TBF500 Series

FiDUS
power in motion...

500 Watts

- Low profile full brick AC-DC converter
- Integrated PFC
- OVCIII
- Current share for paralleling (option)
- Trim, remote sense lines, control and power good

The TBF500 series of full brick AC-DC PSUs provide excellent low profile high power in a standard industry size. The OVCIII range is available in 12-54V output models, all with trim remote on off, sense lines and power good I/O. Optionally current share is available to parallel these low current inrush units together to facilitate higher power applications. All units come fully featured with a suite of protections; short circuit, over voltage overload and over temperature.

Dimensions:
4.6 x 2.4 x 0.5" (116.8 x 61 x 12.7mm)

Models & Ratings

INSTALLATION ADVICE PG 6

Model Number (1)	Output Power base-plate cooled	Output Voltage	Output Current @ 230Vac	Ripple & Noise(2)	Efficiency	Capacitive load
TBF500US12	504W	12V	42A	200mVp-p	90%	20000uF
TBF500US15	502W	15V	33.5A	200mVp-p	90%	12000uF
TBF500US24	504W	24V	21A	240mVp-p	92%	4000uF
TBF500US28	504W	28V	18A	280mVp-p	92%	3000uF
TBF500US48	504W	48V	10.5A	480mVp-p	93%	1000uF
TBF500US54	507W	54V	9.4A	540mVp-p	93%	820uF

Notes

1. For load share option add -**S**. For example TBF500US12-**S**.
2. Noise is measured with 20Mhz BW 1uF/50V (100V for 48 and 50V models) X7R MLCC
3. All specifications are at full load 230VAC 25°C unless otherwise stated.

Key specifications

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
AC Input range	85		264	VAC	See page 3 for derating curve. 88-370V DC
Operating temperature	-40		105	°C	Baseplate temp. See page 3 for derating curve
Efficiency	90		93	%	See models and ratings table above
Dimensions	4.6 x 2.4 x 0.5" (116.8 x 61 x 12.7mm)				
EMC	EN 55032 Level B conducted (with external components) and level A radiated. EN61000-3 and EN61000-4, harmonics, flicker, Surge (with external components), EFT (with external components), ESD, conducted and radiated immunity				
Safety	IEC/ EN/ UL 62368-1 (pending)				

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Input

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
AC Input voltage	85		264	VAC	External fuse T10A/250VAC
DC Input voltage	88		370	VDC	
Input frequency	47		63	Hz	
Power factor	0.95				EN61000-3-2 class A
Input current			278/6.3	A	2.7A at 240VAC, 6.3A at 100VAC
Inrush current			30	A	230VAC thermal fuse resistor 12Ω
Start up time			2	S	
Rise time		20		mS	
No load input power		0.6		W	230VAC

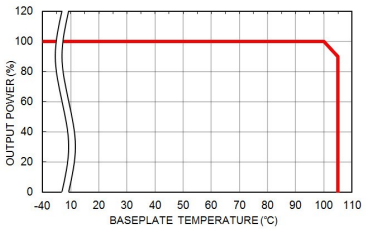
Output

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Output voltage	12		54	VDC	See Model & Ratings table
Set point accuracy			±1	%	
Line regulation			±0.2	%	High line to low line full load
Load regulation			±0.4	%	10% to 90% load change
Voltage adjust			±10	%	Including remote sense
Minimum load	0			%	
Transient response			3	%	Recovery within 1% within 600 μs for 50-75% step at 2.5A/us
Hold up time		16		mS	At 500W load and 115VAC with 660uF/450V Cbus
Overload protection		145		%	Trip & restart. Automatic recovery
Overvoltage protection	115		135		Latch off. AC reset required,
Short circuit protection					Automatic recovery, for high current latch off
Over temperature protection		115		°C	Hiccup mode
Standby power			1000	mA	5V (total standby and fan power 8W)
Droop rate (-S model)		4		%	No load to full load
Load share accuracy (-S model)		20		%	Full load
Remote on off	ON Open or 3-12V OFF Short or 0-1.2V referenced to "–Control" –0.5 to 1mA current draw.				
Power good signal	Power good : low, Power off : Open collector referenced to –Vout				

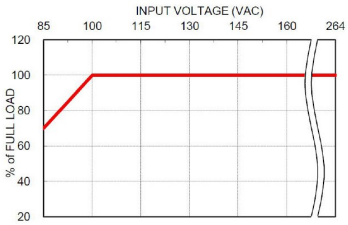
Environmental

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Operating temperature	-40		105	°C	See derating curve page 3. Baseplate temp
Storage temperature	-55		125	°C	Baseplate temp
Temperature coefficient			±0.02	%/°C	
Humidity	5		95	%RH	Non-condensing
Operating altitude			5000	M	
Thermal Shock					MIL-STD-810F
Vibration					MIL-STD-810F
Shock					MIL-STD-810F

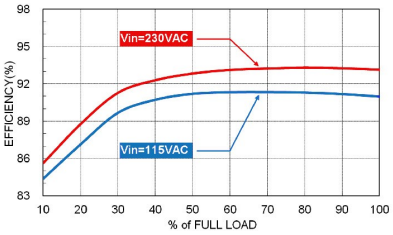
Derating Curves



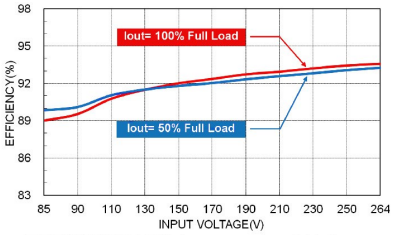
Derating Curve vs. Baseplate Temperature



Derating Curve vs. Input Voltage

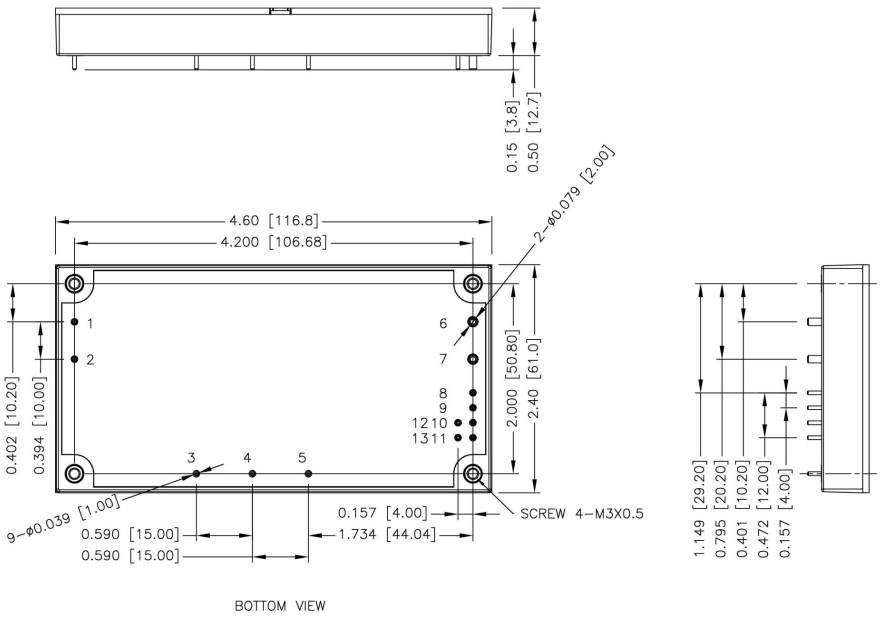


TBF500US24 Efficiency vs. Output Load



TBF500US24 Efficiency vs. Input Voltage

Mechanical Details



Pin Connections Input	
Pin	Function
1	Neutral
2	Line
3	Inrush Ctrl
4	+Vbus
5	-Vbus
6	-Vout
7	+Vout
8	-V sense
9	+V sense
10	Trim
11	PG
12	+Ctrl
13	-Ctrl

Notes

1. All dimensions in inches [mm]. Tolerance 2DP" ±0.02" [1DPmm ±0.5mm] , 3DP" ±0.01" [2DPmm ±0.25mm]
2. Mounting screws not to exceed 5Kgf-cm / 0.49Nm
3. Mounting hole used for PE connection

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General

Parameter	Minimum	Typical	Maximum	Units	Notes & Conditions
Efficiency	90		93	%	See models & Ratings table
Isolation: Input to output	3000			VAC	2x MOPP
Input to baseplate	2500			VAC	
Output to baseplate	1500			VAC	
Isolation resistance	100			MΩ	At 500VDC
Power density			90.57	W/In^3	
Switching frequency		180		KHz	Full load 230VAC
MTBF		250		Khrs	MIL-HDBK-217F 25°C
Case material					Aluminium baseplate with plastic case
Potting material					Silicone (UL94 V-0)
Weight					Open frame 210g

EMC: Emissions

	Standard	Test level	Criteria	Notes & Conditions
Conducted	EN55032	B		With additional components
Radiated	EN55032	A		
Harmonic current	EN61000-3-2	Class D		
Voltage flicker	EN61000-3-3			

EMC: Immunity

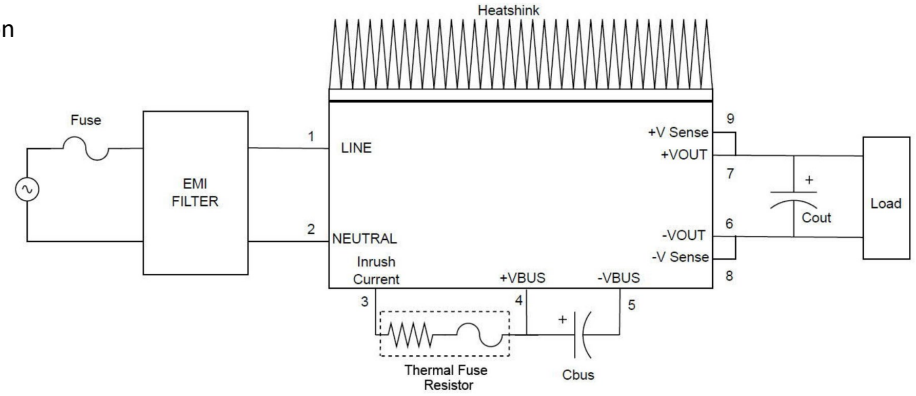
	Standard	Test level	Criteria	Notes & Conditions
ESD	EN61000-4-2	4	A	±8kV contact, ±15kV air
Radiated	EN61000-4-3	3+	A	20V/m
EFT	EN61000-4-4	3	A	±2KV
Surges	EN61000-4-5	Installation Class 3	A	±2KV line—neutral, ±1KV line/neutral—earth
Conducted	EN61000-4-6	3	A	10Vrms
PFMF	EN61000-4-8	4	A	30A/rm
Dips and interruptions	EN61000-4-11			Compliant

Safety Approvals

	Safety standard	Notes & Conditions
UL	UL 62368-1	E193009 Pending
CB	IEC 62368-1	Pending
TUV	EN 62368-1	Pending
CE /UKCA		2014/35/EU Low voltage directive
Equipment protection class		Class I

Application Note

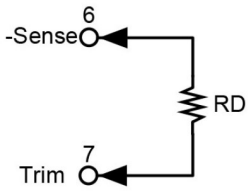
Typical Application



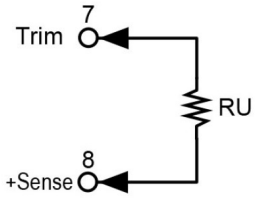
Trim Tables

Output voltage trim function allows the user to increase or decrease the output voltage set point. The module may be connected with an external resistor (Rtrim) between TRIM pin and either +Sense or -Sense. By adjusting Rtrim, the output voltage can be changed by ±10% of nominal the output voltage. Power of resistor needs to be 1/8 of rated power minimum.

Trim up (RU)



Trim Down RD



Trim up equation

$$Ru = \frac{GxL}{Voup - L - K} - H$$

Trim down equation

$$Rd = \frac{(Vodown - L)xG}{Vo - Vodown} - H$$

Module	G	H	K	L
TBF500US12	51000	2000	9.5	2.5
TBF500US15	51000	2000	12.5	2.5
TBF500US24	120000	2000	21.5	2.5
TBF500US28	140000	2000	25.5	2.5
TBF500US48	240000	2000	45.5	2.5
TBF500US54	300000	2000	51.5	2.5

12V OUTPUT TRIM UP											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	12.12	12.24	12.36	12.48	12.60	12.72	12.84	12.96	13.08	13.20	Volts
RU	1060.500	529.25	352.167	263.625	210.5	175.083	149.786	130.813	116.056	104.25	kOhms

15V OUTPUT TRIM UP											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	15.15	15.30	15.45	15.60	15.75	15.90	16.05	16.20	16.35	16.50	Volts
RU	848	423	281.333	210.5	168	139.667	119.429	104.25	92.444	83	kOhms

24V OUTPUT TRIM UP											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	24.24	24.48	24.72	24.96	25.20	25.44	25.68	25.92	26.16	26.40	Volts
RU	1248	623	414.667	310.5	248	206.333	176.571	154.25	136.889	123	kOhms

28V OUTPUT TRIM UP											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	28.28	28.56	28.84	29.12	29.40	29.68	29.96	30.24	30.52	30.80	Volts
RU	1248	623	414.667	310.5	248	206.333	176.571	154.25	136.889	123	kOhms

48V OUTPUT TRIM UP											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	48.48	48.96	49.44	49.92	50.40	50.88	51.36	51.84	52.32	52.80	Volts
RU	1248	623	414.667	310.5	248	206.333	176.571	154.25	136.889	123	kOhms

54V OUTPUT TRIM UP											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	54.54	55.08	55.62	56.16	56.7	57.24	57.78	58.32	58.86	59.4	Volts
RU	1386.889	692.444	460.963	345.222	275.778	229.481	196.413	171.611	152.321	136.889	kOhms

12V OUTPUT TRIM DOWN											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	11.88	11.76	11.64	11.52	11.4	11.28	11.16	11.04	10.92	10.8	Volts
RU	3984.5	1965.75	1292.833	956.375	754.5	619.917	523.786	451.688	395.611	350.75	kOhms

15V OUTPUT TRIM DOWN											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	14.85	14.7	14.55	14.4	14.25	14.1	13.95	13.8	13.65	13.5	Volts
RU	4197	2072	1363.667	1009.5	797	655.333	554.143	478.25	419.222	372	kOhms

24V OUTPUT TRIM DOWN											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	23.76	23.52	23.28	23.04	22.8	22.56	22.32	22.08	21.84	21.6	Volts
RU	10628	5253	3461.333	2565.5	2028	1669.667	1413.714	1221.75	1072.444	953	kOhms

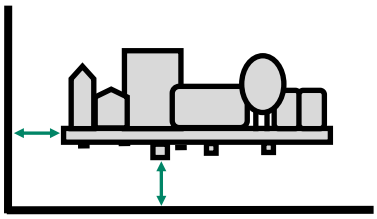
28V OUTPUT TRIM DOWN											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	27.72	27.44	27.16	26.88	26.6	26.32	26.04	25.76	25.48	25.2	Volts
RU	12608	6233	4108	3045.5	2408	1983	1679.429	1451.75	1274.667	1133	kOhms

48V OUTPUT TRIM DOWN											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	47.52	47.04	46.56	46.08	45.6	45.12	44.64	44.16	43.68	43.2	Volts
RU	22508	11133	7341.333	5445.5	4308	3549.667	3008	2601.75	2285.778	2033	kOhms

54V OUTPUT TRIM DOWN											
ΔV%	1	2	3	4	5	6	7	8	9	10	%
Vout	53.46	52.92	52.38	51.84	51.3	50.76	50.22	49.68	49.14	48.6	Volts
RU	28309.111	14003.556	9235.037	6850.778	5420.222	4466.519	3785.302	3274.389	2877.012	2559.111	kOhms

Installation Advice

Safety

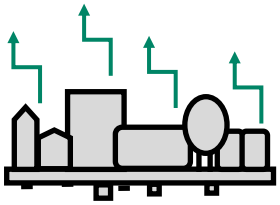


On installation customers must consider the required creepage and clearance distances between the PSU and the end-equipment enclosure. These distances vary depending on the installation class and safety standard requirements.

For **Class I** installations there should be 3-4mm between any part of the PSU and any earthed metal part of the enclosure. 3mm is acceptable for IT applications, 4mm required for medical applications. In Class I installations the PSU earth point must be connected to system safety ground.
For **Class II** installations distances may need to be increased if being installed into a surrounding metal enclosure.
Ensure consideration of components on the underside of the PCB or low lying spills when measuring clearance distances between the PSU and the end-equipment. Also top surface especially in tight enclosures such as 1U boxes. An insulation material can be used between PSU and metal if smaller gap required.

FiDUS recommends installing the PSU on 6mm stand offs typically, but check the distances.

EMC

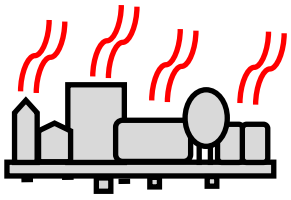


Conducted and radiated emissions compliance is a common application consideration. It is important to remember that even when using a properly filtered PSU, an application may still not achieve compliance if it is not designed to minimise emissions. That being said, there are a number of things that can be done to optimise EMC performance either as best practice, or if you are struggling for compliance:

1) Connect all marked EMI ground points to earth. Often these are combined with the safety earth point (in class I installations), but on some power supplies there may be additional earth tags or mounting points.
2) Minimise the length of input/output wiring where possible and try to maintain max distance of the conductors from the PSU, to prevent noise pick up. Avoid bundling input and output cables together. A common component to avoid placing wiring near is the PFC inductor in power factor corrected power supplies.
3) Apply additional filtering before the PSU input (ensure consideration of which frequencies there are issues with before selecting a filter).
4) When using an open frame PSU, mount the supply on a metal plate and connect EMI mounting points.
5) In multi circuit systems, decouple the circuits locally.
6) Ferrites added between the PSU and system input connector and/or the DC output cables can help in reducing radiated noise issues in systems. If seen, issues are commonly in the 30-150MHz area.

For more detailed assistance, if you still have any concerns with compliance, please get in contact with our Engineering department who are on hand to assist with any queries.

Thermal



Thermal management is an important consideration when thinking about equipment service life. Electrolytic capacitors within the PSU wear with time and are typically the first end-of-life failure. Keeping the operation temperature of key components within the PSU, such as the electrolytic capacitors, as low as possible is paramount. As a general rule, for every 10°C drop in the operating temperature of the electrolytic capacitators you double their lifetime, and thus the lifetime of the power supply. When looking at thermal performance it is helpful to test under a worst-case set of conditions, to ensure component temperatures are in an acceptable range for the required service life. Then consider the impact of operational time, load and temperature profile to estimate a more realistic lifetime for your PSU.

Also, many FiDUS power supplies offer a *Peak Power* rating to provide for customers with pulsing loads. When using a peak power capability customers must consider:
1) Peak duration rating: the maximum length of time the peak can be drawn for
2) Duty cycle: the frequency with which the peak can be drawn. (e.g. 10% duty cycle, 1 second on:9 seconds off)
3) Average power value: datasheets will state the maximum average power acceptable with peak power PSUs.
If any of these elements are exceeded the supply may overheat, with performance and lifetime suffering as a result.