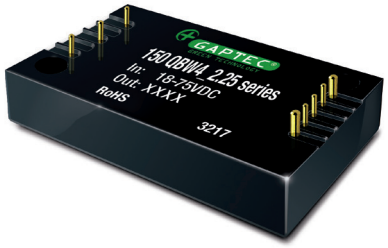


150QBW4_2.25 series

150W Quarter-Brick - Single Output DC-DC Converter - Ultra-wide Input - Isolated & Regulated

24Vin DC-DC Converter 150 Watt

- **Ultra-wide 4:1 input voltage range**
- **High efficiency up to 89%**
- **I/O isolation test voltage: 2250VDC**
- **Operating ambient temp. range -40°C to +85°C**
- **Input under-voltage protection**
- **Output over–voltage, over-current, short-circuit protection, over-temperature protection**
- **Five-sided metal shielded package**
- **Industry standard ¼-Brick package and pin-out**

150QBW4_S2.25 of isolated 150W DC-DC product with ultra-wide 4:1 input voltage. It features efficiency up to 89%, 2250VDC input to output isolation, operating ambient temperature of -45°C to +85°C, input under-voltage, output over–voltage, over-current, short-circuit protection, over-temperature protection. The products meet CLASS A of CISPR32/EN55032 EMI standards by adding the recommended external components, and they are widely used in applications such as battery powered systems, industrial controls, electricity, instrumentation, railway, communication and intelligent robotic.

Common specifications

Short circuit protection:	Continuous, self-recovery
Operation temperature range:	-40°C~+85°C
Storage temperature range:	-55°C ~+125°C
Over temperature protection:	95°C(MIN.) 105°C(TYP.) 115°C(MAX.)
Pin welding resistance temperature:	300°C MAX, 1.5mm from case for 10sec. 260°C MAX, Wave-soldering, 10sec.
Storage humidity range:	5 ~ 95 %RH (Non-condensing)
Shock and Vibration Test:	IEC/EN61373 - Category 1, Grade B
Trim:	90%Vo MIN, 110%Vo MAX
Sense:	105%Vo MAX
MTBF:	500,000 hours
Case material:	Aluminum alloy case; Black plastic bottom, flame-retardant and heat-resistant (UL94 V-0)
Cooling:	Free air convection (20LFM) or forced air convection
Dimensions:	61.8*40.2*12.7 mm 62.0*56.0*14.6 mm (with base-plate) 61.8*40.2*27.7 mm (with heatsink)

Input specifications

Item	Test condition	Min	Typ	Max	Units
Input current	full load/no load, nominal Vin		7023/100	7184/200	mA
Reflected ripple current	Nominal Vin		100		mA
Surge voltage	1sec. max.	-0.7		50	VDC
Start-up Voltage	100% load			9	VDC
Input under voltage protection		5.5	6.5		VDC
Input filter	Pi filter				
Ctrl*	• Module on • Module off • Input current when off	Ctrl open circuit or connected to TTL high level (3.5-12VDC) Ctrl pin connected to GND or low level (0-1.2VDC)		2 10	mA
Hot plug	Unavailable				

Note: *The Ctrl pin voltage is referenced to input GND.

Output specifications

Item	Test condition	Min	Typ	Max	Units
Voltage accuracy			±1	±3	%
Line regulation	Input voltage variation from low to high at full load		±0.2	±0.5	%
Load regulation			±0.5	±0.75	%
Transient recovery time	25% load step change		300	500	µs
Transient response deviation	25% load step change @25°C			±5	%
Temperature coefficient	Full load			±0.03	%/°C
Ripple & Noise*	20MHz Bandwidth		150	300	mVp-p
Output over-voltage protection	Input voltage range	110	130	160	%Vo
Output over-current protection	Input voltage range	110	130	150	%Io
Switching frequency	PFM mode		250		KHz

*The "parallel cable" method is used for ripple and noise test, please see DC-DC

Isolation specifications

Item	Test condition	Min	Typ	Max	Units
Isolation voltage*	• Input-output • Input-case • Output-case	2250 1500 500			VDC VDC VDC
Isolation resistance	Insulation voltage 500VDC	100			MΩ
Isolation capacitance	Input-output, 100KHz/0.1V		2200		pF

* Electric Strength Test for 1 minute with a leakage current of 1mA max

Example:
150QBW4_2424S2.25
150 = 150 Watt; QB = Quarter-Brick; W4 = Wide input (4:1);
24 = 9-36 Vin; 24 = 24Vout; S = Single Output; 2.25 = 2.25kVDC

Note:
1. Operation under minimum load will not damage the converter; However, they may not meet all specification listed, and that will reduce the life of product.
2. All specifications measured at Ta = 25°C, humidity <75%, nominal input voltage and rated output load unless otherwise specified.
3. In this datasheet, all the test methods of indications are based on corporate standards.
4. The products do not support parallel connection of their output.
5. The product test process shall ensure that the current of the input terminal meets the requirements of the starting current to ensure that the power supply of

EMC specifications				
Emissions	CE	CISPR32/EN55032	CLASS A (see EMC recommended circuit, fig. 2)	
Emissions	RE	CISPR32/EN55032	CLASS A (see EMC recommended circuit, fig. 2)	
Immunity	ESD	IEC/EN61000-4-2	Contact ±6KV/Air ±8KV	perf. Criteria B
Immunity	RS	IEC/EN61000-4-3	20V/m	perf. Criteria A
Immunity	CS	IEC/EN61000-4-6	10 Vr.m.s	perf. Criteria A
Immunity	EFT	IEC/EN61000-4-4	±2KV 5/50ns 5kHz (see EMC recommended circuit, fig. 2)	perf. Criteria A

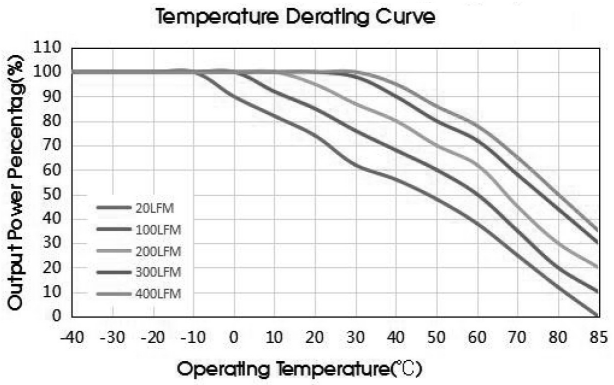
EMC specifications (EN50155)				
Emissions	CE	EN50121-3-2 EN55016-2-1	150kHz-500kHz 99dBuV (see Fig. 2 for recommended circuit) 500kHz-30MHz 93dBuV	
Emissions	RE	EN50121-3-2 EN55016-2-1	30MHz-230MHz 40dBuV/m at 10m (see Fig. 2 for recommended circuit) 230MHz-1GHz 47dBuV/m at 10m	
Immunity	ESD	EN50121-3-2 B	Contact ±6KV/Air ±8KV	perf. Criteria
Immunity	RS	EN50121-3-2 A	20V/m	perf. Criteria
Immunity	CS	EN50121-3-2	0.15MHz-80MHz 10 Vr.m.s	perf. Criteria A
Immunity	EFT	EN50121-3-2	±2KV 5/50ns 5kHz (see EMC recommended circuit, fig. 2)	perf. Criteria A

Product Selection Guide

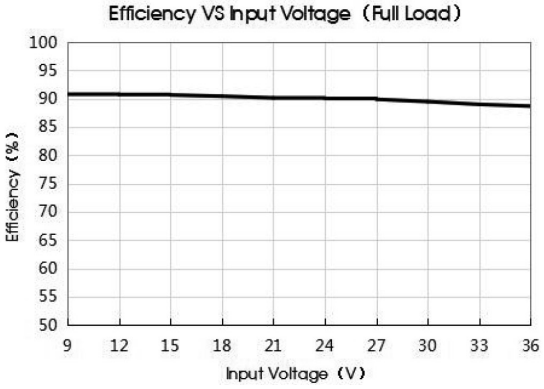
Part Number	Input Voltage [V] Nominal	Range	Max	Output Voltage [VDC]	Output Current [A, max]	Efficiency [%, Min/Typ]	Capacitive load [µF, max]
150QBW4_2424S2.25	24	9-36	40	24	6.25	87/89	1000

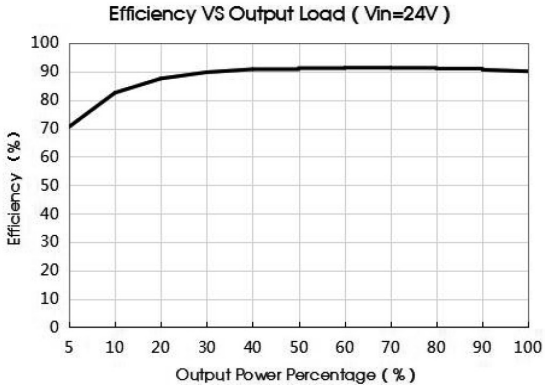
For aluminium base-plate add -BP at the end, f.ex. 150QBW4_xxyyS2.25_24-BP, for heatsink add -H at the end, f.ex. 150QBW4_xxyyS2.25_24-H.

Temperature derating curves



Efficiency



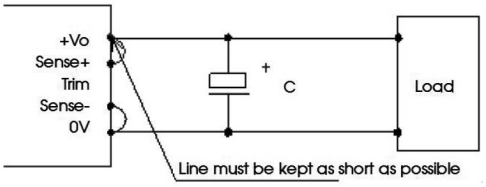


Sense of application and precautions

Remote Sense Connection if not used

Notes:

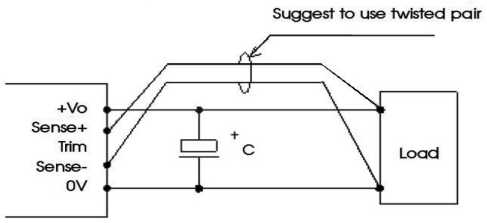
1. When not using remote sense, make sure + Vo and Sense + are shorted, and that 0V and Sense- are shorted as well;
2. Keep the tracks between + Vo and Sense +, 0V and Sense- as short as possible and close to the terminal. Avoid a looping track. If noise interferes the loop, the operation of the power module will become unstable.



Remote Sense Connection used for Compensation

Notes:

(1) Using remote sense with long wires may cause unstable output, please contact technical support if long wires must be used.
(2) PCB-tracks or cables/wires for Remote Sense must be kept as short as possible. Twisted pair or shielded wairs are suggested for remote compensation and must be kept as short as possible.
(3) We recommend using adequate cross section for PCB-track layout and/or cables to connect the power supply module to the load in order to keep the voltage drop below 0.3V and to make sure the power supply's output voltage remains within the specified range.
(4) Note that large wire impedance may cause oscillation of the output voltage and/or increased ripple. Consult technical support or factory for further advice of sense operation.



Typical application

(1) We recommend using the recommended circuit shown in Fig.1 during product testing and application, otherwise please ensure that at least a 220μF electrolytic capacitors is connected at the input in order to ensure adequate voltage surge suppression and protection.
(2) We recommend increasing the value of Cin and pay attention to the unstable input voltage if the product input side is paralleled with motor drive circuit and/or larger energy transient circuits, to ensure the stability of input terminal and avoid repeatedly start-up problems due to input voltage lower than under-voltage protection point.
(3) We recommend increasing the output capacitance with limited to the capacitive load specification and/or increasing the voltage clamping circuit(such as TVS) if the output terminal is inductive device such as relay or a motor, to ensure adequate voltage surge
suppression and protection.
(4) Input and/or output ripple can be further reduced by appropriately increasing the input & output capacitor values Cin and Cout and/or by selecting capacitors with a low ESR (equivalent series resistance). Also make sure that the capacitance is not exceeding the specified max. capacitive load value of the product.

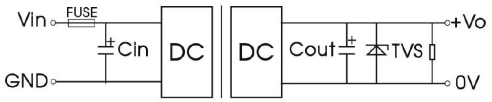


Fig.1

Vout(VDC)	Fuse	Cin*	Cout	TVS
20 220μF	20A, slow blow	220μF	100μF	SMDJ28A

Note: Please pay attention to the ambient temperature of the product when

EMC solution recommended circuit

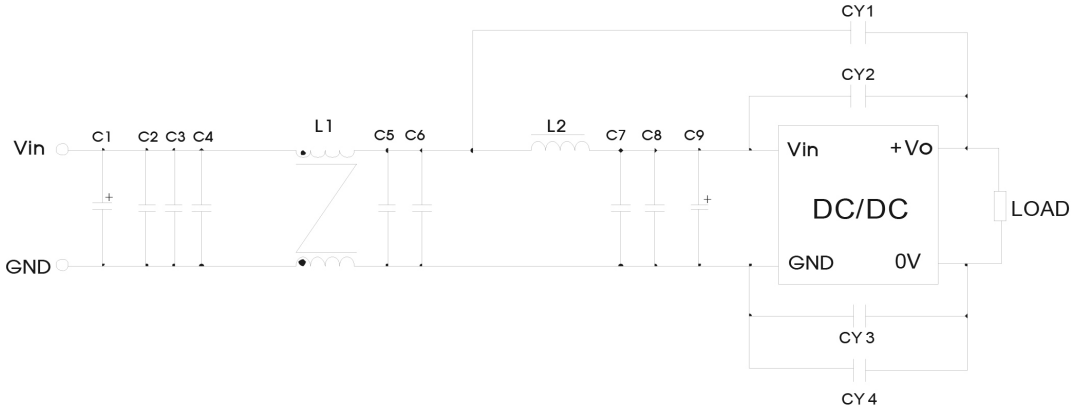
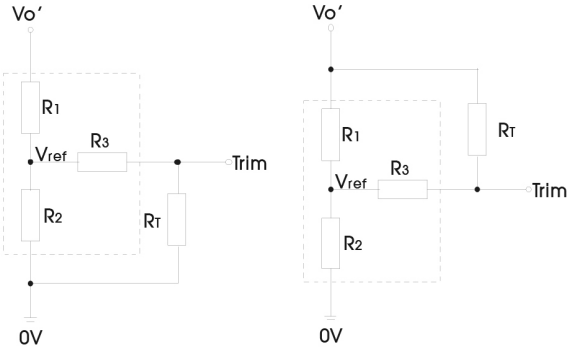


Fig. 2

Components	Recommended Component value
C1	150μF/100V electrolytic capacitor
C9	47μF/100V electrolytic capacitor
C2, C3, C4, C5, C6, C7, C8	2.2μF/100V ceramic capacitor
L1	1.0mH/20A common mode inductor
L2	1.5μH/20A inductance
CY1, CY2, CY3, CY4	1nF Y1 safety capacitor

Trim



TRIM resistor connection (dashed line shows internal resistor network)

Calculation formula of Trim resistance:

$$\text{up: } R_T = \frac{aR_2}{R_2 - a} - R_3 \qquad a = \frac{V_{ref}}{Vo' - V_{ref}} \cdot R_1$$

$$\text{down: } R_T = \frac{aR_1}{R_1 - a} - R_3 \qquad a = \frac{Vo' - V_{ref}}{V_{ref}} \cdot R_2$$

Note:
Value for R1, R2, R3, and V_{ref} refer to the above table 1.
R_T: Resistance of Trim.
a: User-defined parameter, no actual meanings.
Vo': The trim up/down voltage.

Vout(V)	R1(KΩ)	R2(KΩ)	R3(KΩ)	Vref(V)
24	24.872	2.87	15	2.5

e.g. Trim up 10%:

$$a = \frac{2.5}{26.4 - 2.5} \times 24.872 = 2.6$$

$$R_T = \frac{2.6 \times 2.87}{2.87 - 2.6} - 15 = 12.637K\Omega$$

Trim down 10%:

$$a = \frac{21.6 - 2.5}{2.5} \times 2.87 = 21.9268$$

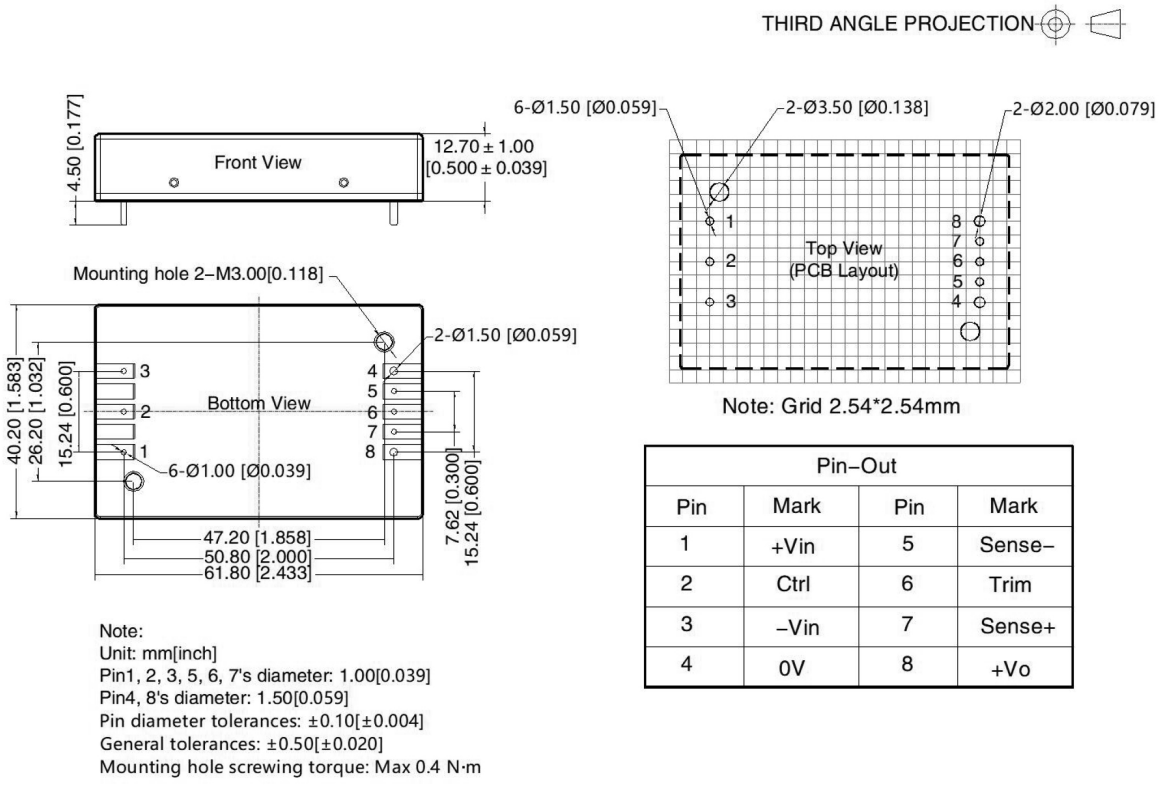
$$R_T = \frac{21.9268 \times 24.872}{24.872 - 21.9268} - 15 = 170.17K\Omega$$

When using the Trim down function make sure that the RT resistor value is calculated correctly. If the Trim pin is shorted with +Vo, or its value is too low, then the output voltage Vo would be lower than 0.9Vo, which may cause

Reflected ripple current--test circuit

Note: Lin(4.7μH), Cin(220μF, ESR<1.0Ω at 100 KHz)

Mechanical dimensions and recommended layout

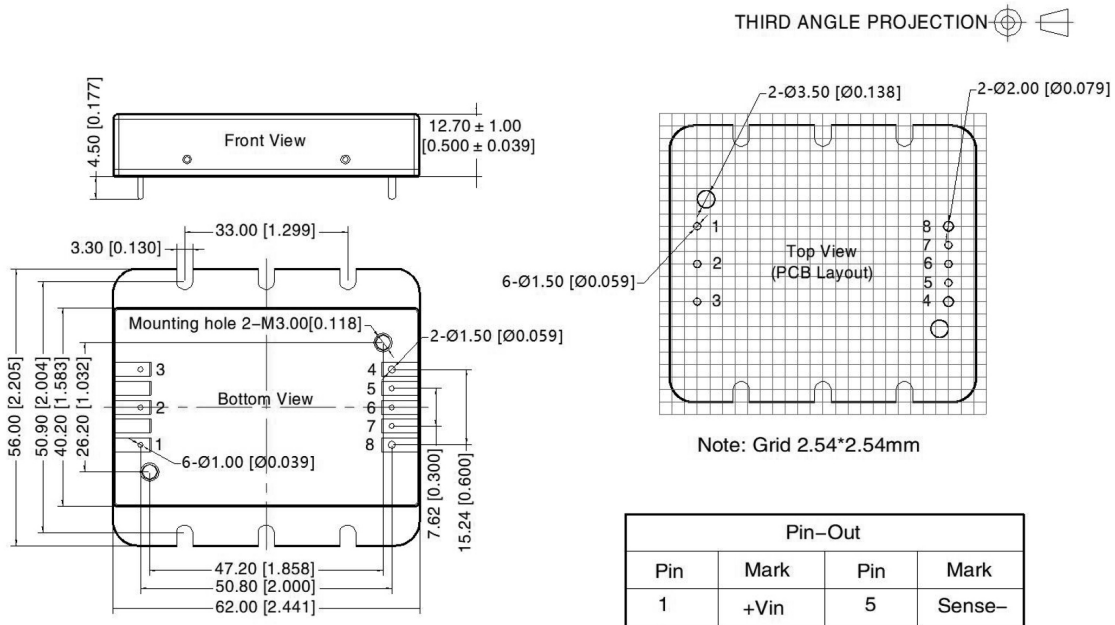


Note: Grid 2.54*2.54mm

Pin–Out			
Pin	Mark	Pin	Mark
1	+Vin	5	Sense–
2	Ctrl	6	Trim
3	–Vin	7	Sense+
4	0V	8	+Vo

Note:
Unit: mm[inch]
Pin1, 2, 3, 5, 6, 7's diameter: 1.00[0.039]
Pin4, 8's diameter: 1.50[0.059]
Pin diameter tolerances: ±0.10[±0.004]
General tolerances: ±0.50[±0.020]
Mounting hole screwing torque: Max 0.4 N·m

Mechanical dimensions and recommended layout (Base plate)



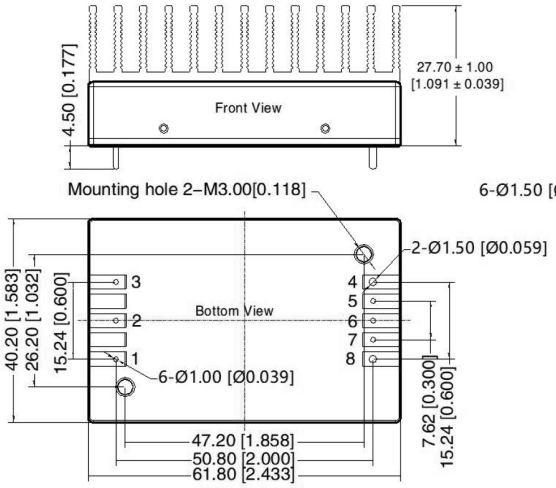
Note: Grid 2.54*2.54mm

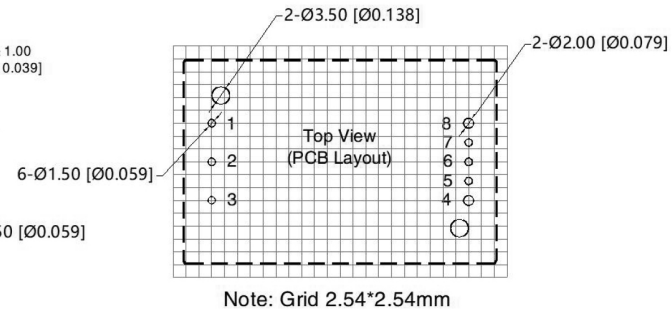
Pin–Out			
Pin	Mark	Pin	Mark
1	+Vin	5	Sense–
2	Ctrl	6	Trim
3	–Vin	7	Sense+
4	0V	8	+Vo

Note:
Unit: mm[inch]
Pin1, 2, 3, 5, 6, 7's diameter: 1.00[0.039]
Pin4, 8's diameter: 1.50[0.059]
Pin diameter tolerances: ±0.10[±0.004]
General tolerances: ±0.50[±0.020]
Mounting hole screwing torque: Max 0.4 N·m

Mechanical dimensions and recommended layout (With heatsink)

THIRD ANGLE PROJECTION

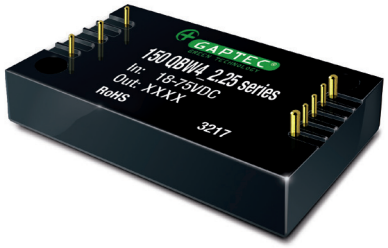




Note: Grid 2.54*2.54mm

Pin–Out			
Pin	Mark	Pin	Mark
1	+Vin	5	Sense–
2	Ctrl	6	Trim
3	–Vin	7	Sense+
4	0V	8	+Vo

Note:
Unit: mm[inch]
Pin1, 2, 3, 5, 6, 7's diameter: 1.00[0.039]
Pin4, 8's diameter: 1.50[0.059]
Pin diameter tolerances: ± 0.10[± 0.004]
General tolerances: ± 0.50[± 0.020]
Mounting hole screwing torque: Max 0.4 N・m



150QBW4_2.25 series

150W Quarter-Brick - Single Output DC-DC Converter - Ultra-wide Input - Isolated & Regulated

48Vin **DC-DC Converter** **150 Watt**

- **Wide Input voltage range (4:1)**
- **High efficiency up to 91%**
- **Short circuit protection (SCP)**
- **Input under-voltage, over-current, over–voltage, over-temperature protection**
- **Isolation: 2.25KVDC**
- **Operating temperature range: -40°C to +85°C**
- **Five-sided metal shielding package**
- **International standard pin-out: 1/4 brick**

The 150QBW4_2.25 series offers 4:1 input voltage, efficiency up to 91%, 2250VDC isolation, Input under-voltage protection, output short circuit protection, over-current protection, over–voltage protection, over-temperature protection and EMI meets CISPR32/EN55032 CLASS A by adding module recommended circuit.

All models are widely applied in battery power supplies, industrial control, electricity, instruments, railway, communication and intelligence robot fields.

Common specifications	
Short circuit protection*:	Hiccup, continuous, automatic recovery
Cooling:	Natural or forced convection
Operation temperature range:	-40°C~+85°C
Storage temperature range:	-55°C ~+125°C
Over temperature protection:	+105°C TYP
Pin welding resistance temperature:	300°C MAX, 1.5mm from case for 10sec. 260°C MAX, Wave-soldering, 10sec.
Storage humidity range:	< 95%
Vibration:	IEC/EN61373 car body 1 B mold
Trim:	90%Vo MIN, 110%Vo MAX
Sense:	105%Vo MAX
Case material:	Plastic [UL94-V0] / aluminium
MTBF:	500,000 hours
Dimensions:	61.8*40.2*12.7 mm 62.0*56.0*14.6 mm (with base-plate) 61.8*40.2*27.7 mm (with heatsink)
Weight:	83g 103g (with base-plate) 114g (with heatsink)

Input specifications					
Item	Test condition	Min	Typ	Max	Units
Input current	full load/no load, nominal Vin		3435/100	3512/200	mA
Reflected ripple current	Nominal Vin		100		mA
Surge voltage	1sec. max.	-0.7		90	VDC
Start-up threshold voltage	100% load			18	VDC
Input under voltage protection		14	16		VDC
Input filter	Pi filter				
Hot plug	Unavailable				
Ctrl (the voltage of Ctrl pin is relative to input pin GND)	• Module switch ON • Module switch OFF • Input current when switched OFF	Ctrl open circuit or connected to TTL high level (3.5-12VDC) Ctrl pin connected to GND or low level (0-1.2VDC) 2		10	mA

Output specifications					
Item	Test condition	Min	Typ	Max	Units
Output voltage accuracy			±1	±3	%
Line regulation			±0.2	±0.5	%
Load regulation			±0.5	±0.75	%
Transient recovery time	25% load step change		300	500	µs
Transient response deviation	25% load step change		±3	±5	%
Temperature coefficient				±0.03	%/°C
Ripple & Noise*	20MHz Bandwidth		150	250	mVp-p
Output over-voltage protection	Input voltage range	110	130	160	%Vo
Output over-current protection	Input voltage range	110	130	150	%Io
Switching frequency	PFM mode		250		KHz

*Test ripple and noise by "parallel cable" method.

Isolation specifications					
Item	Test condition	Min	Typ	Max	Units
Isolation voltage*	• Input-output • Input-case • Output-case	2250 1500 500			VDC VDC VDC
Isolation resistance	Insulation voltage 500VDC	100			MΩ
Isolation capacitance	Input-output, 100KHz/0.1V		2200		pF

* Tested for 1 minute and leak current less than 5mA

Example:
150QBW4_4812S2.25
150 = 150 Watt; QB = Quarter-Brick; W4 = Wide input (4:1);
48 = 18-75 Vin; 12 = 12Vout; S = Single Output; 2.25 = 2.25kVDC isolation

Note:
1. Operation under minimum load will not damage the converter; However, they may not meet all specification listed, and that will reduce the life of product.
2. All specifications measured at Ta= 25°C, humidity <75%, nominal input voltage and rated output load unless otherwise specified.
3. In this datasheet, all the test methods of indications are based on corporate standards.

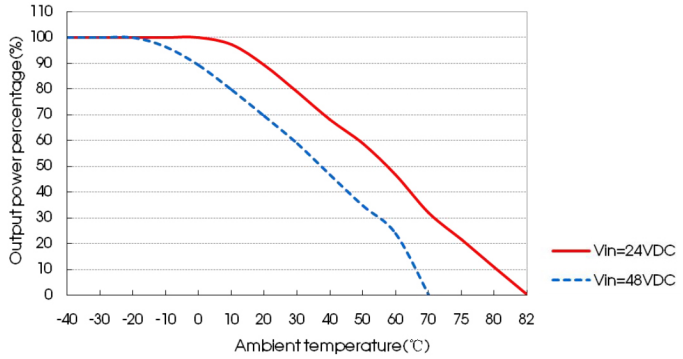
EMC specifications				
EMI	CE	CISPR32/EN55032	CLASS A (see EMC recommended circuit, fig. 2)	
EMI	RE	CISPR32/EN55032	CLASS A (see EMC recommended circuit, fig. 2)	
EMS	ESD	IEC/EN61000-4-2, EN50121-3-2	Contact ±6KV/Air ±8KV	perf. Criteria B
EMS	RS	IEC/EN61000-4-3, EN50121-3-2	10V/m	perf. Criteria A
EMS	EFT	IEC/EN61000-4-4, EN50121-3-2	±2KV (see EMC recommended circuit, fig. 2)	perf. Criteria A
EMS	Surge	EN50121-3-2	differential mode ±1KV, 1.2/50us, source impedance 42Ω (see EMC recommended circuit, fig. 2)	perf. Criteria B
EMS	CS	IEC/EN61000-4-6, EN50121-3-2	10 Vr.m.s	perf. Criteria A

Part Number	Input Voltage [V] Nominal	Range	Output Voltage [VDC]	Output Current [A, max]	Efficiency [%] Min	Typ	Capacitive load [A, max]
150QBW4_4812S2.25	48	18-75	12	12.5	89	91	2000
150QBW4_4824S2.25	48	18-75	24	6.25	89	91	1000
150QBW4_4848S2.25	48	18-75	48	3.13	89	91	450

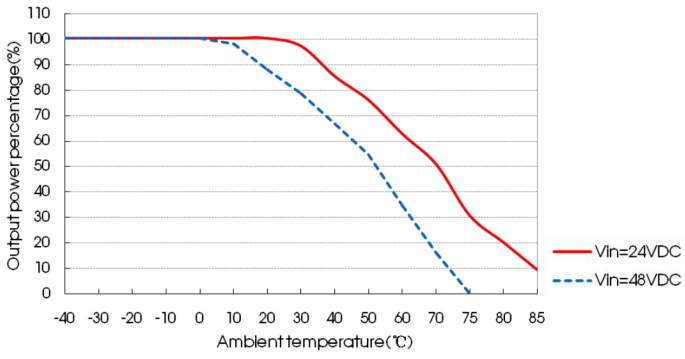
For aluminium base-plate add -BP at the end, f.ex. 150QBW4_xxyyS2.25-BP, for heatsink add -H at the end, f.ex. 150QBW4_xxyyS2.25-H.

Temperature derating curves

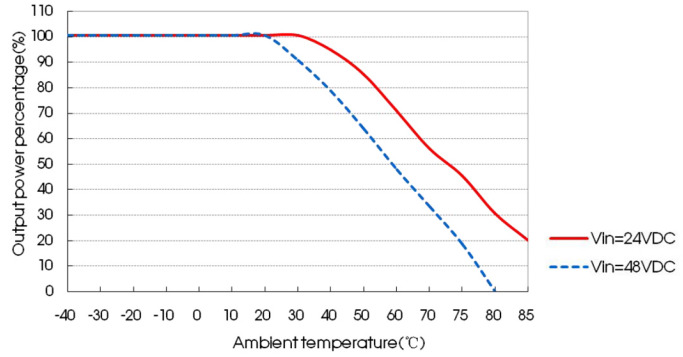
150QBW4_S2.25



150QBW4_S2.25-BP

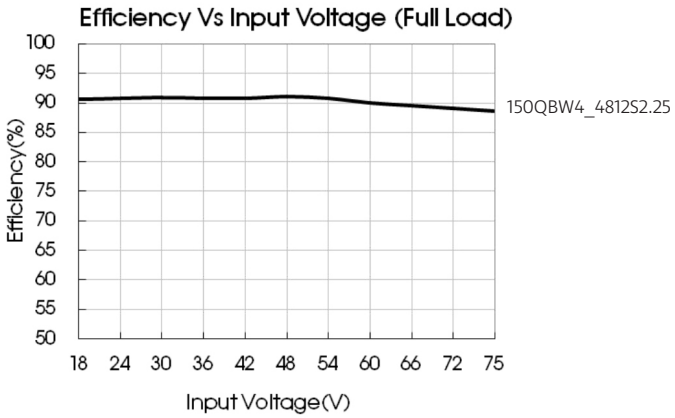


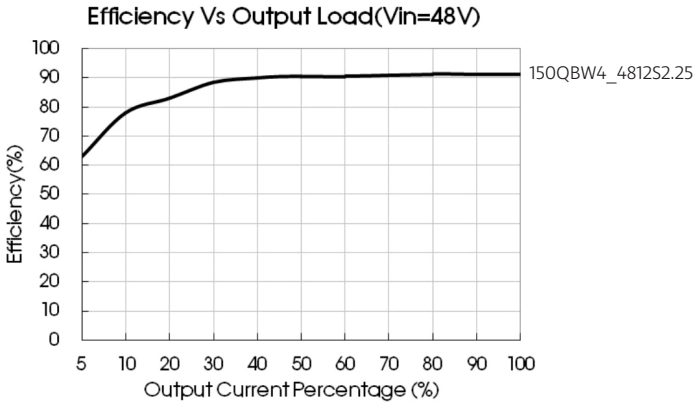
150QBW4_S2.25-H



Note: Temperature Derating Curves were tested at natural convection (20FLM).

Efficiency

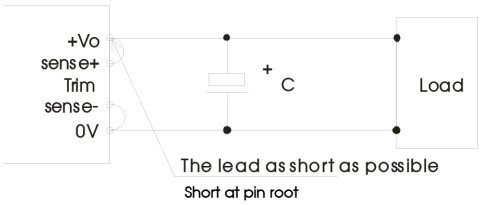




Sense of application and precautions

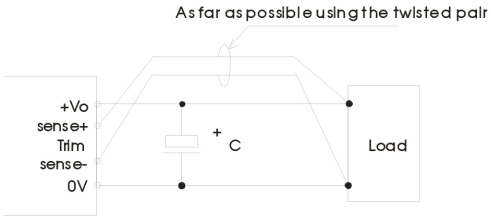
When not using remote sense

Notes:
1. When not using remote sense, make sure + Vo and Sense + are shorted, and that 0V and Sense- are shorted as well;
2. Keep the tracks between + Vo and Sense +, 0V and Sense- as short as possible and close to the terminal. Avoid a looping track. If noise interferes the loop, the operation of the power module will become unstable.



When remote sense is used

Notes:
1. Using remote sense with long wires may cause output voltage to become unstable. Consult us if long sensing wiring is necessary.
2. Sense tracks or wires should be as short as possible. If using wires, it should not use twisted-pair or shielded wires.
3. Please use wide PCB tracks or thick wires between the power supply module and the load, the line voltage drop should be kept less than 0.3V. Make sure the power supply module's output voltage remains within the specified range.
4. The impedance of wires may cause the output voltage oscillation or a greater ripple, please take adequate assessments before using.



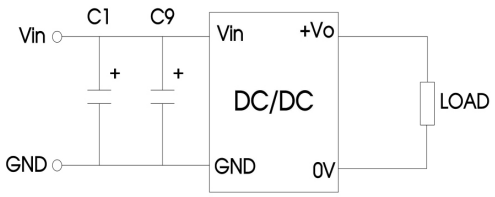
Typical application

If not using Gaptec´s recommended circuit, please ensure an 220µF electrolytic capacitors in parallel with the input, which used to suppress the surge voltage come from the input terminal.
All the DC/DC converters of this series are tested according to the recommended circuit before delivery.

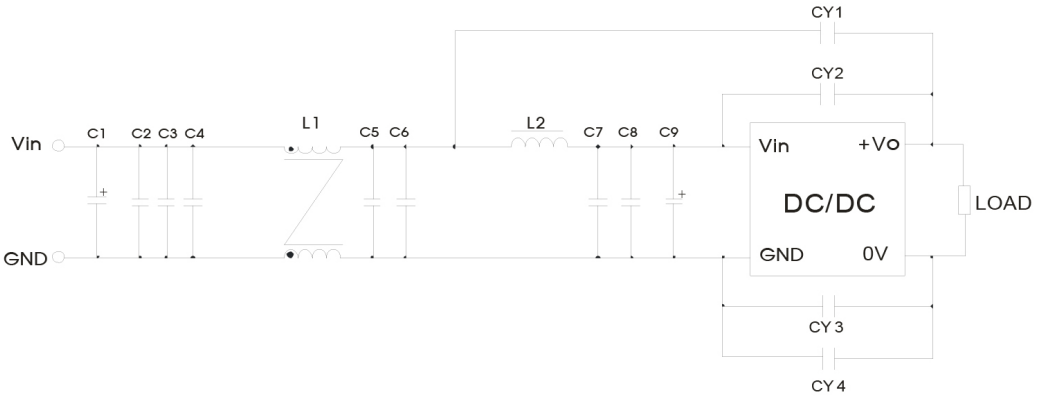
If it is required to further reduce input&output ripple, properly increase the input & output of additional capacitors Cin and Cout or select capacitors of low equivalent impedance, provided that the capacitance is no larger than the max. capacitive load of the product.

Vout (VDC)	Fuse	Cin	Cout
12	15A, slow blow	220µF	220µF
24	15A, slow blow	220µF	100µF
48	15A, slow blow	220µF	100µF

EMC solution recommended circuit



device number	Device parameter	Device function
C1	150μF electrolytic caoacitor	Meet puise group and surge
C9	47μF electrolytic caoacitor	

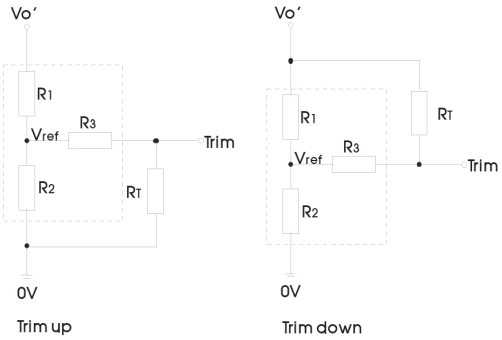


Device number	Device parameter	Device function
C1	150μF electrolytic capacitor	Meet conducted emission and radiated emission
C9	47μF electrolytic capacitor	
C2, C3, C4, C5, C6, C7, C8	2.2μF ceramic capacitor	
L1	1.0mH common mode inductor	
L2	1.5μH inductance	
CY1, CY2, CY3, CY4	1nF Y1 safety capacitor	

Reflected ripple current test circuit

Note:Lin(4.7μH) ， Cin(220μF, ESR < 1.0Ω at 100 KHz)

Trim application & trim resistance



Application circuit for TRIM (Part in broken line is the interior of models)

Calculation formula of Trim resistance:

$$up:\ R_T = \frac{aR_2}{R_2-a} - R_3 \qquad a = \frac{Vref}{Vo'-Vref} R_1$$

$$down:\ R_T = \frac{aR_1}{R_1-a} - R_3 \qquad a = \frac{Vo'-Vref}{Vref} R_2$$

R_T is Trim resistance ,a is a self-defined parameter, with no real meaning. Vo' for the actual needs of the up or down regulated voltage

Vout(V)	R1(KΩ)	R2(KΩ)	R3(KΩ)	Vref(V)
12	11.000	2.87	15	2.5
24	24.872	2.87	15	2.5
48	53.017	2.913	15	2.5

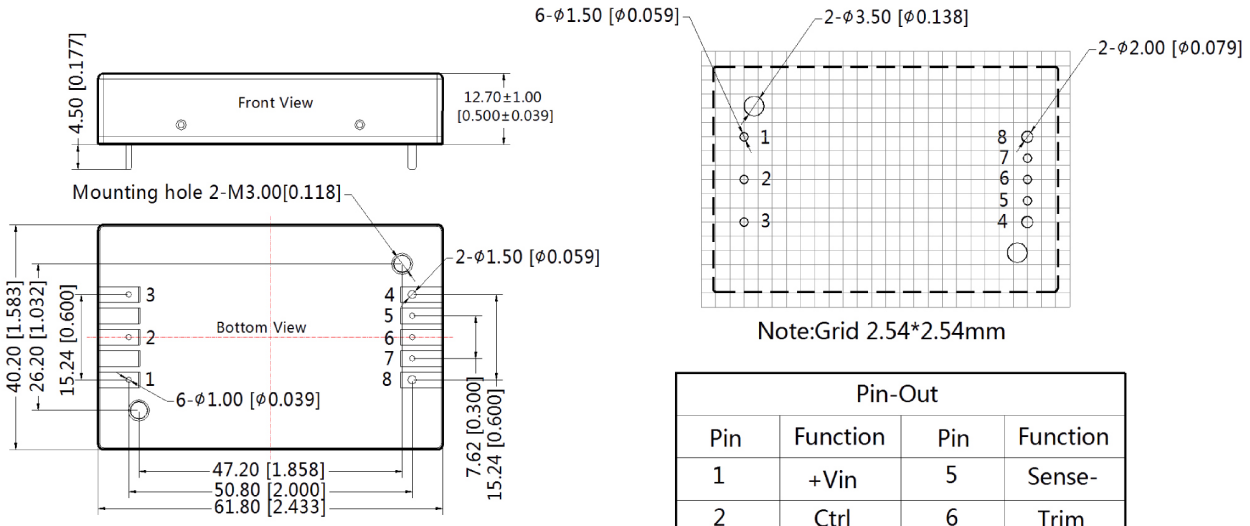
When the Trim function with down regulated is used, If the RT resistor is too low or "Trim" is short with "+Vo", the output voltage Vo' would be lower than 0.9Vo, which may cause the product to be irreversibly damaged.

It is not allowed to connect modules output in parallel to enlarge the power.

Mechanical dimensions and recommended layout

150QBW4_xxyyS2.25

THIRD ANGLE PROJECTION



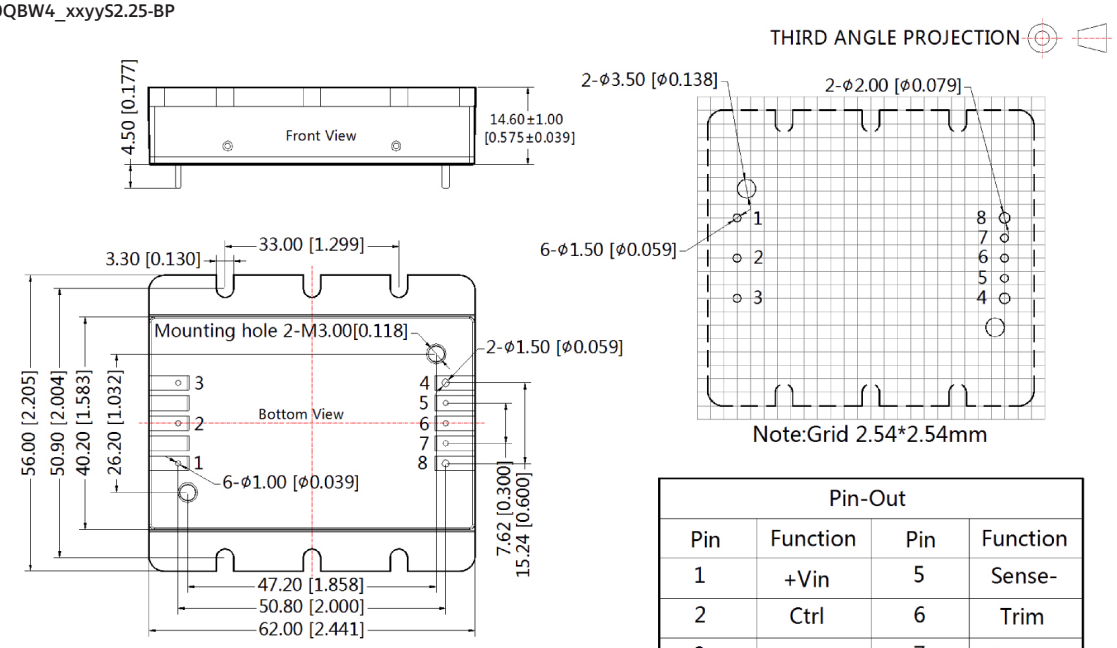
Note:Grid 2.54*2.54mm

Pin-Out			
Pin	Function	Pin	Function
1	+Vin	5	Sense-
2	Ctrl	6	Trim
3	-Vin	7	Sense+
4	0V	8	+Vo

Note:
Unit: mm[inch]
Pin1, 2, 3, 5, 6, 7's diameter: 1.00[0.039]
Pin4, 8's diameter: 1.50[0.059]
Pin diameter tolerances: ±0.10[±0.004]
General tolerances: ±0.50[±0.020]
Mounting hole screwing torque: Max 0.4 N·m

Base plate dimensions and recommended layout

150QBW4_xxyyS2.25-BP

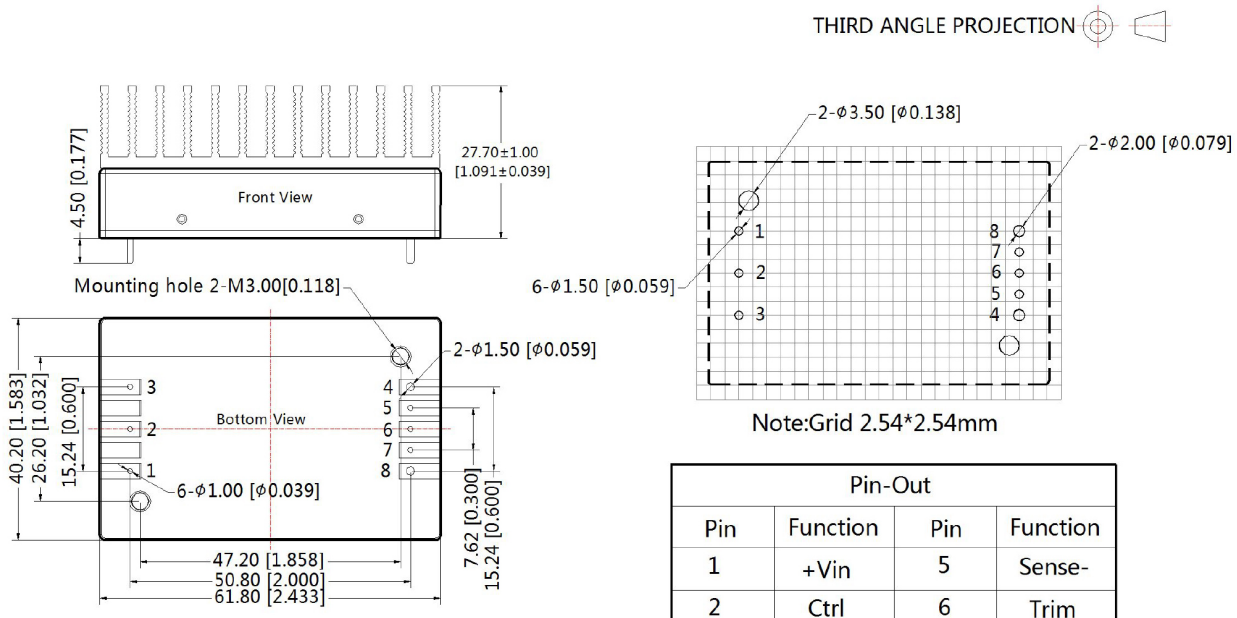


Pin-Out			
Pin	Function	Pin	Function
1	+Vin	5	Sense-
2	Ctrl	6	Trim
3	-Vin	7	Sense+
4	0V	8	+Vo

Note:
Unit: mm[inch]
Pin1, 2, 3, 5, 6, 7's diameter: 1.00[0.039]
Pin4, 8's diameter: 1.50[0.059]
Pin diameter tolerances: ±0.10[±0.004]
General tolerances: ±0.50[±0.020]
Mounting hole screwing torque: Max 0.4 N·m

Base-plate dimensions and recommended layout

150QBW4_xxyyS2.25-H



Pin-Out			
Pin	Function	Pin	Function
1	+Vin	5	Sense-
2	Ctrl	6	Trim
3	-Vin	7	Sense+
4	0V	8	+Vo

Note:
Unit: mm[inch]
Pin1, 2, 3, 5, 6, 7's diameter: 1.00[0.039]
Pin4, 8's diameter: 1.50[0.059]
Pin diameter tolerances: ±0.10[±0.004]
General tolerances: ±0.50[±0.020]
Mounting hole screwing torque: Max 0.4 N·m