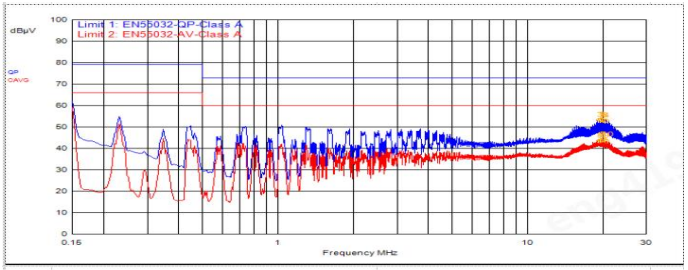
N line

CE Tc=25℃, Vin=230VAC, Pout=1008W, based on recommended circuit 1 test




| ID | Frequency | Probe | Cable | Atten. | Detector | Meter Read | Meas Level | Limit | Limit Dist. |
|---|---|---|---|---|---|---|---|---|---|
| 4 | 150.000kHz | 0.1 | 0.2 | 10.0 | C_AVG | 46.8 | 57.1 | 66.0 | -8.9 |
| 2 | 20.238MHz | 1.0 | 0.2 | 10.0 | C_AVG | 33.1 | 44.3 | 60.0 | -15.7 |
| 1 | 20.238MHz | 1.0 | 0.2 | 10.0 | QPeak | 41.9 | 53.1 | 73.0 | -19.9 |
| 3 | 1.836MHz | 0.3 | 0.2 | 10.0 | C_AVG | 14.7 | 25.3 | 60.0 | -34.7 |

L line



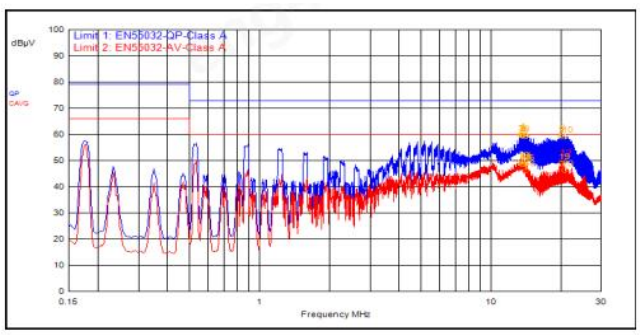

| ID | Frequency | Probe | Cable | Atten. | Detector | Meter Read | Meas Level | Limit | Limit Dist. |
|---|---|---|---|---|---|---|---|---|---|
| 11 | 150.000kHz | 0.1 | 0.2 | 10.0 | C_AVG | 48.8 | 59.1 | 66.0 | -6.9 |
| 7 | 20.064MHz | 1.0 | 0.2 | 10.0 | C_AVG | 32.7 | 43.9 | 60.0 | -16.1 |
| 10 | 20.355MHz | 1.0 | 0.2 | 10.0 | C_AVG | 32.7 | 43.9 | 60.0 | -16.1 |
| 6 | 19.776MHz | 1.0 | 0.2 | 10.0 | C_AVG | 32.6 | 43.7 | 60.0 | -16.3 |
| 8 | 19.488MHz | 1.0 | 0.2 | 10.0 | C_AVG | 32.4 | 43.5 | 60.0 | -16.5 |
| 9 | 20.643MHz | 1.0 | 0.2 | 10.0 | C_AVG | 32.1 | 43.3 | 60.0 | -16.7 |
| 1 | 19.776MHz | 1.0 | 0.2 | 10.0 | QPeak | 42.3 | 53.5 | 73.0 | -19.5 |
| 2 | 20.064MHz | 1.0 | 0.2 | 10.0 | QPeak | 42.0 | 53.2 | 73.0 | -19.8 |
| 3 | 19.488MHz | 1.0 | 0.2 | 10.0 | QPeak | 41.9 | 53.1 | 73.0 | -19.9 |
| 4 | 20.643MHz | 1.0 | 0.2 | 10.0 | QPeak | 41.8 | 53.0 | 73.0 | -20.0 |
| 5 | 20.355MHz | 1.0 | 0.2 | 10.0 | QPeak | 41.8 | 53.0 | 73.0 | -20.0 |

N line

The test results meet the EN55032 CLASS A standard

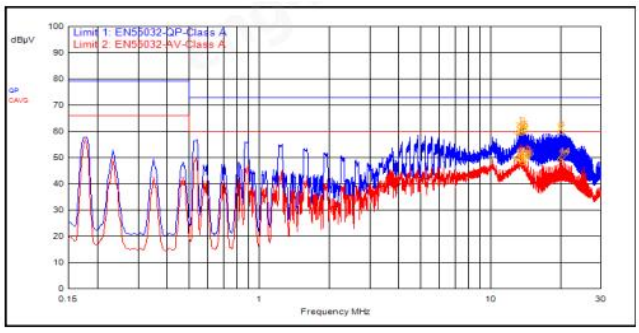
LBF1000-13B48-NS products Safety specifications: CISPR32/EN55032 CLASS A

CE Tc=25℃, Vin=115VAC, Pout=1008W, based on recommended circuit 1 test




| ID | Frequency | Probe | Cable | Atten. | Detector | Meter Read | Meas Level | Limit | Limit Dist. |
|---|---|---|---|---|---|---|---|---|---|
| 12 | 20.256MHz | 1.0 | 0.2 | 10.0 | C_AVG | 38.7 | 49.9 | 60.0 | -10.1 |
| 13 | 13.398MHz | 0.9 | 0.2 | 10.0 | C_AVG | 38.5 | 49.5 | 60.0 | -10.5 |
| 11 | 13.755MHz | 0.9 | 0.2 | 10.0 | C_AVG | 38.4 | 49.5 | 60.0 | -10.5 |
| 19 | 20.187MHz | 1.0 | 0.2 | 10.0 | C_AVG | 37.8 | 49.0 | 60.0 | -11.0 |
| 14 | 13.707MHz | 0.9 | 0.2 | 10.0 | C_AVG | 37.6 | 48.7 | 60.0 | -11.3 |
| 15 | 14.112MHz | 0.9 | 0.2 | 10.0 | C_AVG | 37.4 | 48.5 | 60.0 | -11.5 |
| 17 | 13.659MHz | 0.9 | 0.2 | 10.0 | C_AVG | 37.4 | 48.5 | 60.0 | -11.5 |
| 16 | 13.803MHz | 0.9 | 0.2 | 10.0 | C_AVG | 37.4 | 48.5 | 60.0 | -11.5 |
| 1 | 13.755MHz | 0.9 | 0.2 | 10.0 | QPeak | 49.4 | 60.5 | 73.0 | -12.5 |
| 2 | 20.256MHz | 1.0 | 0.2 | 10.0 | QPeak | 48.7 | 59.9 | 73.0 | -13.1 |
| 3 | 13.398MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.6 | 59.7 | 73.0 | -13.3 |
| 4 | 13.707MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.6 | 59.7 | 73.0 | -13.3 |
| 5 | 14.112MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.5 | 59.5 | 73.0 | -13.5 |
| 6 | 13.803MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.4 | 59.5 | 73.0 | -13.5 |
| 20 | 20.961MHz | 1.0 | 0.2 | 10.0 | C_AVG | 35.1 | 46.4 | 60.0 | -13.6 |
| 7 | 13.659MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.2 | 59.3 | 73.0 | -13.7 |
| 8 | 14.268MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.2 | 59.3 | 73.0 | -13.7 |
| 9 | 20.187MHz | 1.0 | 0.2 | 10.0 | QPeak | 48.0 | 59.2 | 73.0 | -13.8 |
| 10 | 20.961MHz | 1.0 | 0.2 | 10.0 | QPeak | 48.0 | 59.2 | 73.0 | -13.8 |
| 18 | 14.268MHz | 0.9 | 0.2 | 10.0 | C_AVG | 35.1 | 46.2 | 60.0 | -13.8 |

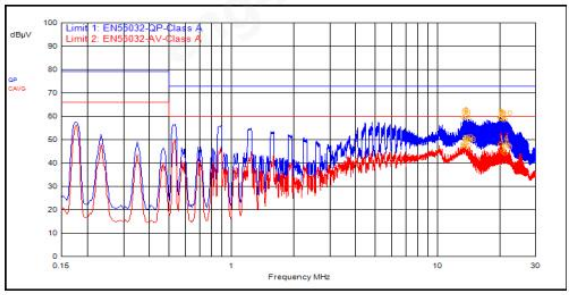
L line



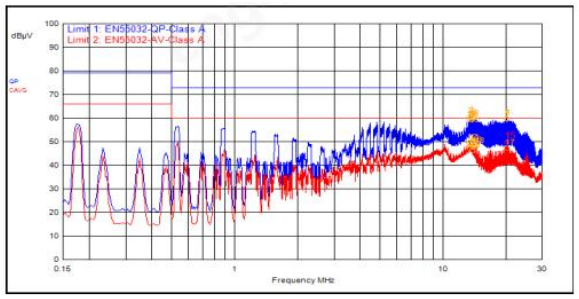

| ID | Frequency | Probe | Cable | Atten. | Detector | Meter Read | Meas Level | Limit | Limit Dist. |
|---|---|---|---|---|---|---|---|---|---|
| 11 | 13.491MHz | 0.9 | 0.2 | 10.0 | C_AVG | 39.6 | 50.7 | 60.0 | -9.3 |
| 12 | 13.851MHz | 0.9 | 0.2 | 10.0 | C_AVG | 39.3 | 50.4 | 60.0 | -9.6 |
| 14 | 20.328MHz | 1.0 | 0.2 | 10.0 | C_AVG | 38.9 | 50.1 | 60.0 | -9.9 |
| 17 | 13.134MHz | 0.9 | 0.2 | 10.0 | C_AVG | 38.6 | 49.7 | 60.0 | -10.3 |
| 16 | 19.971MHz | 1.0 | 0.2 | 10.0 | C_AVG | 38.0 | 49.2 | 60.0 | -10.8 |
| 20 | 13.446MHz | 0.9 | 0.2 | 10.0 | C_AVG | 38.1 | 49.1 | 60.0 | -10.9 |
| 13 | 13.803MHz | 0.9 | 0.2 | 10.0 | C_AVG | 38.0 | 49.1 | 60.0 | -10.9 |
| 15 | 14.211MHz | 0.9 | 0.2 | 10.0 | C_AVG | 38.0 | 49.1 | 60.0 | -10.9 |
| 1 | 13.491MHz | 0.9 | 0.2 | 10.0 | QPeak | 50.6 | 61.7 | 73.0 | -11.3 |
| 2 | 13.851MHz | 0.9 | 0.2 | 10.0 | QPeak | 50.3 | 61.4 | 73.0 | -11.6 |
| 19 | 13.707MHz | 0.9 | 0.2 | 10.0 | C_AVG | 36.9 | 48.0 | 60.0 | -12.0 |
| 18 | 13.755MHz | 0.9 | 0.2 | 10.0 | C_AVG | 36.9 | 47.9 | 60.0 | -12.1 |
| 3 | 13.803MHz | 0.9 | 0.2 | 10.0 | QPeak | 49.1 | 60.2 | 73.0 | -12.8 |
| 4 | 20.328MHz | 1.0 | 0.2 | 10.0 | QPeak | 48.9 | 60.1 | 73.0 | -12.9 |
| 5 | 14.211MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.8 | 59.9 | 73.0 | -13.1 |
| 6 | 19.971MHz | 1.0 | 0.2 | 10.0 | QPeak | 48.4 | 59.6 | 73.0 | -13.4 |
| 7 | 13.134MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.5 | 59.5 | 73.0 | -13.5 |
| 8 | 13.755MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.5 | 59.5 | 73.0 | -13.5 |
| 9 | 13.707MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.4 | 59.5 | 73.0 | -13.5 |
| 10 | 13.446MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.3 | 59.4 | 73.0 | -13.6 |

N line

CE Tc=25℃, Vin=230VAC, Pout=1008W, based on recommended circuit 1 test




| ID | Frequency | Probe | Cable | Atten. | Detector | Meter Read | Meas Level | Limit | Limit Dist. |
|---|---|---|---|---|---|---|---|---|---|
| 17 | 20.187MHz | 1.0 | 0.2 | 10.0 | C_AVG | 37.5 | 48.7 | 60.0 | -11.3 |
| 12 | 13.755MHz | 0.9 | 0.2 | 10.0 | C_AVG | 37.2 | 48.3 | 60.0 | -11.7 |
| 15 | 13.398MHz | 0.9 | 0.2 | 10.0 | C_AVG | 37.2 | 48.2 | 60.0 | -11.8 |
| 14 | 20.259MHz | 1.0 | 0.2 | 10.0 | C_AVG | 36.9 | 48.1 | 60.0 | -11.9 |
| 13 | 13.446MHz | 0.9 | 0.2 | 10.0 | C_AVG | 36.4 | 47.5 | 60.0 | -12.5 |
| 18 | 14.112MHz | 0.9 | 0.2 | 10.0 | C_AVG | 36.3 | 47.3 | 60.0 | -12.7 |
| 1 | 13.803MHz | 0.9 | 0.2 | 10.0 | QPeak | 49.1 | 60.1 | 73.0 | -12.9 |
| 11 | 13.803MHz | 0.9 | 0.2 | 10.0 | C_AVG | 36.0 | 47.1 | 60.0 | -12.9 |
| 2 | 13.755MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.8 | 59.9 | 73.0 | -13.1 |
| 3 | 13.446MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.4 | 59.5 | 73.0 | -13.5 |
| 16 | 20.610MHz | 1.0 | 0.2 | 10.0 | C_AVG | 35.2 | 46.4 | 60.0 | -13.6 |
| 4 | 20.259MHz | 1.0 | 0.2 | 10.0 | QPeak | 48.1 | 59.3 | 73.0 | -13.7 |
| 5 | 13.398MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.2 | 59.3 | 73.0 | -13.7 |
| 6 | 20.610MHz | 1.0 | 0.2 | 10.0 | QPeak | 47.9 | 59.1 | 73.0 | -13.9 |
| 7 | 20.187MHz | 1.0 | 0.2 | 10.0 | QPeak | 47.8 | 59.0 | 73.0 | -14.0 |
| 8 | 14.112MHz | 0.9 | 0.2 | 10.0 | QPeak | 47.8 | 58.9 | 73.0 | -14.1 |
| 9 | 20.961MHz | 1.0 | 0.2 | 10.0 | QPeak | 47.4 | 58.6 | 73.0 | -14.4 |
| 10 | 21.315MHz | 1.0 | 0.2 | 10.0 | QPeak | 47.4 | 58.6 | 73.0 | -14.4 |
| 19 | 20.961MHz | 1.0 | 0.2 | 10.0 | C_AVG | 33.6 | 44.8 | 60.0 | -15.2 |
| 20 | 21.315MHz | 1.0 | 0.2 | 10.0 | C_AVG | 33.1 | 44.3 | 60.0 | -15.7 |




| ID | Frequency | Probe | Cable | Atten. | Detector | Meter Read | Meas Level | Limit | Limit Dist. |
|---|---|---|---|---|---|---|---|---|---|
| 15 | 20.256MHz | 1.0 | 0.2 | 10.0 | C_AVG | 38.5 | 49.7 | 60.0 | -10.3 |
| 12 | 13.443MHz | 0.9 | 0.2 | 10.0 | C_AVG | 38.4 | 49.5 | 60.0 | -10.5 |
| 11 | 13.803MHz | 0.9 | 0.2 | 10.0 | C_AVG | 38.3 | 49.4 | 60.0 | -10.6 |
| 13 | 14.160MHz | 0.9 | 0.2 | 10.0 | C_AVG | 37.3 | 48.4 | 60.0 | -11.6 |
| 14 | 13.755MHz | 0.9 | 0.2 | 10.0 | C_AVG | 37.0 | 48.1 | 60.0 | -11.9 |
| 1 | 13.803MHz | 0.9 | 0.2 | 10.0 | QPeak | 50.0 | 61.1 | 73.0 | -11.9 |
| 18 | 14.520MHz | 0.9 | 0.2 | 10.0 | C_AVG | 36.8 | 47.9 | 60.0 | -12.1 |
| 16 | 13.851MHz | 0.9 | 0.2 | 10.0 | C_AVG | 36.7 | 47.8 | 60.0 | -12.2 |
| 2 | 13.443MHz | 0.9 | 0.2 | 10.0 | QPeak | 49.5 | 60.6 | 73.0 | -12.4 |
| 17 | 20.328MHz | 1.0 | 0.2 | 10.0 | C_AVG | 35.9 | 47.1 | 60.0 | -12.9 |
| 20 | 13.491MHz | 0.9 | 0.2 | 10.0 | C_AVG | 36.0 | 47.1 | 60.0 | -12.9 |
| 3 | 14.160MHz | 0.9 | 0.2 | 10.0 | QPeak | 49.0 | 60.1 | 73.0 | -12.9 |
| 4 | 13.755MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.6 | 59.6 | 73.0 | -13.4 |
| 5 | 20.256MHz | 1.0 | 0.2 | 10.0 | QPeak | 48.4 | 59.6 | 73.0 | -13.4 |
| 6 | 13.851MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.4 | 59.5 | 73.0 | -13.5 |
| 7 | 20.328MHz | 1.0 | 0.2 | 10.0 | QPeak | 48.1 | 59.3 | 73.0 | -13.7 |
| 19 | 13.962MHz | 0.9 | 0.2 | 10.0 | C_AVG | 35.2 | 46.3 | 60.0 | -13.7 |
| 8 | 14.520MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.2 | 59.3 | 73.0 | -13.7 |
| 9 | 13.962MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.1 | 59.2 | 73.0 | -13.8 |
| 10 | 13.491MHz | 0.9 | 0.2 | 10.0 | QPeak | 48.1 | 59.1 | 73.0 | -13.9 |

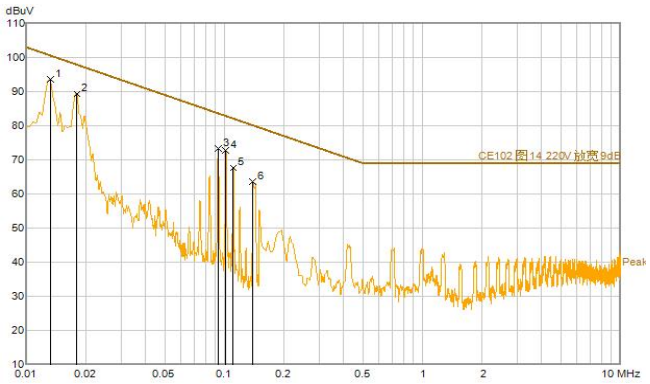
L line

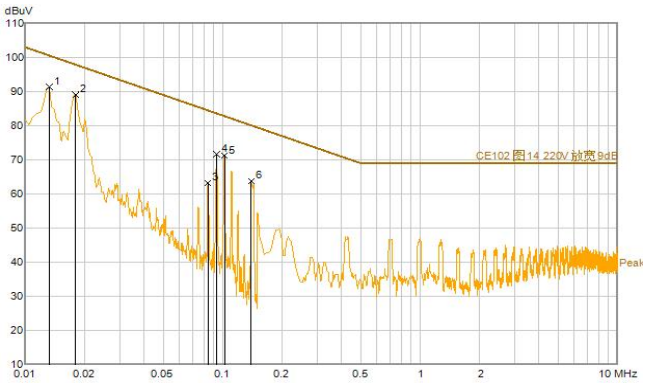
N line

The test results meet the EN55032 CLASS A standard

LBF1000-13B28-NS products Safety specifications: CE102 GJB151B

CE Tc=25℃, Vin=220VAC, Pout=1008W, based on recommended circuit 2 test



| Serial Number | Frequency (MHz) | Read value (dBuV) | Correction factor (dB) | Result (dBuV) | Limit (dBuV) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 0.0132 | 63.8 | 27.57 | 91.37 | 100.59 | 9.22 | Peak |
| 2 | 0.018 | 63.78 | 25.4 | 89.18 | 97.89 | 8.71 | Peak |
| 3 | 0.084 | 42.84 | 20.43 | 63.27 | 84.5 | 21.23 | Peak |
| 4 | 0.0928 | 51.25 | 20.34 | 71.59 | 83.64 | 12.05 | Peak |
| 5 | 0.102 | 50.98 | 20.26 | 71.24 | 82.82 | 11.58 | Peak |
| 6 | 0.1392 | 43.68 | 20.12 | 63.8 | 80.11 | 16.31 | Peak |

L line

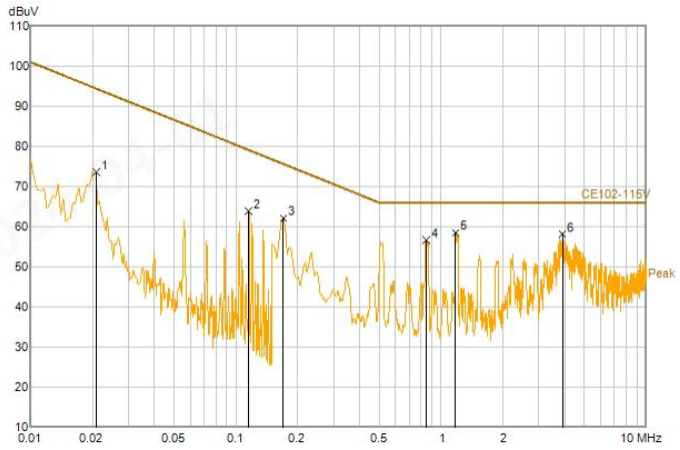
| Serial Number | Frequency (MHz) | Read value (dBuV) | Correction factor (dB) | Result (dBuV) | Limit (dBuV) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 0.0132 | 66.13 | 27.57 | 93.7 | 100.59 | 6.89 | Peak |
| 2 | 0.018 | 63.99 | 25.4 | 89.39 | 97.89 | 8.5 | Peak |
| 3 | 0.0928 | 53.05 | 20.34 | 73.39 | 83.64 | 10.25 | Peak |
| 4 | 0.1016 | 52.49 | 20.26 | 72.75 | 82.85 | 10.1 | Peak |
| 5 | 0.1108 | 47.51 | 20.22 | 67.73 | 82.1 | 14.37 | Peak |
| 6 | 0.1392 | 43.47 | 20.12 | 63.59 | 80.11 | 16.52 | Peak |

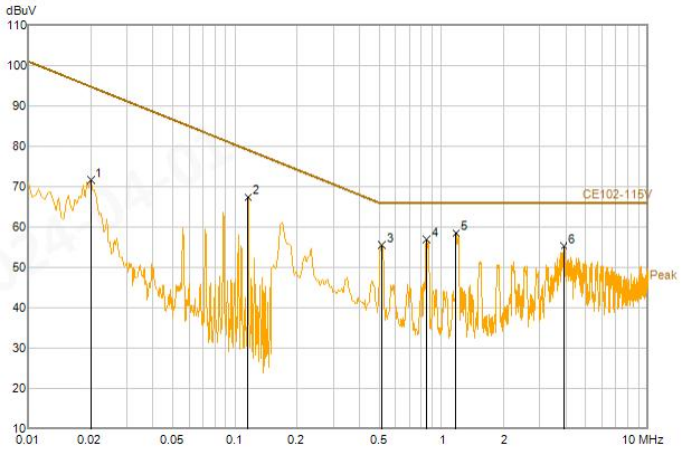
N line

The test results meet the CE102 GJB151B standard

LBF1000-13B48-NS products Safety specifications: CE102 GJB151B

CE Tc=25℃, Vin=220VAC, Pout=1008W, based on recommended circuit 2 test




| Serial Number | Frequenc (MHz) | Real value (dBuV) | Correction factor (dB) | Result (dBuV) | Limit (dBuV) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 0.0208 | 52.36 | 21.25 | 73.61 | 94.45 | 20.84 | Peak |
| 2 | 0.1156 | 43.28 | 20.63 | 63.91 | 79.1 | 15.19 | Peak |
| 3 | 0.17 | 41.53 | 20.57 | 62.1 | 75.65 | 13.55 | Peak |
| 4 | 0.846 | 36.24 | 20.42 | 56.66 | 66 | 9.34 | Peak |
| 5 | 1.178 | 38.15 | 20.4 | 58.55 | 66 | 7.45 | Peak |
| 6 | 3.91 | 37.78 | 20.37 | 58.15 | 66 | 7.85 | Peak |

L line

| Serial Number | Frequency (MHz) | Real value (dBuV) | Correction factor (dB) | Result (dBuV) | Limit (dBuV) | Margin (dB) | Remark |
|---|---|---|---|---|---|---|---|
| 1 | 0.02 | 50.31 | 21.38 | 71.69 | 94.8 | 23.11 | Peak |
| 2 | 0.1156 | 46.83 | 20.61 | 67.44 | 79.1 | 11.66 | Peak |
| 3 | 0.514 | 34.96 | 20.49 | 55.45 | 66 | 10.55 | Peak |
| 4 | 0.846 | 36.4 | 20.45 | 56.85 | 66 | 9.15 | Peak |
| 5 | 1.178 | 38.08 | 20.44 | 58.52 | 66 | 7.48 | Peak |
| 6 | 3.91 | 34.92 | 20.42 | 55.34 | 66 | 10.66 | Peak |

N line

The test results meet the CE102 GJB151B standard

# 4. Appearance specifications

## 4.1 Manufacturing data/dimensions

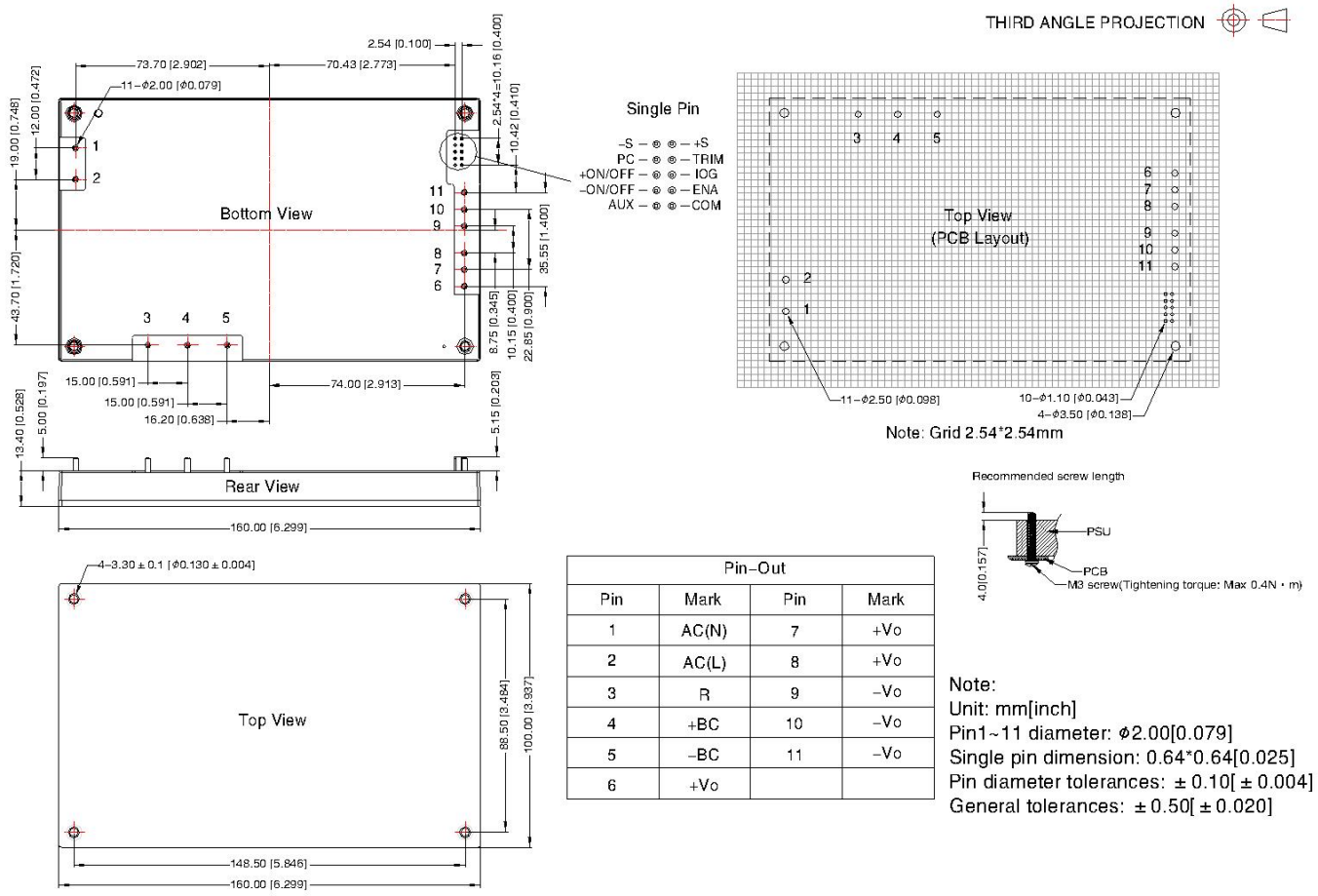
Length: 160.00mm±0.5mm

Width: 100.00mm±0.5mm

Height: 13.40mm±0.5mm

Terminal length: 5.0mm±0.5mm

Weight: 545g±30g




| Pin-Out | | | |
|---|---|---|---|
| Pin | Mark | Pin | Mark |
| 1 | AC(N) | 7 | +Vo |
| 2 | AC(L) | 8 | +Vo |
| 3 | R | 9 | -Vo |
| 4 | +BC | 10 | -Vo |
| 5 | -BC | 11 | -Vo |
| 6 | +Vo | | |

Note:
Unit: mm[inch]
Pin1~11 diameter: ϕ2.00[0.079]
Single pin dimension: 0.64*0.64[0.025]
Pin diameter tolerances: ± 0.10[ ± 0.004]
General tolerances: ± 0.50[ ± 0.020]

Figure 7: Manufacturing data/size diagram

## 4.2 Installation and disassembly methods

Installation method: Place the heat sink on the aluminum base plate and fasten the heat sink to the product using four screws.

Removing method: Use a tool to separate the four screws from the heat sink.

Maximum mounting hole tightening torque: 0.4N.m.

## 4.3 Cooling method

| | | |
|---|---|---|
| Heat dissipation method | Surface heat sink | □ |
| | Natural cooling | □ |
| | Conduction heat dissipation | ■ |
| | In this document, "■" indicates selected, and "□" indicates not selected | |

For more details, please consult the MORNSUN FAE.