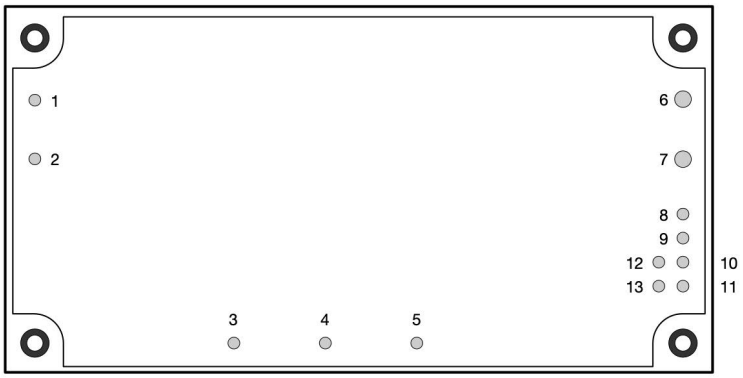
1. Introduction

The TBF500 AC/DC power supply series in a fully encapsulated full-brick package with up to 93% efficiency. For high operating temperature applications, the module can be mounted on the system chassis to dissipate its heat or equipped with the optional heatsink.

TBF500 series has a universal input voltage range of 85-264Vac. The output voltages are 12, 15, 24, 28, 48, and 54VDC and are adjustable by external resistors in the range of +10%/ -10%, The use of the remote sense pins compensate the voltage drop over the PCB tracks for an accurate working voltage at the point of load. The full protection functions include over-current protection (hiccup mode), short-circuit protection (automatic recovery), and output over-voltage protection (latch-off).

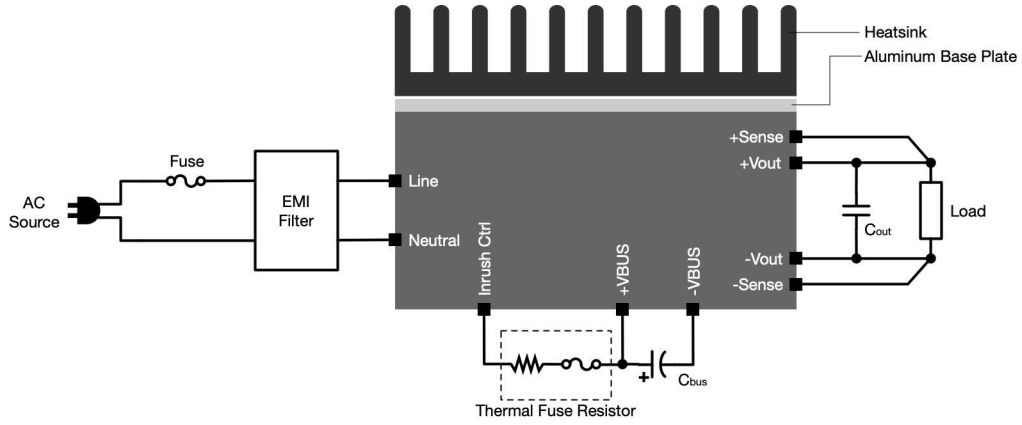
2. Pin Description



Bottom View

Pin No.	Pin Definition	Function		Pin No.	Pin Definition	Function
1	AC (N)	AC Input-Neutral		8	-V Sense	- Remote Sense
2	AC (L)	AC Input-Line		9	+V Sense	+ Remote Sense
3	Inrush Control	Inrush Control Pin		10	Trim	Output voltage Adjust
4	+VBUS	+ VBulk CAP		11	PG	Power Good
5	-VBUS	- VBulk CAP		12	+Ctrl	+ Remote ON/OFF
6	-Vout	- Output Voltage		13	-Ctrl	- Remote ON/OFF
7	+Vout	+ Output Voltage				

3. Typical Connection



Fuse

Fuse is not installed internally. For safety reasons, an external fuse should be installed. Please refer to the fuse specifications below.

Current Rating	Type
10A	Slow-blow

Fuse specifications

Cbus

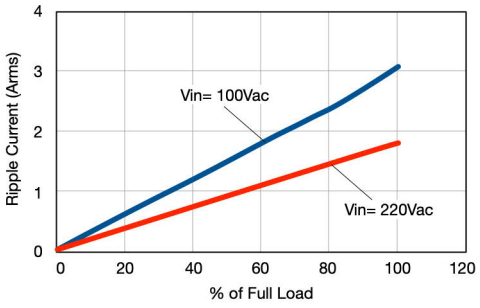
Selection of the Cbus

- Due to the high voltage of 390V between +Vbus and -Vbus, the rated voltage of the Cbus should be 450V or higher.
- Ensure that the ripple voltage does not exceed 30Vp-p. Note that the capacitance may decrease under -25℃ ambient temperature, resulting in a ripple voltage exceeding 30Vp-p.
- The ripple current of the Cbus should meet its specifications.

Rated Voltage	Cbus	Allowable capacitance range
450Vdc	330μF x 2pcs in parallel	660-2200μF

Recommended Cbus

The variation of the Cbus' ripple current is shown below.



Recommended Cbus

3. Typical Connection (Continued)

Termal Fuse Resistor (TFR)

- To reduce inrush current, connect a resistor between the Inrush Current and +Vbus pins. Without this connection, the power supply cannot function properly.
- An over-temperature protected resistor with a temperature range of 110 to 130℃ is recommended.
- The value of the Thermal Fuse Resistor affects the inrush current. A value ranging from 4.7 to 22 ohms (5-10W) is recommended.

4. Output Series and Parallel

Series Operation

- It's available to connect output pins of multiple AC-DC converters as Fig. 4-1. They offer more flexible applications.

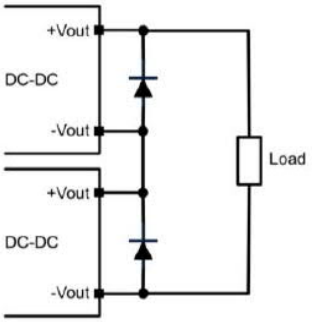


Fig. 4-1 Series Connections

Redundancy Operation

- Redundancy operation is available by connecting as Fig. 4-2.
- Choose low Vf diodes will reduce conduction loss of diodes.

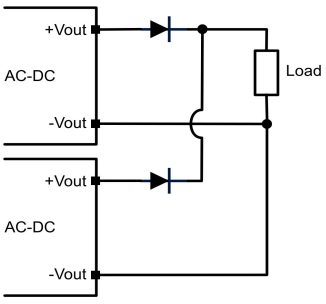
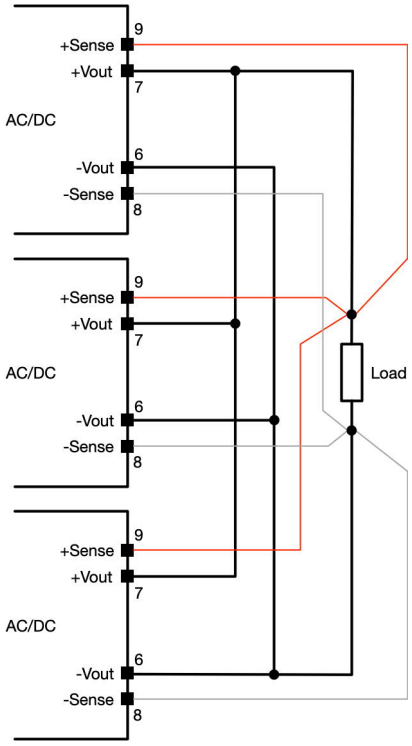


Fig. 4-2 Redundancy Connection

4. Output Series and Parallel (Continued)

Current Sharing
Model name with suffix "-S"

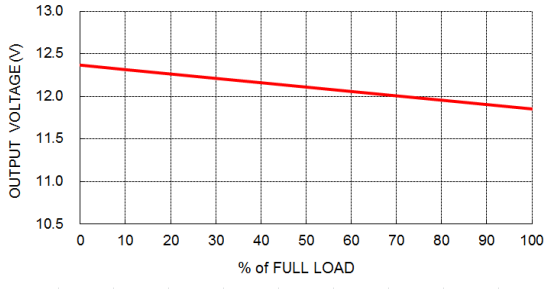
- Each module should not exceed its 85% of maximum output power.
- The maximum 3 modules can be connected in parallel.
- To have balance output current on each module, similar connections from output to load on each module are necessary.
- Individual Cbus and TFR for each module are necessary. The same types of Cbus and TFR should be applied between modules.
- The output power during start-up should not exceed the maximum output power of each individual module. This is because the modules are not able to start up at the same time, and the first one may source an over-loaded output current and trip over-current protection.
- Adding load after all modules have built output voltage is recommended.



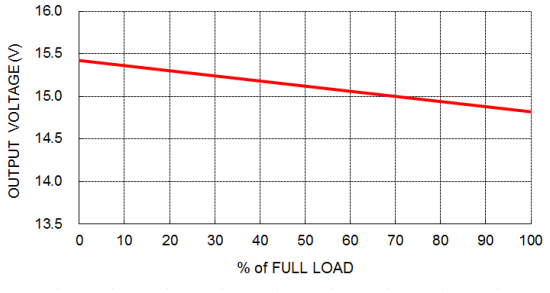
Parallel Connection

4. Output Series and Parallel (Continued)

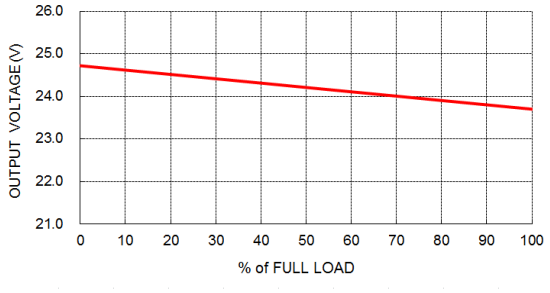
The output voltage automatically adjusts according to the output current. Current sharing can be implemented simply by connecting modules together using the droop function.
Please refer to the diagrams below for output voltage characteristics.



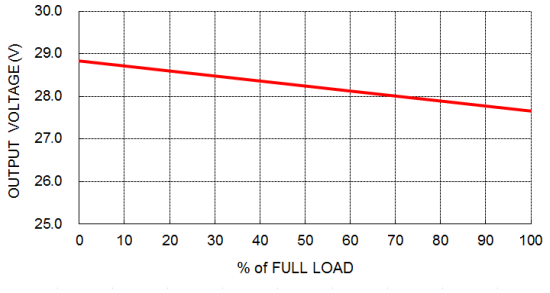
TBF500US12-S



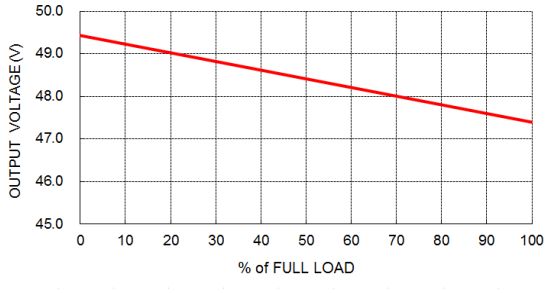
TBF500US15-S



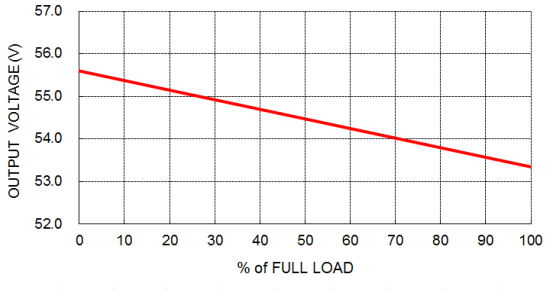
TBF500US24-S



TBF500US28-S



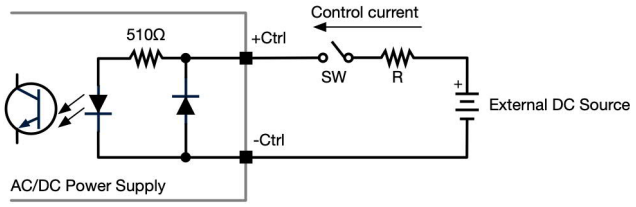
TBF500US48-S



TBF500US54-S

5. Remote Control

- The remote on/off is incorporated in the input circuit and operated with +Ctrl and –Ctrl.
- Remote control signal is referred to –Ctrl.

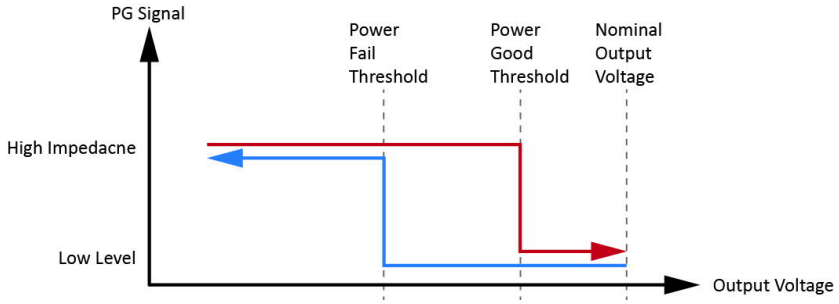


Status	External DC Source	Control Current
Module On	0-0.8V or Floated	20mA, max.
Module Off	4.5-12.5V	

Remote Control Configuration

6. Power Good

Pin PG provides a signal which indicates the status of output voltage.
While the output voltage is building and exceeds power good threshold, PG presents low level.
While the output falls to power fail threshold, PG presents high impedance.



Model	Power Good Threshold *PG: Low level	Power Fail Threshold *PG: High impedance
TBF500US12	10.8V, typ.	9V, typ.
TBF500US15	13.5V, typ.	12V, typ.
TBF500US24	21.6V, typ.	20V, typ.
TBF500US28	25.2V, typ.	24V, typ.
TBF500US48	43.2V, typ.	41V, typ.
TBF500US54	48.6V, typ.	46V, typ.

7. REMOTE SENSING

- When remote sensing is not used, make sure +Vout and +Sense are shorted, and that –Vout and –Sense as well.
- Keep the wires and patterns between +/-Vout and +/-Sense pins are as short as possible. Large loop area induces noise easilyand the operation of the module will become unstable.
- To minimum the effects of distribution losses by regulating the voltage at the Remote Sense pin. The voltage between the +/-Sense pin and +/-Vout pin must not exceed output voltage adjustability range.
- Sensing wires or patterns should be as short as possible. If wires are used, use either twisted-pair or shield wires.
- Sensing patterns should as close as possible.

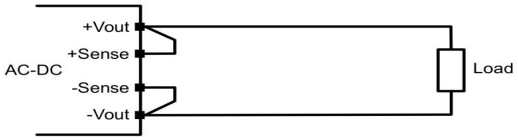


Fig. 7-1 Remote Sensing is Not Used

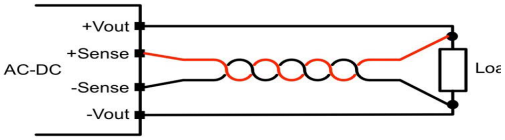
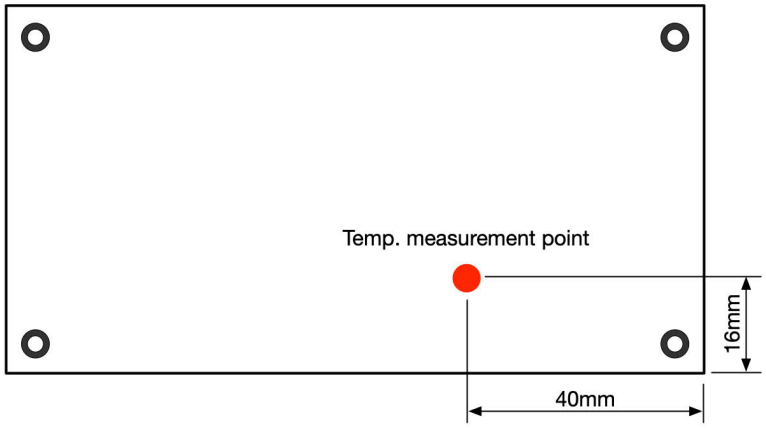


Fig. 7-2 Remote Sensing is Used

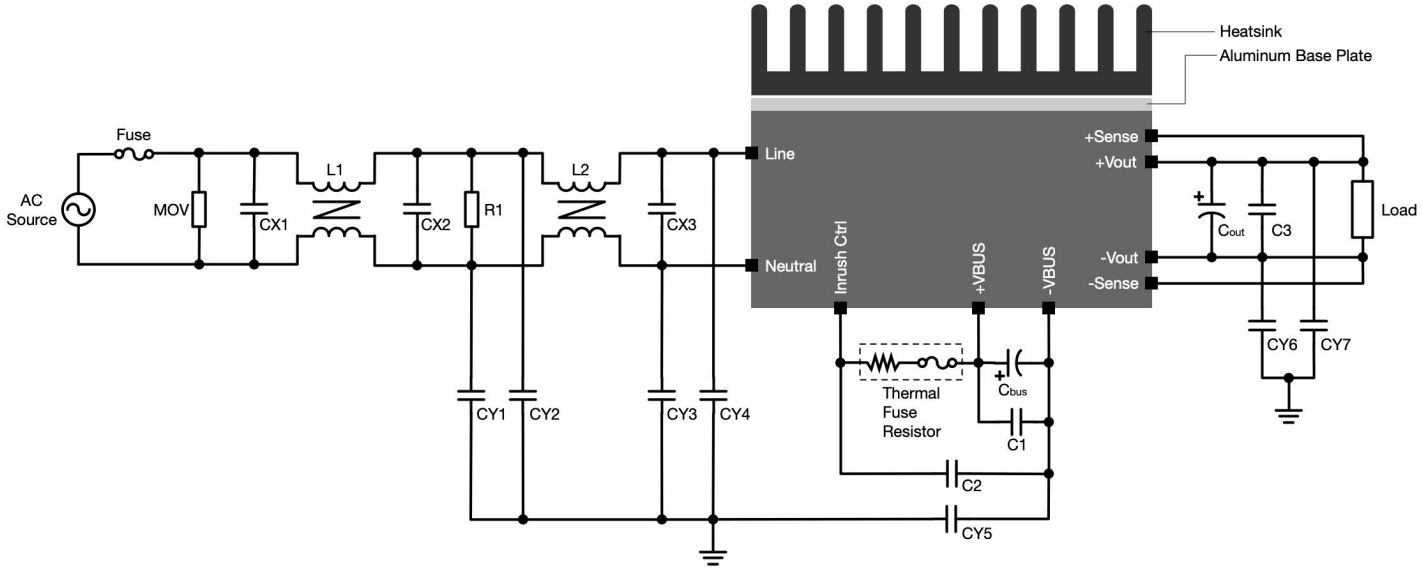
8. Thermal Considerations

The power module operates in a variety of thermal environments.
However, sufficient cooling should be provided to help ensure reliable operation of the unit.
Heat is removed by conduction, convection, and radiation to the surrounding environment.
Proper cooling can be verified by measuring the point as the figure below.
The temperature at this location should not exceed “Maximum case temperature”.
When operating, adequate cooling must be provided to maintain the test point temperature at or below “Maximum case temperature”.
You can limit this temperature to a lower value for extremely high reliability.



Top View

9. Typical Application Circuit



SYMBOL	TBF500US12	TBF500US15	TBF500US24	TBF500US28	TBF500US48	TBF500US54
Fuse	T10A/250VAC ,Slow-Blow			T10A/250VAC , Slow-Blow		
MOV	Φ14 / 300VAC			Φ14 / 300VAC		
R1	1/2W 330KΩ			1/2W 330KΩ		
CX1、CX2、CX3	1μF / 275VAC X2			1μF / 275VAC X2		
L1、L2	9.2mH ϕ1.0mm			9.2mH ϕ1.0mm		
Cbus	330μF /450VDC*2 Parallel			330μF /450VDC*2 Parallel		
CY1、CY2	2200pF / 250VAC Y2			2200pF / 250VAC Y2		
CY3、CY4	220pF / 250VAC Y2			220pF / 250VAC Y2		
CY5	1000pF / 250VAC Y2			1000pF / 250VAC Y2		
CY6、CY7	2200pF / 250VAC Y2			2200pF / 250VAC Y2		
Thermal Fuse Resistor	12Ω / 130℃ / 5W			12Ω / 130℃ / 5W		
C1、C2 Metalized Film	1μF / 450VDC			1μF / 450VDC		
C3 Ceramic Capacitor	10μF / 25V	10μF / 25V	10μF / 50V	10μF / 50V	2.2μF / 100V	2.2μF / 100V
Cout	4800~20000μF 16V ESR ≤2mΩ (100kHz/20℃)	3400~12000μF 25V ESR ≤4mΩ (100kHz/20℃)	1650~4000μF 50V ESR ≤10mΩ (100kHz/20℃)	1650~3000μF 50V ESR ≤10mΩ (100kHz/20℃)	470~1000μF 63V ESR ≤30mΩ (100kHz/20℃)	470~820μF 100V ESR ≤30mΩ (100kHz/20℃)

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