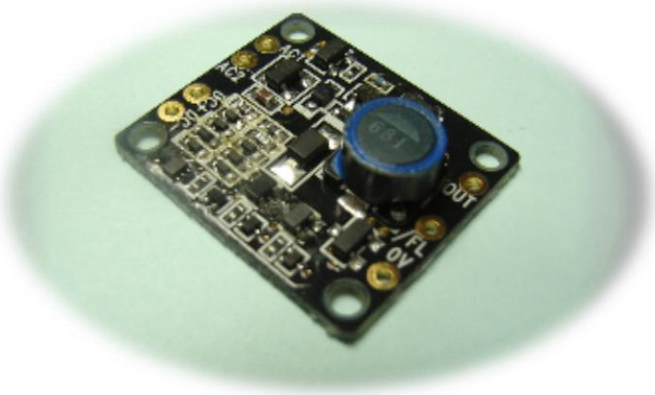
# Ultra Low Power Consumption
# Energy Harvesting Power Management Module
# EHPM Series




OWL Solution Co., Ltd.
Lty932 3F, 1-1-1 Ohji,
Kusatsu-shi, Shiga, 525-0032
Japan
E-mail : info@owl-sol.com



Rev.B3

# Features of the EHPM series

1. Power management module specialized for energy harvesting, supporting high-voltage, high-output-impedance power generation devices.
   (Ideal for piezoelectric and capacitive power generation elements)

2. ultra-low power consumption. (Standby power less than 2μW)

3. Operable from an average input current of 0.5 μA.

4. High efficiency of over 60% at an average input current of 1 μA.

5. Wide range of input voltages available.
   (10V to 50V (5V step) and 100V)
6. Output voltage selectable between 3.3V and 5V.

7. Both AC and DC inputs are supported.

# Specification

| Model | | EHPM-10-AB | EHPM-15-AB | EHPM-20-AB | EHPM-25-AB | EHPM-30-AB |
|---|---|---|---|---|---|---|
| Average input voltage (V) | VinAV | 10 | 15 | 20 | 25 | 30 |
| Input discharge start voltage (V) | VinDIS | 11 | 17 | 23 | 28 | 34 |
| Average output voltage (V) | VoutAV | 3.38V or 5.13V (selectable) | | | | |
| Output upper limit voltage (V) | Vouthigh | 3.47V or 5.25V | | | | |
| Output lower limit voltage (V) | Voutlow | 3.3V or 5.0V | | | | |
| Operable average input current (uA) | IinMIN | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Maximum average input current(mA) | IinMAX | 10.0 | 10.0 | 5.0 | 5.0 | 5.0 |
| Maximum output current (mA) | IoutMAX(3.3V) | 2.0 | 5.0 | 9.0 | 11.0 | 13.0 |
| | IoutMAX(5V) | 2.0 | 5.0 | 6.0 | 8.0 | 9.0 |
| full charge signal | | Available (open drain, active low, maximum voltage 60V, sink current 100mA, voltage 0.9V or less at low) | | | | |
| AC power input | | Possible (AC1, AC2 input) | | | | |

| Model | | EHPM-35-AB | EHPM-40-AB | EHPM-45-AB | EHPM-50-AB | EHPM-100-AB |
|---|---|---|---|---|---|---|
| Average input voltage (V) | VinAV | 35 | 40 | 45 | 50 | 100 |
| Input discharge start voltage (V) | VinDIS | 40 | 45 | 51 | 57 | 114 |
| Average output voltage (V) | VoutAV | 3.38V or 5.13V (selectable) | | | | |
| Output upper limit voltage (V) | Vouthigh | 3.47V or 5.25V | | | | |
| Output lower limit voltage (V) | Voutlow | 3.3V or 5.0V | | | | |
| Operable average input current (uA) | IinMIN | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Maximum average input current(mA) | IinMAX | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 |
| Maximum output current (mA) | IoutMAX(3.3V) | 15.0 | 18.0 | 20.0 | 20.0 | 40.0 |
| | IoutMAX(5V) | 11.0 | 13.0 | 14.0 | 15.0 | 30.0 |
| full charge signal | | Available (open drain, active low, maximum voltage 60V, sink current 100mA, voltage 0.9V or less at low) | | | | |
| AC power input | | Possible (AC1, AC2 input) | | | | |

# Efficiency

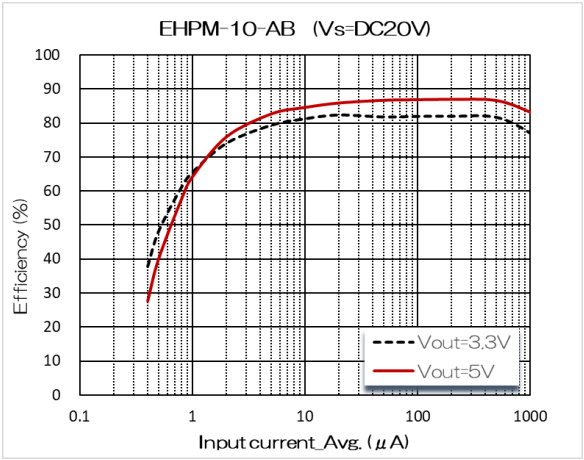
| Model | | | EHPM-10-AB | EHPM-15-AB | EHPM-20-AB | EHPM-25-AB | EHPM-30-AB |
|---|---|---|---|---|---|---|---|
| Efficiency (%) (Typical value) | Average input current at 1uA | Ef1in(Vout=3.3V) | 60 | 65 | 66 | 68 | 68 |
| | | Ef1in(Vout=5V) | 60 | 65 | 68 | 70 | 70 |
| | Average input current at 5uA | Ef5in(Vout=3.3V) | 77 | 77 | 75 | 75 | 75 |
| | | Ef5in(Vout=5V) | 80 | 79 | 79 | 79 | 79 |
| | Average output current at 5uA | Ef5out(Vout=3.3V) | 71 | 70 | 68 | 68 | 67 |
| | | Ef5outVout=(5V) | 76 | 74 | 74 | 73 | 72 |

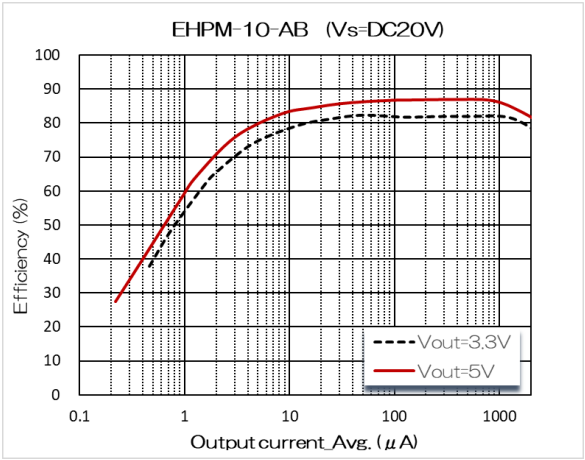
| Model | | | EHPM-35-AB | EHPM-40-AB | EHPM-45-AB | EHPM-50-AB | EHPM-100-AB |
|---|---|---|---|---|---|---|---|
| Efficiency (%) (Typical value) | Average input current at 1uA | Ef1in(Vout=3.3V) | 68 | 69 | 70 | 69 | 65 |
| | | Ef1in(Vout=5V) | 71 | 72 | 73 | 72 | 70 |
| | Average input current at 5uA | Ef5in(Vout=3.3V) | 74 | 74 | 74 | 74 | 69 |
| | | Ef5in(Vout=5V) | 78 | 78 | 78 | 78 | 74 |
| | Average output current at 5uA | Ef5out(Vout=3.3V) | 65 | 65 | 65 | 65 | 60(※) |
| | | Ef5outVout=(5V) | 71 | 71 | 71 | 70 | 68(※) |

(※)Measured at 10μA output current

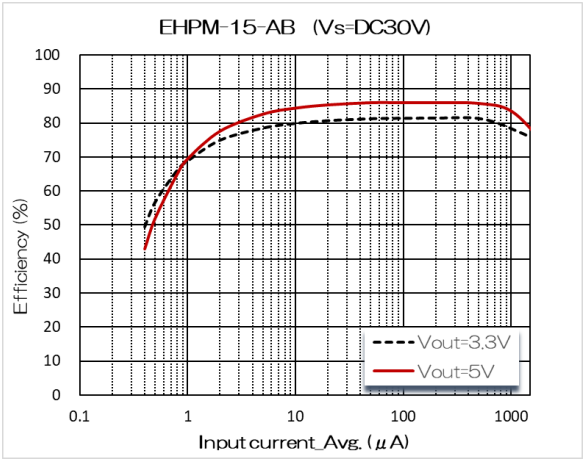
# Efficiency characteristics

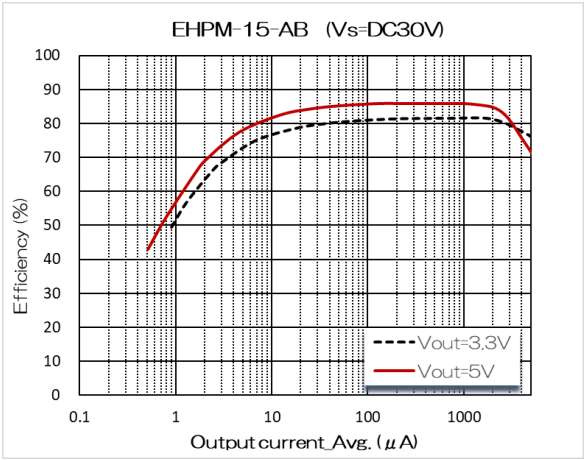
## EHPM-10-AB (VinAV=10V)



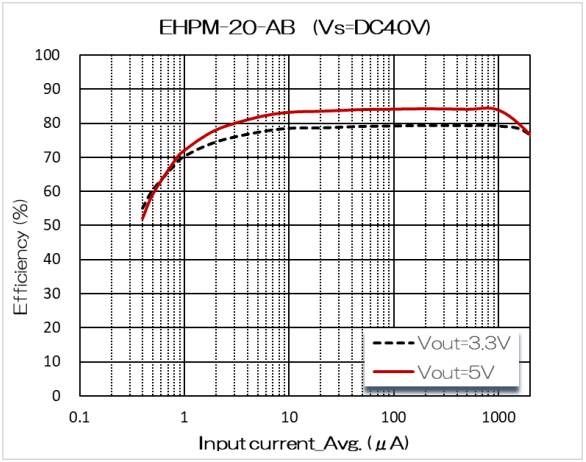

## EHPM-15-AB (VinAV=15V)

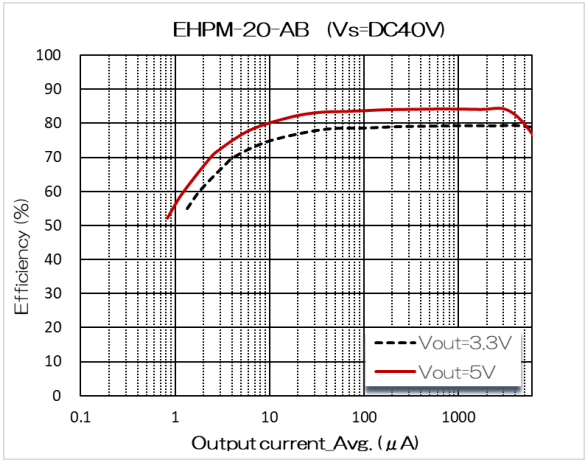


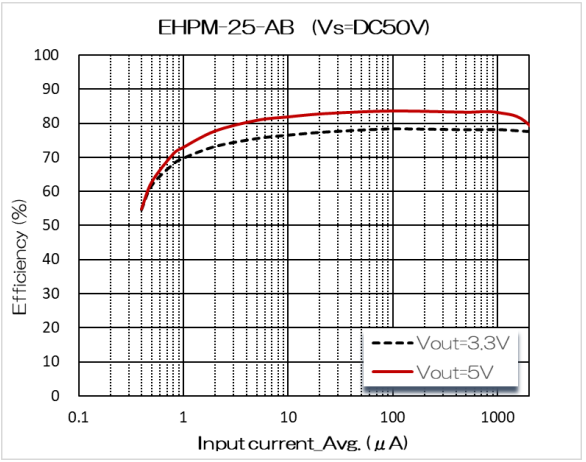
# Efficiency characteristics

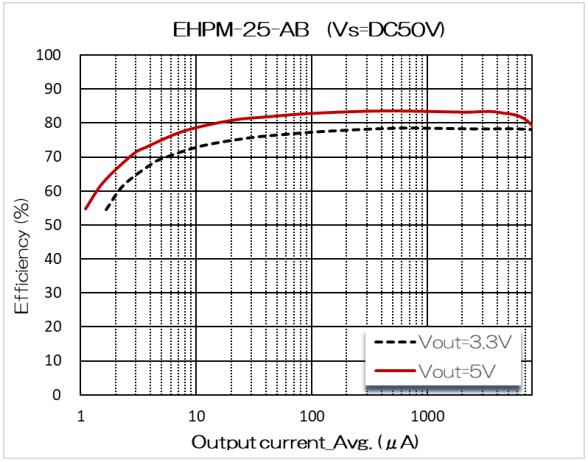
## EHPM-20-AB (VinAV=20V)



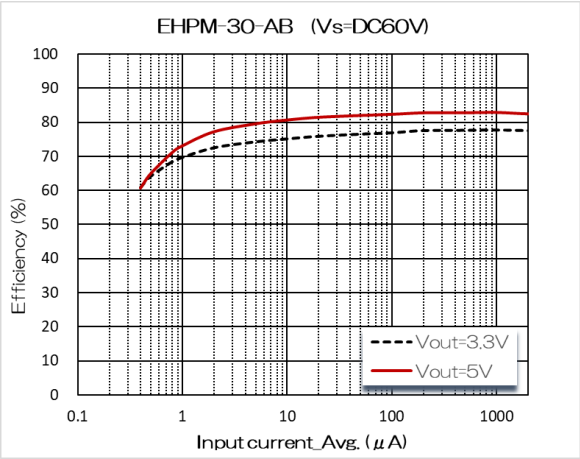

## EHPM-25-AB (VinAV=25V)

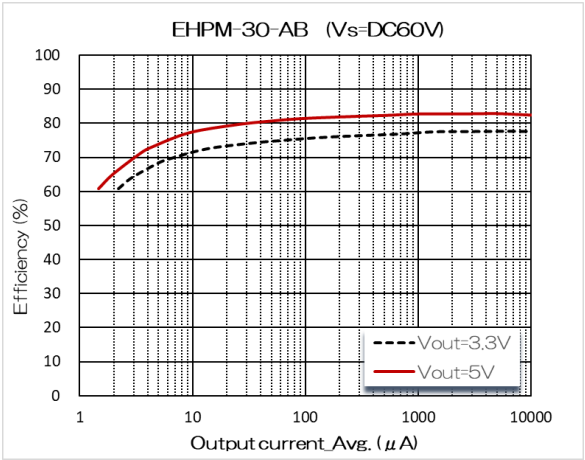


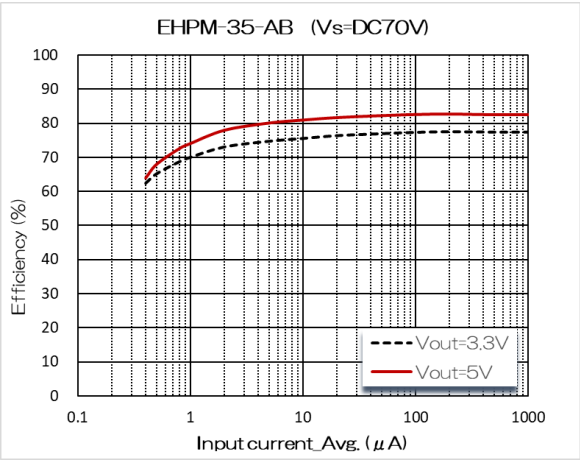
# Efficiency characteristics

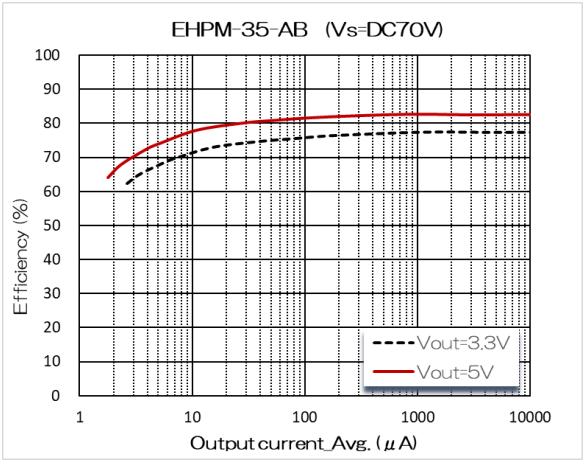
## EHPM-30-AB (VinAV=30V)



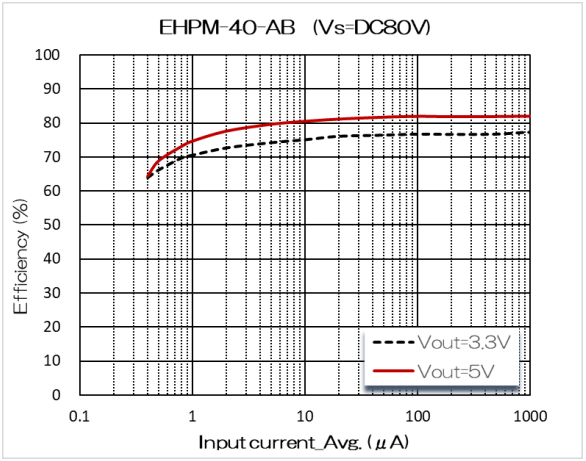

## EHPM-35-AB (VinAV=35V)

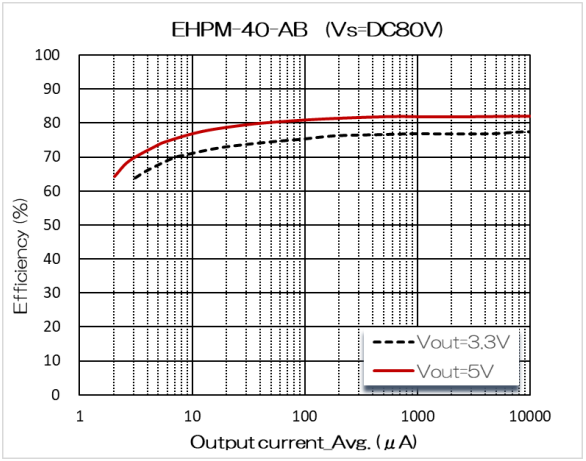


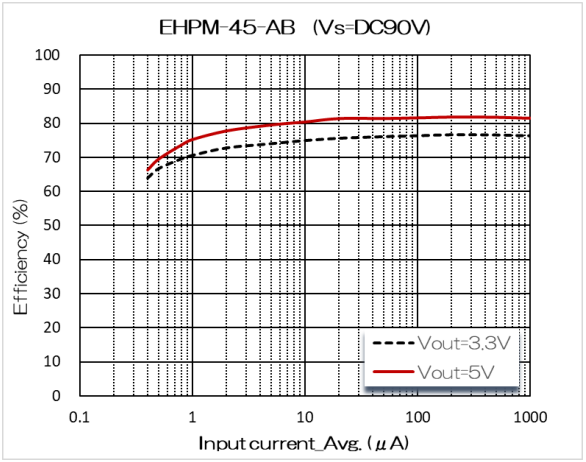
# Efficiency characteristics

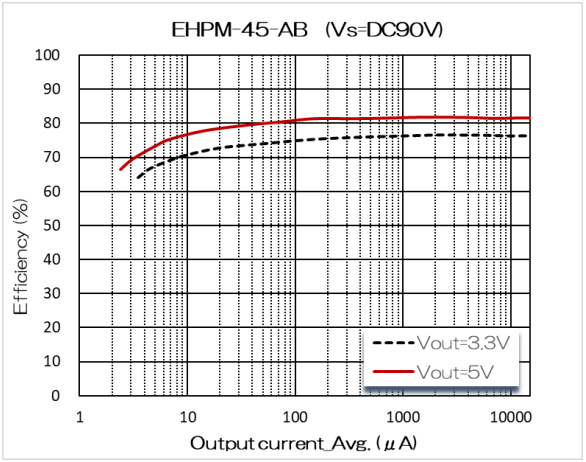
## EHPM-40-AB (VinAV=40V)



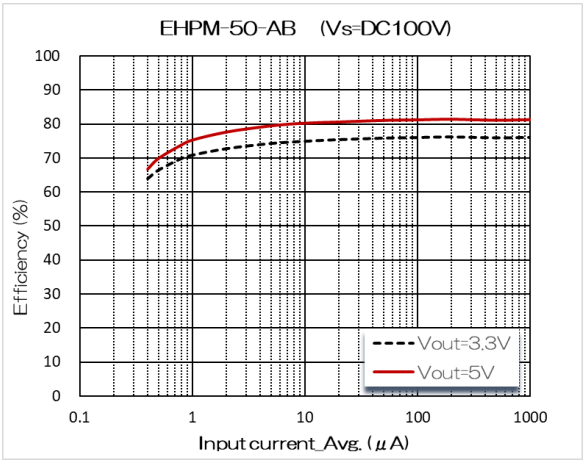

## EHPM-45-AB (VinAV=45V)

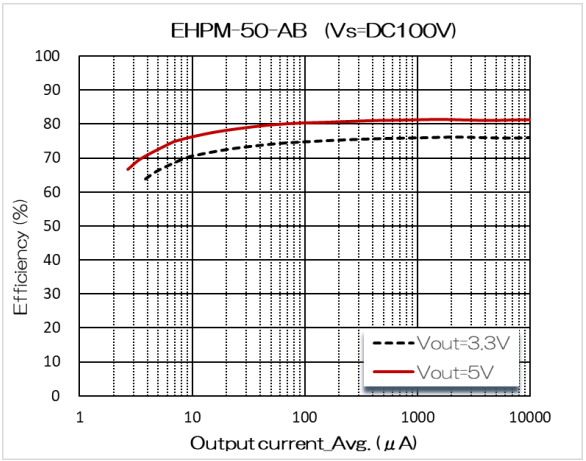


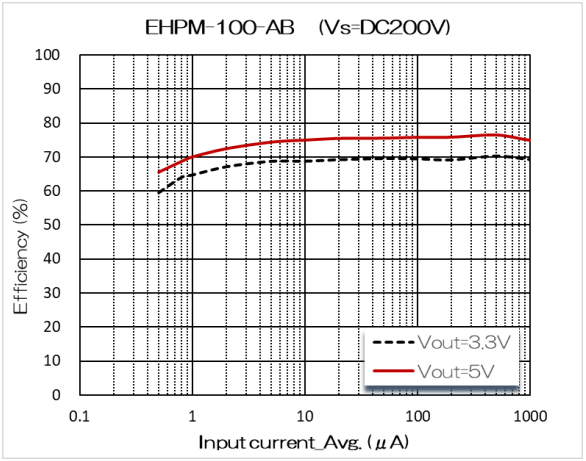
# Efficiency characteristics

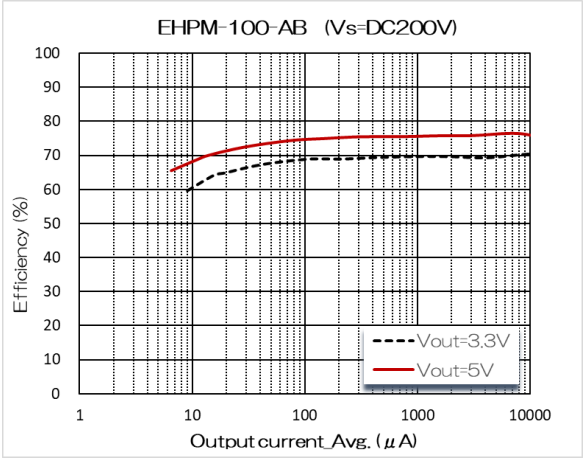
## EHPM-50-AB (VinAV=50V)



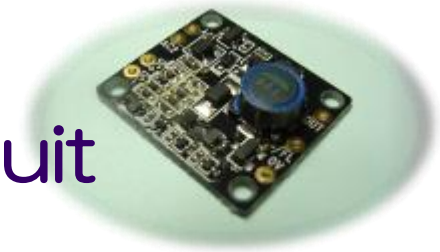



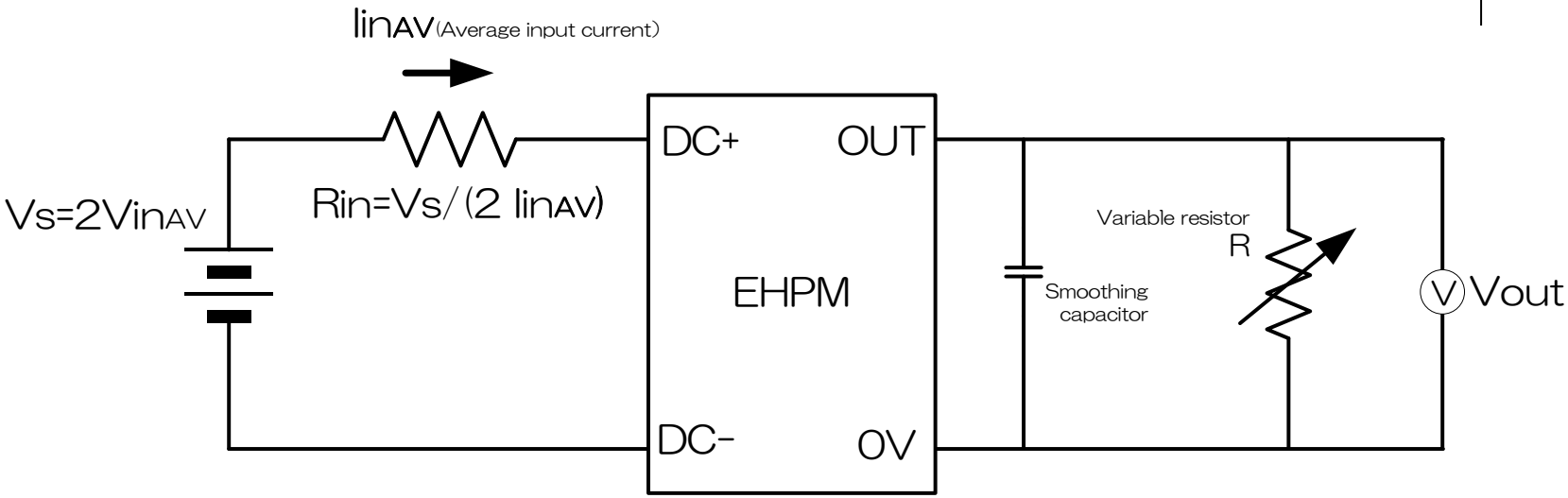

## EHPM-100-AB (VinAV=100V)



# Efficiency measurement circuit

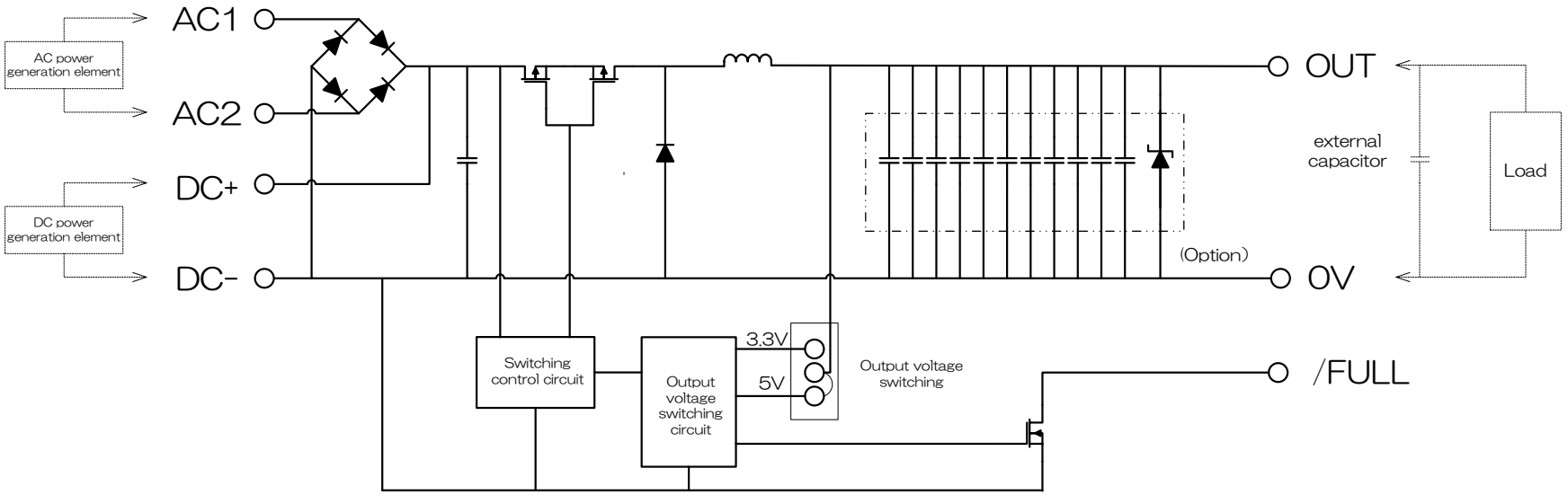





Efficiency calculation :

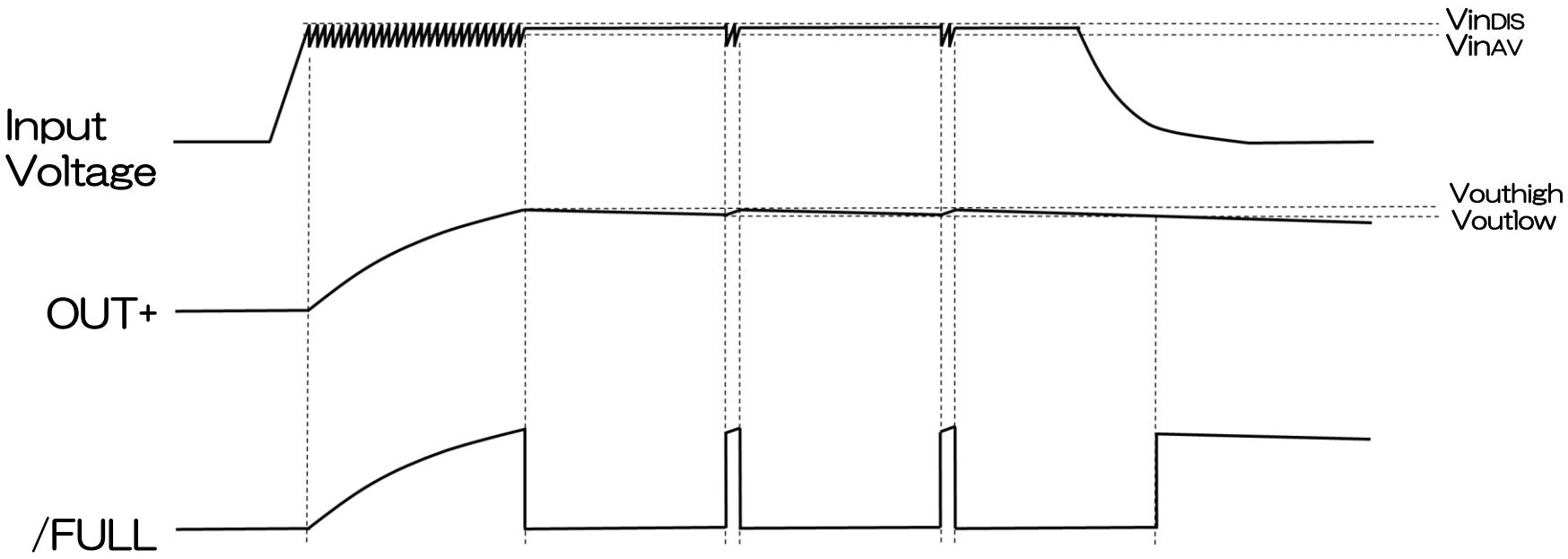
$$\text{Efficency (Ef)} = (\hat{(}\text{Vout})/R)/(\text{VinAV} \cdot \text{linAV})$$

# Block Diagram




(Note) If you do not connect an external capacitor to the OUT output, mount a ceramic capacitor (3216 size) of 100μF or more in the optional area.

# Time chart




(Note) The /FULL signal above is the waveform when pulled up at OUT+ (Output voltage)

# Model description

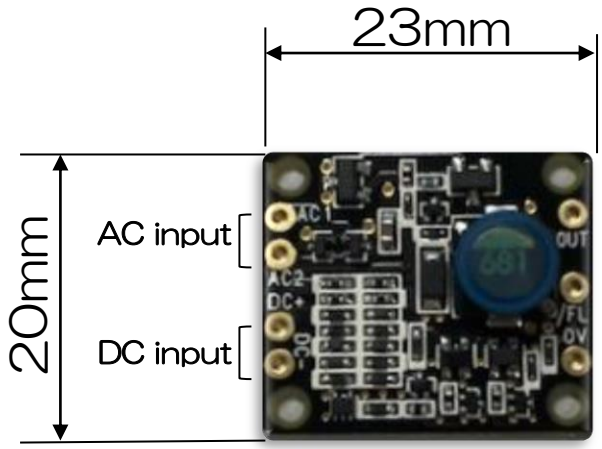
EHPM－AA－XX

①　②　③

①Series model (fixed)
②Input average voltage (eg 25→25V)
③Output voltage (eg AB → 3.3V and 5V setting selection)

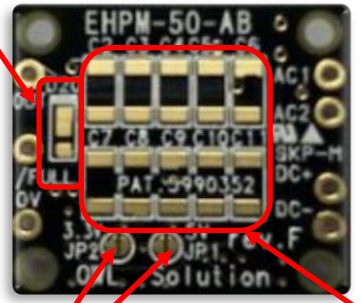
# Appearance (EHPM-XX-AB) ※

※XX=10、15、20、25、30、35、40、45、50




PWB thickness t=1.0
Parts height 5 mm or less

For limiting output voltage
Zener diode can be mounted
(Support other than 5V/3.3V )

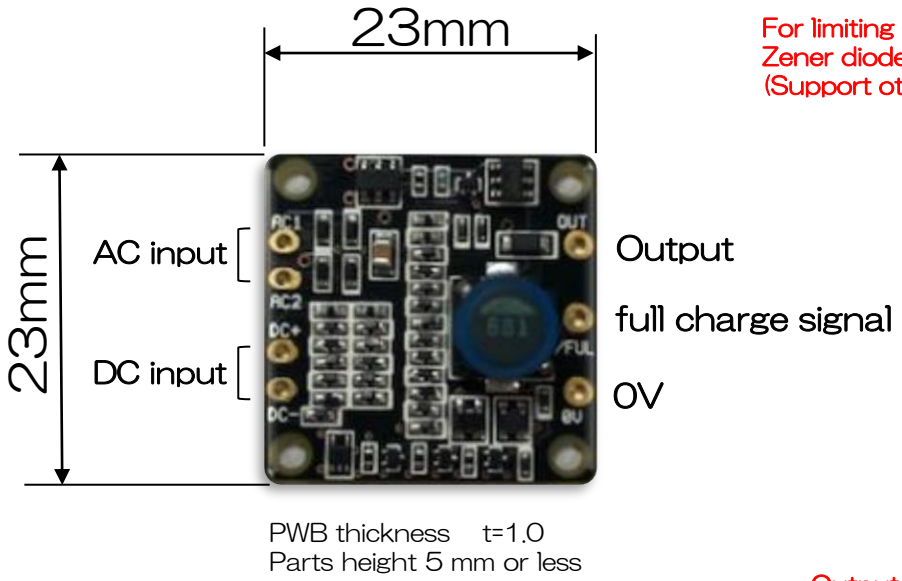



10 ceramic capacitors of 1206 size
can be mounted as
storage/smoothing capacitors.

Output voltage limit selection jumper

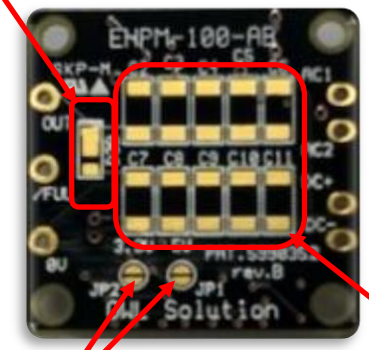
| | JP1 | JP2 |
|---|---|---|
| At 5V limit | Short | Open |
| At 3.3V limit | Open | Short |
| No output limit | Open | Open |

# Appearance（EHPM-100-AB）




PWB thickness　t=1.0
Parts height 5 mm or less

For limiting output voltage
Zener diode can be mounted
(Support other than 5V/3.3V )



10 ceramic capacitors of 1206 size
can be mounted as
storage/smoothing capacitors.

Output voltage limit selection jumper

| | JP1 | JP2 |
|---|---|---|
| At 5V limit | Short | Open |
| At 3.3V limit | Open | Short |
| No output limit | Open | Open |

# One-point advice for module

1. When the power generation element is DC output
   Please select a type with an input average voltage (VinAV)
   that is approximately 50% of the open circuit voltage.
   eg) EHPM-25-AB is optimal when the open-circuit voltage
   of the power generation element is 50V.

2. When the power generation element is AC output (near sine wave)
   Please select a type with an input average voltage (VinAV)
   that is approximately 30 to 40% of the maximum open voltage.
   eg) When the maximum open circuit voltage of
   the power generation element is 50V
   EHPM-15-AB or EHPM-20-AB is optimal.

3. When the power generation element is AC output
   and the input average current is lower than 1 μA
   Try a type with an input average voltage (VinAV)
   that is 5 to 10 V lower than the one selected in 2.

   (Finally, please check with the actual EHPM board)

# Precautions for use

1. When the output is limited (3.3V, 5V limit),
   do not apply a voltage of 7V or more to the output from the outside.
   Internal elements may be destroyed.

2. When using without limiting the output, do not apply a voltage of 30V or more to the output from the outside.
   The internal elements may be destroyed.

3. Connect a capacitor of 100μF or more between OUT output and 0V.
   If you do not have an external capacitor,
   mount one or more ceramic capacitors (1206 size) of
   100μF on C2 to C11 on this board.

4. When using J1 and J2 (no output limit) open,
   please limit the OUT output voltage externally.
   By mounting a Zener diode on EHPM board,
   you can easily limit the voltage of the OUT output.