MORNSUN®

AC/DC Converter • DC/DC Converter • Isolation Transmitter

IGBT Driver • LED Driver • EMC Auxiliary Device

100 FAQs of Product Application

MORNSUN®

MORE THAN RELIABILITY

Contents

1. Instructions

1.1. Fixed Input Voltage DC/DC Converters

Fixed input voltage and unregulated output converters: the range for the converters with input voltages of 3.3V, 5V, 9V, 12V, 15V and 24V is ±10%. These converters are corresponding to unregulated output converters of A, B, D, E, F, G and H series.

Fixed input voltage and regulated output converters: the range for input voltages is ±5%. These converters are corresponding to regulated output converters of IA, IB, IE and IF series.

1.2. Wide Input Voltage DC/DC Converters

For the converters with input voltages of 5V (4.5-9V), 12V (9-18V), 24V (18-36V) and 48V (36-75V), the range is 2:1. These converters are corresponding to wide range voltage input converters of WR series; for the converters with input voltages of 24V (9-36V), 48V (18-75V) and 110V (40-160V), the range is 4:1.

1.3. Non-isolated Converters

Converters named with the prefix K78 are non-isolated converters. K78XXT converters apply SMD packaging, while K78 (L) XX converters apply SIP packaging.

1.4. Low-power DC/DC Converters

The range for the converters with input voltages of 12V (9-18V), 24V (18-36V) and 48V (36-75V) is 2:1. These converters are corresponding to low power converters of VR series; the range for the converters with input voltages of 24V (9-36V), 48V (18-75V) and 110V (40-160V) is 4:1. These converters are corresponding to low power converters of UR series.

1.5. AC/DC Converters

Converters named with the prefix L are AC/DC series converters; LH series are small horizontal packaging converters with universal input voltage range of 85-264VAC; LB series are common horizontal packaging converters with universal input voltage range of 85-264VAC; LD series are extra small dual-in-line packaging (DIP) converters with universal input voltage ranges of 85-264VAC and 85-305VAC; LS series are single-in-line packaging (SIP) converters with universal input voltage range of 85-264VAC; LO series are open frame packaging converters with universal input voltage range of 65-460VAC.

1.6. LED Drivers

Drivers named with the prefix KC are LED drivers. Drivers with DIP packaging include KC24H-R series. Drivers with SMD packaging include KC24RT series. Drivers with waterproof packaging include KC24W series.

1.7. IGBT Drivers

The IGBT drivers include QP series, QC series and QA series which are power converters specialized for drivers.

1.8. Isolated Transmitters

These signal conditioning modules refer to the modules whose names begin with T, TE, TF, TM and TP. In addition, D-type, P-type, N-type and L-type packaging modules are available; signal isolators include analog TA series, thermal resistance TR series, thermocouple TC and switching value TS series (Din-Rail mounting); isolated barriers include analog quantity TA-EX series, TAF-EX series, thermal resistance TR-EX series, thermocouple TC-EX, switch value TS-EX series, switch value TSF-EX series and TD-EX-485 series (Din-Rail mounting); industrial bus-isolated transceivers include TD-485 series and TD-CAN series.

1.9. Photovoltaic Power Converters

These photovoltaic power converters refer to the converters whose names begin with PV. In addition, they have different input voltage ranges, among which the maximum input voltage reaches 1,500VDC. These converters include converters with the powers of 5W, 10W, 15W, 40W and 45W.

1.10. Charging Power Modules

These charging power modules refer to the modules whose names begin with MCP (capacitor charging modules) and MBP (battery charging modules). Voltage outputs are: 27V, 54V and 220V. These modules include four series: MCP75, MCP100, MBP300 and MBP500.

1.11. EMC Filters

EMC filters are named after FC (EMC filters), FI (EMI filters), FT (EFT suppressors), FS (surge suppressors) and FILTER (CM inductor). Two different types of input voltage are available: AC/DC and DC/DC. In addition, there are three types of mounting: PCB mounting, chassis mounting and Din-Rail mounting.

2. Fixed Input Voltage Converters

2.1. EMC Interference

2.1.1. What if fixed input voltage converters fail to pass the EMC test?

Reason: The electrostatic capacity of fixed input voltage converters can reach a contact discharge of 6-8KV. However, as fixed input voltage converters are the converters that use the secondary power source and the limited size of converter, there is no protective circuit designed for other items of EMC.

Answer: If the requirements on the EMC test in the customer's application environment are demanding, please refer to the recommended circuits in the datasheet and build relevant circuits in the periphery of products.

2.1.2. What if fixed input voltage converters interfere with the system in such applications as CAN and 485 communications?

Reason: Aside from such possible causes as defective products and improper use by customers, the most possible cause is that the working frequency of the products coincides with that of the system chips.

Answer: In this case, it is recommended to use different frequencies. Our technicians will help customer select different models or make customized development, so as to use different working frequencies of system chips.

2.1.3. Can fixed input voltage converters be applied in the high magnetic fields?

Reason: The fixed input voltage converters adopt the principle of alternate conversion in the magnetic field direction. If no shielding measures are available, the converters are susceptible to damage and short circuit in a condition where high magnetic field exists.

Answer: It is recommended to wrap the fixed input voltage converters in tinfoil as a shielding measure.

2.1.4. What if fixed input voltage converters interfere with a customer's signal collection?

Reason: Since the chips used by customers require high-quality input signals, the output signals of power modules will cause ripple & noise, thus leading to the malfunction of the chips.

Answer: Implement filtering measures against sensitive chips, such as inductors and capacitors. Please refer to the datasheet.

2.1.5. Why do voltage dips occur when an interphone is approaching the operating system?

Reason: The radiation signal of the interphone will cause interference to the product's operation, resulting in the voltage dips of the product.

Answer: It is recommended to add a filter-absorbing circuit to the front-terminal equipment of

customer module and implement shielding measure (Refer to Question 2.1.3), thus improving the anti-interference capacity.

2.1.6. What is the isolated capacitance of fixed input voltage converters?

Answer: The isolated capacitance of fixed input voltage converters is lower than that of ordinary isolated products, generally below 100 pF. However, the value varies among series. Please check the specific values in the datasheet.

2.1.7. What is the CM withstanding voltage of fixed input voltage converters?

Answer: These fixed voltage modules mainly play an isolated role in the system and are widely used in the secondary power system; i.e., the supply voltage of the front-terminal equipment is generally regulated output high-power AC/DC or DC/DC. While designing system, the CM surge should be implemented in the foremost stage, i.e. high-power AC/DC or DC/DC, to avoid interference to the operation of circuits in the back stages.

2.2. Ripple & Noise

2.2.1. Since there is a ripple & noise of 20 mV and 50 kHz in the input voltage of the fixed voltage module, will it interfere with the operation of the module?

Reason: The ripple & noise is actually the output ripple & noise of the power source.

Answer: In the practical application condition, filter circuit may exist in the two stages of power sources. Please refer to the datasheet. Confirm the working frequency of power source and identify whether the front-terminal or back-end power source module is the interference source.

2.2.2. Does the reflected ripple & noise of the input terminal of the fixed voltage module influence the operation of the system?

Reason: A ripple & noise signal will be sent to the front-terminal during the internal operation of the switching power module, which may influence the front-terminal power source.

Answer: The reflected ripple & noise of the input terminal of the switching power module is inevitable and even ripple & noises may exist in the DC power source. It is recommended to add a large CM inductor at the front-terminal of the module to form a pi filter.

2.2.3. A customer uses a fixed voltage module to supply power to the operational amplifier (used as collection). Will the ripple & noise of the converters be high?

Reason: The switching power converter stores energy by inductors and capacitors, which will inevitably cause some ripple & noise during the output.

Answer: Customers can implement appropriate filtering measures if they worry about excessive ripple & noise. Please refer to the datasheet for recommended circuits and parameters, or apply

our SEN circuit products (about 40 mV) and then add filtering. If the converters with extremely low ripple & noise are required, it is recommended to use the LDO (uV stage) with high precision and low ripple output.

2.2.4. For dual output converters, how to eliminate glitches in the ripple & noises in case of unbalanced load?

Reason: In case of unbalanced load, the outputted ripple & noise and precision of voltage will be worse. The degree of balance for fixed voltage dual output products with dual loads shall be within 5%.

Answer: The glitch is caused by noise. Customers can solve this problem by using FILTER2.

2.2.5. Is there a common ripple & noise reduction solution for fixed voltage modules?

Reason: The common solution is simple in application but complicated in cost and operation.

Answer: Connect an LDO (7805 and 7905; 78012, 7912, etc.) to the back-end of the product.

2.2.6. Why are there high ripple & noise when the power module powers an analog-digital conversion system?

Reason: The analog ground and digital ground are not separate, so there are high ripple & noises.

Answer: The single point grounding method is recommended.

2.2.7. Why is there high noise when the fixed input voltage product is used as the power source of the relay?

Reason: There is high reflected ripple during the operation of the relay.

Answer: It is recommended to implement some filtering measures or add a Y capacitor between the input and output grounds.

2.3. Protective Functions

2.3.1. Is there a short circuit protection function for fixed input voltage converters?

Answer: Continuous short circuit protection and self-recovery functions are available for certain fixed input voltage converters such as IF_RN/T and B_LS-1WR series. The performance is generally improved for the ones suffixed with R2, which offer short circuit protection except the 24V input converters. Please refer to the datasheet for details.

2.3.2. What is the maximum allowed current for the short circuit protection of fixed input voltage converters?

Answer: The exact current points of output overload protection are not set for fixed input voltage converters. However, neither over-current point nor overload function is guaranteed even though the customers want to know more information about it. In case of short circuit, the internal design

standards of the input current for the product shall follow based on its power consumption endurance capacity. For more information, please refer to our R&D engineers.

2.4. Connection (Series & Parallel Connection and Common Ground)

2.4.1. Can the products be used in parallel?

Answer: The output terminal of the product can be connected in parallel only for redundant design. Parallel connection cannot be used to obtain a larger power output. The input terminal can be used in parallel, but a 10 μF capacitor (10 μH inductor) must be connected to the position as close as possible to the product's input terminal; a large filter capacitor, pi filter or 100 μH inductor must be added to the common input terminal.

2.4.2. Is it possible to obtain ±18V by using ±9V dual output products in series?

Answer: Yes, a sophisticated solution has developed for it. When using in series, please add reverse diodes and filter capacitors (see application notes). However, the ripple & noise may increase and the precision may decrease. It is recommended to add an LC filter circuit at the output terminal.

2.4.3. How to get a negative output voltage with single output products?

Answer: Fixed input voltage converters operate under open-loop mode, and the positive or negative outputs are relative values comparing to the 0V voltage value. There are 2 common forms of determining a negative voltage output through the connecting methods:

(1) See Diagram 2-1 below. Vo and 0V indicated at the output terminal are the product's positive output and output ground. To obtain a negative output, please operate indicates in the circles below; 'change the original Vo to 0V and 0V to negative output' and the original 0V becomes negative output.

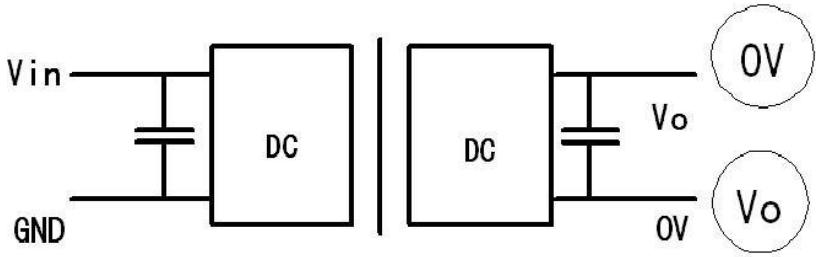

Diagram 2-1 Negative voltage form

(2) See Diagram 2-2 below. Connect 0V and Vo to form a common ground. It should be noted that the product is not isolated at this moment and the noise is high. Capacitors must be added to the input and output terminals (please refer to the datasheet for capacitance values).

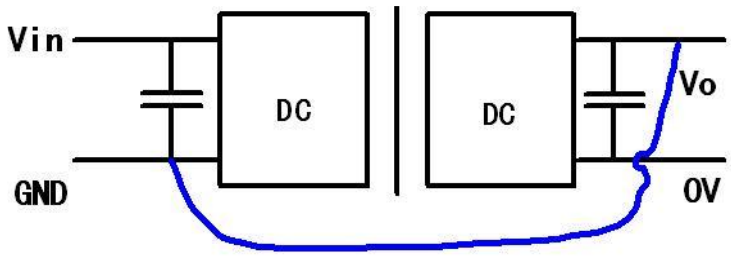

Diagram 2-2 Negative voltage form

2.4.4. Can the input and output grounds of the fixed input voltage converter be short connected?

Answer: Yes. A recommended capacitor must be added to the front and back stages of the product. The isolated function of product will be lost when it is put into short circuit.

3. Wide Input Voltage DC/DC Converters

3.1. Start-up Issues

3.1.1. Why does oscillation occur when using a module with low load?

Reason: When the output load of the module is less than 10% (R2: less than 5%) and the feedback loop of the module is unregulated, oscillation will definitely occur and the output voltage is likely to be unregulated.

Answer: Application in such condition is not recommended. Instead, it is recommended to increase the load (or add the dummy load) or select and use a module with slightly lower power on the premise of reaching the required power.

3.1.2. What problems will be caused and how to avoid them if a module starts up with an input voltage lower than the minimum rated one?

Reason: The module may be damaged when it starts up at a voltage that is lower than that of input voltage range. Because there is no under-voltage protective circuits for the wide input voltage converters. The starting voltage should be determined on the basis of the threshold voltage of MOSFET and soft starting circuit, and the starting voltage of the MOSFET is 2V or more lower than that of the minimum input voltage of the module. In this circumstance, lower voltage input requires higher input current so as to supply equal power; the power module is susceptible to damage in a higher input current condition.

Answer: (1) It should be ensured that the actual input voltage is in the rated range specified in the datasheet; (2) it is recommended to add an input under-voltage protective circuit on the front-terminal of the module in accordance with the *Wide Input Voltage DC/DC Converter Application Guide*.

3.1.3. What are the minimum starting current and input current of a module?

Answer: The starting current of a module is generally about 1.4-1.6 times that of the Iin (max). The increase of capacitive load of the output terminal will also increase the starting current value of the module. It is recommended to select the forestage power supply with higher power. For the minimum input current in the unloading condition, please check the 'No-load current' section in the datasheet of the corresponding module.

3.1.4. The module fails to start up when the capacitive load is relatively large. How to solve it?

Reason: In practical application, the capacitive load exceeds the maximum capacitive load of operating module. In addition, when the output capacitance is extremely large, large starting current is required at the moment of start-up, resulting in the failure of starting the module.

Answer: It is recommended to decrease the connected capacitance of the output terminal or add

a buffer circuit at the output terminal to improve the capacity of the module to withstand capacitive load.

3.1.5. The module fails to start up when the power source on the front-terminal is intrinsically safe power source. How to solve it?

Reason: The maximum starting current limit of the intrinsically safe power source cannot be large enough to meet the starting power requirements of the module (and higher starting power is required to start up the module).

Answer: It is recommended to select products with lower starting currents or connect low-resistance resistors or inductors in series at the input terminal of the module so as to lower its starting current.

3.2. Pin Applications

3.2.1. How to use CS pin?

Answer: The function of output CS pin is only for filtering; in practical application, the CS pin may be ignored in the event where there are no demanding requirements for ripple & noise. But if the CS pin is connected, it can suppress the output ripple & noise to a certain extent. The capacitor should be connected via the recommended method described in the datasheet so as to meet the requirements for ripple & noise. It should not be too large or else the difficulty for starting product may be increased.

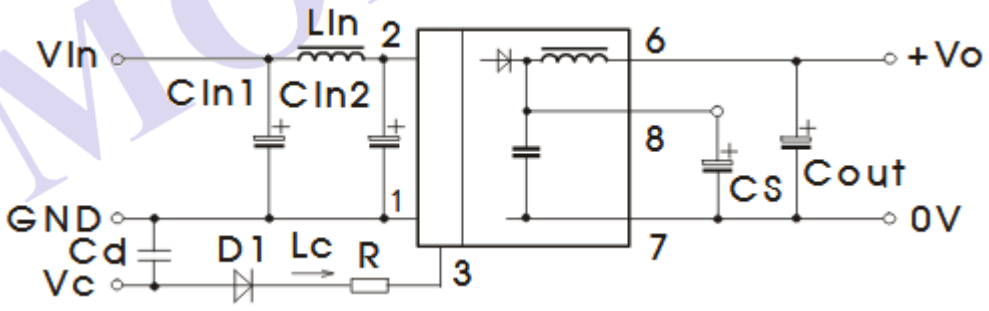

Diagram 3-1 Connection methods of CS pin and CTRL peripheral circuit

3.2.2. How to use peripheries of the CTRL pin?

Answer: When the pin has no connection or is of high resistance, the output of the module functions normally. When the pin is connected with a high level (relative to the input ground), the module is turned off. The input current of the pin is generally 5-10mA, and the range of the high level should be set according to the value and power consumption of resistance R.

3.2.3. What is the function of the diode in the CTRL peripheral application circuit?

Answer: The diode is mainly used to prevent the reverse current from flowing backward or a

small-signal current may be flowed from the module through the control pin in a voltage feedback circuit, which would lead to abnormal operation of the module.

3.2.4. What is the range of the high level and resistance value in a CTRL pin's peripheral circuit?

Answer: The CTRL pin should be connected with the high level to turn the input off. As long as the current flowing into the pins is 5-10mA, the range of the high level should be set according to the resistance value and power consumption of resistance R.

(Formula: $$R = \frac{Vc - Vd - 1.0}{Ic} - 300$$)

Note: In the calculation of our first-generation product R, it is unnecessary to reduce 300Ω.

3.2.5. When the CTRL pin operates, the output of the module is shut down while the input current of the module is high at the moment, what consequences would be caused?

Answer: When the module is shut down via the CTRL pin, low input current may exist due to the power consumption of internal components, but the current value is generally about 2mA which will not influence the module. If the input current is relatively high, the module may not be shut down completely. It is recommended to increase the current that flows through the pin to completely shut down the module output.

3.2.6. How to define NC and NP pins?

Answer: The NC pin means 'not connected'; it may be used as the internal test pin; Customers should not connect and use the NC pin; the 'NP pin' means 'NO Pin', namely there is no such pin.

3.2.7. How to use URB series' Control pin and Trim pin?

Answer: The Ctrl pin is located at the input terminal of the power module and is used to control the turn-on/off of the power source. The application methods for the series are as follows. When the Ctrl pin is suspended or of a high TTL level, the power module turns on. When the Ctrl pin is connected with GND or of a low level, the power module turns off. For the voltage range of the high and low levels, please refer to the datasheet. For instance, there are some differences between R3 DC/DC Converters and R2 ones.

The function of the Trim pin is to calibrate the output voltage. Generally, the adjusting range is ±10% around the rated output voltage. For instance, the normal output voltage is 5V, while customers need an output value of 5.3V. At this time, the Trim pin can be used. To adjust the output voltage to a lower value, a resistor can be connected on the Trim pin to +VO. To adjust the output voltage to a higher value, a resistor can be connected on the Trim pin to 0V. Please refer to the datasheet for the design values of resistance and a detailed formula is included.

3.3. EMC Peripheral Protective Circuit

3.3.1. How to select TVS and output capacitor at the output terminal of wide input voltage converters?

Answer: TVS is determined based on the input voltage; generally, its value is 2.2-2.5 times higher than input voltage; the power is selected according to the protective surge voltage, and output capacitance is generally selected according to the recommended values of external capacitance in the datasheet.

3.3.2. How to handle with the damaged TVS at the front-terminal in the surge test?

Answer: The TVS is susceptible to damage when the surge voltage and current exceed its rated value or the duration of the surge test at the front-terminal for a long time. It is recommended to select TVS of higher power or add a voltage regulating circuit or over-voltage protective circuit at the front-terminal of the module.

3.4. High Ripple & Noise

3.4.1. There is high noise during testing module input and output. Why?

Reason: Check the test method for ripple & noise (parallel cable measuring method or contact measuring method), the bandwidth of the oscilloscope should be set to 20 MHz. High ripple & noise at the output terminal may cause the interference signals introduced from the input terminal of the module.

Answer: It is recommended to add a CM inductor at the input terminal of the module to filter the interference signals and test the actual ripple & noise via parallel cable measuring method or contact measuring method. If customers require lower ripple & noise, it is recommended to add a pi filter circuit or add Y capacitors between the input and output terminals to suppress common-mode noise.

3.4.2. The module is subject to the inference when operating, and the phoneme of oscillation of data acquisition signal occurs. How to solve it?

Answer: There is a demand for output ripple & noise when collecting data signals. It is recommended to select and use modules with Y isolated capacitor. Another solution is to add CM inductor to suppress high-frequency inference to the greatest extent; or add an LC filter circuit at the output terminal to suppress circuit signal interference at the back end.

3.4.3. How to meet the requirement for ripple & noise when using low-power converters?

Answer: Low-power converters have a higher requirement for ripple & noise which need further filtering. There are the following measures: (1) add a capacitor at the output terminal (the function

of the capacitor is to further lower ripple & noise with a relatively low frequency); (2) add a PI filter at the output terminal by filtering methods of capacitor + DM inductor + capacitor or capacitor + CM inductor + capacitor (this method lowers ripple & noise at the same time. If the frequency of the noise is high, it is recommended to use the pattern of capacitor + CM inductor + capacitor); (3) customers can choose a power module whose output voltage is one grade higher and add an LDO to reduce ripple & noise (for instance, customers practically need a 3.3V output power module but there are demanding requirements for ripple & noise. Please recommend customer to choose a 5V output power module and add an LDO to lower it to 3.3V, and the LDO can lower ripple & noise).

3.5. Application

3.5.1. Since the build-up of input voltage of the module is slow, the output voltage is unregulated. How to solve it?

Reason: When the front-terminal of the module shares a power source with other circuits, the impact on the power source may cause input voltage dips, resulting in unregulated output voltage.

Answer: Add an under-voltage protection circuit at the front-terminal of the module to prevent the module from starting at a voltage lower than the minimum starting voltage and operating abnormally.

3.5.2. How does the module realize negative input?

Answer: When the negative voltage is -48V, the '0V' of the input voltage connects with the 'Vin' of the module, and the '-48V' connects with 'GND' to ensure the potential difference at the input terminal. Under a negative input, the flow direction of the input current of the module must correspond with that of the positive input. It is recommended to connect a diode in series to avoid reverse connection.

3.5.3. The input voltage falls lower than the minimum input voltage and the output is abnormal when the module is used in the normal condition. How to solve it?

Reason: When the actual input voltage is lower than the minimum rated input voltage of the module, incomplete starting or excessive starting current will cause damage to the module.

Answer: Ensure that the input voltage is within the rated range or add an under-voltage protection circuit at the input terminal.

3.5.4. Why is there no output of the module upon start-up?

Reason: When the input power of the preceding stage does not meet the starting requirements of the module (the input voltage or current is too low) or the output capacitive load is too heavy, the

module cannot start up normally and the product produces no output.

Answer: (1) Adopt preceding-stage power source with higher power to ensure normal starting voltage and current requirements of the module; (2) decrease the output capacitive load or to add a soft starting circuit at the input terminal.

3.5.5. Why does the module damage when it starts up?

Reason: (1) There is a high capacitive reactance for the module load, so it needs a large starting current upon start-up. The impact of high current may cause damage to the module; (2) the flowing backwards of the output terminal interferes the input control system.

Answer: (1) It is recommended to reduce the input capacitive load according to the recommended capacitance in the datasheet; (2) it is recommended to connect a diode with the output terminal to prevent flowing backwards or connect an inductor filter circuit to eliminate the effects of flowing backwards.

3.5.6. What triggers the start-up protection of the module?

Reason: The load of the module experiences instantaneous abrupt change and exceeds the overload requirements, which triggers the overload protection of the module upon start-up.

Answer: Choose a high power module that can meet the load requirements, and add a buffer circuit to the output terminal of the module to decrease the instantaneous load current.

3.5.7. Can the input and output 'grounds' of the module be put in short circuit and used as non-isolation?

Answer: In practical application, when there are no demanding requirements for EMC and ripple & noise, or there are non-isolated voltage requirements for the module, the input and output 'grounds' can be connected.

3.5.8. Does it make a difference when connecting a tantalum capacitor to the input and output terminal of the module?

Answer: It is not recommended to connect a tantalum capacitor to the input terminal during the application of the module, because tantalum capacitor is susceptible to breakdown and short circuit, and may be burned up by an instantaneous high current due to the poor surge handling capacity. The tantalum capacitor should not be used at the input terminal. Therefore, it is recommended that the input filter circuit adopts a ceramic capacitor or electrolytic capacitor. In addition, the output voltage of the module is regulated; if a tantalum capacitor is connected to the output terminal, the withstanding voltage of the tantalum capacitor should be more than twice the output voltage.

3.5.9. How to deal with customers' request for EN50155 certification of our products?

Answer: If customers require an EN50155 certification of our products, he or she can consult the testing department and apply for the decryption process.

3.5.10. Should capacitors still be added to the input and output terminal as written in the datasheet when using products in chassis mounting package?

Answer: When using the chassis mounting products, the customer can determine whether to use the MORNSUN's recommended circuit based on the actual situation. Generally speaking, MORNSUN's products are operated normally without adding capacitors to the input and output terminals, and can meet the parameters in the datasheet. But if a customer raises a demanding requirement for the ripple & noise, a further noise reduction process can be applied. The implementation of peripheral circuit into input terminal is subject to customers' EMC environment. If the environment is favorable and free of external interference, no peripheral circuit will be required. But if the EMC environment is comparatively unfavorable, the relevant protective peripheral circuits are required.

3.5.11. According to customer's feedbacks, the temperature rise is 20°C for products with the power of 10W. Whether the specific temperature rise tests are implemented against MORNSUN's modules? Which temperature rise is deemed to be within the normal range, and how can customers' issues be answered more professionally?

Answer: Temperature rise of the power module = thermal resistance * its actual loss. Aside from the thermal design of the power module, the thermal resistance of the power module is also related to the external cooling conditions; what's more, the consumption of the power module at each load and each input voltage are different (the power efficiency is different under different input voltages and loads; the amount of loss of power module = power efficiency * (1 - power efficiency)). Therefore, generally the temperature rise given in the datasheet is the testing standard of nominal voltage under full load at an environment temperature of 25°C. The customers provide an approximate value in most cases because the actual working environment of the customer is not always in such conditions. If a customer requires accurate temperature rise data, he or she should apply for our test commissioning procedures according to the actual working environment of that customer in order to obtain this value.

3.5.12. MORNSUN's products produce too much heat to touch, which can cause environment problems and influence the efficiency of the product. Is there a solution to solve it?

Answer: Although the products produce much heat, there is little impact on the efficiency of the whole machine. If the temperature reaches 50°C, the product is too hot to the touch, and if the environment temperature is 25°C at that time, the temperature rise of the product is only 25°C.

However, the working temperature of the electric components and elements of the internal power module can basically withstand above 100°C. First, the customer should know that it won't make negative impact on the reliability of the power source. If a customer believes that the product produces too much heat and wishes to decrease the temperature of the product, the following measures can be taken:

1) Supply external forced cooling air; i.e. add fans to the thermal design of the customer's system;

2) Choose MORNSUN's power module with radiator or add relevant radiators designed by the customer, or install the power module on the customer's system through heat-conducting silicone grease etc.

3) Optimize the PCB layout design of the customer's system to separate components and elements that produce high temperature, thus avoiding an intensive layout; the PCB copper under components and elements that produce high temperature can be thickened and design for relevant metalized via hole can be provided.

3.5.13. In terms of compatibility design, why the pin positions of products with the power of 30W are incompatible with those of 6W/15W/20W? What makes them incompatible if increasing load?

Answer: Since the power density of 30W product is higher, the pin positions of products with the power of 30W are incompatible with those of 6W/15W/20W, What's more, the pin positions may be too close to the outside regarding performance design and EMC design. In addition, our advantages over competitors' products are also taken into consideration, because their pins are also close to the outside.

3.5.14. What are the reasons and solutions for low output voltage?

Answer: The reasons for low output voltage are as follows:

The input voltage is lower than the normal working voltage range of the power module; the input voltage provided is believed to be within the normal range, but the voltage dips may exist due to the wires that are used to connect customers' front-stage power source with our power products are too long, so the actual voltage of input terminal may be lower than the normal power supply range. Customers should determine the actual condition based on the voltage on the input terminal of the actual testing power source.

(1) Solution: The voltage provided by the front-terminal power source is within the normal working voltage range of products; if there are wires, customers can shorten or thicken the wire if they had confirmed that the voltage dips on the wire is too large.

The input power is insufficient. In general, it is recommended that the front-terminal power is at least twice that of our power module.

Solution: Increase the power of the power source.

(2) The output load is too heavy; i.e. the actual load of the customer exceeds the normal power range of MORNSUN's product.

Solution: If the actual power of the customer's product is too large, it is probably that the incorrect types of products are recommended to the customers. The power module with larger power is recommended to customers.

(3) The voltage at actual load location may be lower due to the wires at the output terminal are too long and the voltage dips are too large. The customer can determine via testing the voltage on the output terminal of our power products and the voltage of load location.

Solution: When wires are used for connection, they can be shortened or thickened if it has confirmed that the voltage dip on the lead is too large.

3.5.15. What is the isolated level of the product?

Answer: The isolated level of the voltage module is developed for the isolated power source. If the power module is non-isolated, the isolated level is not applicable. The isolated level can also be understood as dielectric strength and isolated withstanding voltage.

3.5.16. In which situations can 1,500VDC and 3,000VDC isolated power modules be used?

Answer: The 1,500VDC isolated power module is used in the industrial control field, while the 3,000VDC isolated power module is used in the power and rail transit fields. However, the specific isolated voltage demands are subject to the customers' actual situation in the specific system.

3.5.17. As many customer applications fail to pass the EMI test, can the EMI level of DC/DC products be higher?

Answer: The EMI design of the DC/DC products complies with the standard requirements of CISPR22/EN55022, and there are also certain allowances. The load is pure resistive load. However, the actual systems of customers may vary, and there are interference sources in their systems. In this case, the customers should add EMI filtering devices.

4. Non- isolated Converters

4.1. Application of Negative Voltage Converters K78XX-XXR2

4.1.1. What should be noted when K7805-500R2 is used for negative voltage output?

Answer: The maximum input voltage of the product used for negative output is lower than that when used for positive output. When the module is used for negative output, its power is lower than the rated power of the module used for positive output, and our previous products cannot be used for negative output.

4.1.2. Why the starting current of K78XX is high when used for negative output?

Reason: When our previous products are used for negative output performance, the circuit structure changes from BUCK to BUCK-BOOST. However, since the circuit parameter performance is incompatible, it may cause failure in negative output function.

Answer: It's not recommended to use first-generation products for negative output; R2 products are recommended instead. The interior circuit of the product series has been calibrated and positive and negative output performances can be simultaneously met. The starting current is 2.1-2.2 times higher than Iin (max).

4.1.3. The module is used for a transmitter in the form of negative output. In starting and shutdown tests, the module fails to start up (starting and shutdown frequencies are large). How to solve it?

Answer: It is recommend adding certain dummy load to the output terminal of the module and improve the driving capacity of the product. The recommended capacitance in the datasheet should be added to both the input and output terminals to ensure a slow start-up.

4.2. EMC Peripheral Protection

4.2.1. Advices for surge problems of K7805T-500 products

Answer: The product should be able to withstand surge level 4. There is no surge protective circuit inside K78T products, so surge suppression components or circuits like voltage dependent resistors and TVS are added to the front-terminal of the power module. In that way, it can reduce the surge voltage to be within the input voltage range.

4.3. Pins

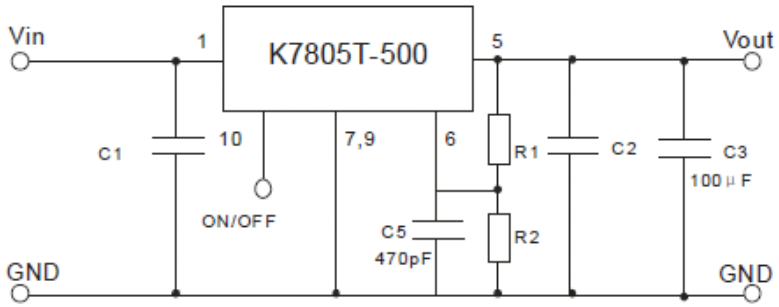

Diagram 4-1 Non-isolated application

4.3.1. How can the ON/OFF pin be used?

Answer: The ON/OFF pin of the K78XXT-500 series is mainly used for ON/OFF control. When the ON/OFF pin connects to 'GND' or receives a low electrical level of 0-0.4V, the module is off. When the ON/OFF pin has no connection or receives an electrical level of 1.2-6 V, the output of module will function normally.

4.4. Application

4.4.1. How to select the ESR of the external capacitors and its value to avoid influencing the product's stability?

Answer: It's recommended to select values in the range of 30mΩ-100mΩ. If the value is too large, it will influence the output ripple & noise.

4.4.2. What is switching frequency of K7805T-500 and is there any internal protective inductor in the internal components**?**

Answer: The switching frequency is subject to the internal components, which is 1.4MHz. There is a built-in power filter inductor in the product, which is only used for energy storage and filtering without protective function.

4.4.3. When the K78 product is used as a power source of the back-end module, the module fails to start up. Why?

Answer: The K78 product is low power product, and the instantaneous power of the power module will increase upon start-up. The K78 module cannot provide enough power to start up the back-end power module. It is recommended to select a product with larger power.

4.4.4. How can K7805T-500 output the 6V voltage by adjusting R1 and R2? Will the change of R1 and R2 values influence the module's performance such as noise and efficiency?

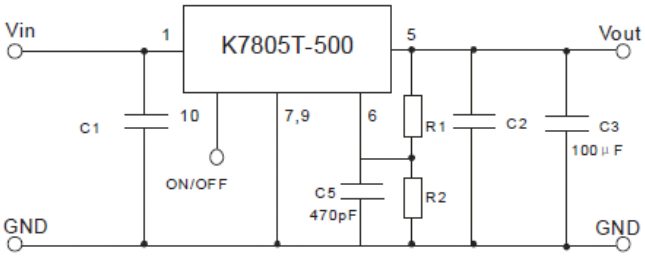

Diagram 4-2 Non-isolated application

Answer: Calculate divider resistance according to the following table:

Product model	Vo-up (Up regulation)	Vo-down (Down regulation)
	R2(KΩ)	R1(KΩ)
K7803T-500	=655.98/(16.07*Vo-53.66)-10	=127.5/(3.3-Vo)-61
K7805T-500	=400.31/(9.81*Vo-48.65)-10	=214.2/(5-Vo)-61
K7809T-500	=99.52/(3.48*Vo-31.34)-10	=292.74/(9-Vo)-45.7
K7812T-500	=148.9/(3.65*Vo-43.72)-20	=571.2/(12-Vo)-71
K7815T-500	=117.09/(2.87*Vo-43.09)-15	=724.2/(15-Vo)-66

Vo represents the targeted output voltage.

Resistors R1 and R2 exert no influence on noise and efficiency.

4.4.5. Advices for hot-plugging of non-isolated products

Answer: Hot-plug instantaneously generates peak voltage and makes an impact on the module. Although hot-plug will not directly cause the malfunction of the product, it can damage the module. The hot-plug operation against module power is prohibited. If it is required, some control circuits for hot-plug should be added to the front-terminal of the module, which will guarantee the normal operation of product.

4.4.6. When should K78 be selected? What are the advantages of K78 compared with the linear regulator?

Answer: K78 products can be used when the input current and the input-output voltage difference are relatively large, efficiency requirements are demanding and non-isolated is required. Compared with the linear regulator, K78 products feature compact size, high efficiency, low stand-by power consumption, wide input voltage range and extremely low ripple & noise and no need for heat sink. In addition, the output voltage of the K78XXT series is adjustable.

5. Low Power DC/DC Converters

5.1. High Ripple & Noise

5.1.1. Will the connection method of the oscilloscope ground lead and bandwidth setting influence the ripple & noise test results? What kind of method can be used for the test?

Reason: (1) MORNSUN's product uses the parallel cable measuring method for the ripple & noise test (See below). (2) During the ripple & noise test, the oscilloscope ground lead introduces a high frequency interference signal and lead to an incorrect test result.

Answer: It is recommended to carry out the test when the ground lead has been removed and the bandwidth of the oscilloscope is set to 20MHz. The parallel cable measuring method is used for the ripple & noise test. See the detailed test in Diagrams 5-1 and 5-2.

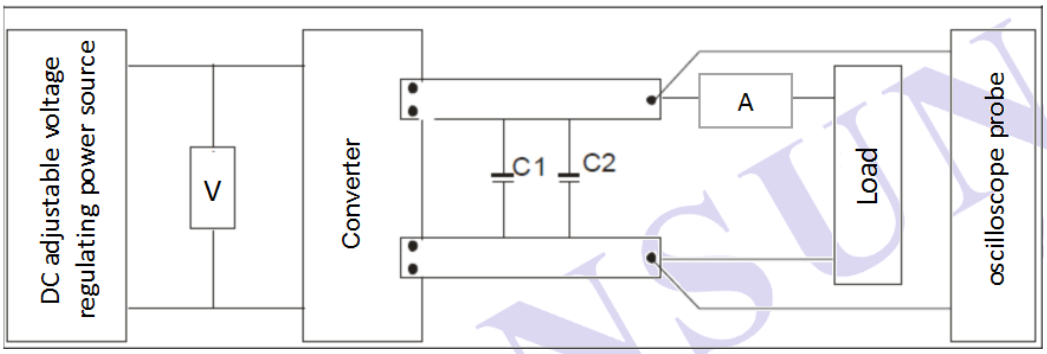

Diagram 5-1 Parallel cable measuring method

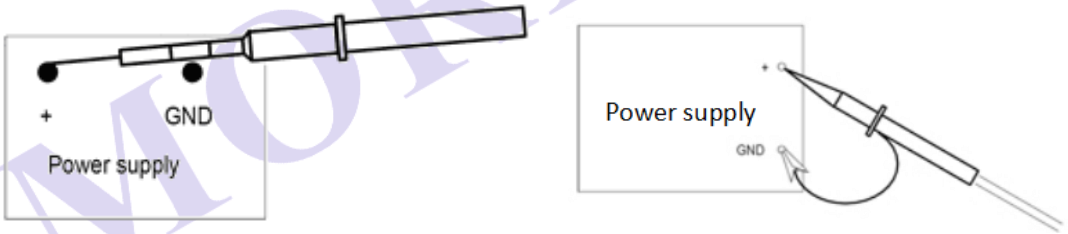

Diagram 5-2 Contact measuring method with oscilloscope connection (the left is correct while the right is inadvisable)

5.1.2. During the ripple & noise test, the module experiences interference in the actual application environment. How to solve this problem?

Answer: The input terminal of the module connects with the CM inductor and filter capacitor, and the output terminal connects with the LC filter circuit. Under normal circumstances, the CM inductor at the input terminal is about 1-2.2mH (please refer to the relevant section of the datasheet), and the filter capacitor is 1-2.2μF. In addition, at the output terminal, inductance L is 2.2-10μH, and the capacitance is 1-10μF. The resonant frequency of the selected LC should be different from the switching frequency of the converters.

5.2. Start-up Issues

5.2.1. How to solve the problem of failing to start up the module due to a large electrolytic capacitor at the output terminal of the module?

Reason: When the electrolytic capacitor at the output terminal of the module is relatively large, the surge current required will also be large upon starting, resulting in failing to start up the module.

Answer: It is recommended to use the recommended values of output external capacitors described in the datasheet.

5.2.2. What can be done if the front-terminal is an intrinsically safe power source, leading to the failure of startup, of the module?

Reason: The output current limit of the intrinsically safe power source cannot provide the starting current required by the module.

Answer: If the actual power requirements are met, it is recommended to select a module of equivalent power or add a soft start-up circuit at the front-terminal of the module.

5.2.3. What can be done if the actual output load of the module is the capacitive load and the module fails to start up?

Answer: The capacitive load requires a heavy input current to start. According to the actual load, a resistor or inductor can be connected in series at the output terminal to suppress the starting current. Otherwise, please replace the module with higher power.

5.2.4. Why does the output load of the module fail to start up when it is an inductive load (motor coil)? How can to solve it?

Reason: The inductive load (generally a motor coil) will not create the induced electromotive force at the moment of start-up. Only the internal resistance r of the coil functions in the entire circuit. However, the internal resistance is low (generally mΩ-Ω), and according to the formula $I = \frac{V}{r}$, the current is heavy at the moment of start-up and surpasses the over-current protection of the module, thus triggering the protection of the module and failing to start-up.

Answer: For a low-power module, it is recommended to connect a low resistor in series at the output terminal or replace the module with higher power.

5.3. Pin Applications

5.3.1. How to fulfill the function of the ON/OFF (CTRL) pin?

Answer: CTRL mainly achieves the function of remote off. When the CTRL pin receives a low level

signal of 0-1.2V, the module is off. When the CTRL pin has no connection or receives a high level voltage more than 2.5V, the output of the module will function normally.

5.3.2. How to fulfill the function of the output voltage regulating terminal (Trim)?

Answer: The external resistor network or voltage source allows adjusting the output voltage of the module within a certain range. When the output voltage is increased, the output current should decrease, which will ensure that the output power will exceed the rated value.

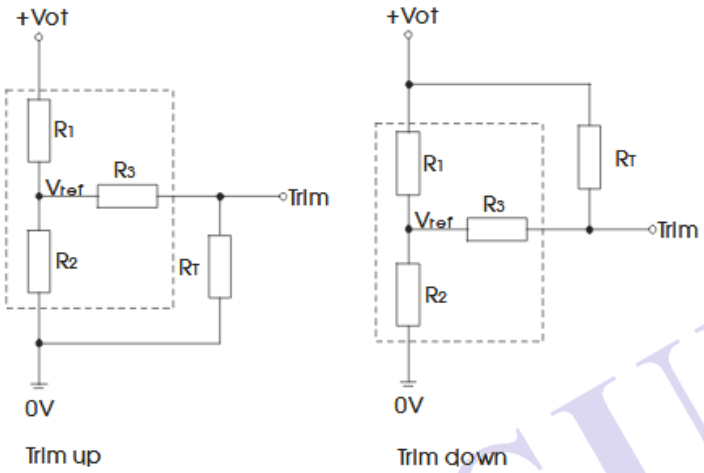

Diagram 5-3 Trim connection

Up: $R_T = \frac{aR_2}{R_2 - a} - R_3$, $a = \frac{V_{ref}}{V_{oup} - V_{ref}} \times R_1$

Down: $R_T = \frac{aR_1}{R_1 - a} - R_3$, $a = \frac{V_{odown} - V_{ref}}{V_{ref}} \times R_2$

Vout(V)	R1(KΩ)	R2(KΩ)	R3(KΩ)	Vref(V)
3.3	4.801	2.87	12.4	1.24
5	2.883	2.87	10	2.5
9	7.500	2.87	15	2.5
12	11.000	2.87	15	2.5
15	14.494	2.87	15	2.5
24	24.872	2.87	17.8	2.5

The URB2412LD-20WR2 is used as an example to calculate external Trim resistance. A 13V output voltage is obtained according to the formula:

$$a = \frac{V_{ref}}{V_{oup} - V_{ref}} \times R_1 = \frac{2.5}{13 - 2.5} \times 10.971 = 2.612$$

$$R_T = \frac{aR_2}{R_2 - a} - R_3 = \frac{2.612 \times 2.864}{2.864 - 2.612} - 17.8 = 11.886$$

Trim resistance is about 12KΩ.

5.3.3. How to explain remote sense function?

Answer: The remote sense terminal of the power source can offset the voltage dips from the power source to the load. The compensation range is limited so that the output voltage falls within the range and does not exceed the maximum power. To reduce the noise, it is recommended to use shielded wires, twisted pairs or coaxial cables. If the remote sense terminal is not required, connect +S and +Vo and –S and –Vo in short circuits respectively.

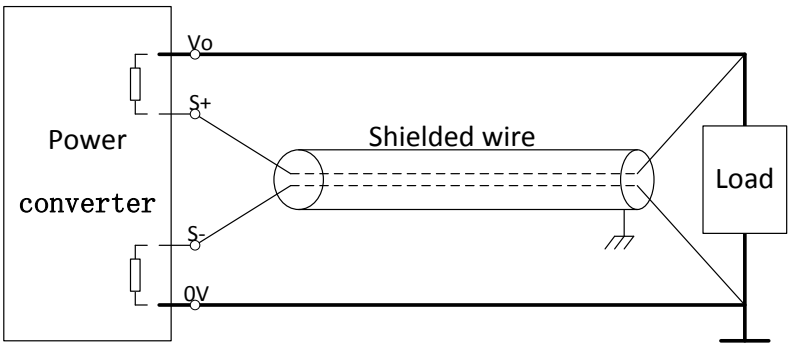

Diagram 5-4 Remote sense terminal connection

5.4. EMC Peripheral Protective Circuits

5.4.1. How should the EMC peripheral circuit in the datasheet be understood?

Answer: In the Diagram below, part ② is the EMI-recommended filter circuit for conduction and radiance, while part ① is the EMS testing of the protective circuit against surges and group pulses. The CM inductor generally ranges from 1mH to 3mH. For the specific parameters of individual parts, please refer to the datasheet.

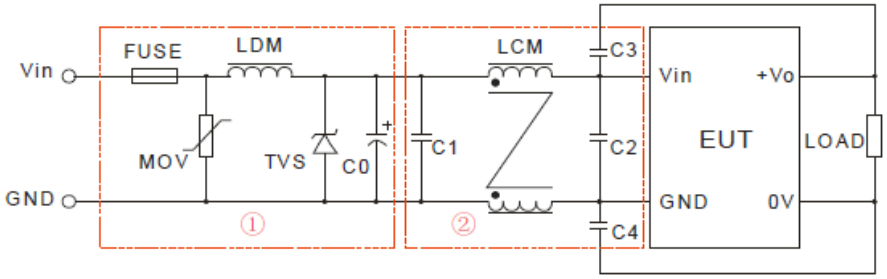

Diagram 5-5 Connection of EMC protective circuit

5.5. Application

5.5.1. Why it is not recommended for customers to use the module in the no-load or light load conditions?

Answer: The module is applicable in the no-load or light load conditions but the conversion efficiency is low. The output ripple of our previous products can exceed the rated value during a no-load process. Coupled with an unregulated loop, this may lead to oscillation and some indicators may fail to meet the requirements of the datasheet. In view of reliability, the no-load or

below light load application of a module should be avoided to the greatest extent; the minimum working current of a module should not be lower than 10% of the rated current (with a minimum load of 5% for R2 DC/DC Converters).

5.5.2. How to select module when there is an imbalance in the use of dual output load?

Answer: When the loads of two outputs differ greatly (for example, the primary output is overloaded whilst the secondary output is light-loaded), dual output modules will experience imbalanced load to exceed the limit of voltage accuracy, which is therefore not recommended. It is recommended to select two modules on the basis of their actual load, and their connection can be referred to in Diagram 5-6:

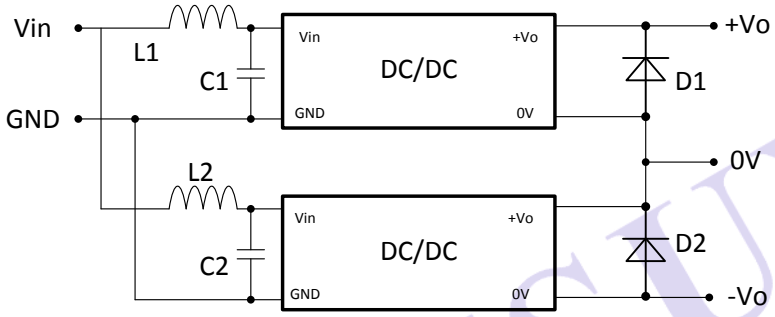

Diagram 5-6 dual output of two single modules

5.5.3. Why does damage occur when filter circuits on the input terminal of a module are connected with a tantalum capacitor?

Reason: It is not recommended to connect a tantalum capacitor to the input terminal during the application of the module, because tantalum capacitor is susceptible to breakdown and short circuit, and may be burned up by an instantaneous high current due to the poor surge handling capacity. In addition, it may create a short circuit or break down on starting due to a very high surge voltage.

Answer: Use a ceramic capacitor or an electrolytic capacitor to connect with the filter circuits at the input terminal of the module.

5.5.4. Will it influence the performance of products when non-isolated module is used as isolated one?

Answer: When a product is applied in the environment where there is no high requirement for EMC and ripple & noise, or there is no requirement for the isolated voltage of the module, the product can meet the non-isolated purposes, which will have no impact on its performance and reliability.

5.5.5. When the power module supplies power to AD of DSP, the sampled signal is influenced. How to solve this problem?

Reason: (1) The power module might also supply power to other modules apart from the AD.

(2) The ripple & noise of the power module might be beyond the standard value and influence the sampling precision.

Answer: It is recommended to add an LC filter circuit at the output terminal according to the recommended circuit in the datasheet so as to filter interference signals.

5.5.6. The power source of single output modules in series connection may produce high voltage. Why the ripple & noise is higher than that in the single output test?

Reason: When outputting in series connection, operating power modules may interfere with each other, so the measured ripple & noise is higher than that in the separated condition. In addition, the ripple & noises in this case come from both modules.

Answer: Add LC filter circuits at the input and output terminals of the modules so as to eliminate interference.

5.5.7. The power source of dual output modules may produce high voltage. Why the ripple & noise is higher than that in individual tests of positive and negative outputs?

Answer: The power source of dual output modules may produce high voltage, and the ripple & noise here come from both outputs. Add LC filter circuits to the output terminals of the modules to eliminate the interference between two outputs.

5.5.8. What is the definition of input reflected ripple current in the datasheet?

Answer: The input reflected ripple current refers to the alternating current component of the ripple current that has not completely filtered out by modules' filters and then is reflected to the input terminal of DC power

5.5.9. If a module is applied in the mining industry and the power source on the front-terminal is under intrinsically safe power source, what can be done if there is a current limit in the start-up of the module?

Answer: For a module with lower power, add an NTC thermistor or low inductor or resistor to the input terminal to suppress the starting current. When the actual power meets the requirements in the application, it is recommended to select a module with equivalent power according to the actual load.

5.5.10. What would happen to a module if the load connected with its output terminal creates high instantaneous starting current?

Answer: If an output load requires high current at the moment of start-up, the over-current protection of the module will be triggered and the start-up may fail. Please first confirm the current required by the load at the moment of start-up before selecting a module for application.

5.5.11. Why is protection triggered in a high temperature situation during module application?

Answer: When modules are applied in the environment at high temperature, attention must be paid to the 'safe operation area' on the derating curve. The actual environments in which customers apply modules are often poor and tough. In the environment with high temperature, the over-current threshold of module will reduce, thus triggering the over-current protection. It is recommended to select a module with higher power in case of reducing rating, and prevent from placing it near the heat sources as well.

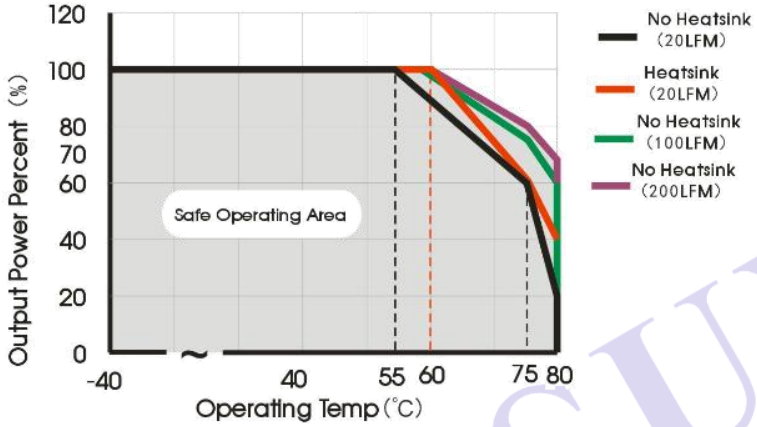

Diagram 5-7 Derating curve

5.5.12. Under the same load, why the modules with higher output power also require a higher starting current?

Answer: The rated over-current at the input terminal of a module with higher power may also be higher, so those modules with higher output power under the same load may require relatively larger starting current.

5.5.13. What would cause the voltage accuracy of negative output in a dual output module to be out of range?

Answer: The unbalanced load application between the primary output and secondary output may lead negative voltage out of accuracy range. Customers are advised to maintain a maximum value difference between two outputs of less than 5% during application.

6. AC/DC Converters

6.1. Ripple & Noise Issues

6.1.1. Does the difference in test methods cause high ripple & noise?

Answer: Yes. The test methods of switching power supply ripple & noise should comply with some industrial standards, and the parallel cable measuring method or contact measuring method is adopted. Specific tests can be referred to Diagrams 6-1 and 6-2.

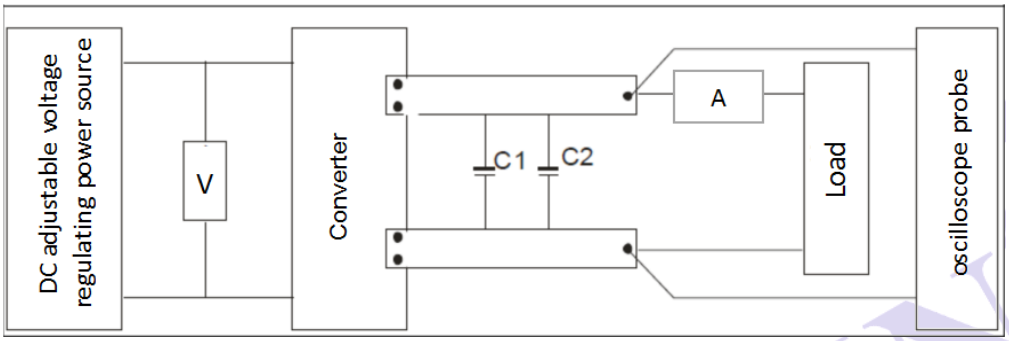

Diagram 6-1 Parallel cable measuring method

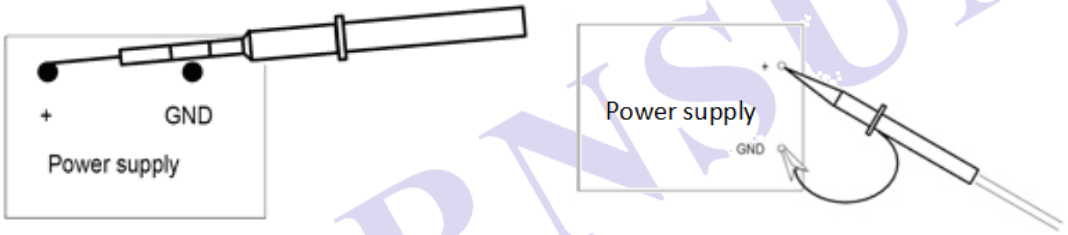

Diagram 6-2 Contact measuring method with oscilloscope connection (the left is correct while the right is inadvisable)

6.1.2. How to eliminate the interference and high noise among power sources of systems?

Answer: The crosstalk interference may occur when the switching power sources are supplied power in input-series connection, and especially when the power sources are in parallel connection. The generally adopted method is to add a filter circuit at the input and output terminals, a CM inductor and X capacitor at the input terminal, and a pi filter at the output terminal.

6.1.3. Why are ripple & noise high when products operate in the light load?

Reason: To lower the standby power consumption of the product and improve the light load efficiency, AC/DC Converters may operate in a skipping cycle mode in the light load condition. The ripple & noises are fairly high but the output voltage is regulated.

Answer: It is a normal phenomenon for fairly high ripple & noise in the light load condition (below 10%). To avoid this situation, it is recommended that customers use a module with load no lower than 10%.

6.2. Squeak

6.2.1. Why does squeak occur when products are operating in the no-load or light load condition?

Reason: To improve the efficiency of products under low-power and standby power consumption, AC/DC Converters operate in a skipping cycle mode in a light load condition. When the products operate in frequency conversion mode (with normal operation period of 65 kHz or 100 kHz), the output voltage changes greatly and the ripple & noise is fairly high, but the output voltage is regulated.

Answer: It is a normal phenomenon for fairly high ripple & noise below light load (below 10%). To avoid this situation, it is recommended that customers use a module with load no lower than 10%.

6.3. EMC Issues

6.3.1. What can be done if the EFT of the products cannot meet the requirements of the customers?

Answer: Requirements for group pulses are taken into consideration during the design of the AC/DC Converters. When performing test, the levels that the bare products may pass are different from those of converters with additional peripheral circuit. In general, bare products should meet level three of the EN61000 testing standard and special ones should refer to the specific instructions in the datasheet. If customers require higher requirements, it is recommended that they should refer to the datasheet and use the MORNSUN's recommended peripheral circuits or EMC filter modules.

6.3.2. When the product supplies power to five AD (or other IC chips), what can be done if the AD (or other IC chips) is damaged by lightning?

Reason: When a module is struck by lightning and other surges at the input terminal, certain interference may occur at the output terminal. If it is beyond the nominal value of the AD (or other IC chips), it may cause damage to the AD (or other IC chips).

Answer: Add the recommended peripheral EMC circuits to lower the interference caused by lightning and protect the post-AD (or other IC chips).

6.3.3. How to solve the strong interference of the motor, circuit breaker, etc. at the front-terminal of the module in the system?

Answer: While there is strong interference from the motor, circuit breaker, etc. at the front-terminal of the module in the system, the equivalent model of interference is fast and

transient EFT interference. When it is severe, customers' system processor may reset or crash. It is recommended that customers add an EMC filter at the front-terminal of the module.

6.3.4. What if the customers' electrostatic requirements exceed the product specifications?

Answer: In general, the electrostatic level of MORNSUN's AC/DC Converters is 6 KV, and special products should refer to the specific instructions in the datasheet. If customers require higher electrostatic requirements, a protective circuit should be added to the pins. General reference devices include TVS, capacitors, resistors, etc. The practical protection capability can be adjusted by the customers based on their required levels of debugging.

6.3.5. The system resets during the electrostatic test and there is no electrostatic discharge route in the customer's system. How to solve this problem?

Answer: In general, the electrostatic level of MORNSUN's AC/DC Converters is 6 KV, and special products should refer to the specific instructions in the datasheet. If customers require higher electrostatic requirements, a protective circuit should be added to provide an electrostatic discharge route. General reference devices include TVS, capacitors, resistors, etc. The practical protection capability can be adjusted by the customers based on their required levels of debugging.

6.4. Wire Connection

6.4.1. How does the constant voltage transmission of AC/DC Converters supply power back-end LED lights?

Answer: The brightness and service life of LEDs are subject to the currents flowing through the lights. It is recommended to directly connect LED lights in series and add current-limiting resistors, or connects LED lights for application after using three-terminal regulators such as LM2596 to lower the voltage appropriately.

6.4.2 What will happen if the COM pin of a product is grounded?

Reason: AC/DC Converters adopt a Y capacitor between the earth and input terminal, and AC components are coupled to the ground through this Y capacitor. The COM pin connecting to the ground will increase the interference sources and may lead to abnormal operation.

Answer: The output COM pin cannot be directly connected to the ground. If such a connection is required, it should be connected to the ground through a Y capacitor.

6.4.3. Why does the module motor fail to start up?

Reason: In general, the motor is equivalent to a large inductor. The start-up of the module requires a very large starting current, and the equivalent overload of the output terminal will lead

to the failure of starting the module.

Answer: Add a NTC at the output terminal of the module to reduce the starting current of the motor, and make sure that the output current of the motor is within the overload range of the module upon start-up, thus ensuring that the product will start up normally.

6.4.4. How can the product's shutdown delay time be extended?

Answer: The term "shutdown delay time" is described as "hold-up time" in the datasheet. The rate value for AC/DC Converter is generally 80mS (typ.), which is subject to the load value of the back-terminal and the capacitor of the front-terminal. Once the system load is regulated, the hold-up time can only be extended via increasing the front-terminal capacitance.

6.4.5. Can the input and output of AC/DC Converters be reversely connected?

Answer: The output terminal of the AC/DC product is low DC voltage. The secondary circuit products are all of products with under-voltage rated value. If the input and output are reversely connected, the circuit products of the output terminal will bear a high voltage alternating current and the product will be directly burnt up, so reverse connection is unallowable.

6.4.6. Can the L/N of module input be reversely connected?

Answer: The input terminal of AC/DC Converters adopts a full bridge rectifier which filters into the direct voltage to power the power circuit. The reverse connection of the L/N wires will exert no influence on the rectifier circuit. After implementing reverse connection, the product will function normally without faults. At the same time, the input terminal can be directly supplied with a direct current. Special attention should be paid to products with built-in fuses, as the reverse connection of L/N wires is unallowable according to safety requirements.

6.4.7. Can the N line of the module input be connected with the output ground?

Reason: The AC component of the N line at the input terminal will be sent to the input terminal, which will interfere with the normal power supply of the back-end equipment to some extent. If the circuit of the output terminal is accidentally touched, it may lead to safety accidents.

Answer: For the sake of personal safety, it is not recommended to implement short circuit between the input N line and output ground line, which should be connected via a safety capacitor.

6.4.8. Why is there a high voltage between the PE-terminal and 0V in the system?

Reason: The output terminals of the isolated products adopt a floating ground design. There is no discharge output for charge gathered at the output terminal, leading to a relatively high voltage between the PE terminal and 0V.

Answer: Customers are recommended to ensure proper grounding of system or add safety

capacitors and resistors to lower the floating voltage.

6.4.9. Is hot-plug available for AC/DC Converters?

Reason: There is generally a high voltage fluctuation during the AC input of products. In particular, the hot-plug of products will cause a high spike in voltage and current. The spark occurred at the moment of hot-plug is a hard evidence.

Answer: Customers are recommended to avoid hot-plug.

6.4.10. What is the difference between slow-break fuses and other fuses?

Answer: Under the normal circumstance, the current at the moment of closing and opening the module is several times larger than the normal working current. Although the current peak is very high, it only lasts for a very short time. This current is called 'pulse current' (also 'impact current' or 'surge current'). Common fuses cannot withstand this current. If the common fuses are used in the circuit, it is impossible to start up normally. If larger-scale fuses are used, protection cannot be provided in the case of circuit overload. Slow fuse melting is caused by special processing and has the function of energy absorption. The amount of energy absorption should be adjusted so that it will not only resist the surge current but also provide overload protection.

6.4.11. How should the rated current of fuses be selected?

Answer: There is a high current spike upon start-up. Therefore, for fuse selection, the rated current should have a certain allowance and the fuse should be a slow-break type. It is recommended to select 1A for products below 10W and 2A or 3.15A for products above 10W.

6.4.12. Can the product work normally under 115VAC, 400Hz?

Answer: Generally, the product can operate less than 37 Hz-440 Hz but the leak current is a little higher, which mainly influences the front-terminal rectification circuit and input filter capacitor. It will not have any impact on the normal operation of the products.

6.4.13. What are the function and application method of NTC?

Answer: NTC is mainly used to suppress the surge current upon start-up, which is integrated in products of 20W and above and not suitable for low-power products. In addition, products can also operate normally without it. In view of long-term reliable operation, customers are recommended to provide an external NTC.

6.4.14. What does the equipment classification mean (some product inputs have no PE terminal)?

Answer: Equipment is classified into Class I, Class II and Class III. Protection method for Class I equipment: basic insulation + protective grounding; protection method for Class II equipment: double insulation (i.e. basic insulation + additional insulation); protection method for Class III

equipment: power supply through SELV (safe extra-under-voltage). Generally speaking, Class I: primary power supply with ground connection; Class II: primary power supply without ground connection; Class III: secondary power supply, similar to our DC/DC products. Our AC/DC Converters are basically Class I equipment, but the 15W single output products are Class II products. Therefore, our 15W single output products have no PG pin, i.e. ground pin.

6.4.15. Does the suspension of the input ground pin influence the module? Is ground connection necessary?

Answer: The grounding for input pin of the power module will not impact the function of the module itself. Suspending the module can also operate normally. In certain cases, connecting the ground pin of the module to the ground or system ground can provide access to external interference and improve the anti-interference performance of the products. When connection to the ground or system ground is available, customers can perform ground connection according to the practical situation.

6.4.16. Whether can connect the two-wire module with three-phase four-wire power source?

Answer: In fact, the input of the three-phase four-wire power module is not connected with four wires. Therefore, it cannot be directly used for three-phase four-wire products. A certain peripheral circuit should be added. However, the single-phase withstanding voltage of three-phase four-wire products is much higher than that of common products. As long as the input voltage is within the withstanding voltage range of the products, any two wire connection from three-phase four wire system is acceptable.

6.5. Unregulated Output Issues

6.5.1. Whether unbalanced load among the outputs is available when customers are using multiple output products?

Answer: No. The unbalanced load will lead the output voltage of products to go beyond the precision range, resulting in failing to meet the power supply requirements of the customer system. Customers are recommended to ensure the load balance among the outputs (the load difference should be within +/-5%). Measures can be taken to add a dummy load for the output with low load.

6.5.2. Why is the output voltage of products low under high load current?

Reason: Since the line loss is serious when the load current is high, the voltage is lower than the specification requirements if the test method is incorrect.

Answer: The correct method for testing the output voltage of products is to test the voltage of the

output terminal via multimeter, thus preventing from making negative impact on the test result due to the voltage drop of the lines.

6.5.3. The module supplies power the backlit LCD. What if the voltage drops upon start-up?

Reason: For voltage modules, some backlit LCDs in the market can be equivalent to greater capacitance load. The requirements for current are high upon start-up and overload occurs, resulting in the voltage drop.

Answer: NTC or resistors can be added to the back-terminal of the output to limit the current and avoid overload; alternatively, products with larger power can be selected to power the backlit LCD.

6.5.4. Why does the product make noises when the output line is in shorts circuit?

Reason: The general short circuit modes of MORNSUN's designed products include the hiccup mode, sustainable mode and self-recovery mode. When the hiccup mode is adopted, low noise may be heard.

Answer: Noise may be heard in the short circuit conditions. It is the working mode designed for the products and will not influence their normal operation.

6.5.5. What are the applications of LS series?

Reason: LS series are MORNSUN's most economical and cost-efficient products. Customers should connect external capacitors at the input and output terminals of the products. For the recommended values, please refer to the specific models in the datasheet.

Answer: External capacitors must be provided. It is recommended to add the EMC protective circuit.

6.5.8. How to check whether the Trim pin is normal?

Answer: The Trim pin is used to slightly adjust the output voltage. However, in view of stability of the internal loop, this adjustment is limited (generally ±10%). If customers need quickly checking whether the Trim function is normal, connect the Trim pin to the ground and check whether the output voltage is regulated and the ripple & noise meet the requirement. In general, the degree of the voltage peak should not exceed the over-voltage protection range of the output of the products.

6.5.9. The AC/DC Converters produce instantaneous high current upon load access. Does this influence the module?

Answer: If the large instantaneous current of the AC/DC Converters upon load access does not exceed the over-current protection point of the module, it will not have any impact on the module. See the datasheet for the over-current protection point of the module. If the current exceeds the over-current protection point of the module, the module will trigger the protection and voltage

dip occur, and then recover.

6.6. Other Issues

6.6.1. Can AC/DC Converters operate under 110VDC?

Answer: According to the below diagram showing the relations between working voltage and load, the converters can operate normally under 110VDC provided that the working load is derated (to about 80% Io).

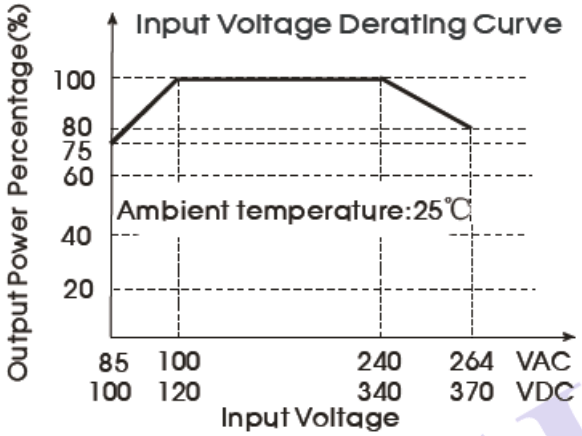

Diagram 6-3 Derating curve

6.6.2. Why does the mark of the products show 100VAC-240VAC while the datasheet shows 85VAC-264VAC?

Answer: This is mainly for safety certification purposes. When certification authority tests product performance, they will make the input voltage range on the mark fluctuate by +10% and -15%, so the common practice in the industry is to set the input voltage range of 100VAC-240VAC on the mark.

6.6.3. Why do the positive and negative voltages change when the load of AC/DC positive and negative dual output products is unbalanced?

Answer: AC/DC multi- output products generally apply single output feedback design. The output voltage without feedback will fluctuate when the output load is unbalanced. Most of our AC/DC positive and negative dual output products adopt negative output voltage feedback design, so a load imbalance will cause a change in positive output voltages.

6.6.4. Why does no voltage output or poor load capacity for LS01/03-R2 products during the tests?

Answer: LS01/03-R2 series are in compact size and there is no internal electrolytic capacitor for energy storage and filtering, so both the input and output terminals require external capacitors. Different external capacitance values are recommended for different output voltages. Please refer to the datasheet for specific models.

6.6.5. What is the possible reason for the surface temperature rise of the power module case?

Answer: The temperature rise of the power module case depends on the efficiency and loss of the module, and the surrounding environment temperature. Under the normal circumstance, the temperature for power module will remain stable within 30 to 60 minutes upon start-up. The temperature rise is continuously ascending in the earlier stage. If the power module is in a confined space without an effective heat consumption output, the environment temperature will keep rising due to the presence of the heating elements, which also causes the temperature rise of the module.

7. LED Drivers

7.1. What is the function of the resistor in analog dimming?

Answer: The resistor in analog dimming mainly serves the function of voltage division.

7.2. The output current declines a little after operating in a short period of time; can the module be used in this way?

Answer: The temperature of the module is not stable at the beginning of operation. As the temperature drift of the current-sensing resistor increases slightly, it is normal for the current to decline, provided that it does not exceed the value specified in the datasheet.

7.3. What is the function of the current-sensing resistor?

Answer: There is a current-sensing circuit in the module which can detect via a sampling resistor. The analog dimming function is realized by changing the resistance value of the sampling resistor; the greater the resistance is, the lower the dimming current will be. The sampling resistance for analog dimming cannot be too large or the output current will be extremely low.

7.4. How to use the functions of analog dimming and digital dimming?

Answer: For analog dimming, the output current is changed through voltage division using the external sampling resistor; for PWM dimming, the output current is changed by changing the duty ratio of the switching elements in the product via the control chip. It should be noted that it is normal for the driver to make noise during PWM dimming because the frequency of PWM dimming is within the range of human hearing (generally 20 Hz-20 KHz). It is recommended to set the PWM dimming frequency above 100 Hz in order to avoid the visible flicker of the LED.

7.5. What will happen if the input voltage is lower than the required output voltage? Is there normally a large surge current at the moment of start-up or shutdown?

Answer: The LED driver is a step-down product and the rated output voltage is 2V lower or more than the input voltage. It is not recommended to use the product when the input voltage is lower than the output voltage, otherwise oscillation will occur. There are surge currents when the module starts up or shuts down. It is recommended to apply suppression at the input terminal of the module (a series of small inductors or resistors can be adopted).

7.6. What are the recommended parameters of the input filter circuit in the datasheet*?*

Answer: C1 and C2 are ceramic capacitors of 2.2 μF; the inductor is FILTER2T; for electrolytic capacitors, RUBYCON can be used.

7.7. Can KC24RT analog dimming be achieved via DAC signal?

Answer: Yes. The current driving capability can be obtained at the same time; the voltage can be adjusted according to the customer's demands and resistors can be added at the output terminal

to achieve voltage division.

7.8. Why does the LED light flicker during PWM dimming when customers use the product?

Answer: It is interfered by the PWM signal; there is no interference filtering measure for the pin end of the PWM signal of the module. Customers are recommended to add a high-frequency bypass capacitor to the PWM pin; the on-off cycle of the LED is visible when the PWM dimming frequency is below 100 Hz.

7.9. What is the output current and service life of KC24RT?

Answer: The output voltage changes with the number of outputted LEDs. MTBF is 2 million hours, much longer than the service life of an LED light.

7.10. A customer complains that KC24AH-700 does not operate. The details are as follows: when KC24AH-700 is connected to DC power of 12V or 24V input with the back end being an open circuit, the output voltage is the same as the input voltage; when it is connected with a 3x3W LED bulb, the output voltage is about 3V and the bulb glimmers. Considering that the PWM pin is an open circuit, the customer tries to connect the PWM pin to 0V, but it does not work and the bulb still glimmers.

Answer: The input voltage is the same as the output voltage when the circuit is open. It means that the module is normal. All of the following are possible reasons why the output voltage of the module is only 3V when a 3x3W LED bulb is connected to the KC24AH-700:

1) The power of the bulb is 3W and the rated current may be 1.5A, but our output current is 0.7A, which cannot meet the customer's needs.

2) The customer may have connected three LED bulbs in parallel, leading to only 230 mA current in each circuit and the LED can operate normally. The output voltage is the voltage drop of the LED light, generally about 2-3V.

7.11. What should be noted when customers select LED driver models?

Answer: 1) Obtain parameters of the LED light used by the customer such as power, voltage drop, rated current, etc.; 2) Obtain the project. For example, how many bulbs are used? Are the bulbs in parallel or in series? For what are the bulbs used? Is the input voltage AC or DC? 3) Understand the environment in which the customer uses the bulbs and their requirements such as temperature, water resistance, price, etc.; 4) Our LED DEIVER is generally suitable for driving high-power LED lights, and are mainly used for streetlights, stage lamps, indoor lighting and automobile lights. They cannot be used for small decorative lights or mobile phone backlights.

7.12. What are the major input current specifications of LED lights in the market now?

Answer: There are different input current specifications for different diodes. Please check the

parameters from the manufacturers. There are commonly two kinds of ordinary SMD LEDs: 5 mA and 10 mA. The ordinary red-green LEDs are generally 10 mA and the white-blue LEDs are 20 mA. However, powered LEDs can be greatly different according to different powers. Normally, the power is 350 mA per W. For instance, the 1W LED is 350 mA and the 3W LED is 1,050 mA.

General service conditions:

5 mA and 10 mA: mobile phone backlights and SMD LEDs;

20 mA: decorative lamps and low-power landscape lights;

300-1,500 mA: street lights, large stage lamps, indoor lighting, automobile lights and high-power landscape lights.

7.13. What should be known about LED lights?

Answer: An LED (Light Emitting Diode) is a kind of diode, which can give out light of different colors when the electric current flows in the forward direction. A high-power LED is a kind of LED. Compared with low-power LEDs, a single high-power LED features much higher power, a brighter light and a higher price. The rated current of a low-power LED is 20 mA. Basically, LEDs with rated current over 20 mA can be regarded as high-power LEDs. The common powers are as follows: 0.25w, 0.5w, 1w, 3w, 5w, 8w, 10w, etc. The main unit of luminance is lm (lumen). The unit of luminance of low-power LEDs is generally mcd. These two units cannot be converted. At present, LEDs are widely used in automobile lights, flashlights and indoor lighting as an emerging green, environmentally-friendly and energy-saving light source.

At present, there are three criteria for the classification of high-power LEDs:

First, according to power, there are 0.5W, 1W, 3W, 5W, 10W to 100W, etc. The power varies with the total power of the finished products after packaging.

Second, according to the packaging process, there is large-size epoxy resin package, piranha-imitating epoxy resin package, MCPCB package, TO package, power SMD package and MCPCB integrated package.

Third, according to the degree of light failure, there are low light-failure high-power products and non-low light-failure high-power products.

7.14. What are the advantages and disadvantages of LED drivers compared with the traditional driver IC?

Answer:

Items	LED Driver	Traditional Driver IC
Peripheral circuit	Only connect with external filter capacitors	Seven external elements are required.
Dimension	High working frequency and small dimension	The operating frequency is relatively low and the dimension is slightly large.
Cost	Although the cost of a single driver is relatively high, it facilitates application and saves time and labor in design, so the overall cost is satisfactory.	Apart from the IC, seven peripheral elements should be purchased. Professional designers are also needed and the design cycle is long. The overall cost cannot necessarily be saved unless there is a large quantity demanded, in which the previous design cost can be offset.
Product protection	There are only modules and capacitors; the elements are not easily damaged.	All elements are open, so they can be damaged. If damaged elements fall on the circuit, the circuit may be damaged.
Requirements for customers	Customers do not need any design ability. They can put forward requirements and we will provide suitable modules after contacting only two manufacturers.	Customers need strong design ability. If the design is unreasonable, there may be problems with the reliability and efficiency of the product. It should contact five manufacturers.
Requirements for order quantity	There is no limit to the minimum order quantity. It can be purchased along with our supporting AC/DC modules; the delivery time is short; sometimes the products are already in stock.	There are minimum purchase volume requirements for all IC and electronic materials, with a volume ranging from 1,000 to 5,000 pcs. The delivery time is long, generally 6-8 weeks. If there are products in stock, they will be delivered in about four weeks. If the order quantity is large, the manufacturers may help to design the peripheral circuits.

8. IGBT Drivers

8.1. Selection

8.1.1. What are the differences among QP12W05S-37, QP12W05S-37A and QP12W08S-37? What are the differences between QC962 and QC962-8A?

Answer: QP12W05S-37, QP12W05S-37A and QP12W08S-37 are internally integrated IGBT drivers with isolated power supply; the supply voltage of QP12W05S-37 is 15V and the driving current is ±5A. The supply voltage of QP12W05S-37A is 12V and its driving current is ±5A. The supply voltage of QP12W08S-37 is 15V and its driving current is ±8A. There is no integrated isolated power supply in QC962 and QC962-8A. The driving current of QC962 is ±5A and QC962-8A is ±8A, and the protection threshold voltage of product can be adjusted.

8.1.2. How to select D1 in the recommended circuit?

Answer: (1) D1 is required a fast recovery diode but low reserve cut-off current, to avoid damaging the driver during reversion.

(2) The withstanding voltage should be larger than or equal to the withstanding voltage of IGBT; if the withstanding voltage is insufficient, two diodes can be applied in series to increase the withstanding voltage. However, it should be noted that this method will decrease the protection threshold voltage, the IGBT will easily in the protection state.

8.1.3. How to select gate resistance Rg in the recommended circuit?

Answer: The gate driving current can be adjusted through the gate resistance (Rg); and suitable gate resistance Rg should be selected to drive the IGBT. When the value of Rg is lower, the switching speed of IGBT will become faster and its switching loss will be also lower; when the value of Rg is higher, the collector voltage overshoot of IGBT will be lower and the switching noise will be also lower. Generally, the larger the volume of IGBT, the lower the Rg resistance value; on the contrary, for IGBT with low volume, it should increase the Rg resistance value. The following can be selected for the preliminary test:

Rated current of IGBT (A)	50	100	200	300	600
Range of Rg resistance (Ω)	10-20	5.6-10	3.9-7.5	3-5.6	2-3

Different IGBT modules may raise their own requirements, and adjustments can be made according to the recommended values in the datasheet. It should be noted that the minimum value of gate resistance Rg of QP12W05S-37 is 2.0Ω; when applying the IGBT module with gate resistance Rg lower than 2.0Ω, its maximum current will exceed 5A, which may cause damage to the driver.

8.1.4. Can the QA series be replaced with fixed input voltage converters as the driving power

source of IGBT?

Answer: It is not recommended because the IGBT driver provides driving current through two high- capacitance capacitors, while the capacitive load capacity of fixed input voltage converters is generally low; for the QA series with larger capacitive load capacity, lower isolated capacitance (10 pF) and higher isolated withstanding voltage (3,000VAC), it is suitable for the IGBT driver's applications.

8.1.5. For other issues about selection, Please see *Application Datasheet of Hybrid Integrated Gate Driver QP12W05S-37* (2012).

8.2. Product Application Issues

8.2.1. How is the driving capability of the IGBT driver?

Answer: The driving capability of IGBT is mainly determined by the following factors: instantaneous driving current, driving frequency and driving voltage. Our drivers can drive IGBT of 600V/600A, 1,200V/400A and 1,700V/200A under 20 kHz.

8.2.2. What power is required for IGBT drivers QP series?

Answer: The power of the power source of an IGBT is determined by the kind of IGBT and its driving power. In general, the power of the power source for IGBT drivers QP series is at least 2W.

8.2.3. Can pin 2 and pin 4 of QP-37 be put in common ground connection? Can pin 4 of QP be connected with the ground of IGBT?

Answer: The former two can be put in common ground connection in the single point grounding mode. The latter two can also be put in common ground connection, but the driving signal is not isolated from the ground in this way.

8.2.4. While using MORNSUN's IGBT driver QP12W05S-37A, it is observed that there is no IGBT at the back-terminal, but the output voltage remains 8V regardless of what signals are input. Why?

Reason: There are two reasons why the output voltage remains at a low level:

1) The high-level voltage of the input signal is too low, including under-voltage caused by insufficient power supply. Levels exceeding 3V-5V are regarded as high levels. Levels below 2V are regarded as low levels.

2) The peripheral circuit is not set correctly; for example, if pins 14 and 15 decrease, the output will drop to low levels. No connect of Pin 13 or high voltage will make the output drop to low levels and cause several sharp pulses.

Answer: There is no IGBT (i.e. Reason 2, no connect of Pin 13) so the protection signal is not

shielded (connect pin 13 with pin 9 through a 4.7K resistor). Therefore, the short circuit protection of IGBT can be shielded before testing the IGBT driver.

8.2.5. How to solve problems of unstable operating waveform of IGBT's gate, and generated unexpected heat of IGBT?

Reason: A gate resistor is not connected or an improper gate resistor is selected.

Answer: Connect the gate resistor; the larger the driving current is, the lower the resistance value should be. Eliminate gate oscillation: the recommended resistance value is 2Ω-10Ω and the power is 3W.

8.2.6. Are there any requirements for the driving signal of QP12W05s-37? Can it be driven with a single-chip machine?

Answer: The driving signal of MORNSUN's IGBT driver has a built-in high-bandwidth optocoupler which requires a driving capacity of 10-20 mA (typically 16 mA) and a voltage of 3-5V (typically 4.2V). If the voltage is too high, a current-limiting resistor should be connected to distribute the voltage, so the single-chip machine cannot be used for direct drive; the output current of the single-chip machine will be hard to reach or it will be easy to damage the single-chip machine. Under the normal circumstance, a bipolar transistor needs to be added for the PWM signal of the single-chip machine to amplify the signal and use it as the driving signal of IGBT; alternatively, a push-pull circuit can be used to amplify the signal.

8.2.7. What if incorrect protection occurs during IGBT driver debugging?

Reason: The reason for easily triggering protection of the driver is that the suppression duration of short circuit protection is too short and the control signal is disturbed.

Answer: 1) Increase the driving resistance value to decrease the driving current, or add a filter capacitor at the back end of driving resistor to buffer large driving currents, which can reduce the possibility of wrongly triggering the protection function.

2) Increase the suppression duration of fault protection. To prevent incorrect protection, the suppression duration should usually be increased, which means normalizing the circuit using a 10nF capacitor before decreasing it.

3) Improve the layout and connection to avoid disturbing the control signal. For the over-current detection signal of pin 13, take filtering measures; for example, add a 1 nF decoupling capacitor to prevent the wrongly triggering of the driver caused by peak interference during IGBT conversion.

8.2.8. The IGBT driver outputs low level when is powered by the driving signal with the power source. How can to solve it?

Reason: When the supply voltage is insufficient due to abnormalities in the power supply system,

and the driving voltage cannot meet the requirements for the saturation conduction of IGBT, the IGBT driver will be burnt out. Therefore, MORNSUN's IGBT driver is equipped with an under-voltage protection function which requires supplying power before issuing signals. If the power and signals are transmitted to the IGBT driver simultaneously, it is required to supply the low level first (the time is 2uS longer than the dead zone time), and then supply the high level after the power supply starts.

Answer: Supply power before giving signals, or provide low level (the time is longer than the dead zone time) before giving driving signals.

8.2.9. Why is the average current of the QA power source 80mA while the peak current of the QP and QC series is ±5A?

Answer: 'Average current' is the current when the power supply is operating normally, while 'peak current' is the instantaneous high current which is output after the IGBT driver is amplified; the duration of instantaneous current is on the uS level.

8.2.10. How to eliminate the influence of the Miller platform?

Answer: The Miller platform is the characteristic parameter of IGBT; the influence of the Miler platform can usually only be eliminated by increasing the driving current of the IGBT gate.

9. Isolated Transmitter

9.1. No Output Signal Issues

9.1.1. What will cause damage to the power section?

Cause a: The input voltage of power is too low to supply operating power for following circuit.

Answer: Check whether the input voltage of power is excessively low and below the minimum level given in the datasheet.

Cause b: The power's positive and negative polarities are inversely connected.

Answer: Check whether the power's positive and negative polarities are inversely connected.

Cause c: The input terminal may experience lightning strike, surge or voltage spike, which will make damage to the device.

Answer: Replace the product and add surge protection measures (for example, connect a TVS) to the power input terminal.

Cause d: The product's isolated distribution of power outputs the maximal current of 25 mA. Overloaded use for a long time will cause damage to the product's power section.

Answer: If a high-power isolated transmitter is required, another power supply is needed rather than take power from the output terminal of the power distribution of the transmitter itself.

9.1.2. What will cause damage to the signal input?

Cause a: Inconsistency between the actual inputted signal type and required input signal type of the product.

Answer: Check the design and identify the input signal type and the product's input signal type are inconsistent.

Cause b: Surge or voltage spike that may exist on the output terminal will damage the device.

Answer: Replace the product and add surge protection measures (for example, connect a TVS) on the power output terminal.

9.1.3. What will cause damage to the signal output?

Cause a: For products that output voltage, long-term short circuit at the signal output terminal will damage the internal components.

Answer: Check if there is a short circuit in the external output circuits.

9.2. Poor Accuracy Issues

9.2.1. If a customer's front input signal features rapid variable frequency such as sine wave and square wave signals. How to select?

Cause: Since the responsive frequencies for regular T_D modules are low, T_D module is

applicable in the isolation of regular direct current signals.

Answer: For sine-wave and square-wave signals, it is recommended to select a T_P module (the frequency response is 2K), or TP210 module (the frequency response is 10K).

9.2.2. How to confirm whether output impedance matches the product?

Cause: For current output products, the output impedance must be ≤500Ω for the active series, ≤300Ω for the passive series and >1KΩ for the voltage output series.

Answer: Decide the output impedance for the isolated transmitters according to the standard value in the datasheet, and the impedance should not exceed the value.

9.2.3. What if the product's driving capability is insufficient?

Cause: The input voltage range of a regular T-D module is ±5% and an isolator's is slightly wider. Low supply voltage will decrease the output accuracy and driving capability.

Answer: Keep the input voltage within the rated range.

9.2.4. Will electrostatic damage lead to poor accuracy?

Cause: An isolated transmitter is an electrostatic sensitive device, so the inner IC will decrease in accuracy when electrostatic damage occurs.

Answer: Strengthen electrostatic protection such as ESD and MSD protection in the production and storage.

9.2.5. Why is the signal output terminal not '0' when the signal input terminal opens its circuits, for voltage input products?

Cause: The signal input terminal of voltage input isolated transmitter is designed to be highly resistant with impedance over 10 Mohms. When the signal input terminal opens the circuits, the metal pin and its connecting wires work as an antenna that is likely to receive environmental noise. When it is reflected in the output terminal, it causes the signal output terminal not being 0.

Answer: Prevent the signal input terminal from opening the circuits, or connect a resistor of 100K to 300K in parallel on the signal input terminal to reduce the antenna effect.

9.2.6. In the application of the absolute value circuit, when the signal output is negative, voltage input products T_D still outputs -0.7V while T_P outputs 0. Why?

Cause: The voltage input product T_D is able to keep linearly outputting within the rated input range and receive a negative signal input of -0.7V, so it is still able to output -0.7V in the application of the absolute value circuit. In the case of the voltage input product T_P, it is able to keep linearly outputting within the rated input range but its negative signal clamp is less than -7mV. When the signal output is negative, it outputs almost 0.

Answer: In the application of the absolute value circuit, the voltage input product T_P is

recommended to produce a better absolute value effect. While conducting an application that calls for positive and negative signal input, the product T_CP or T_AP is recommended.

9.3. Withstanding voltage Issues

9.3.1. The customer application system requires withstanding voltage of 2,000VAC, but in the datasheet only DC voltage is available. How to solve?

Cause: The maximum AC withstanding voltage, for a same value in tests**,** is higher than that of DC..

Answer: Multiply the AC withstanding voltage by 1.4 times to obtain a corresponding DC withstanding voltage. The calculated DC voltage is available as long as it is lower than the product's requirement.

9.4. EMC Issues

9.4.1. Why is there certain probability of damage when detecting the output voltage of a high voltage power supply with T6640D?

Cause: When switching on the power supply, there is certain surge voltage that damages the module.

Answer: It is recommended to add EMC protective circuits in the input terminal of the module and implement similar protection measures at the power supply ports.

9.4.2. Why the T6630CP is burnout?

Cause: The voltage has no protection when detecting the motor, which will generate much surge and group impulse interference and damage the product

Answer: It is recommended to add EMC protection to the output terminal of the module. Please consult FAE for recommended circuit.

9.4.3. When a customer connects a 2-meter signal line from the outside to an instrument with a T1100L module, is it necessary to add a protective circuit, e.g., a lightning protective circuit?

Cause: 'Withstanding voltage' usually refers to the voltage value that the input and output can withstand over a relatively long period of time, while 'surge' refers to differential mode interference added between inputs, or common mode interference from the input line to the ground. An EMC circuit is recommended.

Answer: it is recommended to use the lightning protective circuit T1100L, and give a withstanding voltage of the product after carrying the circuit.

9.4.4. Some customers complain that module products as T1630D perform unsatisfactorily in terms of anti-electrostatic. Is there any standard about it?

Cause: When selecting some T1630D products implementing electrostatic tests against them (contact discharge of 6KV and air discharge of 8KV), it has found that they passed the tests. In most electrostatic accidents, the products are not immediately broken down but damaged, so the testing results are not directly reflecting their performances.

Answer: I. Anti-electrostatic measures should be strengthened. Now that the enhancement programs of ESD and MSD have been improved, better conditions are expected in this respect. II. Customers should take appropriate protection steps to reduce damage caused by ESD. III. Another reason for the product damage of the customer is surge. Based on the consideration of volume and cost, the module doesn't equip with so many protections like safety barriers. The module itself is less resistant to the surge, so the customer should provide relevant surge protection.

9.4.5. Is it permissible to add certain peripheral circuits to a T1100 product to be a safety barrier?

Answer: If the Zenner diode is served as safety barrier, circuits are recommended. However, it is impossible to implement an isolated barrier.

9.4.6. How about the performance of isolated transmitters in anti-electromagnetic interference?

Cause: With their existing circuit schemes, our products are not in fact applicable to high magneto-gravitational environments. However, the isolated efficiency can be high by using magneto-electric isolated techniques in the environment.

Answer: Customers are recommended to adopt shielding or refrain from using magneto-electric isolated products.

9.5. Temperature Rise Issues

9.5.1. What is the temperature rise of T6135D?

Answer: When T6135D operates at ambient temperature for an hour, the maximum temperature is 50°, increased by 25°**.**

9.6. Extensive Connection Issues

9.6.1. Can TA600-25 be connected with 8 inverters at the same time?

Answer: The load capacity of TA600-25 is equal to a resistance of ≥1KΩ. Thus, the input impedances of 8 inverters in parallel should be greater than 1K, i.e., each of analog input impedance should be greater than 8K.

9.6.2. Can TE650CN be used to replace TE6650N?

Answer: The two products' pins are incompatible with each other and **T**E6650N has a higher accuracy and more pins. If there is no zero-point and full-scale adjustment and lower requirement for accuracy, TE6650CN can replace TE6650N. The same goes for TExxxxN and TExxxxCN.

9.6.3. How to use the zero-point and full-scale adjustment of TE and TF products? What should be done when it is not in use?

Answer: According to the recommended methods explained in our datasheet, it is used along with an adjustable resistor. When it is not used, the customer can simply suspend it.

9.6.4. Is it permissible to add a capacitor filter to the signal output terminal to reduce the noise of the output signal?

Answer: It is not permissible because adding a capacitor will reduce the bandwidth of the signal; thus, when the capacitance exceeds a certain level, it will cause an output signal oscillation that will fail the whole system. It is recommended to connect RC in series to the filter.

9.6.5. The output of isolated transmitters as TE6644N is not 0V when there is no input. Is this normal?

Answer: It is normal. When the input is highly resistant (≥10MΩ), static electricity will accumulate on the input capacitance. Since the input voltage could be any value, the output can also be any value. If it is necessary to keep the value of the output at 0V when suspended, it is recommended to add a pull-down resistor of 100KΩ-300KΩ to the input terminal.

9.6.6. If an isolated transmitter is intended to acquire multi-output signals with several modules, how to connect, in series or in parallel?

Answer: Connect, in series for voltage signals and in parallel for current signals.

9.6.7. How to confirm quickly the signal collection module according to a customer's requirements?

Answer: In customers' application TE series are recommended for collecting signal. For a system outputting analog signals, TF series are recommended. If it's a two-wire system and requires isolation, T1100L/T1100L-F/HK series are recommended. Please refer to the application scheme introduced by FAE for more detailed information.

10. Photovoltaic Power Converters

10.1. Which PV products does MORNSUN offer for customers to select?

Answers: Currently, the specifications of the PV products produced by MORNSUN include the following ranges**:**

PV05-27Bxx/PV10-27Bxx: 5W/10W, input voltage: 200V-1,200VDC, dimension: 74*52*28 (mm), case material: aluminum

PVxx-27BxxR: 5W/10W, input voltage: 200V-1,200VDC, dimension: 74*52*28 (mm), case material: aluminum

PVxx-27BxxR2: 5W/10W/15W, input voltage: 100V-1,000VDC, dimension: 70*48*23.5 (mm), case material: black flame-retardant and heat-resistant plastic (UL94-V0)

PV15-27Bxx: 15W, input voltage: 100V-1,200VDC, dimension: 70*48*23.5 (mm), case material: black flame-retardant and heat-resistant plastic (UL94-V0)

PV40-27Bxx: 40W, input voltage: 200V-1,200VDC, dimension: 89*63.5*25 (mm), case material: black flame-retardant and heat-resistant plastic (UL94-V0)

PVxx-29Bxx: 15W/40W, input voltage 200V-1,500VDC, dimension: 125*75*40 (mm), case material: black flame-retardant and heat-resistant plastic (UL94-V0)

PVxx-29BxxL: 15W/40W, input voltage: 200V-1,500VDC, dimension: 105*85.5*30 (mm), case material: black flame-retardant and heat-resistant plastic (UL94-V0)

PV45-29Bxx: 45W, multiplexed output, dimension: 144.5*105*40 (mm), case material: metal, encapsulation form: lead in wire encapsulation

10.2. What are the differences between MORNSUN's PV15-27Bxx and PV15-27BxxR2?

Answer: The differences between PV15-27Bxx and PV15-27BxxR2 are as follows:

Difference in temperature range: working temperature range of PV15-27BxxR2: -40°C to +70°C; working temperature range of PV15-27Bxx: -25°C to +70°C.

Difference in input voltage: input voltage range of PV15-27BxxR2: 100V-1,000VDC; input voltage range of PV15-27Bxx; 100V~1,200VDC.

Certification difference: PV15-27BxxR2 obtains EN62109 certification for photovoltaic products, while PV15-27Bxx obtains no such certification.

In addition, as the R2 generation is at a favorable price, if a customer's input voltage is 100V-1,000VDC, R2 Generation PV products are recommended.

10.3. What are the differences among MORNSUN's PVxx-27BxxR2, PVxx-29Bxx and PVxx-29BxxL?

Answer: The differences among PVxx-27BxxR2, PVxx-29Bxx and PVxx-29BxxL are as follows:

1) Difference in input voltage range: input voltage range of PVxx-27BxxR2: 100V-1,000VDC; input voltage range of PVxx-29Bxx: 200V-1,500VDC; input voltage range of PVxx-29BxxL: 200V-1,500VDC

2) Difference in dimension: dimension of PVxx-27BxxR2: 70*48*23.5 (mm); dimension of PVxx-29Bxx: 125*75*40 (mm); volume of PVxx-29BxxL: 105*85.5*30 (mm)

3) Certification difference: PVxx-27BxxR2 and PVxx-29Bxx obtain EU EN62109 certification for photovoltaic products, while PVxx-29BxxL obtains no such certification.

4) Difference in temperature range: working temperature range of PVxx-27BxxR2 and PVxx-29Bxx: -40°C to +70°C; working temperature range of PVxx-29BxxL: -25°C to +70°C.

10.4. What advantages and characteristics do MORNSUN's PV power supplies have?

Answer: Green and environmentally friendly, meeting RoHS demands.

Superior performance: The products possess an ultra-high wide input voltage range and wide working temperature range, high insulation, high efficiency, low ripple & noise, and multiple protection functions including OVP, SCP, OCP, UVP and input anti-reverse connection protection; Available packages are PCB mounting, chassis mounting and DIN-Rail mounting.

Safety and reliability: With a wide working temperature range, PVxx-27BxxR2 and PVxx-29Bxx can meet temperatures ranging from -40°C to +70°C. The products possess multiple protection functions including OVP, SCP, OCP, UVP and input anti-reverse connection protection, and can meet insulation withstanding voltage at a maximum of 4,000VAC. The bare product can meet electrostatic demands at Contact ±6KV/Air ±8KV, and possesses excellent EMC performance.

Meeting export requirements: PVxx-27BxxR2and PVxx-29Bxx meet EU EN62109 standard.

10.5. What certification standards do MORNSUN's PV power supplies comply with?

Answer: All PV power supply supplies from MORNSUN are environmentally friendly products which meet RoHS demands.

PVxx-27BxxR2 and PVxx-29Bxx series products comply with CE certification. Certification standard: EN62109.

10.6. Do the PV power supplies from MORNSUN support connection in series?

Answer: The PV power supplies from MORNSUN support connection in series, but the lowest output voltage of products connection in series is viewed as the output voltage required by the entire system. Moreover, to prevent the possibility of the series-bound power supply causing damage to the internal capacitors when starting up, it is recommended to connect a diode at the output terminal. Please refer to the *Guide Selection* for details.

10.7. Do the PV power supplies from MORNSUN support connection in parallel?

Answer: Similar products in the industry doesn't **s**upport connect in parallel. Otherwise, the

product with higher voltage will generate the majority or all power consumption when two products have different output voltages. It is recommended to choose distinctive products providing a parallel connection function.

10.8. How to choose fuses for MORNSUN PV power supplies?

Answer: The input voltage of the PV power supplies is high voltage up to 1,500V. A high voltage fuse should be chosen. Customers can determine the corresponding fuse depending on the usage and design of the products. Please refer to the selection recommended in the datasheet.

10.9. How to clean MORNSUN's PV power supplies?

Answer: When PV power supplies are installed into customers' systems, cleaning steps may be involved. There are two kinds of cases for our PV power products, a metal case and a plastic case. Chemical reactions will occur when corrosive cleaning fluid is applied, which can lead to the deterioration of the product's appearance. Therefore, customers are recommended to use alcohol for simple cleaning rather than carrying out soaking operations.

10.10. How to design the periphery EMC of MORNSUN's PV power supplies?

Answer: PV power supplies are mainly used in high voltage applications where is harsh**,** including photovoltaic power generation, high-voltage inverters and SVG. In practical application, it is recommended to add a must electric protective circuit. For example, if solar array panels are placed outside or even in the Gobi Desert, the system will easily sense strong interference and this can influence the stability of the system and even lead to the breakdown of the product. Please refer to the corresponding section of the datasheet for detailed recommendations.

10.11. What is the working temperature range of MORNSUN's PV power supplies?

Answer: PVxx-27BxxR2 and PVxx-29Bxx can meet working temperatures ranging from -40°C to +70°C, while PV45-29Bxx can meet -40°C-+85°C. Other PV series can meet working temperatures ranging from -25°C to +70°C. Under some circumstances, customers need to conduct power derating on the basis of the actual working temperatures. Please refer to the product model section of the datasheet for detailed contents of the derating curve.

10.12. Is customization acceptable for MORNSUN's PV power converters special for SVG?

Answer: Various kinds of outputs customization is acceptable.

10.13. Are MORNSUN's PV power converters specialized for SVG influenced by load imbalance?

Answer: Internal design has been conducted for our PV power converters special for SVG, removing the troubles of customers' load imbalance. Even if load imbalances occur, the precision of the two voltages can be guaranteed within ±2%.

10.14 Can the PCB bases of all modules be offered to customers?

Answer: The PCB bases of MORNSUN's power modules can be decoded and sent to our customers. The corresponding PCB bases are provided based on the models required by customers instead of sending all bases together. However, customers should inform whether they use drawing software Altium Designer. If not, our bases will be useless even though we provide them.

10.15. What problems would occur and how to solve them if the front-terminal input voltage of PV15-27B24A4 is lower than 200V?

Answer: As there is no under-voltage protection for PV15-27B24A4, corresponding design allowances are calculated. When the input voltage is lower than but close to 200V, the output voltage will remain at 24V. If the input voltage is even lower, the output voltage will become unregulated. Customers are recommended to use products within the setting range.

10.16. How long will the service life of PV15-27B24A4 be if it works at an environmental temperature of 75 degrees?

Answer: In addition to working environment temperatures, service life also depends on the actual working voltage and working load. The delegating tests can be carried out based on the actual application of customers. The quality department will calculate the MTBF values.

11. Charging Source

11.1. MBP series are used in an automated system of electric distribution network. Whether they passed the formal verification of the Electricity Power Research Institute or applied by other customers in batch?

Answer: All the parameters of MORNSUN's MBP series comply with standard DL/T721-2013 of the distribution network automation industry, and the reports meet such standard foundations as GB/T 7261-2008 Fundamental test approach of relay protection and security automation equipment, IEC 61000-4-18: 2006+A1: 2010 Susceptibility test of damped oscillation, DL/T721-2013 Distribution automation remote terminal units and so on.

11.2. MBP series adopt constant current to charge the storage batteries, but MORNSUN plans to use a super capacitor as a backup unit due to the lifetime of storage batteries. Can the MBP series charge it?

Answer: In the design process, MORNSUN developed the MBP series based on related electric power and electric network standards. If the input alternating current fails, the backup power supply will reach a seamless switching state, thereby making a certain parallel connection between the load output circuit and the charging circuit. When the storage battery starts to charge, the charge is not 0 (when the energy of a 24V storage battery is low, the voltage is about 23V), but the energy storage of a super capacitor is calculated at maximum voltage and the charging voltage is 0V at first. Charging with MBP series will lower the output circuit and make the back-end control unit break down, which will cause poor start-up.

11.3. Can MBP series meet the standby power consumption requirements of FTU and DTU?

Answer: There is an active PEC circuit in the internal design of our MBP series to ensure relatively high work efficiency in all kinds of light load conditions. The input of the MBP300 series is less than 15VA when the standby power consumption of the system is 7W, and less than 25VA when it's 14W. The input of MBP500 series is less than 25VA when the standby power consumption of the system is 14W, and less than 40VA when it is 20W. While these indicators are given in the datasheet, actual tests of the products show better results. Customer requirements can be perfectly met.

11.4. The maximum instantaneous loads listed in the datasheet for MBP series are 13A/30S, 20A/30S, 10A/30S, but the standard usually requires 10S. Is there any over-design? What happens if it exceeds 30S? Can the product recover itself quickly?

Answer: Instantaneous high-power load only occurs when FTU and DTU executive devices operate. As the test standard of the power network usually requires instantaneous states to last for 10S, its

duration is only on the millisecond scale. Since some problems may occur on some devices such as charging time, over-high instantaneous current etc. due to variance among different batches when customers' apply MBP series products, MORNSUN has guaranteed adequate time capacity. What's more, the actual-designed millimeter-scale instantaneous high current of the MBP series is a recessive parameter which perfectly meets the actual needs, aiming to prevent the executive devices from failing to operate.

11.5. The instantaneous high current for MBP series is 30S as listed in the datasheet. What would happen if the duration was no more than or exceeded 30S?

Answer: If normal load recovers and the product will maintain the normal output when the instantaneous high current is constantly less than 30S. If it lasts for more than 30S, it indicates that the executive devices are deficient, and the product will enter into an overload protection state which will last for about 5 minutes and then recover itself. If the high current lasts for over 30S after recovery, it means that the deficiency has not resolved and the products will enter into production again. Circular inspection will last until the product recovers itself. The protection time design is mainly to improve the reliability during continuous circular protection preventing the overheating damage of the products and ensure intervals to protect the frequent action of the executive devices.

11.6. What is the over-current protection of MBP series?

Answer: When the instantaneous over-current of a product exceeds its protection point, it will enter an over-current protection state for about 5 minutes. Then it recovers and restarts itself, and maintains a normal output if the deficiency is resolved, or else it will remain in a circular protection state. If the instantaneous over-current does not exceed the over-current point and falls within the instantaneous high power range, it will remain in an instantaneous high power overload protection state.

11.7. What are the differences between the under-voltage alarm point and cutoff point of MBP series?

Answer: When there is no input alternating current in the products but the storage battery is charging as backup electric power, the battery will keep discharging; when the electric quantity declines to the alarm point, a notice signal will be sent through the alarm node so that customer can be informed in time and take action. If the customer ignores this alarm, the electric quantity of the battery will continue to decline after the continuous discharge of the storage battery; when it declines to the cutoff point, the output will be automatically cut and the product will enter a standby state, and when the alternating current comes it will be automatically cut and charged.

12. EMC Filters

12.1. Selection Issues

12.1.1. How to select EMC filters?

Answer: EMC filters are selected according to the following main parameters:

EMC standard: EMC filters are selected according to the EMC standard to be protected, such as EMI or EMS. MORNSUN currently offers EMI filter, EMS filter and EMC filter, which are identified according to the naming rules.

Input voltage: Input voltage is divided into AC and DC, and the appropriate filter is selected on the basis of the input voltage type. A general AC filter can be applied to an AC circuit and DC circuit, but a DC filter cannot. Meanwhile, it should be selected according to the input voltage value.

Filter power and current: EMC filters are divided into active and passive filters. The active filter is distinguished by power while the passive filter is by the current. The appropriate selection cannot exceed the maximum power or current of the filter, and this is mainly due to the power handling of the active devices or current withstand of inductance.

12.1.2. Is an EMC filter the same as the recommended circuit? What are its specific features?

Answer: EMC filters are divided into AC/DC filters and DC/DC filters. The circuit structure of the AC/DC filter is similar to that of the EMC recommended circuit in the AC/DC datasheet. Although the specific parameters are different, the protection functions are the same, which can both provide EMI filtering and EMS protection. What's more, the standard requirements in the datasheet are met; the DC/DC filter mainly differs from the EMC recommended circuit in the DC/DC datasheet in configuration. Most DC/DC filters are active filters while EMC recommended circuits are passive filters, but they have the same functions which can be both EMI filtering and EMS protection, and they meet the standard requirements in the datasheet.

12.1.3. Why does the EMC filter of MORNSUN come in plastic case while those of other companies in metal case? What is the difference?

Answer: The EMC filter developed by MORNSUN is mainly matched with the Company's power supply test to meet the corresponding EMC standards. In the case of EMC standards, plastic case is cheaper than metal one in cost. However, the difference between them is that the former has better insulating properties but worse shielding effectiveness and force resistance than the latter. The latter has better conductivity, allowing it to maintain a good rounding effect, and better shielding effectiveness and force resistance but worse insulating properties than the former. In fact, as long as it can pass the corresponding EMC test standards, both cases can be selected. However, if there are considerations except above, the selection should be comprehensive.

12.1.4. Is there a filter suitable for the non-isolated K78 series? If not, are there any plans to develop one?

Answer: MORNSUN currently has neither a matched EMC filter for the non-isolated K78 series nor any corresponding development plans. The main reason is that a non-isolated power supply is generally a secondary power supply with AC/DC switching power supply in the input terminal and low interference in the output terminal, which can be immediately solved with a simple TVS and capacitance separator. If the customer requires an EMC recommended circuit, please refer to the EMC recommended circuit section of the datasheet.

12.1.5. How to select EMC recommended circuit component?

Component Type	Domestic Brand	Foreign Brand
MOV	Guangzhou New Volt, Taiwan Thinking	TDK, Littelfuse
X Capacitor	Taiwan Hua Jung	TDK
Y Capacitor	Walsin, Dongguan Qiya	Murata
DM Inductor LDM	Shenzhen Kedajia, Taiwan ABC	TDK, Murata
CM Inductor LCM	Shenzhen Kedajia, Taiwan ABC	Pulse, TDK
NTC	Shenzhen Anpeisheng, Guangzhou New Volt	TDK, Murata
PTC	Shenzhen Anpeisheng, Guangzhou New Volt	TDK, Murata
Gas Discharge Tube	Taiwan BrightKing, Taiwan Thinking	TDK
Winding Resistance	Yageo	--

12.1.6. How to select CM inductors?

Answer: CM inductors are mainly selected according to the inductance value, impedance property and current. In terms of the voltage type design, in general, AC/DC requires a high inductance of several mH to dozens of mH, such as FL2D-30-102 to FL2D-Z5-223; DC/DC requires an inductance of several μH to several mH, such as FIERTER2/T and FL2D series. In terms of impedance character design, use high inductance to filter for low-frequency noise and low inductance to filter for high-frequency noise. In terms of material design, manganese zinc is used for low-frequency filtering while nickel zinc is for high-frequency filtering.

12.1.7. Why is the DC/DC active filter so expensive? What is the difference compared with other passive filters?

Answer: The DC/DC active filter (with power as an indicator) has internal integrated active equipment (MOSFET). It has provided not only normal EMC protection filtering but also the functions of long-term input over-voltage and input anti-reverse, while other filters are composed of passive equipment and lack of long-term input over-voltage function. Although the cost of the active filter is high, it is multi-functional.

12.2. Datasheet Issues

12.2.1. What are the functions of the EMC recommended circuit components in the AC/DC datasheet? Can the components be reduced during design due to limited customer's system in size?

Answer: As shown in the diagram below, the functions of each part of the components are as follows: MOV1 (varistor) is mainly used for lightning surge protection; the LC filter composed of CX (X safety capacitor) and LDM (DM inductor) is used for EMI low-frequency filtering, and can play a supporting role in surge; and the LCM filter circuit composed of LCM (CM inductor) and CY (Y safety capacitor) is mainly used for EMI high-frequency filtering, and plays an important role in pulse group suppression. The circuit is mainly matched with the Company's power supply test to meet the EMC standard requirements in the datasheet. If the size of the customer's system is limited, it is not recommended to reduce the number of components to meet the same EMC level requirements, as it can cause an unsatisfactory level of risk; if the level is reduced, according to the standards, it is recommended to appropriately reduce the EMI components.

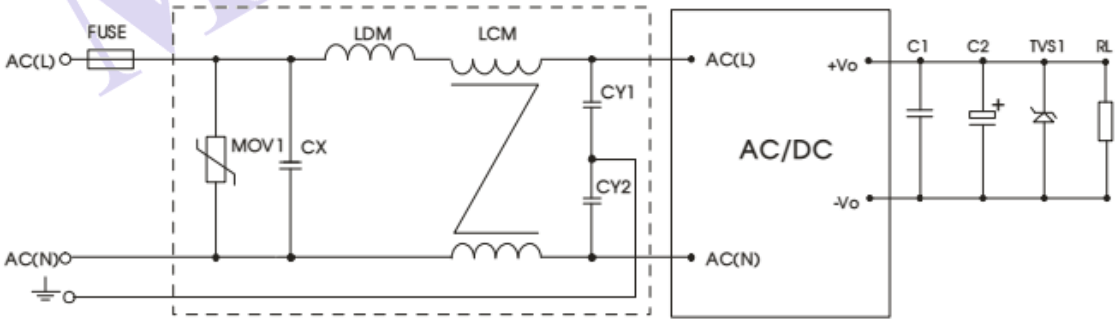

Diagram 12-1 AC/DC EMC recommended circuit

12.2.2. What are the functions of the EMC recommended components in the DC/DC datasheet?

Answer: The following circuit diagram is divided into two parts: ① is mainly used for EMS protection and is also important for lightning surge protection, while ② is used for EMI filtering. An LC filter circuit composed of C1 (ceramic capacitor) and LDM1 (DM inductance) is used for EMI low-frequency filtering, and CY (Y safety capacitor) is used for EMI high-frequency filtering.

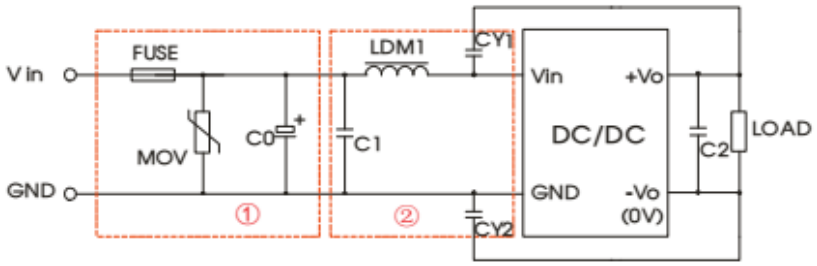

Diagram 12-2 DC/DC EMC Recommended Circuit

12.2.3. What EMC filters suffixed with -RIA are? How do they differ from other filters?

Answer: The EMC filters suffixed with –RIA are EMC filters specially designed for British railway industry to meet the requirements of standard RIA12. The main difference between filters suffixed with –RIA and others is that the former meet the requirements of 3.5 times input over-voltage 20mS in the RIA12 standard while the latter do not.

12.2.4. What are the differences among the FCC standard, 3C standard and CE standard?

Answer: FCC certification is mainly for the US market and adopts EMI standard, and FCC Part 15 is the most common one. 3C certification refers to China's mandatory certification. Domestic switching power supply does not have mandatory certification requirements, but mainly for equipment certification requirements. CE certification refers to EU certification, including safety standards and EMC such as EN60950 safety certification requirements and EN55022/EN55024 electromagnetic compatibility EMI and EMS certification. The EMI limits in terms of FCC, 3C and CE are equivalent, and general products meeting CE can also meet FCC and 3C certification except under special circumstances.

12.3. Conducted Emission Failure Issues

12.3.1. Why does the conducted emission fail to meet the requirements in the datasheet after using our power supply products and carrying out the EMC recommended circuit design? How to analyzes and solve it?

Answer: 1. The interference signal has been filtered after passing the periphery, but some are directly sent to the front-terminal of the periphery, resulting in secondary interference (namely, crosstalk interference and free-space coupling) which can be caused by metal case and incorrect connection. 2. The recommended circuits of the customers are incorrect, or else the device selection is wrong.

Solution: Remove the recommended circuits and put them in front of the metal case. It will be immediately observable whether the situation has improved. It should optimize the layout and strengthen the filter wave.

12.3.2. What are possible reasons and corrective measures for exceeding the low-frequency standards (≤1 MHz) while performing a conducted emission test on a customer's system with our power supply?

Reasons: The possible reasons for exceeding the standards of a conducted emission test are as follows: (1) the power supply itself can meet the requirements; (2) there is no differential mode filtering circuit on the input terminal; (3) incorrect selection of the filter devices; (4) there are unrolling methods in the layout of the filter circuit; (5) over standard of low frequency caused by CM noise; (6) filter circuit structure problems.

Answer: First, ensure whether the power supply itself can meet the requirements of the test standards; if not, add the relevant filter circuit on the power supply port as per the recommended circuit and parameters in the datasheet. The selection of devices should be based on the recommended parameters in the datasheet as closely as possible, and the circuit layout should be kept in a straight line. If the requirements still cannot be met after taking all the above measures, alter the structures and parameters of the circuit, exchange the positions of the differential mode devices and filter the CM inductor or Y capacitor.

12.3.3. What are possible reasons and corrective measures for exceeding the high frequency standards (≥5 MHz) while performing a conducted emission test with our power supply?

Reasons: The high frequency exceeds the standards in a conducted emission test. The possible reasons are as follows: (1) the power supply itself can meet the requirements; (2) there is no CM (high frequency) filter circuit; (3) incorrect selection of filter devices; (4) there are unrolling methods in the layout of the filter circuit; (5) incorrect filter circuit structure; (6) problem of ground connection.

Answer: First, ensure whether the power supply itself can meet the requirements of the test standards; if not, add the relevant filter circuit on the power supply port as per the recommended circuit and parameters in the datasheet. The selection of devices should be based on the recommended parameters in the datasheet as closely as possible, and the circuit layout should be kept in a straight line. If the requirements still cannot be met after taking all the above measures, apply a magnetic bead to the input line; if it passes, alter the structures and parameters of the filter device circuit and the parameters of the CM inductor, or apply a multi-level filter circuit.

12.4. Radiated Emission Failure Issues

12.4.1. Why does radiated emission fail to meet the requirements in the datasheet when the customer uses our power supply and design as per the EMC recommended circuit? What is the solution?

Reasons: Some reasons for radiated emission failing to meet the requirements are as follows: (1) the structures and parameters of the filter devices are quite different from those of products recommended by MORNSUN; (2) the layouts of the filter devices are incorrect, existing U-shapes or unrolling cable routes; (3) the power supply lines or signal of the internal system is so long that it causes coupling noise; (4) poor ground connection.

Answer: First, make sure the EMC standard of the power supply itself can meet the test standards of the customer; if not, customers can select a module with a higher level or add an appropriate external circuit. Please refer to the recommended circuits and parameters in the datasheet. Test the filter module or circuit outside of the system, thereby excluding the irrationality of the layout of the filter devices; if it is ok, re-adjust the layout of the filter devices. For the coupling noise of the power supply lines or signal of the internal system, a magnetic bead or shield can be applied to the lines.

12.4.2. When the customer uses power converters and the front-terminal also adopts the protection filtering design as per the MORNSUN's recommended circuits, what are the possible reasons and corrective measures should be taken to solve the problems such as the occurrence of bread-shape or wave peak while testing radiated emission (RE) in the frequency range of 30MHz-300 MHz ?

Answer: If it exceeds 30MHz-300MHz, the wave shape will be like bread-shape or wave peak, which is generally caused by power supply noise, but is largely related to the structure, ground connection and internal signal line of the system. To resolve this situation, a CM inductor (Ni-Zn filters high frequency and Mn-Zn filters low frequency) and Y capacitor can be added to the input terminal, a magnetic bead or shield applied to the power supply line or signal **line**, and a CM inductor filter added to the output terminal of the power converter.

12.4.3. When the customer uses power converters and the front-terminal also adopts the protection filtering design as per the MORNSUN's recommended circuits, what are the possible reasons and corrective measures should be taken to solve the problems such as the occurrence of wave peak or glitch while testing radiated emission (RE) in the frequency range of 30 MHz-1 GHz?

Answer: The main noise source for the occurrence of peaks and glitches during a radiation test is the work frequency of the system, such as the crystal oscillator. However, the antenna is the ground line, power supply line and signal line (cables, etc.) of the inner system. To resolve such failures, the following measures can be adopted: (1) apply a magnetic bead or use shielding line on the signal line; (2) add a CM inductor filter or magnetic bead to the input port of the power supply;

(3) add an RC filter circuit to the clock signal line to slow the elevation of the signal; (4) use the spread-spectrum technique.

12.5. Surge Susceptibility Failure

12.5.1. What are possible reasons and corrective measures for the occurrence of restarting when the customer conducts a differential module surge test of the complete machine using our power converters?

Answer: The restarting of the differential module is generally caused by the power down of the power module, which is ordinarily caused by an insufficient energy supply resulting from the negative pressure of a surge. AC/DC Converters does not display this power down phenomenon in general, but the wave shape of the output voltage must be checked. The power down of DC/DC products can be solved by adding a counter-attack diode and enlarging the absorbing inductance to ensure a sufficient energy supply.

12.5.2. What are possible reasons and corrective measures for the occurrence of system breakdown when the customer conducts a differential module surge test of the complete machine using our power converters?

Answer: When the module breaks down during differential module surge test, it should distinguish whether it is module and non-module. If it is a module, it is generally caused by insufficient protection; check whether the protection is appropriate according to the recommended circuit, including the implementation of proper current limiting protection with thermistor or resistor after applying pressure sensitive element Non-module's breakdown is generally caused by the insufficient protection of the other parts of the system, so protections are needed for parts that are breaking down. It is suggested to select a varistor according to their working voltage. The selection can refer to the maximum working voltage of the varistor.

12.5.3. What are possible reasons and corrective measures for the appearance of restarting without system breakdown when the customer conducts a differential module surge test of the complete machine using our power converters?

Answer: The crash or restarting of system during a CM surge test is a normal phenomenon, but the products during the differential mode surge test are normally damaged. This is because the protection of the CM surge mainly depends on the insulation properties of the power module and the anti-interference performance of the customer's system. A little current leakage in the surge test passes through the Y capacitor to the output terminal and influences the system. In this case, the system should generally be optimized and its anti-interference properties enhanced due to the high cost of decreasing the current leakage. If the low voltage terminal (such as the 5VDC of the

power supply output and all following circuits) of the customer's system has no requirements for withstanding voltage in the protected area, it can be directly short connected to the ground or adopt a voltage dependent resistor to connect it to the ground. The voltage of the voltage dependent resistor can be lower, and 7D560 is recommended. If the low voltage terminal has a requirement for withstanding voltage in the protected area, the layout must be optimized to prevent the influence of the CM surge loop on the system, or copper foil adopted as shielding between the low voltage terminal and the protected area (generally a metal case) with the shielding layer connected to the negative pole of the low voltage terminal.

12.5.4. What are possible reasons and corrective measures for the occurrence of system breakdown when the customer conducts a CM surge test for the complete machine using our power converters?

Answer: There are two reasons for system breakdown in a CM surge test: first, poor susceptibility causes the failure of the insulation and finally leads to the breakdown; and second, poor susceptibility of the customer's system which can easily be damaged by the CM leaks current (see 12.5.3). In the first case, it's suggested to decrease the capacitive value of part of the low voltage terminal to the protective grounding and ensuring sufficient distance and no possibility of sparking or electric arcs. The solution for the second case, given in 12.5.3, is an aggravation of the restarting described in 12.5.3. The specific situation is related to the customer's system.

12.6. EFT Failure Issues

12.6.1. During the EFT test of a customer's system, why does the system emit sound and how to solve it?

Answer: The sound is caused by high voltage, inadequate distance, ignition and arc discharge. Check which part has arc discharge (arc light). Generally, the electric arc may exist in the CM inductor winding or is caused by the insufficient distance between PCB routing and case. If the CM inductor has arc discharge, it is recommended to reduce the winding layer of the CM inductor or add a varistor between the initial line and wire collection of the winding. 7D471K is recommended. If the part similar to the PCB routing and case has arc discharge, it is recommended to increase the distance between the initial line and the case.

The distance should be greater than 4 mm. Alternatively, adding an insulation barrier and gummed paper between them.

12.6.2. During the EFT test of a customer's system, why does the system restart and how to solve it?

Answer: There are two reasons for this: either the power module is off or the power module works well but the system (generally a single-chip CPU) experiences interference. First, it is necessary to confirm whether the power module is off. If it is off, a CM inductor and ground capacitor Y can be added to the front-terminal (typical combination 1 mH +1 nF). If the system experiences interference, a CM inductor filter can be added between the output terminal and the CPU; alternatively, identify the pin experiencing interference (generally the reset pin) and add a capacitor filter (typical value: 1 nF) to the negative pole of the CPU's power supply.

12.6.3. During the EFT test of a customer's system, why does the LCD screen flicker or display messy code, and how to solve it?

Answer: The signal control line between the CPU and the LCD screen is experiencing interference. On the pin close to the LCD screen, add a capacitor filter (typical value: 10 pF-1 nF) to the ground, or shield the input terminal from the LCD screen.

12.6.4. During the EFT test of a customer's system, why does the sample data surpass the given standard and how to solve it?

Answer: The collected data is experiencing interference and noise is created. On the sampling terminal close to the single chip, add a capacitor filter (typical value: 10 pF-1 nF) to the ground, or a magnetic bead to cover the collection data line.

12.7. Electrostatic Discharge Invalidation Issues

12.7.1. During the electrostatic contact discharge of the customer's system, why does the system restart and how to solve it?

Answer: There are two reasons: either the power module is off or the power module operates well but the system (generally a single-chip CPU) experiences interference. First, it is necessary to confirm whether the power module is off. If it is off, a capacitor discharge circuit (typical value: 1 nF) can be added between the sensitive discharge point and the protected area so as to guarantee reliable grounding. If there is no protected area, it should be added between the input negative pole and output negative pole of the power source. If the system experiences interference, identify the pin experiencing interference (generally the reset pin) should be identified and add a capacitor filter (typical value: 1 nF) to the negative poles of the CPU's power supply.

12.7.2. The customer's system comes in plastic case. During electrostatic air discharge, why does the system break down or restart, and how to solve it?

Answer: There are two reasons: either the power module is off or the power module operates well but the system (generally a single-chip CPU) experiences interference. The cause of the

breakdown is the second one. First, it is necessary to observe whether there is any arc discharge during discharge. If there is arc discharge, the distance from the discharge point to the case should be increased or insulation shielding applied. Next, it is necessary to confirm whether the power module is off. If it is off, a capacitor discharge circuit (typical value: 1 nF) can be added between the input negative pole and output negative pole of the power source. If the system experiences interference, a CM inductor filter (typical value: 1 nF) can be added between the output terminal and the CPU; alternatively, identify the pin experiencing interference (generally the reset pin) and add a capacitor filter (typical value: 1 nF) added to the negative poles of the CPU's power supply.

12.7.3. The customer's system comes in plastic case. During the contact discharge of the interface, why does the system break down or restart, and how to solve it?

Answer: There are two reasons: either the power module is off or the power module operates well but the system (generally a single-chip CPU) experiences interference. The cause of breakdown is the second one. First, it is necessary to confirm whether the power module is off. If it is off, a capacitor discharge circuit (typical value: 1 nF) can be added between the input negative pole and output negative pole of the power source. If the system experiences interference, identify the pin experiencing interference (generally the reset pin) and add a capacitor filter (typical value: 1 nF) to the negative poles of the CPU's power supply. If it is isolated interface such as the communication port, the isolation should be reliable. To prevent electrostatic from crossing the isolated strip, the distance should generally be longer than 4 mm.

12.7.4. The customer's system comes in plastic case. During the contact discharge of the LCD screen, why the LCD fails and how to solve it?

Answer: It might be that the backlight is disconnected or there is no display on the LCD screen. If the backlight is disconnected, a capacitor discharge circuit (typical value: 1 nF) can be added to the negative poles of the backlight circuit. If there is no display on the LCD screen, it must be confirmed whether the CPU has broken down. A capacitor filter (typical value: 10 pF-1 nF) can then be added closely to the signal control line of the LCD screen.