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DC-DC Converter DATA Sheet

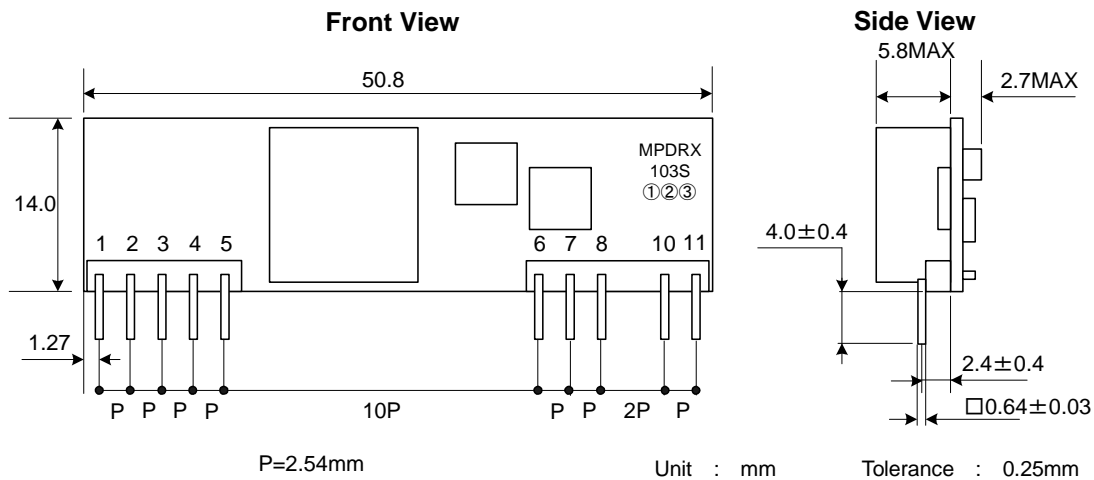
MPDRX103S

1. Features

- Ultra high-speed response is realized by using original ripple detecting control.
- Up to 16A output current, non-isolated POL.
- Wide adjustable output voltage range by connecting external resistance (0.8V to 1.8V).
- Wide operating temperature (-40 °C to +85 °C).
- UVLO function, ON/OFF function, Output voltage sense function, Over-current function and Over-temperature function are built in.



2. Appearance, Dimensions



- Marking (1) MFG ID (2) Part No. MPDRX103S (3) Lot No. ①②③
- ① Production factory Mark
 - ② Production Year
 - ③ Production Month (1,2,3,...9,O,N,D)

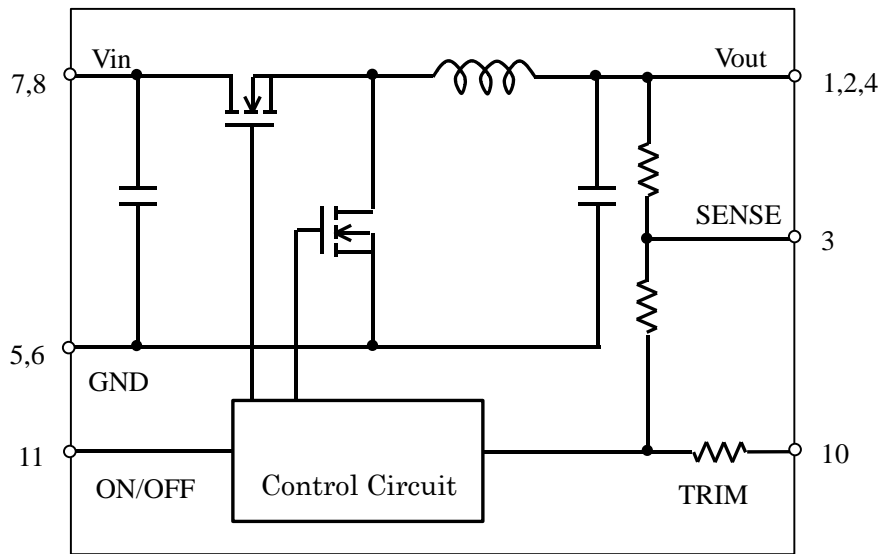
Pin Number and Function

| Pin No. | Symbol | Function |
|---------|--------|---|
| 1,2,4 | Vout | Output terminal of this DC-DC Converter |
| 3 | SENSE | Output + sense |
| 5,6 | GND | GND |
| 7,8 | Vin | Input terminal of this DC-DC Converter |
| 10 | TRIM | Output voltage adjust terminal. Output voltage can be adjusted by connecting a resistor between TRIM pin and GND pin. |
| 11 | ON/OFF | Remote ON/OFF terminal. This DC-DC converter is shut down when this pin is connected to GND. This DC-DC converter operates if this pin left open. |

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3. Block Diagram



4. Environmental Conditions

| | |
|---------------------------------|---|
| 4.1 Operating Temperature Range | -40 to +85 °C (Temperature gradient $\leq 10^{\circ}\text{C}/\text{H}$) |
| 4.2 Storage Temperature Range | -40 to +85 °C (Temperature gradient $\leq 25^{\circ}\text{C}/\text{H}$) |
| 4.3 Operating Humidity Range | 20% ~ 85% (No water condenses in any cases.) |
| 4.4 Storage Humidity Range | 10% ~ 90% (Unpacked condition. No water condenses in any cases.) |
| 4.5 Maximum Wet Bulb | 39°C |

5. Absolute Maximum Rating

| | |
|------------------------------------|-------------------------------|
| 5.1 Input Voltage Range | 10.8V – 13.2V |
| 5.2 ON/OFF Pin Input Voltage Range | -0.3V to $V_{in}+0.3\text{V}$ |

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6. Characteristics

6.1 Electrical Characteristics (Ta=25 °C)

| Item | Symbol | Condition | Value | | | Unit | |
|---------------------------------|--------|--|----------------|------|------|------|---------|
| | | | Min. | Typ. | Max. | | |
| Input Voltage Range | Vin | | 10.8 | - | 13.2 | V | |
| Rising UVLO Threshold | UVLO | Vin Increasing | 9.3 | 10.0 | 10.8 | V | |
| Falling UVLO Threshold | UVLOf | Vin Decreasing | 9.0 | 9.5 | 10.3 | V | |
| Output Voltage Adjustable Range | Vout | ON/OFF= Open | 0.8 | - | 1.8 | V | |
| Output Current | Iout | See the thermal derating curve in clause 6.2. | 0 | - | 16 | A | |
| Output Voltage Accuracy | Vo tol | Over Vin, Io, temperature range Rset=0.5% tolerance | -3 | - | +3 | %Vo | |
| Ripple Voltage | Vrpl | Vin=12V, Iout=16A BW=20MHz, Cout=100µF | Vout=1.8V | - | 15 | - | mV(p_p) |
| | | | Vout=0.8V, | - | 25 | - | |
| Transient Response | Ttr | Vin=12V, out=1.8V Iout=8↔16A, di/dt=2A/µs, Cout=100µF | Recovery Time | - | 30 | - | µsec |
| | Δ Vtr | | Vout Deviation | - | 50 | - | mV |
| Efficiency | EFF | Vin =12.0V, Vout=1.8V, Iout=16A | - | 86 | - | % | |
| Operating Frequency | Frq | Vin =12.0V, Vout=1.8V | - | 600 | - | kHz | |
| | | Vin =12.0V, Vout=0.8V | - | 300 | - | | |
| ON/OFF pin High Voltage | VIH | ON/OFF pin is pulled up to Vin inside of the DC-DC Converter. If ON/OFF pin is left open, the DC-DC Converter shall be "ON". This pin will be pulled down to GND inside the DC-DC Converter when OCP or OTP events occur. Please do NOT connect this pin to Vin with low impedance line, so as not to damage the converter.. | | | | | |
| ON/OFF pin Low Voltage | VIL | | Vin-0.3 | - | 0.7 | V | |
| Short Circuit Protection | SCP | Reset, Followed by Auto-Recovery | 17 | 25 | - | A | |
| Over Temperature Protection | OTP | Reset, Followed by Auto-Recovery | - | 115 | - | °C | |
| External Output Capacitor | Cout | When input voltage is ideal voltage source | 47 | 100 | 1000 | µF | |

※Caution

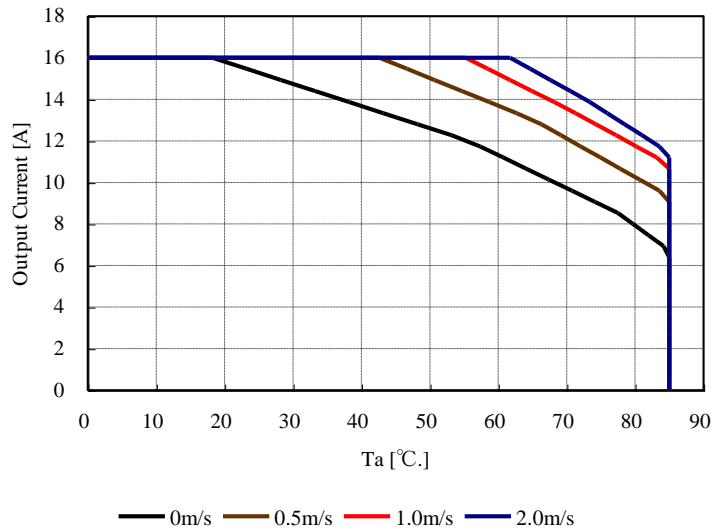
The above electrical characteristics are guaranteed with the condition that the impedance of the input voltage source is sufficiently low as shown in section 9. Connecting an input inductance or using an input power supply with output inductance may cause an unstable operation of this device. Please check the proper operation of this device with the peripheral circuits on your system.

 **Note:**

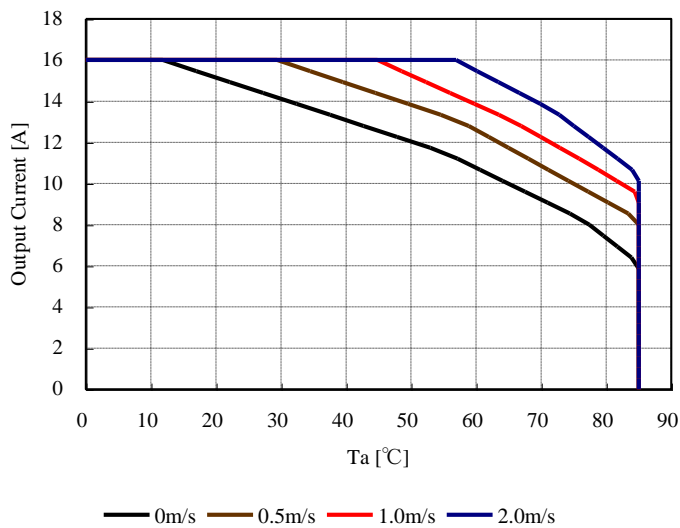
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6.2 Thermal Derating

MPDRX103S Thermal Derating
[Vin=12V , Vout=1.2V]



MPDRX103S Thermal Derating
[Vin=12V , Vout=1.8V]



The above derating limits apply to this product soldered directly to 101.6*180mm*1.6mm PCB (double-sided, with 70um copper). Any adjacent parts of high temperature may cause overheating. For reliable operation, please ensure that the FET temperature of this product is maintained below 120°C and the inductor temperature is below 106°C.

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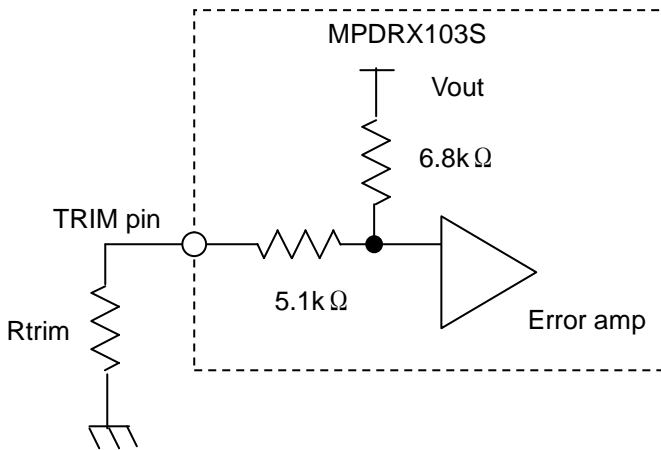
7. Operation in information

7.1 Adjusting the Output Voltage

The output voltage can be adjusted ranging from 0.8V to 1.8V by connecting resistors between TRIM-pin (10Pin) to GND-pin (5Pin).

The following equation gives the required external-resistance value to adjust the output voltage to the required Vout.

Internal circuit



$$R_{trim} = \frac{5440}{V_{out} - 0.8} - 5100 \quad [\text{ohm}]$$

< Rtrim calculation example >

| Vout [V] | Calculated Rtrim[Ω] | Applied Rtrim (example) [Ω] |
|----------|---------------------|-----------------------------|
| 1.8 | 340 | 330 |
| 1.5 | 2671 | 2.4k+270 |
| 1.2 | 8500 | 8.2k+300 |
| 1.0 | 22100 | 22k+100 |
| 0.8 | ∞ | Open |

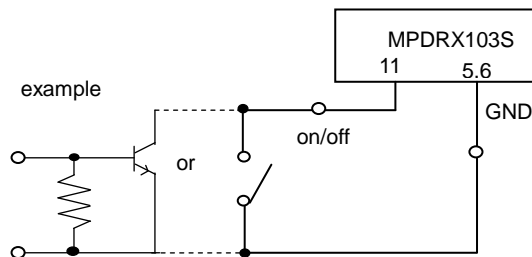
7.2 ON/OFF Control

ON/OFF function

By using ON/OFF function, the operation of this product can be disabled without disconnection of input voltage. Sequence of a power supply system and power-saving control can be easily achieved using this function.

ON/OFF control usage

- When ON/OFF-pins(11pin) are left open Output Voltage =ON
- When ON/OFF-pins(11pin) are connected to GND Output Voltage=OFF

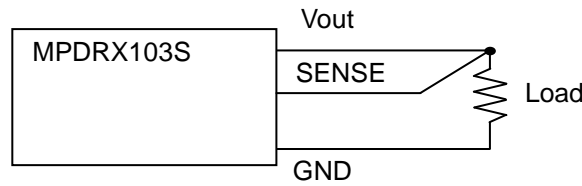


Note:

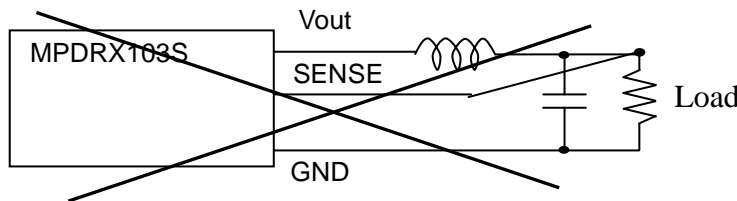
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7.3 Output Voltage Sensing

By connecting SENSE-pin to the load, output voltage drop in wiring shall be compensated.



Please do NOT connect SENSE-pin to the output of LC filter that is set to the Vout line. When using this way, this product will not operate properly.



7.4 Input External capacitor

It is recommended to connect a ceramic capacitor or a low-impedance electrolytic capacitor of 22 μ F or more at Vin terminal. Smaller input capacitor may leads to an unstable operation of this product caused by input voltage fluctuation. Please check the proper operation of it on your product when smaller input capacitor is used.

7.5 Output External capacitor

Ceramic capacitors are recommended as output external capacitor. Using ceramic capacitors, small output variation and small ripple voltage are realized.

Output capacitor should be within 47 μ F to 1000 μ F. Output capacitor shall be placed near the output terminal. When using plural capacitors, please make sure to place a capacitor of at least 47 μ F near the output terminal, and place other capacitors near the load.

When using LC output filter, please make sure to place a capacitor of at least 47 μ F near the output terminal.

8. Reliability

8.1 Humidity

According to JIS-C-0022.

40 \pm 2 $^{\circ}$ C, 90 to 95%RH, 100 hours. Leave for 4 hours at room temperature.

No damage in appearance and no deviation from electrical characteristics (section 6.1.).

8.2 Temperature Cycles

Repeat cycle 5 times. Leave 2 hours at room temp.

No damage in appearance and no deviation from electrical characteristics (section 6.1.).

| Step | Condition | Time |
|------|---------------------------------------|--------------|
| 1 | -40 $^{\circ}$ C \pm 3 $^{\circ}$ C | 30 minutes |
| 2 | Room Temp. | 5-10 minutes |
| 3 | +85 $^{\circ}$ C \pm 2 $^{\circ}$ C | 30 minutes |
| 4 | Room Temp. | 5-10 minutes |

8.3 Vibration

10 to 55Hz, 1.5mm amplitude (1minute cycle), 1 hour for each of X, Y, Z directions.

No damage in appearance and no deviation from electrical characteristics (section 6.1.).

8.4 Mechanical Shock

20G, 1 time for each X, Y, Z directions.

No damage in appearance and no deviation from electrical characteristics (section 6.1.).

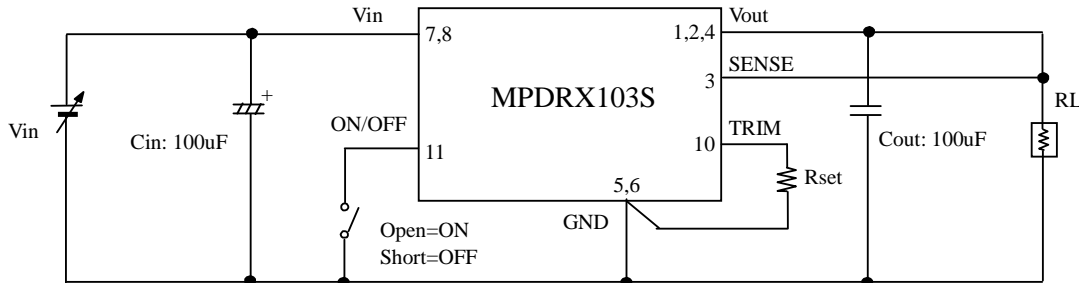
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9. Test Circuit

In the following test circuit, the initial values under item 6.1. should be met.

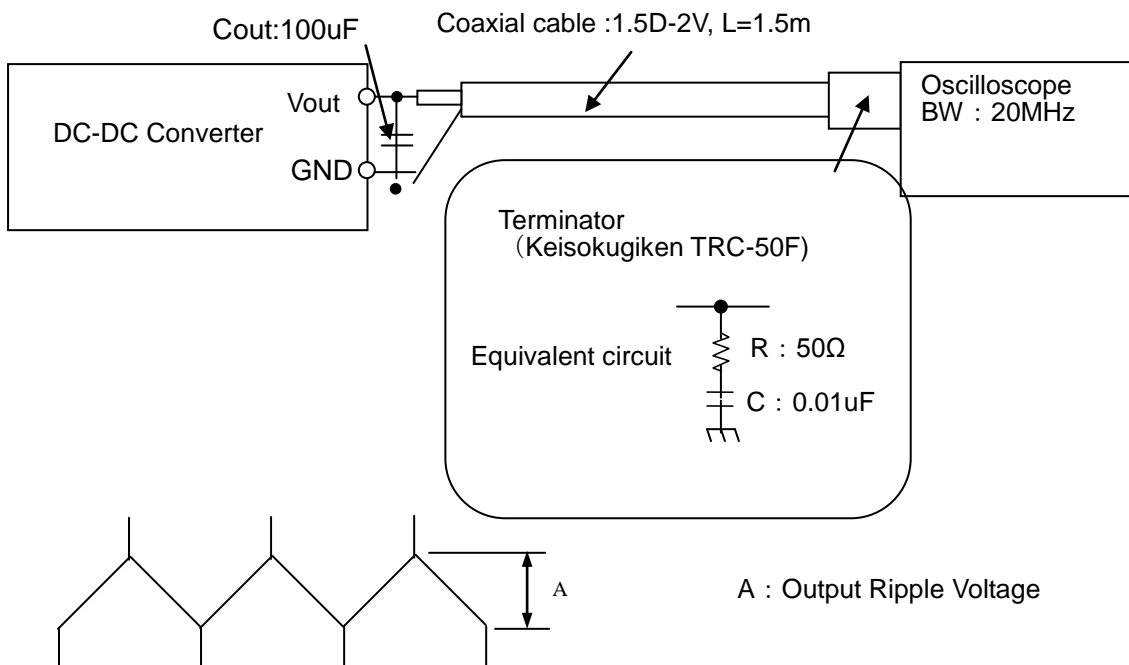
9.1. General Measure Circuit



Cin : 100uF / 16V (16ZL120MMRKA6.3X11, Rubycon)
(Low-impedance Electrolytic Capacitor)

Cout : 100uF / 6.3V (GRM32EB30J107ME16L, Murata)
(Ceramic Capacitor)

9.2. Ripple Voltage Measurement Circuit



A : Output Ripple Voltage

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10. Packaging Specification

- ① Like the figure below, put the product on the conductive mat in a row. (5lines × 4columns) 「
- ② Pile and pack the 3 above-mentioned units at maximum.

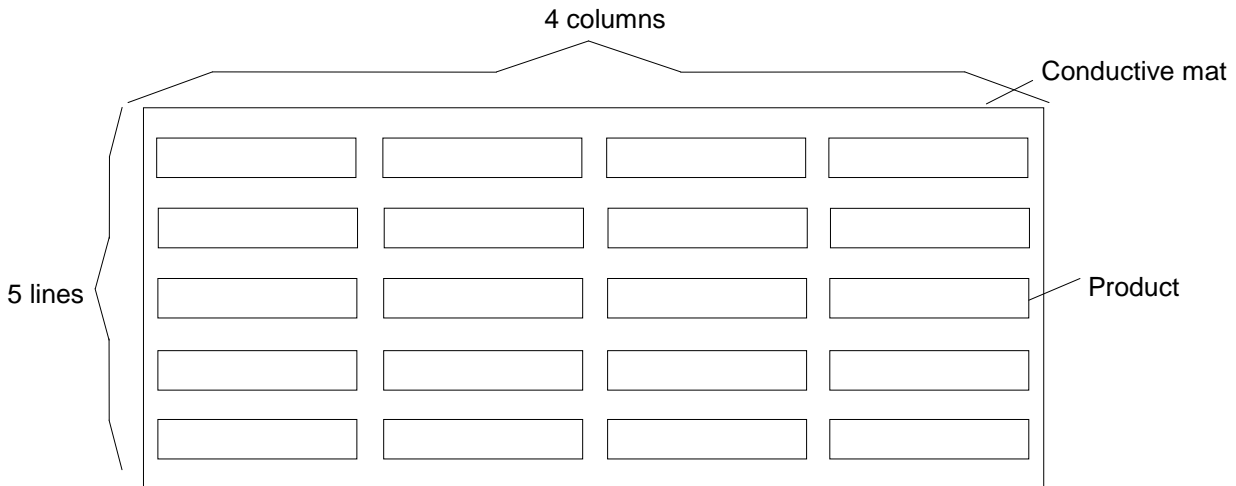


Fig1-1. Top View

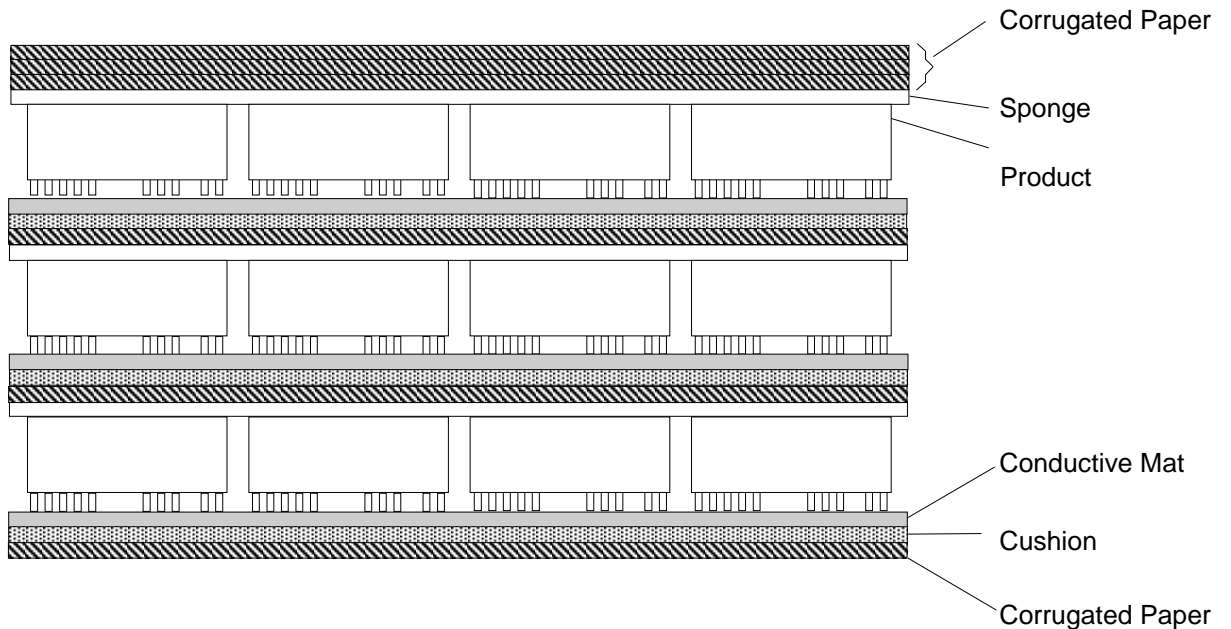
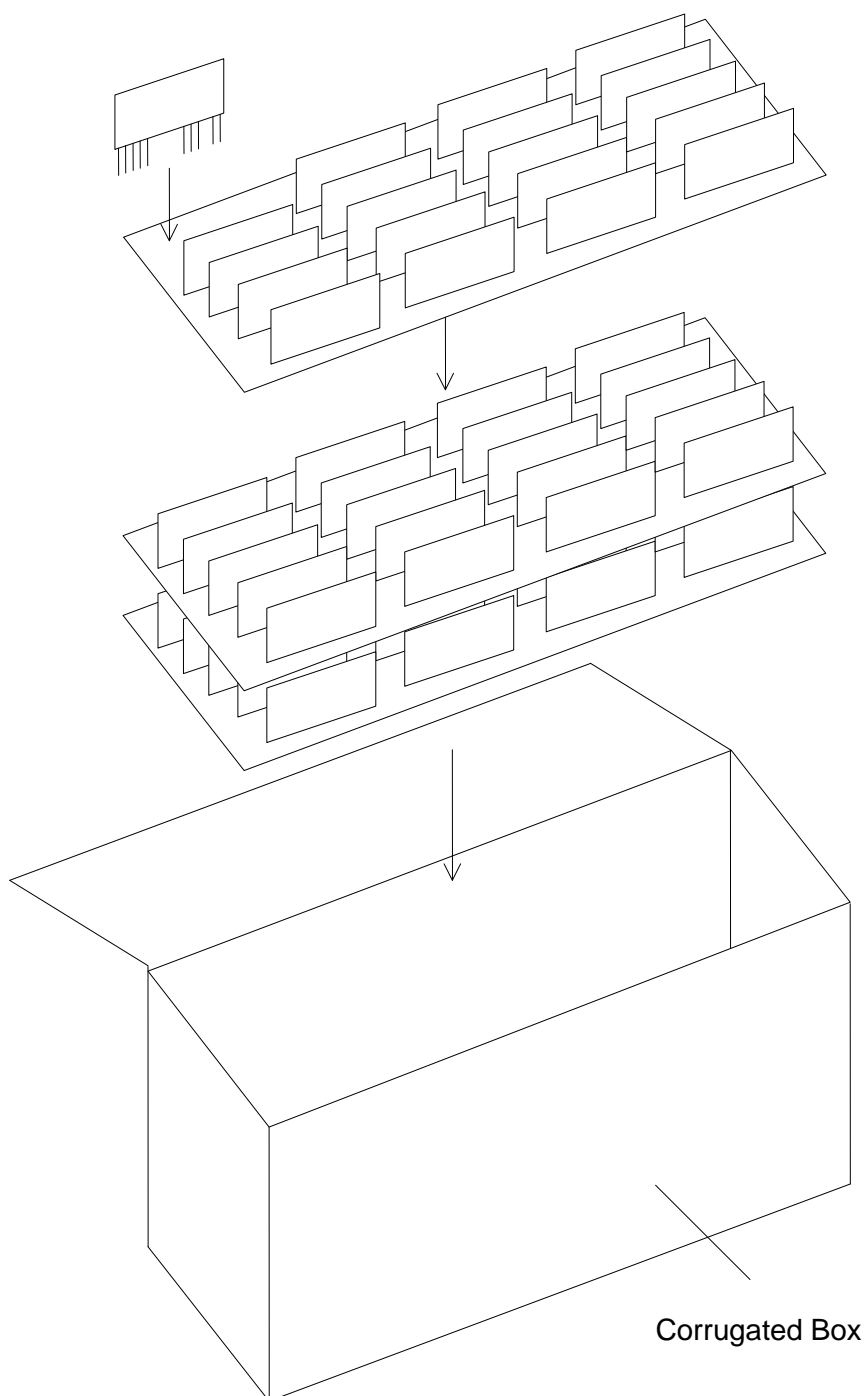


Fig1-2.Side View

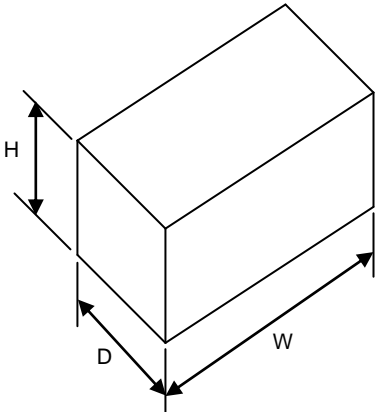
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| Item | Specification |
|---|---|
| Packaging form typical classification | Box |
| Dimensions of packaging form(typ.)  | $W = 245 \text{ (mm)}$ $D = 78 \text{ (mm)}$ $H = 104 \text{ (mm)}$ |
| The number of products in packaging form | 60 (pcs) |
| Mass of one product | 5 (g) |
| <p>Remark</p> <ul style="list-style-type: none"> • The number of the product in one box may be less than 60, if needed. <p>※On the packing box, the following is indicated.○</p> <p>Murata Part No. Quantity Stamp No.</p> | |

11. Production factory

Komatsu Murata Mfg.Co.,Ltd.

Kanazu Murata Mfg.Co.,Ltd.

Wakura Murata Mfg. Co., Ltd.

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12. Typical Characteristics Data

12.1 Load Transient Response

Our original ripple-detective control method achieves better load transient responses.

$V_{in}=12V, V_o=1.8V, I_o=8A \rightarrow 16A, di/dt=2A/\mu s, C_{out}=100\mu F(\text{Ceramic})$

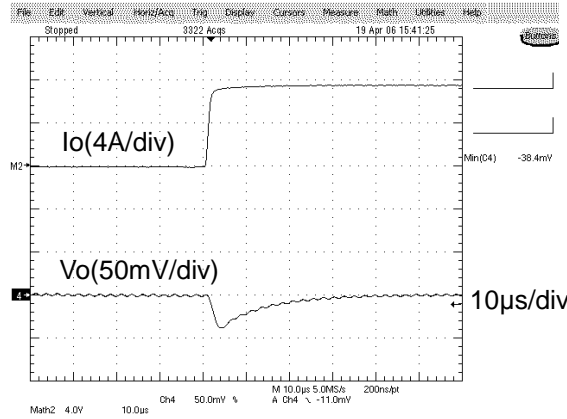


Fig. 12.1 Load Transient Response

12.2 Output Impedance characteristics

Our original ripple-detective control method achieves very low output impedance in wide frequency range. (Fig. 12 shows the output impedance characteristics of MPDRX003S, which uses the same control method)

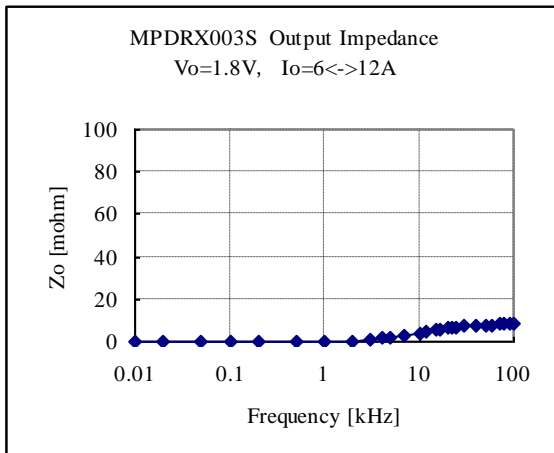


Fig. 12.2.1 Output Impedance of MPDRX003S

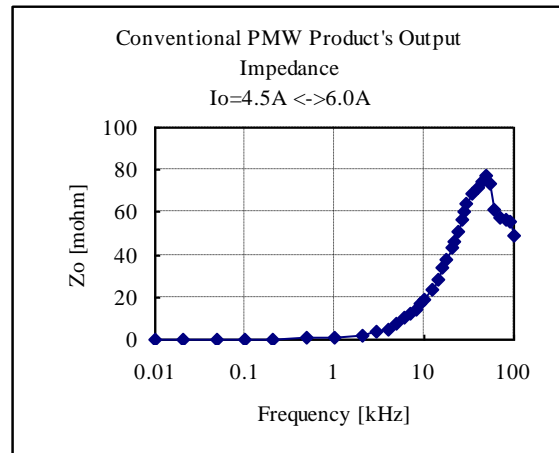


Fig. 12.2.2 Output Impedance of conventional product

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12.3 Other electrical characteristics

12.3.1 Vout=1.8V

(Ta=25°C, Cin= 100μF Low-impedance Electrolytic Capacitor, Cout=GRM32EB30J107ME16L, Rtrim=340Ω)

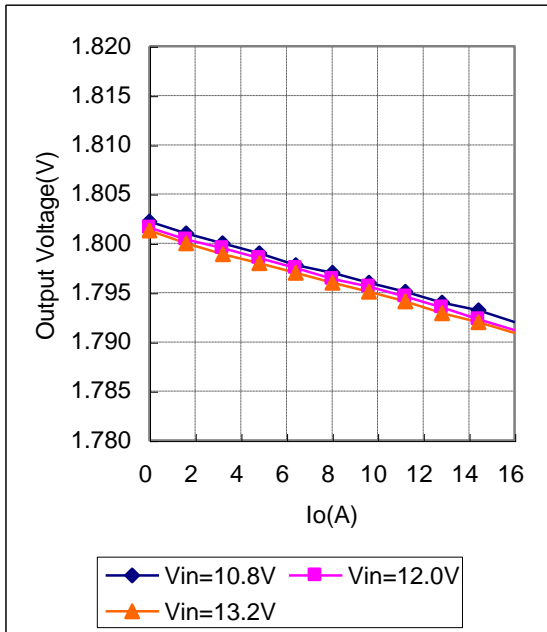


Fig. 12.3.1 Output Voltage v.s. Output Current

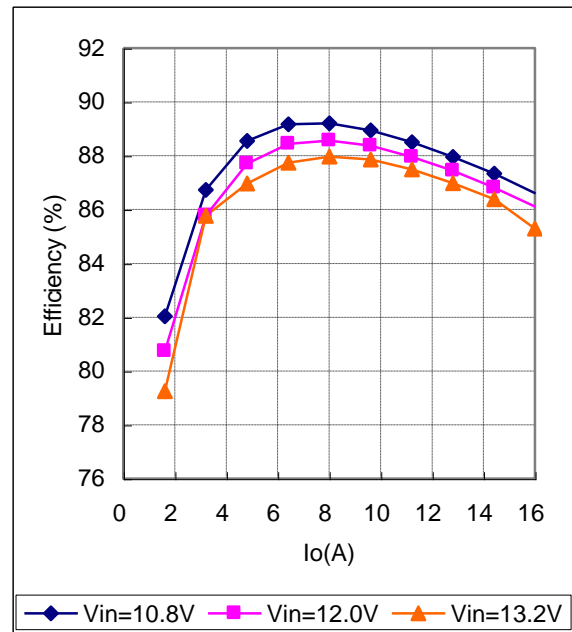


Fig. 12.3.2 Efficiency v.s. Output Current

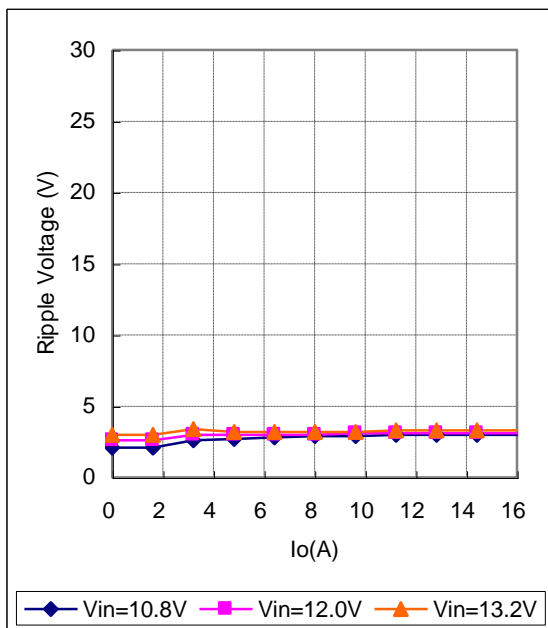


Fig. 12.3.3 Ripple Voltage v.s. Output Current

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12.3.2 Vout=1.2V

(Ta=25°C, Cin= 100μF Low-impedance Electrolytic Capacitor, Cout=GRM32EB30J107ME16L, Rtrim=8.5kΩ)

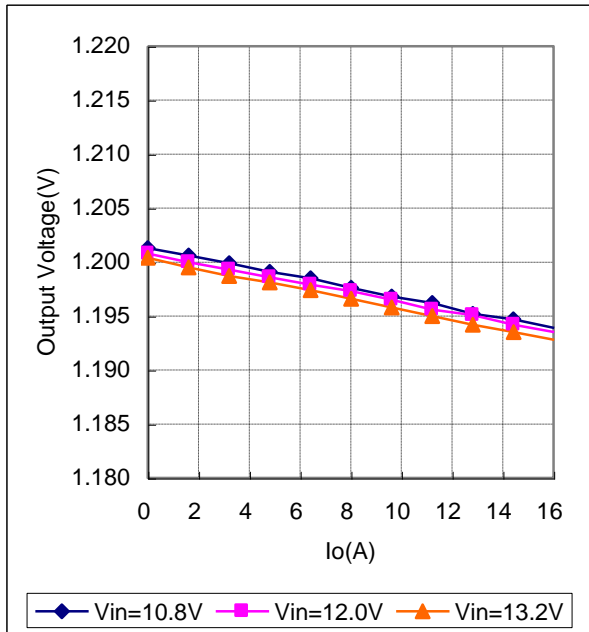


Fig. 12.3.4 Output Voltage v.s. Output Current

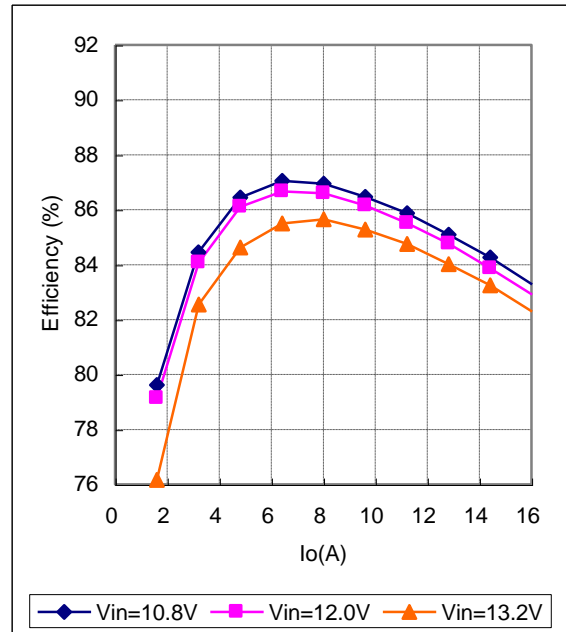


Fig. 12.3.5 Efficiency v.s. Output Current

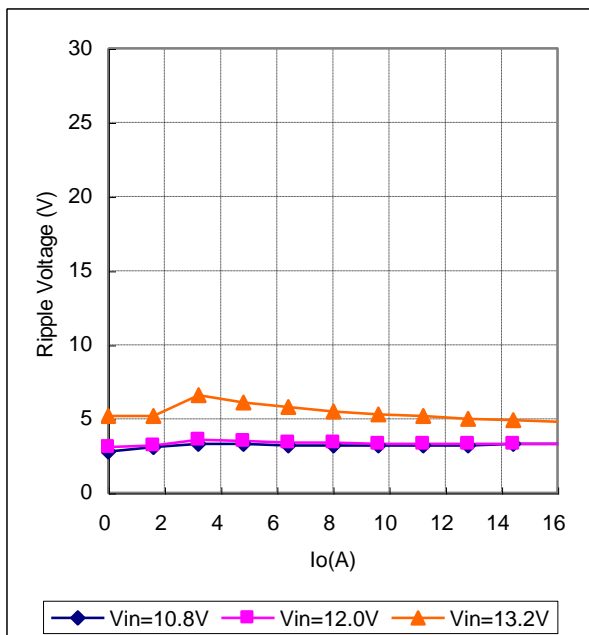


Fig. 12.3.6 Ripple Voltage v.s. Output Current

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13. Mounting Condition

13.1 Recommendable Solder Land Pattern

| Pin Size | Hole diameter | Land diameter |
|----------|---------------|---------------|
| 0.64mm | φ 0.9mm | φ 2.0mm |

As for the position of holes, refer to the appearance figure.

13.2 Solder

13.2.1 Solder

Lead Free Solder

Please use the solder Sn-3Ag-0.5Cu.

13.2.2 Eutectic Solder

Please use the solder H60, H63 (in JIS Z 3282) or the equivalent type .

13.3 Recommended Soldering Conditions

13.3.1 Lead Free Solder

Please solder under the following condition :

Flow soldering Preheating :120±10°C 60~120 seconds

Soldering :260°C +0°C /-5°C

Time :not more than 10seconds

Condition of iron soldering :350°C MAX, 3 seconds at maximum

(Soldering iron of less than 30W should be used.)

13.3.2 Eutectic Solder

Please solder under the following condition :

Flow soldering Preheating :120±10°C 60~120 seconds

Soldering :230°C +0°C /-5°C

Time :not more than 10 seconds

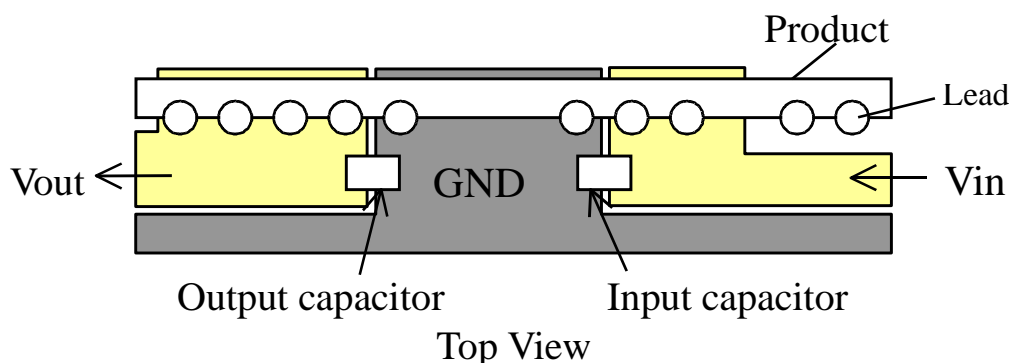
Condition of iron soldering :300°C MAX, 3 seconds at maximum

(Soldering iron of less than 30W should be used.)

14. Notice

14. 1 Both input-side and output side, please make the wiring loop between plus and minus as small as possible. The influence of a leakage inductance can be reduced.

14. 2 Please make the power line pattern as wide and short as possible. The Following figure is an example of recommendable PCB design.



14. 3 This product should not be operated in parallel nor in series.

14. 4 Please do not use a connector or a socket to connect this product to your product. The electric characteristics may be deteriorated by the influence of contact resistance.

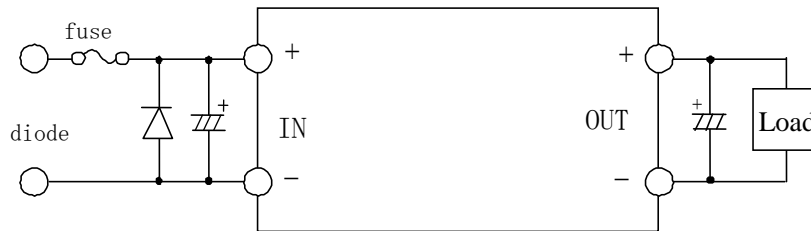
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14. 5 Be sure to provide an appropriate fail-safe function on your product to prevent secondary damage that may be caused by the functional trouble or the failure of this product.

14. 6 Inrush current protection is not a feature of this product.

14. 7 Please connect the input terminals with the correct polarity. If an error in polarity connection is made this product may be damaged. If this product is damaged internally, an elevated input current may flow, and so this product may exhibit an abnormal temperature rise, or your product may be damaged. Please add a diode and fuse per the following diagram to protect them.



※Please select diode and fuse after confirming the operation of your product.

14. 8 Cleaning

14.8.1 Please clean the products to remove flux from them using the dipping, and vapor methods in isopropyl alcohol for up to 5 minutes.

Please inform us if you are to use aqueous or semi-aqueous cleaning or another methods.

Do not use ultrasonic cleaning as semiconductor devices on the products, may be damaged by resonance.

14.8.2 After cleaning, please dry the products thoroughly. If you touch the products that have not been dried enough, you must take care because the products markings may thin or blur.

Do not measure electrical characteristics, until the products are completely dry.

14. 9 Storage

14.9.1 Please avoid dampness and heat or locations where temperatures may vary widely to avoid Possible water condensation on the product. Exposure to such environments may degrade the performance and/or the reliability of the product.

If the product must be stored for a longer time than 1 year it is recommend that solderability be tested regularly to confirm material degradation has not occurred.

14. 10 Please do not store the products in the places such as in a dusty place, in a place exposed directly to sea breeze, in an atmosphere containing corrosive gas (Cl₂,NH₃,SO₂,NO_x and so on).

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14. 11 Operational Environment and Operational Conditions

14.11.1 Operational Environment

The products are not waterproof, chemical-proof or rust-proof.

In order to prevent leakage of electricity and abnormal temperature increase of the products, do not use the products under the following circumstances:

- (1) in an atmosphere containing corrosive gas (Cl₂, NH₃, SO₂, NO_x and so on).
- (2) in a dusty place.
- (3) in a place exposed to direct sunlight.
- (4) in such a place where water splashes or in such a humid place where water condenses.
- (5) in a place exposed to sea breeze.
- (6) in any other places similar to the above (1)through (5).

14.11.2 Operational Conditions

Please use the products within specified values (power supply, temperature, input, output and load condition, and so on). Input voltage drop for line impedance, so please make sure that input voltage is included in specified values.

If you use the products over the specified values, it may break the products, reduce the quality, and even if the products can endure the condition for short time, it may cause degradation of the reliability.

Also please take care that the external voltage over output voltage of DC-DC Converter does not applies to output of this DC-DC Converter.

14.11.3 Note prior to use

If you apply high static electricity, over rated voltage or reverse voltage to the products, it may cause defects in the products or degrade the reliability.

Please avoid the following items:

- (1) over rating power supply, reverse power supply or not-enough connection of 0 V(DC) line.
- (2) electrostatic discharge by production line and/or operator.
- (3) electrified product by electrostatic induction.

Do not give an excessive mechanical shock..

If you drop the products on the floor, etc., it may occur a crack to the core of inductors and monolithic ceramic capacitors.

Do not give a strong shock such as a drop in handling.

14. 12 Transportation

If you transport the products, please pack them so that the package will not be damaged by mechanical vibration or mechanical shock, and please educate and guide a carrier to prevent rough handling.

If you transport the products to overseas (in particular, by sea), it is expected that the transportation environment will be the worst, so please pack the products, in the package designed on the consideration of mechanical strength, vibration-resistant and humidity-resistant. The package of the products which Murata sells in Japan, may not resist over seas transport.

Please consult us if you are to use the Murata package of the products sold in Japan for transport to overseas.



Note

1. Murata recommends that customers ensure that the evaluation and testing of these devices are completed with this product actually assembled on their product.
2. Please contact our main sales office or nearby sales office before using our products for the applications listed below which require especially high reliability for the prevention of defects which might directly cause damage to the third party's life, body or property or this products for any other applications that described in the above.
 - ① Aircraft equipment
 - ② Aerospace equipment
 - ③ Undersea equipment
 - ④ Power plant control equipment
 - ⑤ Medical equipment
 - ⑥ Transportation equipment (vehicles, trains, ships, etc.)
 - ⑦ Traffic signal equipment
 - ⑧ Disaster prevention /crime prevention equipment
 - ⑨ Data-processing equipment
 - ⑩ Application of similar complexity and/or reliability requirements to the applications listed in the above.
3. This DATA Sheet is indicated in Apr. 2006. About the written contents, since changing without a preliminary announcement for improvement and supply are sometimes stopped, please confirm in case of ordering. If written contents are unknown, please ask to our main sales office or nearby sales office.

Note:

1. This datasheet is downloaded from the website of Murata Manufacturing co., ltd. Therefore, it' s specifications are subject to change or our products in it may be discontinued without advance notice. Please check with our sales representatives or product engineers before ordering.
2. This datasheet has only typical specifications because there is no space for detailed specifications. Therefore, please approve our product specifications or transack the approval sheet for product specifications before ordering.