



3

YEARS  
WARRANTY

ROHS  
COMPLIANT

REACH  
COMPLIANT



Railway



Automation



Datacom



IPC



Industry



Measurement



Telecom



Automobile



Boat



Charger



Medical



PV



3000  
VAC  
Reinforced  
Insulation

4 : 1  
Wide  
Input  
Range

Internal  
EN55032  
Class  
Filter **A**

LOW  
Standby  
Power

NO  
Min. Load  
Required

REMOTE  
ON  
OFF

OCP

OTP

OVP

SCP

UVP

## PART NUMBER STRUCTURE

| Series Name | Input<br>Voltage<br>(VDC) | Output<br>Quantity | Output<br>Voltage<br>(VDC)                      | Input<br>Range | Remote On/Off<br>Options                                       |
|-------------|---------------------------|--------------------|-------------------------------------------------|----------------|----------------------------------------------------------------|
| RHM20 -     | 110                       | S                  | 05                                              | W              | - N                                                            |
|             | 110: 36~160               | S: Single          | 05: 5<br>5P1: 5.1<br>12: 12<br>15: 15<br>24: 24 | 4:1            | <input type="checkbox"/> : Positive logic<br>N: Negative logic |
|             |                           | D: Dual            | 05: $\pm 5$<br>12: $\pm 12$<br>15: $\pm 15$     |                |                                                                |

**TECHNICAL SPECIFICATION** All specifications are typical at nominal input, full load and 25°C unless otherwise noted

| Model Number   | Input Range | Output Voltage | Output Current @Full Load | Input Current @No Load | Efficiency | Maximum Capacitor Load |
|----------------|-------------|----------------|---------------------------|------------------------|------------|------------------------|
|                | VDC         | VDC            | mA                        | mA                     | %          | μF                     |
| RHM20-110S05W  | 36 ~ 160    | 5              | 4000                      | 10                     | 90.5       | 5000                   |
| RHM20-110S5P1W | 36 ~ 160    | 5.1            | 4000                      | 10                     | 90.5       | 5000                   |
| RHM20-110S12W  | 36 ~ 160    | 12             | 1670                      | 10                     | 88.5       | 850                    |
| RHM20-110S15W  | 36 ~ 160    | 15             | 1330                      | 10                     | 89.5       | 700                    |
| RHM20-110S24W  | 36 ~ 160    | 24             | 833                       | 10                     | 88.5       | 220                    |
| RHM20-110D05W  | 36 ~ 160    | ±5             | ±2000                     | 10                     | 86         | ±2500                  |
| RHM20-110D12W  | 36 ~ 160    | ±12            | ±833                      | 10                     | 88.5       | ±500                   |
| RHM20-110D15W  | 36 ~ 160    | ±15            | ±667                      | 10                     | 89.5       | ±350                   |

#### INPUT SPECIFICATIONS

| Parameter                     | Conditions                | Min. | Typ. | Max.                | Unit |
|-------------------------------|---------------------------|------|------|---------------------|------|
| Operating input voltage range | 110Vin(nom)               | 36   | 110  | 160                 | VDC  |
| Start up voltage              | 110Vin(nom)               |      |      | 36                  | VDC  |
| Shutdown voltage              | 110Vin(nom)               | 32   | 34   | 35.8                | VDC  |
| Start up time                 | Constant resistive load   |      | 30   | 60                  | ms   |
|                               | Power up                  |      | 30   | 60                  |      |
|                               | Remote ON/OFF             |      |      |                     |      |
| Input surge voltage           | 1 second, max.            |      |      | 200                 | VDC  |
| Input filter                  |                           |      |      | Pi type             |      |
| Remote ON/OFF                 | Referred to –Vin pin      |      |      | Open or 3 ~ 12VDC   |      |
|                               | Positive logic (Standard) |      |      | Short or 0 ~ 1.2VDC |      |
|                               | Negative logic (Option)   |      |      | Short or 0 ~ 1.2VDC |      |
|                               | Input current of Ctrl pin | -0.5 |      | 0.5                 | mA   |
|                               | Remote off input current  |      | 3    |                     | mA   |

#### OUTPUT SPECIFICATIONS

| Parameter                        | Conditions                                             | Min.  | Typ.                  | Max.  | Unit                           |
|----------------------------------|--------------------------------------------------------|-------|-----------------------|-------|--------------------------------|
| Voltage accuracy                 |                                                        | -1.0  |                       | +1.0  | %                              |
| Line regulation                  | Low Line to High Line at Full Load                     | -0.2  |                       | +0.2  | %                              |
| Load regulation                  | No Load to Full Load                                   | -0.5  |                       | +0.5  | %                              |
|                                  | Single                                                 | -1.0  |                       | +1.0  | %                              |
|                                  | Dual                                                   |       |                       |       |                                |
| Cross regulation                 | Asymmetrical load 25%/100% FL                          | -5.0  |                       | +5.0  | %                              |
| Voltage adjustability            | Single output                                          | -10   |                       | +10   | %                              |
|                                  | 15Vout, 24Vout                                         | -10   |                       | +20   | %                              |
| Ripple and noise                 | Measured by 20MHz bandwidth<br>With a 1μF/50V X7R MLCC |       | 75<br>100<br>150      |       | mVp-p                          |
| Temperature coefficient          |                                                        | -0.02 |                       | +0.02 | %/°C                           |
| Transient response recovery time | 25% load step change                                   |       | 250                   |       | μs                             |
| Over voltage protection          | Zener diode clamp                                      |       | 6.2<br>15<br>20<br>30 |       | VDC                            |
|                                  | 5Vout, 5.1Vout<br>12Vout<br>15Vout<br>24Vout           |       |                       |       |                                |
| Over load protection             | % of Iout rated; Hiccup mode                           |       | 150                   |       | %                              |
| Short circuit protection         |                                                        |       |                       |       | Continuous, automatic recovery |

## GENERAL SPECIFICATIONS

| Parameter             | Conditions                                       | Min. | Typ. | Max.                         | Unit |
|-----------------------|--------------------------------------------------|------|------|------------------------------|------|
| Isolation voltage     | 1 minute (Reinforced insulation) Input to Output | 3000 |      |                              | VAC  |
| Isolation resistance  | 500VDC                                           | 1    |      |                              | GΩ   |
| Isolation capacitance |                                                  |      |      | 1000                         | pF   |
| Switching frequency   |                                                  | 250  | 275  | 310                          | kHz  |
| Safety approvals      | IEC/ EN/ UL62368-1                               |      |      | UL:E193009<br>CB:UL(Demko)   |      |
| Standard approvals    | EN50155<br>EN45545-2                             |      |      |                              |      |
| Case material         |                                                  |      |      | Non-conductive black plastic |      |
| Base material         |                                                  |      |      | Non-conductive black plastic |      |
| Potting material      |                                                  |      |      | Silicone (UL94 V-0)          |      |
| Weight                |                                                  |      |      | 24g (0.85oz)                 |      |
| MTBF                  | MIL-HDBK-217F, Full load                         |      |      | 1.558×10 <sup>6</sup> hrs    |      |

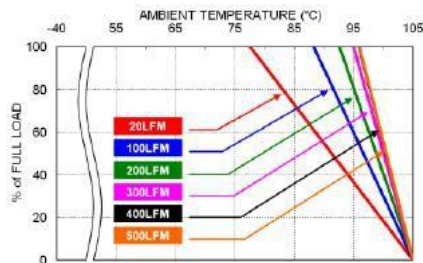
## ENVIRONMENTAL SPECIFICATIONS

| Parameter                     | Conditions    | Min. | Typ.  | Max.                        | Unit |
|-------------------------------|---------------|------|-------|-----------------------------|------|
| Operating ambient temperature | With derating | -40  |       | +105                        | °C   |
| Maximum case temperature      |               |      |       | 105                         | °C   |
| Over temperature protection   |               |      |       | Internal temperature sensor |      |
| Storage temperature range     |               | -55  |       | +125                        | °C   |
| Thermal impedance             |               |      | 11.48 |                             | °C/W |
| Thermal shock                 |               |      |       | MIL-STD-810F                |      |
| Shock                         |               |      |       | EN61373, MIL-STD-810F       |      |
| Vibration                     |               |      |       | EN61373, MIL-STD-810F       |      |
| Relative humidity             |               |      |       | 5% to 95% RH                |      |

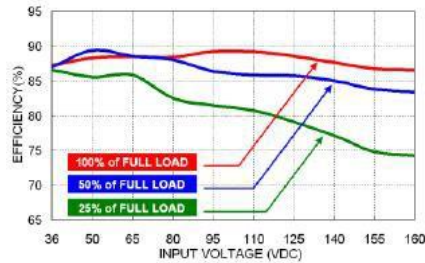
## EMC SPECIFICATIONS

| Parameter                      | Conditions                                                                                                                                                                             | Level              |
|--------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------|
| EMI                            | EN55032, EN50121-3-2<br>Without external component<br>With external components                                                                                                         | Class A<br>Class B |
| EMS                            | EN55024, EN50121-3-2                                                                                                                                                                   |                    |
| ESD                            | EN61000-4-2<br>Air ± 8kV and Contact ± 6kV                                                                                                                                             | Perf. Criteria A   |
| Radiated immunity              | EN61000-4-3<br>20V/m                                                                                                                                                                   | Perf. Criteria A   |
| Fast transient                 | EN61000-4-4<br>± 2kV                                                                                                                                                                   | Perf. Criteria A   |
|                                | RHM20-110□□□W<br>With 2 pcs of aluminum electrolytic capacitor (Nippon chemi-con KXJ series, 220μF/200V in parallel) and a TVS(SMDJ170A, 170V, 3000Watt peak pulse power) in parallel. |                    |
| Surge                          | EN61000-4-5<br>± 2kV                                                                                                                                                                   | Perf. Criteria A   |
|                                | RHM20-110□□□W<br>With 2 pcs of aluminum electrolytic capacitor (Nippon chemi-con KXJ series, 220μF/200V in parallel) and a TVS(SMDJ170A, 170V, 3000Watt peak pulse power) in parallel. |                    |
| Conducted immunity             | EN61000-4-6<br>10Vr.m.s                                                                                                                                                                | Perf. Criteria A   |
| Power frequency magnetic field | EN61000-4-8<br>100A/m continuous; 1000A/m 1 second                                                                                                                                     | Perf. Criteria A   |

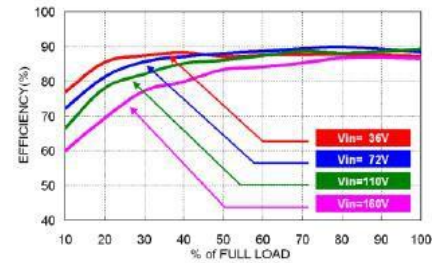
## CHARACTERISTIC CURVE



RHM20-110S05W Derating Curve



RHM20-110S05W Efficiency vs. Input Voltage



RHM20-110S05W Efficiency vs. Output Load

## FUSE CONSIDERATION

This power module is not internally fused. An input line fuse must always be used.

This encapsulated power module can be used in a wide variety of applications, ranging from simple stand-alone operation to an integrated part of sophisticated power architecture.

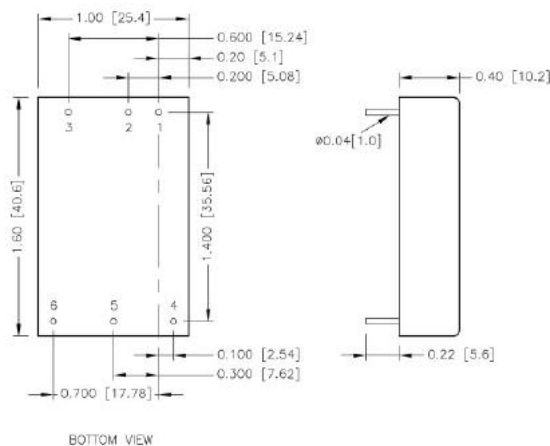
To maximum flexibility, internal fusing is not included; however, to achieve maximum safety and system protection, always use an input line fuse.

The input line fuse suggest as below :

| Model         | Fuse Rating (A) | Fuse Type |
|---------------|-----------------|-----------|
| RHM20-110□□□W | 1               | Slow-Blow |

The table based on the information provided in this data sheet on inrush energy and maximum DC input current at low Vin.

## MECHANICAL DRAWING

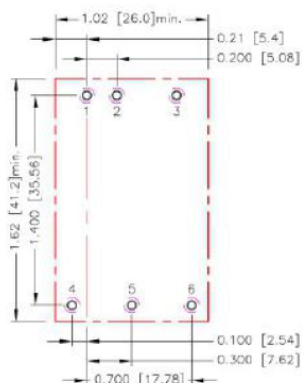


## PIN CONNECTION

| PIN | SINGLE | DUAL   |
|-----|--------|--------|
| 1   | + Vin  | + Vin  |
| 2   | - Vin  | - Vin  |
| 3   | Ctrl   | Ctrl   |
| 4   | + Vout | + Vout |
| 5   | - Vout | Com    |
| 6   | Trim   | - Vout |

- All dimensions in inch [mm]
- Tolerance :x.xx±0.02 [x.x±0.5]  
x.xxx±0.010 [x.xx±0.25]
- Pin dimension tolerance ±0.004[0.10]

## RECOMMENDED PAD LAYOUT



All dimensions in inch[mm]  
 Pad size(lead free recommended)  
 Through hole 1.2.3.4.5.6:  $\Phi 0.051[1.30]$   
 Top view pad 1.2.3.4.5.6:  $\Phi 0.064[1.63]$   
 Bottom view pad 1.2.3.4.5.6:  $\Phi 0.102[2.60]$

## 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".

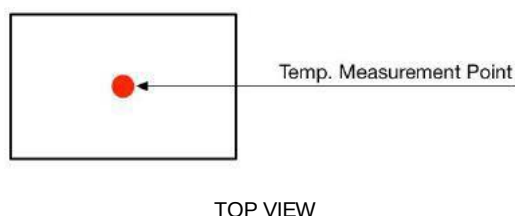
When operating, adequate cooling must be provided to maintain the test point temperature at or below "Maximum case temperature".

You can limit this temperature to a lower value for extremely high reliability.

The unit will shutdown if the thermal reference point exceeds 115°C (typical), but the thermal shutdown is not intended as a guarantee that the unit will survive temperature beyond its rating.

The module will automatically restarts after it cools down.

Thermal test condition with vertical direction by natural convection (20LFM).



## OUTPUT VOLTAGE ADJUSTMENT

It allows the user to increase or decrease the output voltage of the module.

This is accomplished by connecting an external resistor between the Trim pin and either the +Vout or -Vout pins.

With an external resistor between the Trim and -Vout pin, the output voltage increases.

With an external resistor between the Trim and +Vout pin, the output voltage decreases.

The external Trim resistor needs to be at least 1/8W of rated power.

## ■ Trim Up Equation

$$R_U = \left[ \frac{G \times L}{(V_{o,up} - L - K)} - H \right] \Omega$$

## ■ Trim Down Equation

$$R_D = \left[ \frac{(V_{o,down} - L) \times G}{(V_o - V_{o,down})} - H \right] \Omega$$

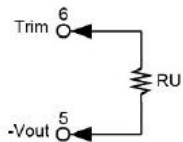
## ■ Trim Constants

| Module         | G     | H     | K    | L   |
|----------------|-------|-------|------|-----|
| RHM20-110S05W  | 5100  | 2050  | 2.5  | 2.5 |
| RHM20-110S5P1W | 5100  | 2050  | 2.6  | 2.5 |
| RHM20-110S12W  | 10000 | 5110  | 9.5  | 2.5 |
| RHM20-110S15W  | 10000 | 5110  | 12.5 | 2.5 |
| RHM20-110S24W  | 56000 | 13000 | 21.5 | 2.5 |

## EXTERNAL OUTPUT TRIMMING

Output can be externally trimmed by using the method shown below.

Trim-up



## □□S05W

| ΔV (%)   | 1       | 2       | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |
|----------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V) | 5.05    | 5.10    | 5.15   | 5.20   | 5.25   | 5.30   | 5.350  | 5.40   | 5.45   | 5.50   |
| RU (kΩ)  | 253.450 | 125.700 | 83.117 | 61.825 | 49.050 | 40.533 | 34.450 | 29.888 | 26.339 | 23.500 |

## □□S5P1W

| ΔV (%)   | 1       | 2       | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |
|----------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V) | 5.151   | 5.202   | 5.253  | 5.304  | 5.355  | 5.406  | 5.457  | 5.508  | 5.559  | 5.610  |
| RU (kΩ)  | 248.440 | 123.195 | 81.447 | 60.573 | 48.048 | 39.698 | 33.734 | 29.261 | 25.782 | 22.999 |

## □□S12W

| ΔV (%)   | 1       | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |
|----------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V) | 12.12   | 12.24  | 12.36  | 12.48  | 12.60  | 12.72  | 12.84  | 12.96  | 13.08  | 13.20  |
| RU (kΩ)  | 203.223 | 99.057 | 64.334 | 46.973 | 36.557 | 29.612 | 24.652 | 20.932 | 18.038 | 15.723 |

## □□S15W

| ΔV (%)   | 1       | 2      | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |
|----------|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V) | 15.15   | 15.30  | 15.45  | 15.60  | 15.75  | 15.90  | 16.05  | 16.20  | 16.35  | 16.50  |
| RU (kΩ)  | 161.557 | 78.223 | 50.446 | 36.557 | 28.223 | 22.668 | 18.700 | 15.723 | 13.409 | 11.557 |

| ΔV (%)   | 11     | 12    | 13    | 14    | 15    | 16    | 17    | 18    | 19    | 20    |
|----------|--------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Vout (V) | 16.65  | 16.8  | 16.95 | 17.1  | 17.25 | 17.4  | 17.55 | 17.7  | 17.85 | 18    |
| RU (kΩ)  | 10.042 | 8.779 | 7.711 | 6.795 | 6.001 | 5.307 | 4.694 | 4.149 | 3.662 | 3.223 |

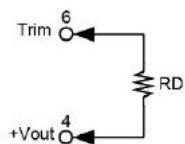
## □□S24W

| ΔV (%)   | 1       | 2       | 3       | 4       | 5       | 6      | 7      | 8      | 9      | 10     |
|----------|---------|---------|---------|---------|---------|--------|--------|--------|--------|--------|
| Vout (V) | 24.24   | 24.48   | 24.72   | 24.96   | 25.20   | 25.44  | 25.68  | 25.92  | 26.16  | 26.40  |
| RU (kΩ)  | 570.333 | 278.667 | 181.444 | 132.833 | 103.667 | 84.222 | 70.333 | 59.917 | 51.815 | 45.333 |

| ΔV (%)   | 11     | 12     | 13     | 14     | 15     | 16     | 17     | 18     | 19     | 20     |
|----------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V) | 26.64  | 26.88  | 27.12  | 27.36  | 27.60  | 27.84  | 28.08  | 28.32  | 28.56  | 28.80  |
| RU (kΩ)  | 40.030 | 35.611 | 31.872 | 28.667 | 25.889 | 23.458 | 21.314 | 19.407 | 17.702 | 16.167 |

## OUTPUT VOLTAGE ADJUSTMENT(CONTINUED)

Trim-down



## □□S05W

| $\Delta V$ (%)   | 1       | 2       | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |
|------------------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V)         | 4.95    | 4.90    | 4.85   | 4.80   | 4.75   | 4.70   | 4.65   | 4.60   | 4.55   | 4.50   |
| RD (k $\Omega$ ) | 248.340 | 120.590 | 78.007 | 56.715 | 43.940 | 35.423 | 29.340 | 24.778 | 21.229 | 18.390 |

## □□S5P1W

| $\Delta V$ (%)   | 1       | 2       | 3      | 4      | 5      | 6      | 7      | 8      | 9      | 10     |
|------------------|---------|---------|--------|--------|--------|--------|--------|--------|--------|--------|
| Vout (V)         | 5.049   | 4.998   | 4.947  | 4.869  | 4.845  | 4.794  | 4.743  | 4.692  | 4.641  | 4.590  |
| RD (k $\Omega$ ) | 253.350 | 123.095 | 79.677 | 57.968 | 44.942 | 36.258 | 30.056 | 25.404 | 21.786 | 18.891 |

## □□S12W

| $\Delta V$ (%)   | 1       | 2       | 3       | 4       | 5       | 6       | 7      | 8      | 9      | 10     |
|------------------|---------|---------|---------|---------|---------|---------|--------|--------|--------|--------|
| Vout (V)         | 11.88   | 11.76   | 11.64   | 11.52   | 11.40   | 11.28   | 11.16  | 11.04  | 10.92  | 10.80  |
| RD (k $\Omega$ ) | 776.557 | 380.723 | 248.779 | 182.807 | 143.223 | 116.834 | 97.985 | 83.848 | 72.853 | 64.057 |

## □□S15W

| $\Delta V$ (%)   | 1       | 2       | 3       | 4       | 5       | 6       | 7       | 8      | 9      | 10     |
|------------------|---------|---------|---------|---------|---------|---------|---------|--------|--------|--------|
| Vout (V)         | 14.85   | 14.70   | 14.55   | 14.40   | 14.25   | 14.10   | 13.95   | 13.80  | 13.65  | 13.50  |
| RD (k $\Omega$ ) | 818.223 | 401.557 | 262.668 | 193.223 | 151.557 | 123.779 | 103.938 | 89.057 | 77.483 | 68.223 |

## □□S24W

| $\Delta V$ (%)   | 1        | 2        | 3        | 4        | 5       | 6       | 7       | 8       | 9       | 10      |
|------------------|----------|----------|----------|----------|---------|---------|---------|---------|---------|---------|
| Vout (V)         | 23.76    | 23.52    | 23.28    | 23.04    | 22.80   | 22.56   | 22.32   | 22.08   | 21.84   | 21.60   |
| RD (k $\Omega$ ) | 4947.667 | 2439.333 | 1603.222 | 1185.167 | 934.333 | 767.111 | 647.667 | 558.083 | 488.407 | 432.667 |