



# **TN/TS-1500 INVERTER**

## **Instruction Manual**

# **TN/TS-1500 Series Instruction Manual**

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## 1. Safety Guidelines (Please read through this manual before assembling TN/TS-1500)

- Risk of electrical shock and energy hazard. All failures should be examined by the qualified technician. Please do not remove the case of the inverter by yourself!
- After connecting the AC input of the inverter to the utility, the AC outlet of the inverter will have AC output even if the power switch on the front panel is in the OFF position.
- Please do not install the inverter in places with high moisture or near water.
- Please do not install the inverter in places with high ambient temperature or under direct sunlight.
- Please only connect batteries with the same brand and model number in one battery bank. Using batteries from different manufacturers or different capacity is strictly prohibited!
- Never allow a spark or flame in the vicinity of the batteries because they may generate explosive gases during normal operation.
- Make sure the air flow from the fan is not obstructed at both sides (front and back) of the inverter. (Please allow at least 15cm of space)
- Please do not stack any object on the inverter.

**⚠ Warning: Batteries will have aging problem after years of operation. It is suggested to execute regular maintenance for the batteries every year. Once aged, the batteries should be changed by professional technician, or the failed batteries may cause explosion or fire hazard.**



Don't disassemble



Away from moisture



Away from fire or high temperature



Don't stack on the inverter



Keep good ventilation

## 2. Introduction

- Fully digital controlled by an advanced CPU, TN-1500 is a true sine wave inverter equipped with an AC charger and solar charger. It can also operate under UPS and Energy saving modes. **(Descriptions which are high lighted represents functions only for the TN-1500 series)**
- TS-1500 series only possess the inverter function. It uses batteries as the input source and converts the energy into AC output.
- TN-1500 is capable of drawing energy from solar panel thus provide uninterrupted power (UPS mode). Besides providing uninterrupted power, it also has user adjustable energy saving mode. The main purposes of energy reduction and building an independent sub power station are realized. We can say that TN-1500 series is a multi-functional and designed to be environmentally friendly.

- TN-1500 series will automatically detect the input sources (whether AC main or solar panels exist) and then adjust its internal setting. Users can also set up the operating mode, output voltage, frequency, and saving mode by themselves based on their special needs, geographic area, and environmental conditions.
- With pure sine wave output, TN/TS-1500 can provide 1500W continuously, 1750W for 3 minutes, or 20~40A of peak current for all kinds of load such as inductive, capacitive, or resistive. General applications include PC, ITE, vehicles, yachts, home appliances, motors, power tools, industrial control equipments, AV system, and etc...

## 2.1 Features

- Selectable UPS or Energy saving mode
- True sine wave output (THD<3%)
- 1500W rated output
- High efficiency up to 90%
- Complete LED indication for operating status
- Battery low alarm and indicator
- Surge power capability up to 3000W
- Output voltage / frequency selectable
- Fully digital controlled
- Compliance to UL458 / FCC / E13 / CE
- Can be used for most of electronic products with AC input
- 2 year global warranty
- Solar charging current 30A max
- Fast transfer time < 10ms

## 2.2 Main Specification

MODEL	112	124	148	212	224	248	
O U T P U T	Rated power	1500W max. continuously, 1750W max. for 180 seconds, 2250W max. for 10 seconds, 3000W for 30 cycle					
	Surge Current	40A (500ms typ.)			20A (500ms typ.)		
	Factory setting	110V 60Hz			230V 50Hz		
	Output voltage	100 / 110 / 115 / 120V			200 / 220 / 230 / 240V		
	Frequency	50 / 60Hz±1Hz					
	WAVEFORM	True sine wave (THD <3.0%)					
	PROTECTION	AC short · Overload · Over Temperature					
I N P U T	BAT. VOLTAGE	10.5 ~ 15.0V	21.0 ~ 30.0V	42.0 ~ 60.0V	10.5 ~ 15.0V	21.0 ~ 30.0V	42.0 ~ 60.0V
	DC CURRENT	150A	75A	37.5A	150A	75A	37.5A
	EFFICIENCY	87%	89%	90%	88%	90%	91%
	OFF MODE CURRENT DRAW	Under 1.0mA at power switch OFF					
	PROTECTION	Over current · battery polarity reverse by fuse · battery low shutdown · battery low alarm					
C H A R G E R	CHARGE VOLTAGE	14.5V	29.0V	58.0V	14.5V	29.0V	58.0V
	AC CHARGE CURRENT	5.5A±0.5A	2.7A±0.4A	1.35A±0.2A	5.5A±0.5A	2.7A±0.4A	1.35A±0.2A
	SOLAR OPEN CIRCUIT VOLTAGE	25Vmax	45Vmax	75Vmax	25Vmax	45Vmax	75Vmax
	SOLAR CHARGE CURRENT	30A max.					

## 2.3 System Block Diagram

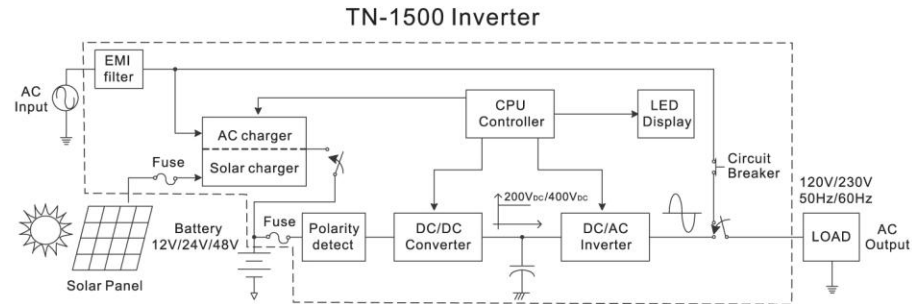


Figure 2.1 System Block Diagram

## 3. User interface

### 3.1 Front Panel

- Ⓐ **POWER on/off switch:** The inverter will turn OFF if the switch is in the OFF position.
- Ⓑ **AC output outlet:** To satisfy application demand of different geographic areas all over the world, there are many optional AC outlets to choose from.
- Ⓒ **No Fuse Breaker; Reset:** Under "Bypass Mode", when the AC output is shorted or the load current exceeds the rated current of the No Fuse Breaker, the No Fuse Breaker will open and that stops bypassing energy from the utility getting to prevent possible danger. When the abnormal operating condition is removed, user can press down on the Reset button to resume operation.
- Ⓓ **Ventilation holes:** The inverter requires suitable ventilation to work properly. Please make sure there is good ventilation and the lifespan of the inverter can be preserved.
- Ⓔ **Function Setting:** Operating Mode, Output voltage, frequency, and saving mode can be set through this button.
- Ⓕ **LED Indicating Panel:** Operating status, load condition, and all types of warnings will be displayed on this panel.
- Ⓖ **Communication Port:** For remote monitoring purpose, the unit can be connected to a PC through this communication port by using the optional cable and monitoring software.



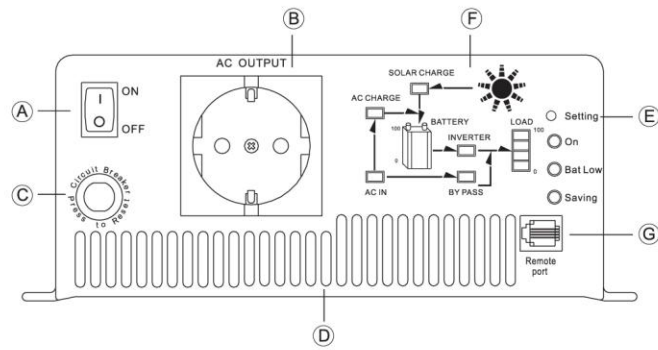


Figure 3.1: Front Panel (TN-1500)

### 3.2 LED Indicator on Front Panel

**Battery Capacity Indicator:** represents the remaining capacity of external batteries.

LED Display	LED 1 ON	LED 1~ 2 ON	LED 1 ~ 3 ON	LED 1 ~ 4 ON
Battery Capacity	0 ~ 25%	26 ~ 50%	51 ~ 75%	76 ~ 100%

**Load Condition Indicator:** represents the magnitude of output loads.

LED Display	LED 1 ON	LED 1~ 2 ON	LED 1 ~ 3 ON	LED 1 ~ 4 ON
Battery Capacity	0 ~ 30%	30 ~ 50%	50 ~ 75%	75 ~ 100%

### 3.3 Function Indication and Alarm

- ⊙ **On** : The inverter started up and output is normal.
- ⊙ **Bat Low** : Voltage of external batteries is too low. The inverter will send out a "Beep" sound to warn the users.
- ⊙ **Saving** : The inverter is operating under the "Saving Mode" and there's no AC output.
- ⊙ **AC CHARGE** : The built-in AC charger is charging external batteries.
- ⊙ **SOLAR CHARGE** : The external solar panels are providing energy to the external batteries through the built-in solar charger.
- ⊙ **AC IN**: The status of utility is normal.
- ⊙ **BYPASS**: The unit is working under "Bypass Mode". The AC electricity consumed by the loads is provided by the utility instead of the inverter.
- ⊙ **INVERTER**: The unit is working under "Inverter Mode" The AC electricity consumed by the loads is converted from the batteries.
- ⊙ **BATTERY**: Display the remaining capacity of external batteries.
- ⊙ **LOAD**: Display the output load status.

### 3.4 Rear Panel

- Ⓐ Battery input (+), (-).
- Ⓑ Utility / AC inlet (IEC320).
- Ⓒ Solar panel input terminal.
- Ⓓ Frame ground (FG).

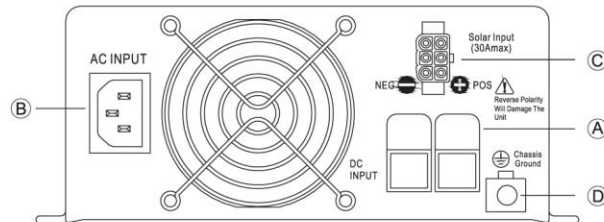


Fig 3.2: Rear Panel (TN-1500)

### 4.Explanation of Operating Logic

TN-1500 (CPU controlled inverter) is designed to achieve the goal of energy saving and possesses both UPS and Energy saving modes. These 2 modes are user adjustable. The unit will be factory set in the UPS mode. Depending on weather and utility conditions, users can manually adjust or use the monitoring software to switch to the Energy saving mode.

The main difference between UPS and Energy saving mode is the amount of energy conserved. Under the UPS mode, the unit will remain in the Bypass mode as long as utility is available. Thus less energy is conserved (refer to Fig. 4.1 for UPS mode control logic). Under the Energy saving mode, the priority of input source chosen is solar panel AC main battery. If available, the CPU will select external solar panels as its first priority in order to conserve energy. In case of insufficient solar power and utility failure, battery power will be drawn as the last resort. When the capacity of batteries is around 10~20%, the CPU will remind end users by continuously sending out warning siren until the system shuts down.

#### 4.1 Explanation of UPS Mode Control Logic

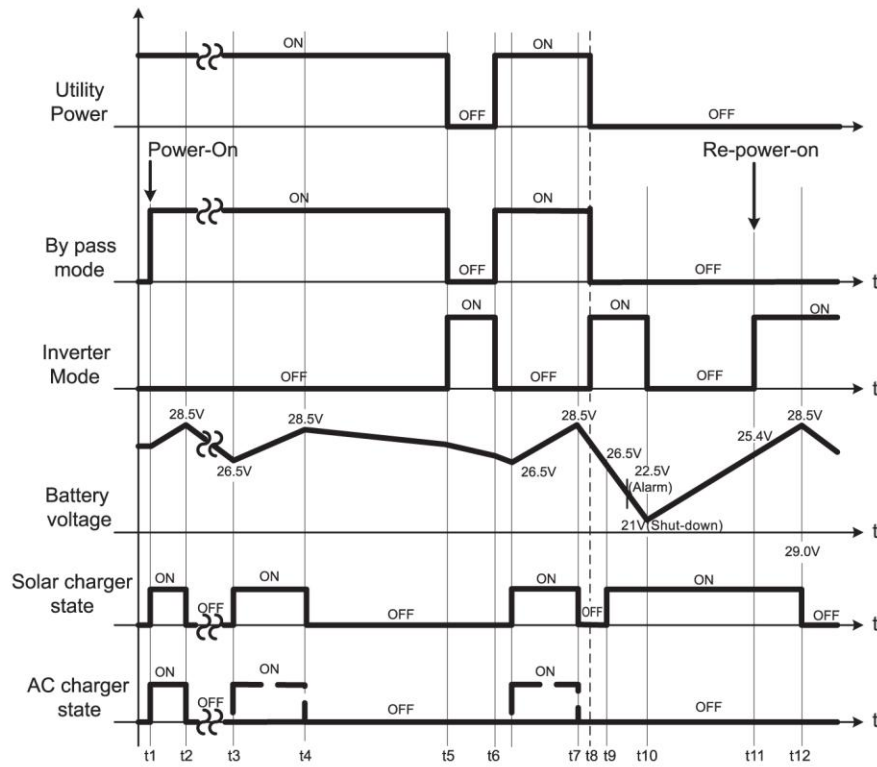


Figure 4.1: Diagram of UPS Mode Control Logic

- t1: To ensure the battery is at full capacity, when the TN-1500 is turned on, the CPU will execute the "Bypass Mode" automatically connecting the AC main to the load. In the meantime, it will activate both the AC charger and solar charger to simultaneously charge the batteries.
- t2: When the batteries are full (battery voltage around 28.5V), both the AC and solar charger will be turned off by the CPU to prevent overcharging and reducing the battery lifetime. In the meantime, the system will remain in the "Bypass Mode" and AC electricity provided to the loads is coming from public utility.



- t3: At this time period, TN-1500 is still in the Bypass mode. The battery voltage level will decrease gradually due to standby power dissipation. When the batteries are consumed to around 75% of their capacity (battery voltage around 26.5V) the CPU will restart the charger. The CPU will use charging current of 3A as a guide point. When the provided charging current is under 3A, the AC charger will be turned ON (e.g. Night time or cloudy day). As for charging current of over 3A, the solar charger will be turned ON instead.
- t4: If the energy provided by the charger is larger than what is consumed by the load, voltage of battery bank will increase gradually until 28.5V is reached then the CPU will be shut off the charger to prevent overcharging. At this point, output load is still supplied by utility.
- t5: Since the chargers are in the OFF mode, the battery voltage will gradually decrease to the range of 26.5~28.5V (floating voltage level). If utility were to fail at this moment, the CPU will automatically switch (<10ms) to the inverter mode insuring uninterrupted power.
- t6: Once utility recovers, the CPU will switch back to the bypass mode
- t7: When battery voltage drops to below 26.5V, the battery charger will be activated to charge the battery bank (refer to t3 for detailed description).
- t8: Same as t4
- t9: Due to lack of utility, TN-1500 will switch to the inverter mode. AC charging function will be turned off. Since AC output relies purely on battery power, the battery bank will be depleted rather quickly.
- t10: As the battery discharges to below 26.5V and utility remains unavailable. Only the solar charger is turned ON. The battery bank could be depleted rather quickly.
- t11: Same as Energy Saving mode
- t12: When solar charger is providing current of larger than 3A, the voltage level of the battery bank will rise slowly. Once the battery voltage reaches inverter mode reactivation level, the inverter will be revived.

- t1 : When the TN-1500 is turned on, CPU will execute the "Bypass Mode" automatically connecting the AC main to the load. In the mean time, it will activate both the AC charger and solar charger to simultaneously charge the batteries.
- t2 : When the batteries are full (battery voltage around 28.5V), both the AC and solar charger will be turned off to prevent overcharging and reducing the battery lifetime. In the meantime, the system will switch to the "Inverter Mode" and the AC electricity provided to the loads will be coming from the batteries.
- t3: When the batteries are depleted to around 75% of their capacity (battery voltage around 26.5V), CPU will restart the solar charger but not the AC charger to achieve the purpose of energy-saving.
- t4: If the energy provided by the solar panels is larger than the load requirement, voltage of battery bank will increase gradually until reaching 90% capacity (battery voltage around 28.5V) and then the solar charger will be shut off to prevent the batteries from overcharging.

- t5: When the capacity of batteries go down to about 75% (battery voltage around 26.5V), solar charger will restart and begin charging.
- t6: If the energy provided by the solar panels is lower than consumed by the loads, voltage of battery bank will decrease gradually to 20% of its capacity (battery voltage around 22V), the built-in buzzer will be activated and inform the users to take proper action.
- t7: If the power consumption of the loads does not decrease and the AC main is normal, CPU will detect this and the unit will be transferred to "Bypass Mode". The utility will provide energy to the loads and charge the battery bank at the same time in order to prevent the unit from shutting off. If the solar current is higher than 3A, the CPU will not activate the "AC charger" and just let the "Solar Charger" charge the batteries to achieve the goal of energy-saving.
- t8: When lacking AC main, the CPU will shut down the whole system if the capacity of external battery bank is less than 10% (battery voltage around 21V) in order to prevent over-discharging and reducing its lifetime. After shut down, the CPU will provide LED indication to the user know why the inverter has shut off.

## **5. Initial Setup of TN/TS-1500 (Operating Mode, Output Voltage, Frequency, and Saving Mode)**

### **5.1 Initial State**

The initial state of TN/TS-1500 is 120Vac/60Hz or 230Vac/50Hz and both the "UPS mode" and "Saving Mode" is activated. If the users need to revise it for certain application, it can be done through the setting button on the front panel (Please refer to section 5.3). The unit will start up automatically after the setting procedure is finished and the new settings will be executed. These new settings will be kept even if AC, battery, and solar is disconnected or occurrence of fault conditions leading to failure of output voltage thus requiring powering the inverter OFF and ON.

### **5.2 Initial Set Point for Transition Voltages**

TN/TS-1500

Factory Setting	112	212	124	224	148	248
AC Charger Transition Voltage	14.3V		28.5V		57V	
AC Charger Start Up Voltage	11V		22V		44V	
Solar Charger Start Up Voltage	13.3V		26.5V		53V	
Solar Charger Shut Down Voltage	14.3V		28.5V		57V	
Inverter Shut Down	10.5V		21V		42V	

### 5.3 Procedure of Setting Operating Mode, Output Voltage, Frequency, and Saving Mode

Note: TS-1500 does not have Step 3~5.

STEP 1: The inverter should be turned off while resetting. Input batteries should be connected, AC main can either be connected or disconnected, and the loads should be removed.

STEP 2: Use an insulated stick to press the setting button and then turn on the power switch. After pressing for 5 seconds, the inverter will send out a "Beep" sound. Users can release the button and go into the setting procedure.

STEP 3: Please refer to Table 5.1 and check the LED status to see if the Operating Mode is the one you need. If yes, please skip to STEP 5. If change is required, please follow STEP 4~11.

Table 5.1 Operating Mode

Energy Saving Mode	On	●
	Bat Low	★
	Saving	★
UPS Mode	On	○
	Bat Low	★
	Saving	★

● Light  
○ Dark  
★ Flashing

STEP 4: The LEDs will change state by pressing the setting button for 1 second and then release. Operating Mode can be adjusted as required.

STEP 5: After selecting the Operating Mode, press the setting button for 3~5 seconds and the inverter will send out a "Beep" sound. The button can be released and you can go on to the setting section of "Voltage/frequency."

STEP 6: Please refer to Table 5.2 and check whether the combination of output voltage and frequency is the one you need. If yes, please skip to STEP 8. If change is required, please follow STEP 7~11.

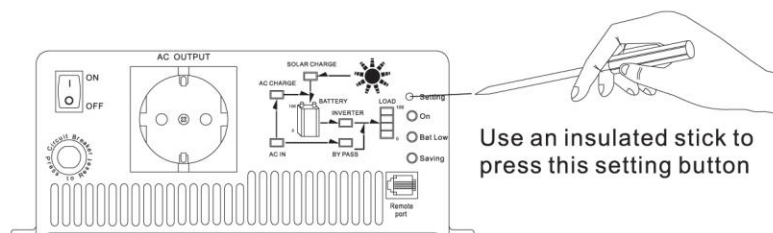


Figure 5.2: Adjustment of Output Mode, Output Voltage, Frequency, and Saving Mode

Table 5.2 : LED Indication of Output Voltage / Frequency Combination

Output Voltage Frequency		100Vac (200Vac)	110Vac (220Vac)	115Vac (230Vac)	120Vac (240Vac)
50Hz	On	●	●	●	●
	Bat Low	○	○	●	●
	Saving	○	●	○	●
60Hz	On	★	★	★	★
	Bat Low	○	○	●	●
	Saving	○	●	○	●

● Light  
○ Dark  
★ Flashing

STEP 7: The LEDs will change state by pressing the setting button for 1 second and then release (refer to Figure 5.2). Please select the combination of output voltage and frequency you need.

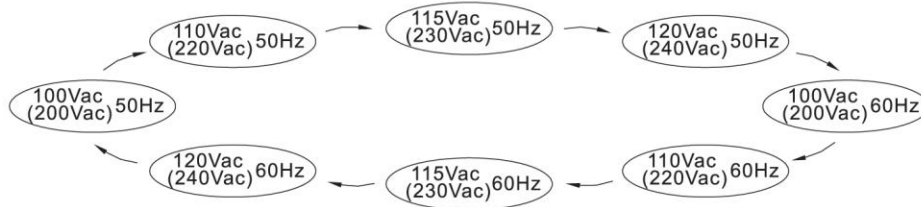


Figure 5.2: State Circulation Diagram of Output Voltage and Frequency

STEP 8: After selecting the output voltage and frequency, press the setting button for 3~5 seconds and the inverter will send out a "Beep" sound. The button can be released and it will go into the setting section for "Saving Mode."

STEP 9: Please refer to Table 5.3 and check whether the "Saving Mode" is set as required. If yes, please skip to STEP 11. If change is required, please follow STEP 10~11.

Table 5.3 LED Indication for Saving Mode ON/OFF

Saving Mode ON	On	★
	Bat Low	★
	Saving	●
Saving Mode OFF	On	★
	Bat Low	★
	Saving	○

● Light  
○ Dark  
★ Flashing



STEP 10: The LEDs will change state by pressing the setting button for 1 second and then release. You can activate or cancel the "Saving Mode" function by this adjustment.

STEP 11: After activating or canceling the "Saving Mode", press the setting button for around 5 seconds and the inverter will send out a "Beep" sound. The button can be released and all the settings are finished. The inverter will automatically store all the settings and then start to operate.

#### 5.4 Remote Monitoring Software

Users can also make Operating Mode, voltage/frequency, saving mode, and transition voltage adjustments by using this software. Software update can be downloaded from the MW website. Please contact us or our distributor if you have any questions.

### 6. Protection

#### 6.1 Input Protection

**(A)Battery Polarity Protection:** If the battery input is connected in reverse polarity, the internal fuse will blow and the inverter should be send back to MEAN WELL for repair.

**(B)Battery Under Voltage Protection:** When the battery voltage is lower than the preset value, the inverter will automatically terminate the output and "Battery Low" signal on the front panel will light up. Please refer to Table 6.1 for more detail about the failure signals displayed through the "Load Meter."

**(C)Battery Over Voltage Protection:** When the battery voltage is too high, inverter will automatically terminate the output and the built-in buzzer will activate to inform the users. Please refer to Table 6.1 for more detail about the failure signals displayed through the "Load Meter."



**Warning:**

Please choose suitable batteries that is within the rated input DC voltage of TN/TS-1500 (refer to the SPEC). If the input DC voltage is too low (ex. using 12Vdc battery bank for 24Vdc input models), TN/TS-1500 can't be started up properly. If the input DC voltage is too high (ex. using 48Vdc battery bank for 24Vdc input models), TN/TS-1500 will be damaged!

**(D)Solar Charger Over Current Protection:** The maximum charging current of the built-in solar charger is 30A. If the charging current is too high, the internal fuse will blow and the inverter should be send back to MEAN WELL for repair.

## 6.2 Output Protection

**(A) Bypass Mode:** Uses "No Fuse Breaker" as automatic over current protection. When over current occurs, the button of the circuit breaker on the front panel will pop up and the inverter will shut down. At this time, users should remove the loads, restart the inverter and press down on the button of the circuit breaker and the AC output can now be provided normally.

**(B) Inverter Mode:** Under the "Inverter Mode", if any abnormal situation occurs, the front panel will send out failure messages through the "Load Meter" (Please refer to Table 6.1).

**(1) Over Temperature Protection:** When the internal temperature is higher than the limit value, the "Over Temperature Protection" will be activated. The unit will automatically turn off and should be restarted again.










**(2) AC Output Abnormal Protection:** When the AC output voltage of the inverter is too high or too low, the unit will turn off and should be restarted again.

**(3) AC Output Short Circuit Protection:** When a short circuit situation occurs at the output side of the inverter or the load increase greatly in a short period of time, the unit will turn off and should be restarted again.

**(4) Battery Voltage Abnormal Protection:** When the battery voltage is too high or too low, this protection will be activated. The inverter will auto-recover once the battery voltage go back to a safe level and users do not need to restart it.

**(5) Output Overload Protection:** When output is overloaded between 1500W ~ 1750W, the inverter can continuously provide power for 3 minutes. After that, if the overload condition is not removed, the overload protection will be activated. When the load is higher than 2250W, the overload protection will activate instantly. For these overload protections, once activated, you should reset the unit.

Table 6.1: Failure Messages On Front Panel

Failure Message	LED Indicator 	Failure Message	LED Indicator 
Output Overload (1500W~1750W)		Abnormal AC Output Voltage	
Output Overload (1750W~2250W)		AC Output Short Circuit	
Output Overload (>2250W)		Abnormal Battery Voltage	
Over Temperature			

## 7. Installation & Wiring

**(A)Wiring for Batteries:** Wire connections should be as short as possible and less than 1.5 meter is highly recommended. Make sure that suitable wires are chosen based on Safety requirement and rating of current. Too small cross-section will result in lower efficiency, less output power, and the wires may also become overheated and cause danger. Please refer to Table 7.1 and consult our local distributor if you have any questions.

Table 7.1: Suggestion for Wire Selection

Rated Current of Equipment (Amp)	Cross-section of Lead (mm <sup>2</sup> )	AWG	Note
10A ~ 13A	1.25	16	Choosing suitable wires based on the rating of solar panels and distance from the inverter
13A ~ 16A	1.5	14	
16A ~ 25A	2.5	12	
25A ~ 32A	4	10	
32A ~ 40A	6	8	
40A ~ 63A	10	6	Models using 48V batteries
63A ~ 80A	16	4	
80A ~ 100A	25	2	Models using 24V batteries
100A ~ 125A	35	1	
≥ 125A	50	0	Models using 12V batteries

### (B)Suggested Battery Type and Capacity

TN/TS-1500

Battery Type	Lead-acid					
Battery Capacity	112	212	124	224	148	248
	12V / 120Ah ~ 12V / 400Ah		24V / 60Ah ~ 24V / 200Ah		48V / 30Ah ~ 48V / 100Ah	
Input Current from Solar Panel	5A ~ 25A					

### (C)Requirement of Installation:

The unit should be mounted on a flat surface or holding rack with suitable strength. In order to ensure the lifespan of the unit, you should refrain from operating the unit in environment of high dust or moisture. This is a power supply with built-in DC fan. Please make sure the ventilation is not blocked. We recommend that there should be no barriers within 15cm of the ventilating holes.

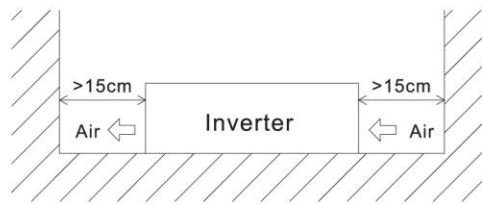
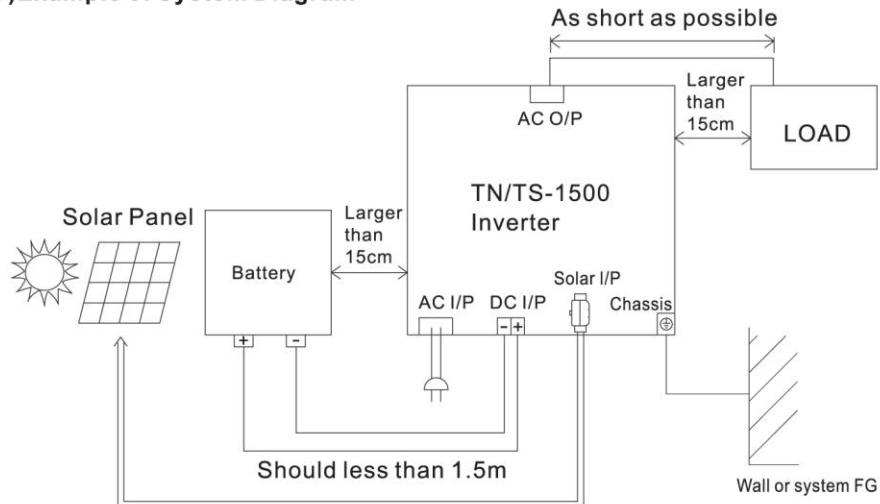


Figure 7.1: Example of Installation

**(D) Example of System Diagram**



Based on the actual length of wiring and choose suitable cross-section of the leads

**(E) Derating**

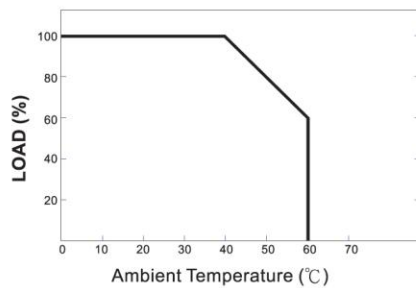


Figure 7.2: Output Derating Curve

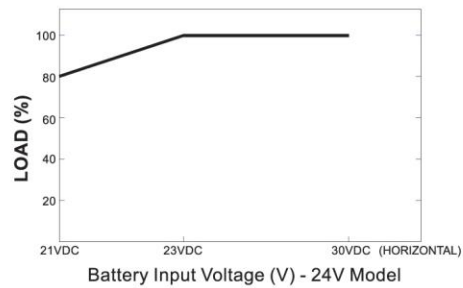


Figure 7.3: Input Derating Curve

**(F) ⚠ Notes on Output Loads:**

**TN/TS-1500 Series can power most of equipments that need an AC source of 1500W. But for certain specific type of load, the unit may not work properly.**



(1) Since inductive loads or motor based equipments need a large start up current (6~10 times of its rated current), please make sure this start up current is less than the maximum current capability of the inverter.

(2) When the output are capacitive or rectified equipments (such as switching power supply), we suggest operating these equipment at no load or light load condition. Increase the loads slightly only after the TN/TS-1500 has started up to ensure proper operation.

#### 8. Failure Correction Notes

TN/TS-1500 should serviced by a professional technician. Improper usage or modification may damage the unit or result in shock hazard. If you are not able to clear the failure condition, please contact Mean WELL or any of our distributors for repair service.

Status	Possible Reasons	Ways to Eliminate
No AC output voltage	Abnormal input	Check the AC or DC input sources. Make sure the voltage is within the required range.
	No input (battery, AC main, or solar energy)	Make sure the wiring and polarity is correct.
	Over temperature protection	Make sure that the ventilation is not blocked or whether the ambient temperature is too high. Please derate output usage or reduce the ambient temperature.
	Overload protection	Make sure the output load does not exceed the rated value or the instantaneous start up current is not too high (for inductive or capacitive loads).
	Short circuit protection	Make sure the output is not overloaded or short circuit
Discharging period of batteries is too short	Batteries are aging or broken	Replace the batteries
	Battery capacity is too small	Reconfirm the specification and enlarge the battery capacity as suggested
	Malfunction of the charger (no charging voltage)	Repair required. Please send it back to us or any of our distributors
Fan does not spin	Clog with foreign objects	Remove the foreign objects
	Malfunction of the fan	Repair required. Please send it back to us or any of our distributors

#### 9. Warranty

**Two years of global warranty is provided for TN/TS-1500 under normal operating conditions. Please do not change components or modify the unit by yourself or MEAN WELL may reserve the right not to provide the complete warranty.**