HBT500T series

XP Power

500W Baseplate cooled

DC-DC converters

The HBT500T series of compact 500W DC-DC converters offer single output voltages of 12V to 54VDC for demanding industrial technology applications. Its industry-standard half-brick footprint and integral baseplate simplify mechanical integration, making it suitable for space-constrained systems and applications with limited airflow.

Wide 4:1 input ranges, remote sense, output adjustment, remote on/off and optional current sharing give designers greater control and configuration flexibility, while high efficiency, 3kVDC isolation and comprehensive protection support reliable operation in robotics, autonomous equipment, process control and instrumentation.



Features

- Regulated single outputs 12V to 54VDC
- 4:1 input ranges 9V to 40VDC & 16.5V to 75VDC
- Baseplate cooled half brick package
- 3kVDC input to output isolation
- Wide output voltage trim, -20% to +15%
- High efficiency, up to 92%
- IEC 62368-1 ITE safety agency approvals
- Remote On/Off & remote sense
- Optional current sharing
- Overvoltage, overcurrent & continuous short circuit protection
- -40°C to +105°C operating case temperature
- 3 year warranty

Applications

Process control

Robotics

Instrumentation

Autonomous equipment

Industrial printing

Technology

Dimensions

57.9 x 61.0 x 12.7 mm (2.28" x 2.4" x 0.5")
½ brick package

Documentation

For further information click the link or scan the code

→ xppower.com

Models & ratings

Model number[1,2,3]	Input voltage	Output voltage	Output current	Input current[4]		Efficiency[5]
				No load	Full load	
HBT500T24S12	9-40VDC (24VDC nominal)	12.0VDC	42.0A	80mA	23.4A	90.0%
HBT500T24S24		24.0VDC	21.0A	80mA	23.1A	91.0%
HBT500T24S28		28.0VDC	18.0A	80mA	23.4A	90.0%
HBT500T24S48		48.0VDC	10.4A	100mA	23.2A	90.0%
HBT500T24S54		54.0VDC	9.26A	100mA	23.2A	90.0%
HBT500T48S12	16.5-75VDC (48VDC nominal)	12.0VDC	42.0A	80mA	11.6A	92.0%
HBT500T48S24		24.0VDC	21.0A	80mA	11.6A	91.0%
HBT500T48S28		28.0VDC	18.0A	80mA	11.6A	90.5%
HBT500T48S48		48.0VDC	10.4A	80mA	11.6A	91.5%

Notes:

1. Add suffix '-N' to the model number to receive the unit with negative logic Remote On/Off, e.g. HBT500T24S12-N.
2. Standard mounting holes are 3.2mm clear holes. Add suffix -T for optional M3 x 0.5 threaded holes e.g. HBT500T24S12-T / -NT (negative logic & threaded holes).
3. Add suffix '-LS' to the model number to receive the unit with current share e.g. HBT500T24S12-LS / -TLS / -NLS / -NTLS (threaded holes & current share/negative logic & current share / negative logic, threaded holes & current share).
4. Input current specified at 24VDC & 48VDC nominal input voltage
5. Typical value at 24VDC and 48VDC nominal input voltage at full load.
6. To order optional heatsink, use model number ICH HEATSINK

HBT500T series

Input

Characteristic	Minimum	Typical	Maximum	Units	Notes & conditions
Input voltage range	9		40	VDC	24VDC nominal
	16.5		75		48VDC nominal
Undervoltage lockout		8.5		VDC	On (24VDC nominal), full load
		8.0			Off (24VDC nominal), full load
		16.0			On (48VDC nominal), full load
		15.5			Off (248DC nominal), full load
Input surge			50/100	VDC	24/48VDC nominal, 100ms
Input current	See models and ratings table				
Input reflected ripple current		100		mA	Through 12µH inductor, 5Hz to 20mHz, 24 & 48VDC nominal
Input filter	Pi type				

Output

Characteristic	Minimum	Typical	Maximum	Units	Notes & conditions
Output voltage trim	-20		+10	%	24S54 at ≥12VDC input
	-20		+15		Others at ≥12VDC input (24Sxx) and ≥17VDC input (48Sxx)
Initial set accuracy			±1.0	%	24VDC & 48VDC input voltage, full load
Minimum load	No minimum load required				
Line regulation			±0.2	%	Measured from high line to low line, full load
Load regulation			±0.2	%	24VDC & 48VDC input voltage, full load to no load
Transient response			±5.0	%	Maximum deviation, recovery to within 1%, 25% step load change
Start up delay		40		ms	
Rise time		100		ms	
Ripple and noise			120	mV pk-pk	12VDC, 20MHz bandwidth with 100µF polymer capacitor and 1.0µF ceramic capacitor, full load
			280		24VDC & 28VDC, 20MHz bandwidth with 10µF polymer capacitor and 1.0µF ceramic capacitor, full load
			480		48VDC & 54VDC, 20MHz bandwidth with 10µF aluminium capacitor and 1.0µF ceramic capacitor, full load
Overvoltage protection	120		140	%	48V & 54V model OVP <60V, Clamp, auto recovery
Short circuit protection	Continuous, auto recovery				
Overcurrent protection	110		140	%	Hiccup mode, auto recovery
Thermal shutdown		110		°C	Case temperature, non latching
Temperature coefficient		±0.02		%/°C	
Remote on/off	Standard version: Output is 'ON' if remote On/Off (pin 2) is open or high (3.5-75VDC) with respect to -Vin (pin 4) Output turns 'OFF' if remote On/Off (pin 2) is low (<1.2VDC max) with respect to -Vin (pin 4) Negative Logic (optional, -N): Output is 'OFF' if remote On/Off (pin 2) is open or high (3.5-75VDC) with respect to -Vin (pin 4) Output turns 'ON' if remote On/Off (pin 2) is low (<1.2VDC max) with respect to -Vin (pin 4)				
Remote sense	Compensates up to 10%/15% (54VDC/others) of Vout nominal				
Current share	±20%/±10% (54VDC/others) load accuracy at 50%-100% load for 2 modules. If use more modules, please contact XP Power.				

HBT500T series

General

Characteristic	Minimum	Typical	Maximum	Units	Notes & conditions
Efficiency	See models & ratings table				
Isolation: input to output	3000			VDC	60s, reinforced
Isolation: input to case	1600				60s, basic
Isolation: output to case	1600				60s, basic
Isolation resistance	10^7			Ω	
Isolation capacitance		2000		pF	
Switching frequency		250		kHz	48Vin (28VDC, 48VDC)
		200			Other models
Power density		11.5 (182.7)		Wcm^3 (W/in^3)	
Mean time between failure	400			khrs	MIL-HDBK-217F, +25°C GB

Environmental

Characteristic	Minimum	Typical	Maximum	Units	Notes & conditions
Operating case temperature	-40		+105	°C	See derating curve
Maximum case temperature			+110	°C	Measured at the centre of the case
Storage temperature	-55		+125	°C	
Operating humidity			95	%RH	Non-condensing
Cooling	Baseplate cooled				

EMC: emissions

Phenomenon	Standard	Test level	Notes & conditions
Conducted	EN55032	A	With external components
Radiated	EN55032	A	With external components

EMC: Immunity

Phenomenon	Standard	Test level	Criteria	Notes & conditions
ITE / Low voltage PSU EMC	EN55035/ EN 61204-3		as below	
ESD immunity	EN61000-4-2	±6kV contact, ±8kV air	A	
Radiated	EN61000-4-3	20V/m	A	
EFT/burst	EN61000-4-4	±2kV	A	On power input port with external components
Surges	EN61000-4-5	±2kV	A	With external components
Conducted	EN61000-4-6	10Vrms	A	

Safety approvals

Safety agency	Standard	Notes & conditions
EN	EN62368-1	
UL	UL62368-1, IEC62368-1	
CE	Meets all applicable directives	
UKCA	Meets all applicable legislation	

Application notes

Output voltage adjustment

The Trim input permits the user to adjust the output voltage up by 15% or down by 20% (except for 54V model, output voltage up by 10% or down by 20%). This is accomplished by connecting an external resistor between the Trim pin and either the +Sense pin or the -Sense pin. The trim pin should be left open if trimming is not being used.

To trim up

Connecting an external resistor (Ru) between the Trim pin and the -Sense pin increases the output voltage. The following table can be used to determine the required external resistor value to obtain a percentage output voltage change of Δ%.

Trim up	12V	24V	28V	48V	54V
%	Ru (kΩ)				
1	263.17	515.62	666.51	1040.50	1075.00
2	126.59	247.81	321.65	498.72	512.44
3	81.06	158.54	206.7	318.04	324.63
4	58.29	113.91	149.23	227.73	230.71
5	44.63	87.12	114.74	173.54	174.38
6	35.53	69.27	91.75	137.42	136.81
7	29.02	56.52	75.33	111.62	109.98
8	24.15	46.95	63.01	92.27	89.86
9	20.35	39.51	53.43	77.21	74.21
10	17.32	33.56	45.77	65.17	61.69
11	14.83	28.69	39.50	55.32	
12	12.76	24.64	34.28	47.11	
13	11.01	21.2	29.85	40.16	
14	9.51	18.26	26.06	34.21	
15	8.21	15.71	22.78	29.05	

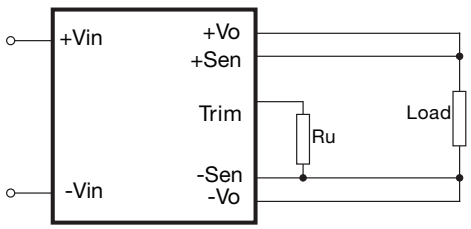
To trim down

Connecting an external resistor (Rd) between the Trim pin and the +Sense pin decreases the output voltage. The following table can be used to determine the required external resistor value to obtain a percentage output voltage change of Δ%.

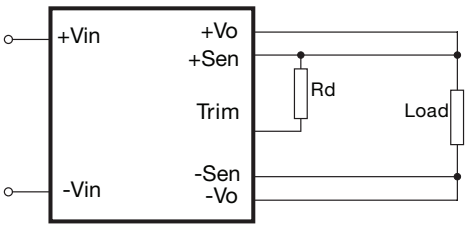
Trim down	12V	24V	28V	48V	54V
%	Rd (kΩ)				
1	389.67	929.51	811.80	1715.60	2382.10
2	186.43	447.25	386.60	821.86	1147.50
3	118.69	286.50	244.87	523.94	736.05
4	84.82	206.13	174.00	374.98	530.28
5	64.49	157.90	13.48	285.60	406.83
6	50.94	125.75	103.13	226.02	324.52
7	41.27	102.79	82.89	183.46	265.73
8	34.01	85.56	67.70	151.54	221.64
9	28.36	72.17	55.89	126.71	187.35
10	23.85	61.45	46.44	106.85	159.91
11	20.15	52.68	38.71	90.60	137.47
12	17.07	45.38	32.27	77.06	118.76
13	14.47	39.19	26.82	65.60	102.93
14	12.23	33.89	22.14	55.78	89.37
15	10.30	29.30	18.09	47.27	77.61
16	8.60	25.28	14.55	39.82	67.32
17	7.11	21.74	11.42	33.25	58.24
18	5.78	18.58	8.64	27.41	50.17
19	4.59	15.76	6.16	22.18	42.95
20	3.52	13.23	3.92	17.48	36.46

External trim

Voltage trim up



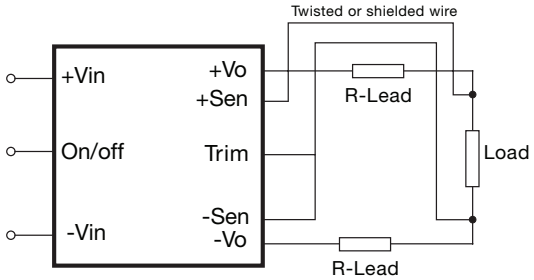
Voltage trim down



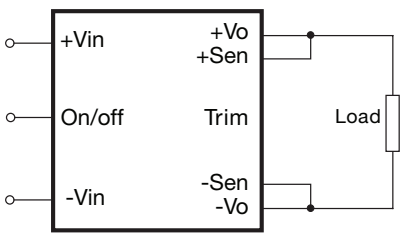
Remote/local sensing

The HBT500T series converter has the capability to remotely sense both output lines. This automatically adjusts the output voltage to compensate for voltage drops in distribution and maintains a regulated voltage at the point of load. The remote sense voltage range is: ≤ 10% / ≤ 15% (54V model / others) of Vo nominal. If the remote sense is not used, the sense pins should be connected locally where +Sense pin should be connected to +Vout pin and -Sense pin to -Vout pin.

Remote sensing



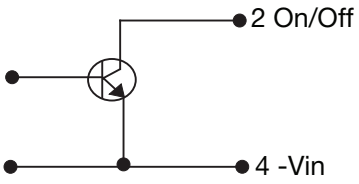
Local sensing



Application notes

Remote on & off control

The HBT500T series converter allows the user to switch the module on and off electronically with the remote on / off feature.
If not using the remote on/off pin, leave the pin open.



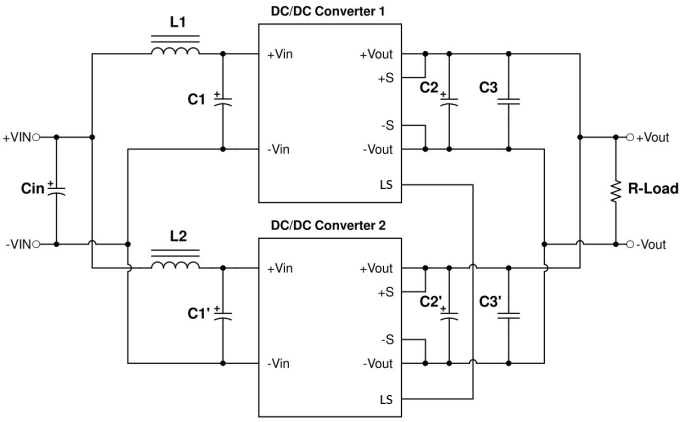
Positive logic: "On" if pin 2 is high >3.5V to 36VDC
"Off" if pin 2 is low <1.2V to 0VDC

Negative logic (-N): "Off" if pin 2 is high >3.5V to 36VDC
"On" if pin 2 is low <1.2V to 0VDC

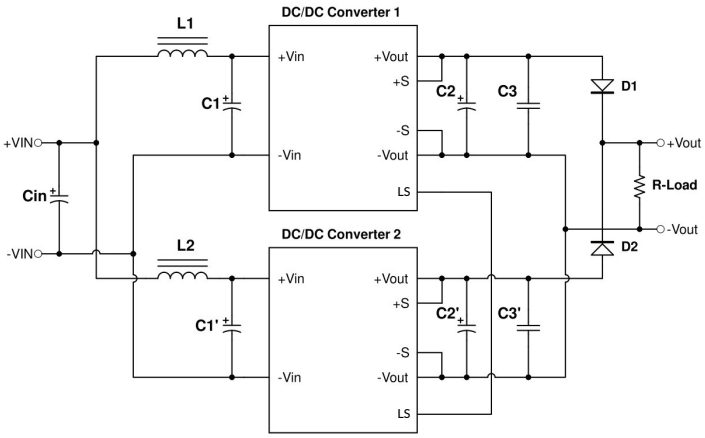
Parallel configuration

The HBT500T series are also designed for parallel operation (optional, -LS suffix).

When paralleled, the load current can be equally shared between modules by connecting the LS pins together.



Parallel configuration

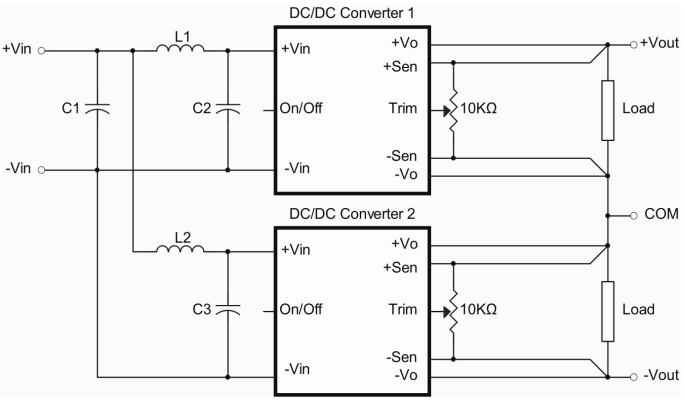


L1, L2: 1.0µH
Cin, C1, C1': 2200µF/100V ESR <0.12Ω
C2, C2': 1000µF/63V
C3, C3': 1µF MLCC

If the impedance of input line is high, Cin, C1 capacitance must be more than above. Use more than two recommended capacitors above in parallel when ambient temperature becomes lower than -20°C.

Redundant configuration

Parallel for redundancy operation is possible by connecting the units as shown below. The current of each converter becomes unbalanced by a slight difference of the output voltage. Make sure that the output voltage of units of equal value and the output current from each power supply does not exceed the rated current. Suggest using an external potentiometer to adjust output voltage from each power supply.

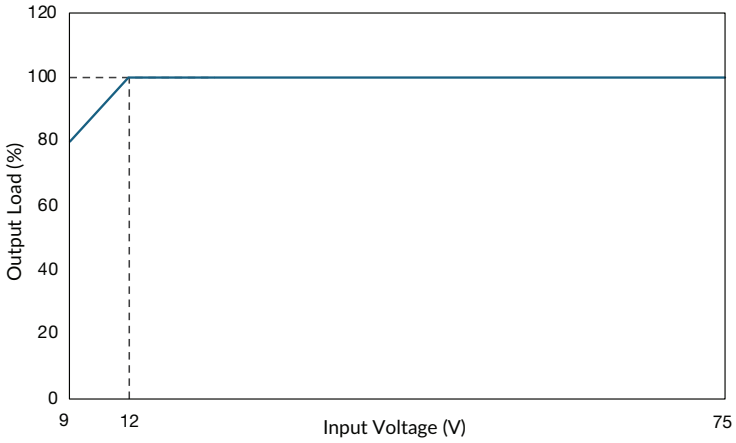


L1, L2: 1.0µH
C1, C2, C3: 2200µF/100V ESR <0.12Ω

If the impedance of input line is high, C1, C2, C3 capacitance must be more than above. Use more than two recommended capacitors above in parallel when ambient temperature becomes lower than -20°C

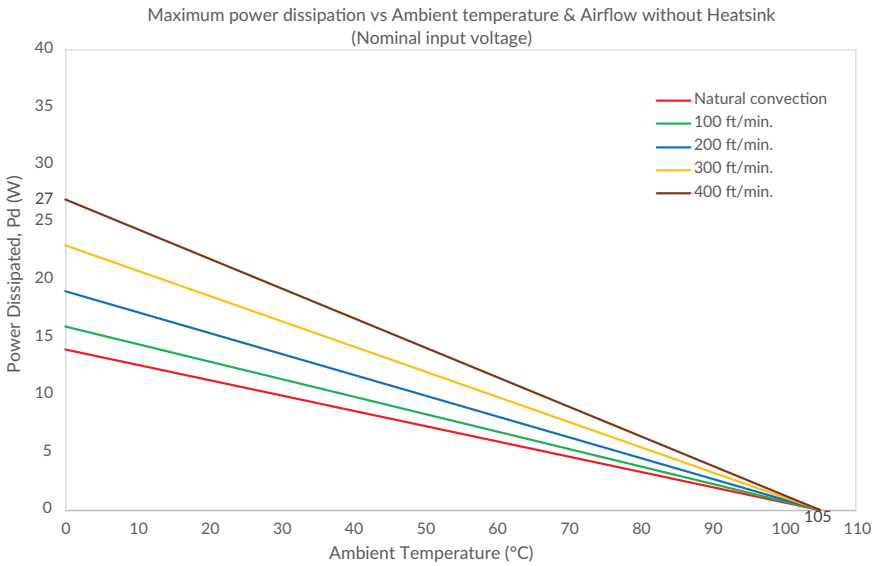
Application notes

Input derating curve



Power derating curves

Without heatsink

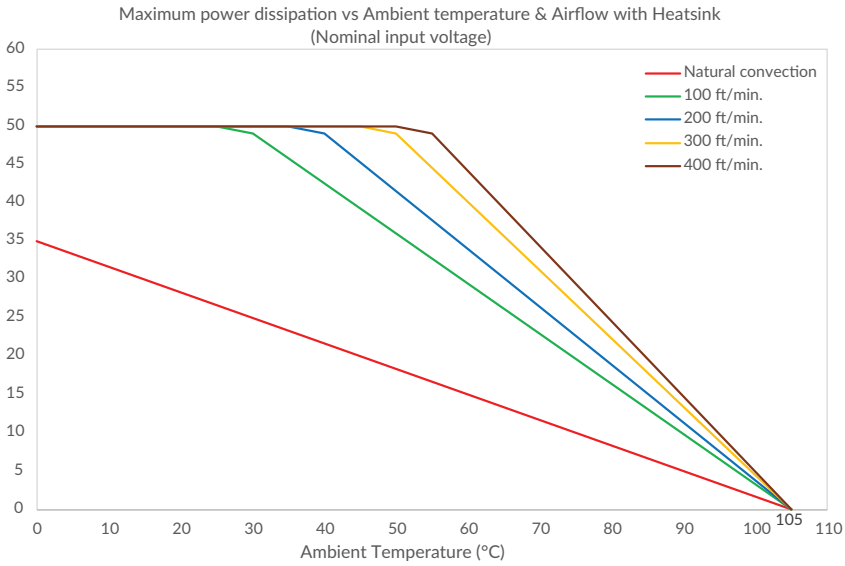


Air flow rate	Typical Rca
Natural Convection 20ft./min. (0.1m/s)"	7.12°C/W
100 ft./min. (0.5m/s)	6.21°C/W
200 ft./min. (1.0m/s)	5.17°C/W
300 ft./min. (1.5m/s)	4.29°C/W
400 ft./min. (2.0m/s)	3.64°C/W

Application notes

Power derating curves

With heatsink



Air flow rate	Typical Rca
Natural Convection 20ft./min. (0.1m/s)"	3.00°C/W
100 ft./min. (0.5m/s)	1.44°C/W
200 ft./min. (1.0m/s)	1.17°C/W
300 ft./min. (1.5m/s)	1.04°C/W
400 ft./min. (2.0m/s)	0.95°C/W

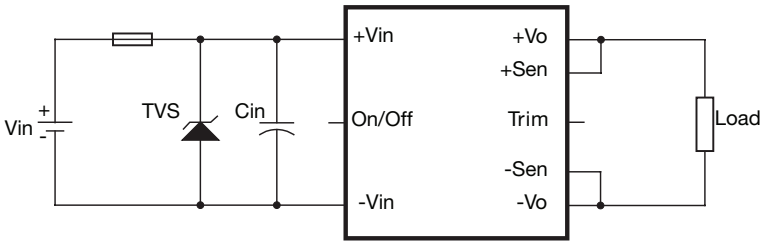
Rca = Thermal resistance from case to ambient
To order heatsink, use part number ICH HEATSINK

Example with heatsink

To determine the minimum airflow necessary for a HBT500T24S24 operating at nominal line voltage, an output current of 21.0A and maximum ambient of +50°C.
Determine power dissipation (Pd): Pd=Pi-Po=Po(1-η)/η,
Where Pi = Input power, Po = Output power and η = Efficiency (refer to models & ratings table)
Pd=24×21.0× (1-0.91)/0.91=49.85Watts
Determine airflow from airflow derating graph using data points for Pd = 49.85W and Ta=+50°C,
then take the next line up to get the minimum airflow = 400ft/min
To determine the heatsink/typical Rca, refer to the Air flow Rate table.
To check the maximum case temperature of +110°C is not exceeded:
Determine maximum temperature rise (ΔT):
ΔT= Pd×Rca, where Rca is the thermal resistance from case to ambient ΔT= 49.85×0.97=48.35°C
Determine maximum case temperature (Tc):
Tc=Ta+ΔT, where Ta is ambient temperature Tc=50+48.35=98.35°C <110°C

Input fusing and safety considerations

The HBT500T series converters have no internal fuse. In order to achieve maximum safety and system protection, always use an input line fuse. We recommended a 80A / 40A time delay fuse for 24V / 48V nominal input models. It is recommended that the circuit has a transient voltage suppressor diode (TVS) and external input capacitor (Cin) across the input terminals to protect the unit against surge or spike voltages and input reverse voltages (as shown). A suitable part would be SMDJ40A / SMDJ78A (TVS) for 24V / 48V nominal input models and 3300µF/100V (Cin).

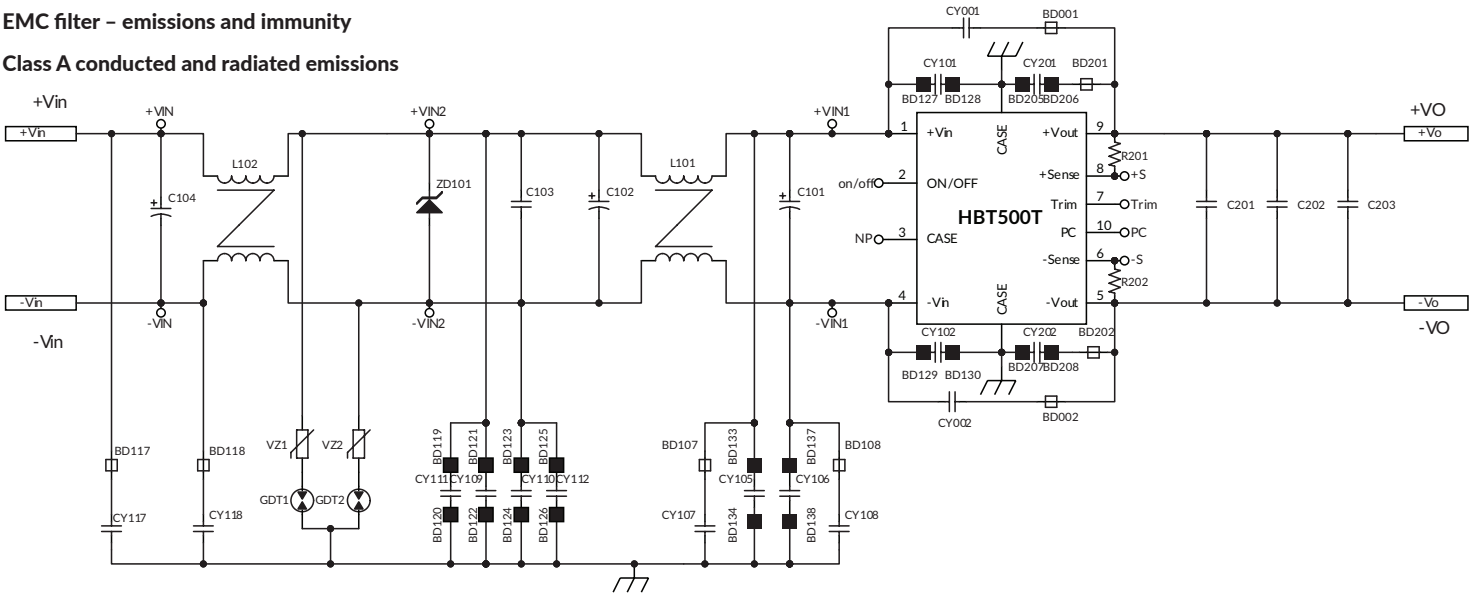


HBT500T series

Application notes

EMC filter – emissions and immunity

Class A conducted and radiated emissions

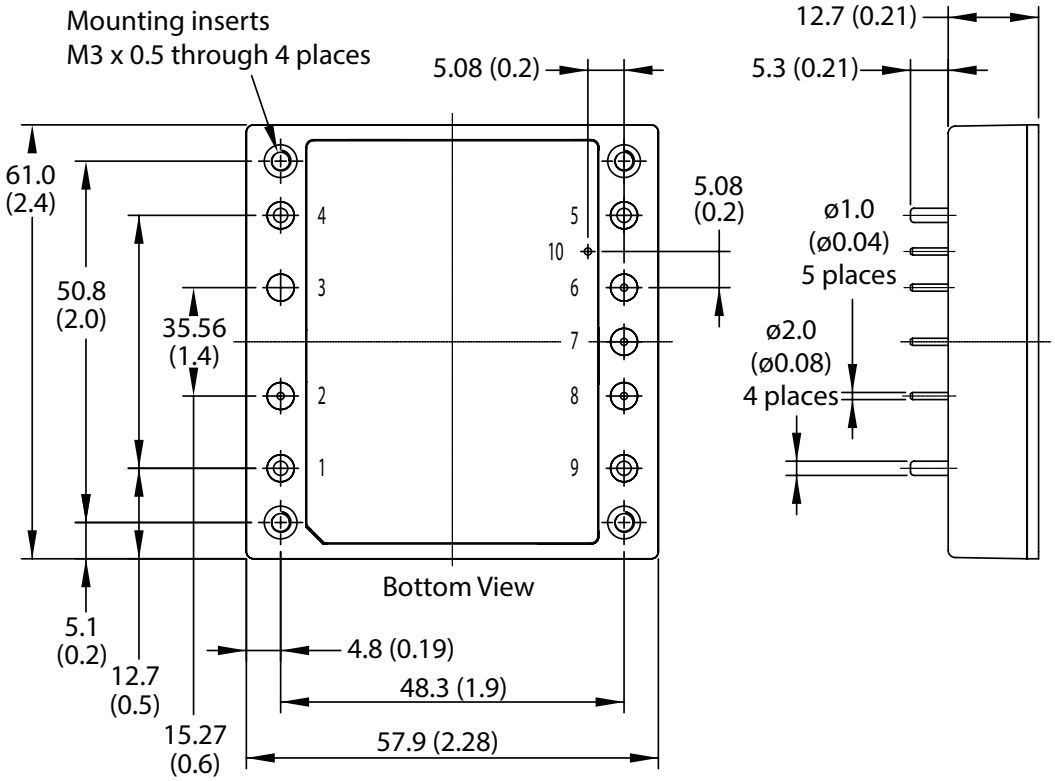


	24S12	24S24	24S28	24S48	24S54	48S12	48S24	48S28	48S48
C101, C102, C104	820µF/50V					470µF/100V			
C103	10µF/50V					NC			
C201	NC					10µF/25V	6.8µF/50V		4.7µF/100V
C202	1µF/250V								
CY001, CY002	NC					2200pF/2211	NC		2200pF/2211
CY101, CY102	4700pF/250V								
CY105, CY106	NC		2200pF/400V			NC			
CY107, CY108	2200pF/250V					NC	2200pF/250V	NC	
CY109, CY110	4700pF/250V					2200pF/250V		NC	
CY111, CY112	2200pF/400V			4700pF/250V			2200pF/250V	4700pF/250V	
CY117, CY118	NC						680pF/4kV	NC	
CY201, CY202	10000pF/250V								
BD001, BD002	NC					2200pF/2211	NC		2200pF/2211
BD107, BD108	BHP403022R52-400T-G					NC	BHP853025R5-101T-NB	NC	
BD117, BD118	NC						BHP853025R5-101T-NB	NC	
BD119, BD120, BD125, BD126	BRH3.5*3.2*1.2mm CHILISIN			NC		SN030 T2.8*1.7*1.2 SM			
BD121, BD122, BD123, BD124	NC					SN030 T2.8*1.7*1.2 SM		NC	
BD127, BD128, BD129, BD130	NC					SN030 T2.8*1.7*1.2 SM			
BD205, BD206, BD207, BD208	SN030 T2.8*1.7*1.2 SM								
R201, R202	0R 1%								
L101	1.58mH					3.1mH			
L102	1.58mH								
ZD201	SMDJ40A					SMDJ78A			
VZ1, VZ2	TVR10471KIC7AV								
GDT1, GDT2	2RK2500M-5-SS								

Notes:

C101, C102, C104: 24Sxx (NIPPON CHEMI-CON KY series aluminium capacitor or equivalent), 48Sxx (SUSCON SDN series aluminium capacitor or equivalent)
C103: 2220 X7R ceramic capacitors
C201, C202: 1812 X7R ceramic capacitors
C203: NC
CY001, CY002: Y2 CAP. SMD 2211 X7R
CY101, CY102, CY105, CY106, CY109, CY110, CY111, CY112: TDK Y1 DIP capacitor or equivalent
CY107, CY108: Y2 CAP, SMD 2211 X7
CY117, CY118: SMD 1808 X7R
CY201, CY202: TDK Y2 DIP capacitor or equivalent
BD107, BD108, BD117, BD118: SMD bead core TAI-TECH or equivalent
BD133, BD134, BD137, BD138: NC
BD201, BD202: SHORT
R201, R202: 0805 chip resistor
L101 (3.1mH): W523 core Nanocrystalline VAC, wire 1.5mm*1/10T
L101, L102 (1.58mH): T60405-R6123-X263 VAC or HF322010-371B204-PF SUNLEI or MP5093015-220204BFA-L4.5 GLOBAL MAGIC or equivalent
ZD101: TVS SMD DO-214AB LITTLEFUSE
VZ1, VZ2: TVR10471KIC7AV TKS or equivalent
GDT1, GDT2: 2RK2500M-5-SS YAGEO or equivalent

Mechanical details



Pin	Standard	Option -LS
1	+Vin	+Vin
2	Remote On/Off	Remote On/Off
4	No pin	No pin
5	-Vin	-Vin
6	-Vout	-Vout
7	-Sense	-Sense
8	Trim	Trim
9	+Vout	+Vout
10	No pin	LS (option)

Pin size: ø1.0 ±0.1 (ø0.04 ±0.004)
Pin size: ø2.0 ±0.1 (ø0.08 ±0.004)

Notes:

]1. All dimensions are in mm (inches)
2. Weight: 114g / 138g (0.25lbs / 0.30lbs) 24Sxx / 48sxx approx
3. Tolerances: x.xx (x.x) = ±0.5 (±0.02). x.xxx (x.xx) = ±0.25 (±0.01)
4. Optional M3 x 05 threaded mounting holes add suffix -T