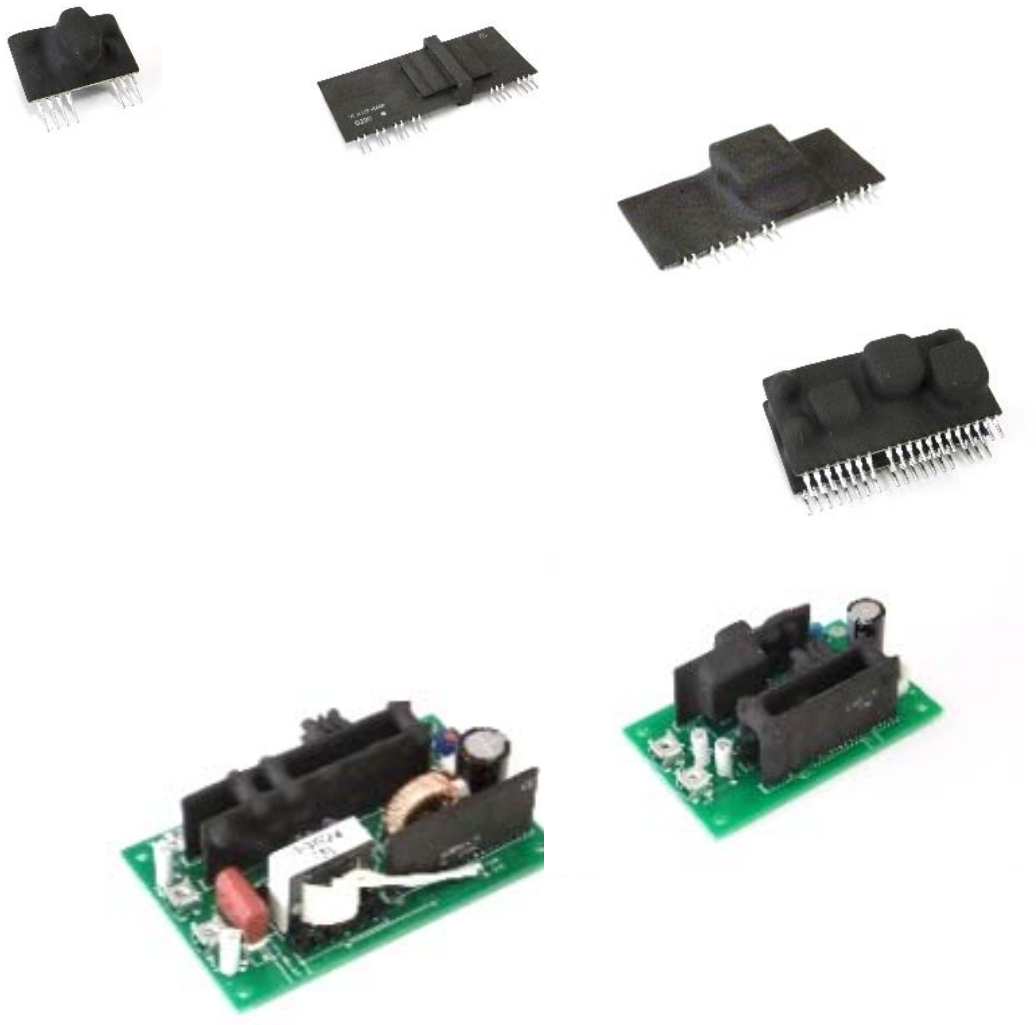
DC/DC Converter
Application Manual



ISAHAYA ELECTRONICS CORPORATION

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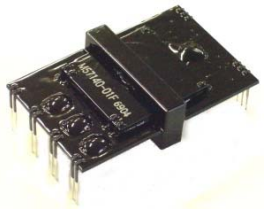


ISAHAYA ELECTRONICS DC/DC Converter

【Features】

■ Broad product lineup

The wide variety of available products includes isolation types, non-isolation types, low-voltage input types, and high-voltage input types.

■ Extensive inverter-peripheral products

Especially products for inverter control and products for inverter-peripheral product control allow extensive selections.

■ Lineup of small, high-isolation-voltage products

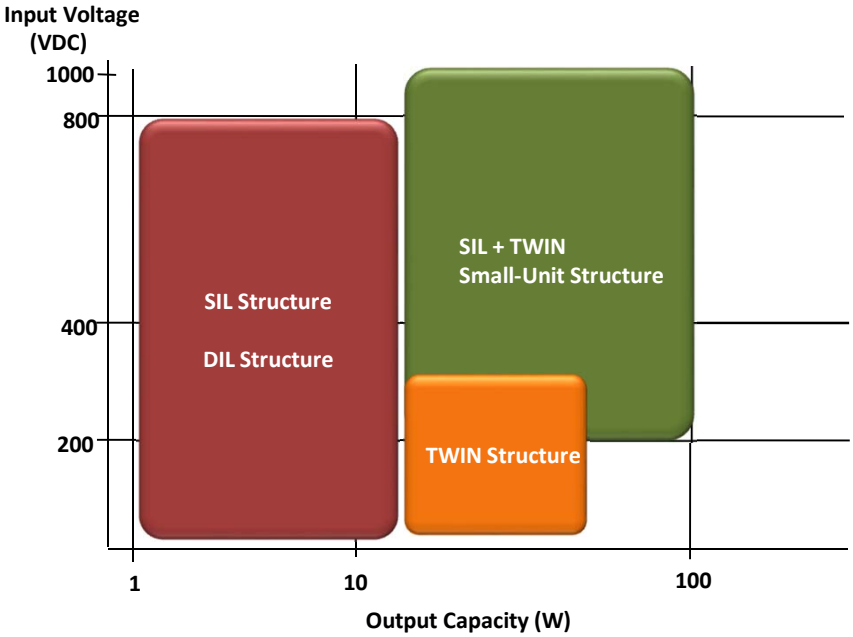
Despite the small size, the isolation voltage is 2,500Vrms.

■ Lineup of high-voltage wide input products

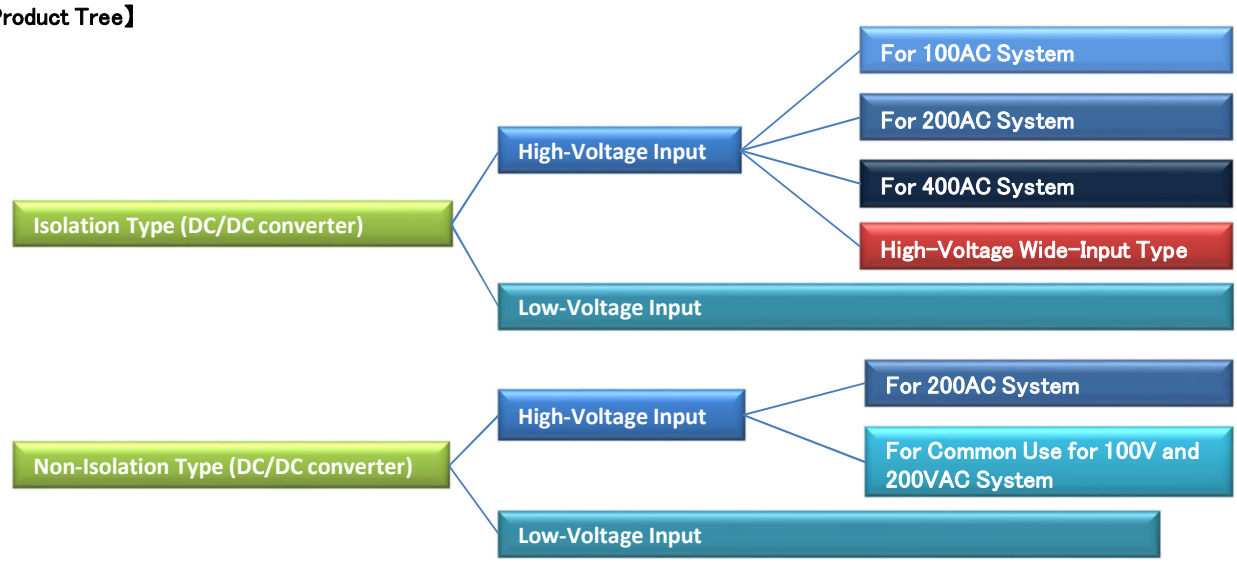
Isolation-type DC/DC converter series which is able to input up to 1,000VDC is available.

【Product Range】

Besides the main products – isolation-type DC/DC converters such as IGBT drive gate power supply and IPM control power supply–, peripheral-equipment control power supply and high-voltage input type pre-regulators are available. A wide range of power supply have been commercialized through the employment of the single inline (SIL) structure, dual inline (DIL) structure, TWIN structure, and the combinations of these structures resulting in a small-unit structure.



【Product Tree】



Important Notes for Use

1. Connection Terminals

Depending on the product shape, the connection terminals of the DC/DC converter are lead pins, connectors, and terminal blocks. For the terminal numbers and terminal names, see the data sheet of the relevant product. When making connections, properly identify the indicated terminal placement, so that product damage and deterioration due to wrong connections are avoided. Be careful that energization with wrong connections made may result in a short-circuit fault.

2. Connection Methods

2.1 Basic Connections

To use the DC/DC converter, basically the connections shown in Figure 2.1 have to be made. For peripheral components needed for the product, see the data sheet for the product.

The DC/DC converter can be used only through DC input. Directly connecting to AC input causes the product to malfunction, and thus never connect to AC input directly.

If attempting to use AC input, connect a rectification smoothing circuit to the input portion as shown in Figure 2.2. Because the input voltage range of the DC/DC converter is the one after rectification smoothing, use within the input voltage rating of the DC/DC converter.

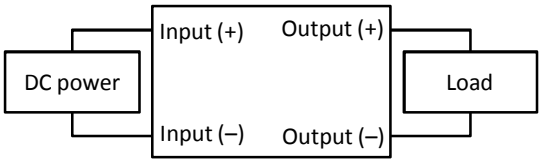


Figure 2.1 Input/Output Connection Method

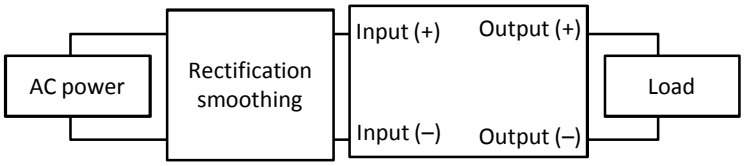


Figure 2.2 For AC Input Connections

2.2 Serial/Parallel Connections

Basically, the DC/DC converter does not allow serial connections and parallel connections. If considering such connections for the product, contact our sales representative.

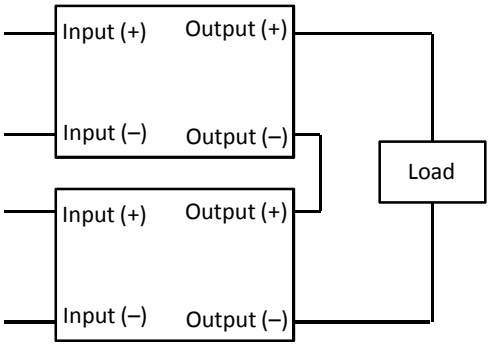


Figure 2.3 Serial Connections

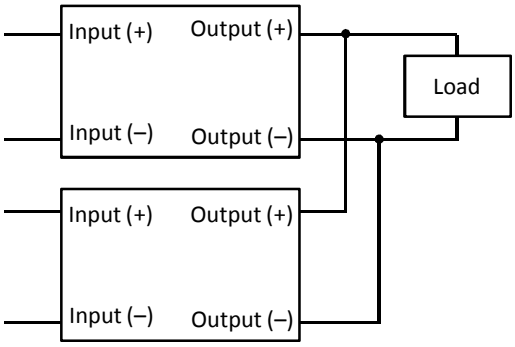


Figure 2.4 Parallel Connections

2.3 Peripheral Connections

1) Input-side connections

■Electrolytic Capacitor

- To stabilize the operation of the DC/DC converter, put an electrolytic capacitor between the input (+) and input (–).
- For the capacitance of the electrolytic capacitor, check with the measurement circuit on the data sheet of the relevant product.
- Place the electrolytic capacitor as close to the product as possible.

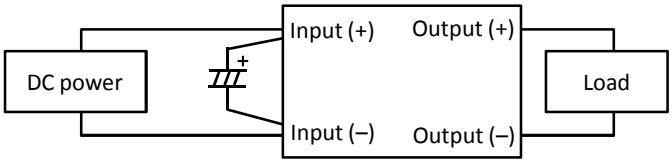


Figure 2.5 Input-Side Capacitor Connection

Important Notes for Use

■ Fuse

Some DC/DC converters contain fuses but the others do not contain them. No matter whether a fuse has been contained, attach a fuse to the input (+) to secure safety.

When the fuse has brown out, the product may have malfunction. Therefore, do not energize the product after replacing the fuse.

■ Prevention of Reverse Connections

In a case where voltage of reverse polarity may be applied to the input side, add a protection circuit as shown in Figure 2.6.

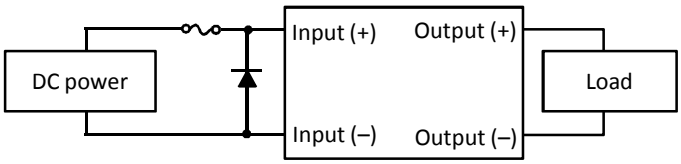


Figure 2.6 Fuse addition/reverse connection prevention example

■ Reduction of Mains Terminal Interface Voltage

The DC/DC converter does not contain a filter circuit. To reduce mains terminal interface voltage, connect an external filter circuit.

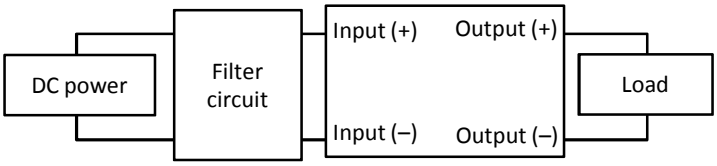


Figure 2.7 Filter Circuit Connection

2) Output-side connection

■ Electrolytic Capacitor

- To stabilize the operation of the DC/DC converter, put an electrolytic capacitor between the output (+) and output (–).
- For the capacitance, check with the measurement circuit on the data sheet of the relevant product.
- Choose an electrolytic capacitor which has good harmonic characteristics.
- When choosing an electrolytic capacitor, be careful with the ripple current rating.
- Place the electrolytic capacitor as close to the product as possible.

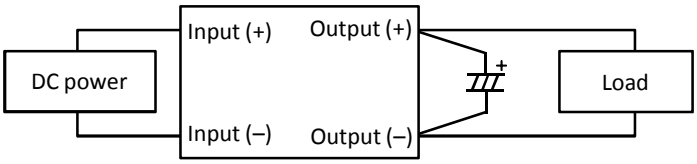


Figure 2.8 Output-Side Capacitor Connection

■ Resistor/Capacitor

Some models allow output voltage to be changed with an external resistor. Check with the measurement circuit on the data sheet of the relevant product.

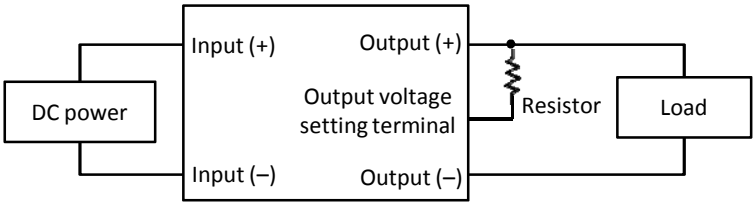


Figure 2.9 Voltage setting resistor connection example

3) Other peripheral connections

■ Coil

Some models require a coil to be placed. Check with the measurement circuit on the data sheet of the relevant product.
Depending on the placement of the coil, the characteristic may change. See the pattern layout in Section 4.2.

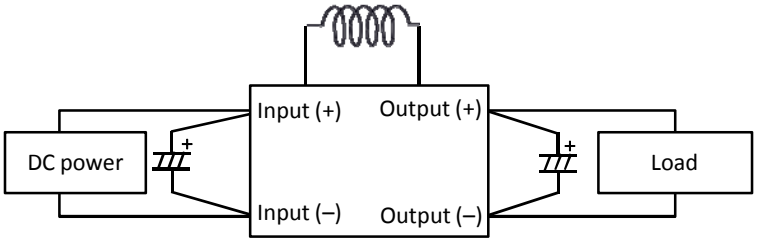


Figure 2.8 Connection of External Coil

3. Functions

3.1. Overcurrent Protection

The characteristics of the DC/DC converter during overcurrent occurrence differ depending on the product. The operations are shown in the figures below:

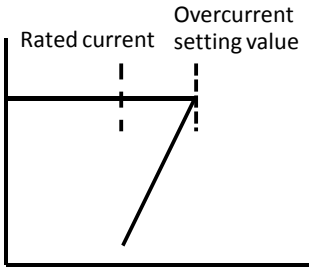


Figure 3.1 Fold-back Current Limiting Characteristic

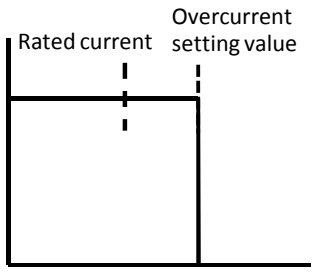


Figure 3.2 Drooping Characteristic

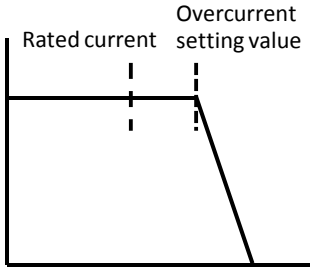


Figure 3.3 Fold-Forward Current Limiting Characteristic

The setting has been made so that overcurrent protection starts to function when current becomes 1.1 times larger than the rated current. The operation differs depends on each characteristic at larger than the overcurrent setting value.

- For the fold-back current limiting characteristic, both of the output voltage and output current decrease when overcurrent flows.
- For the drooping characteristic, the output voltage decreases when overcurrent flows. The output current remains uniform near the overcurrent setting value.
- For the fold-forward current limiting characteristic, the output voltage decreases but the output current increases.

The fold-back current limiting characteristic and the drooping characteristic are acceptable. However, the fold- forward current limiting characteristic does not allow current restriction and thus it must be avoided: especially in short-circuit status, the product may be damaged.

Any of these characteristics allows automatic recovery when overcurrent status is ended.

Typically, the DC/DC converter contains an overcurrent protection function. However, avoid continuous use of the converter at the time of overcurrent flow or in short-circuit status, to prevent product damage and life reduction.

For the presence/absence of an overcurrent protection function and the characteristic at the time of overcurrent flow, check with the data sheet of the relevant product.

3.2. Overvoltage Protection

Some DC/DC converters contain an overvoltage protection function. Check with the data sheet of the relevant product. Because of the latch mode, recovery is made regarding overvoltage protection when input voltage is applied again.

The overvoltage protection function serves to protect the product so that overvoltage is not applied to the load when high voltage is generated at the output side due to malfunction of internal components (etc.). Therefore, overvoltage operation check at acceptance inspection and application of voltage which exceeds output voltage from the output side has not been assumed. Avoid such check and use because the product is exposed to stress and may be damaged.

3.3. Isolation Voltage

The isolation voltage of isolation-type DC/DC converters differs depending on the product. Check with the data sheet of the relevant product.

When an isolation voltage test is conducted at an occasion such as acceptance inspection, increase and decrease the voltage gradually.

4. Mounting

4.1. Mounting Method

Depending on the product shape, the connection terminals of the DC/DC converter are lead pins, connectors, and terminal blocks.

For the soldering of the lead pins, see the flow conditions and soldering conditions described in other relevant sections.

Regarding connector and terminal block attachment, information (type name) on the connectors and terminal blocks is shown on the data sheet of the relevant model. Use the matching connectors, screws, and terminals.

4.2. Pattern Layout

The size of lead pins differs depending on the product. Check with the outline diagrams on the data sheet or the outline diagram for the relevant model. When designing, be careful with the appropriateness of the hole diameter.

Separate the input side and the output side, makes the line short, and be careful not to make a loop.

For a product to be attached with an external coil, the placement of the coil may affect the characteristics. Therefore, as the layout in Figure 4.1 shows, place the coil at the opposite side of the electrolytic capacitors and GND line across the product.

Also, for the peripheral circuit, be careful not to make the GND line pass near the coil.

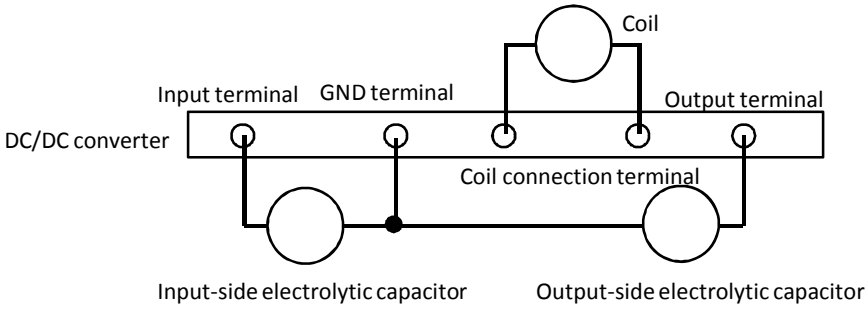


Figure 4.1 Placement of External Coil

4.3. Heat Radiation

Regarding the DC/DC converter, natural cooling has been assumed. While the attachment orientation is not specified, avoid mounting the converter in a sealed place or onto a unit which is not subjected to air convection flow. When using, be careful with the ambient temperature of the DC/DC converter.

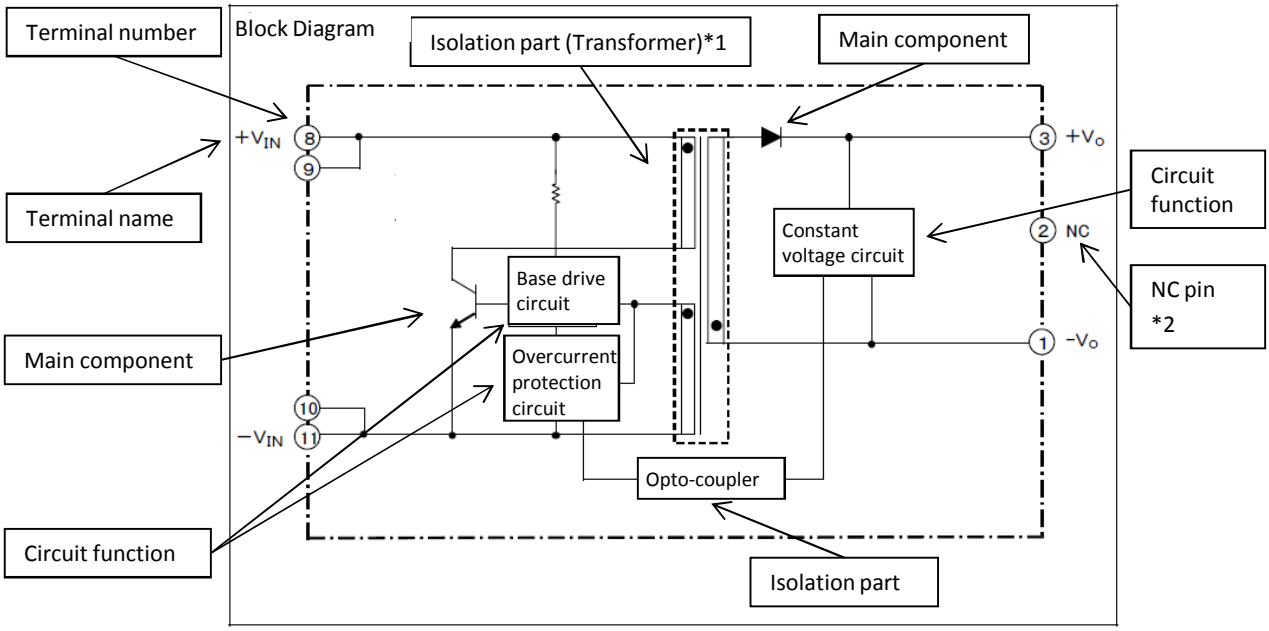
For some models, usable current is restricted by operating ambient temperature. See the derating characteristics on the data sheet of the relevant product.

How To Read Data Sheets

【Block Diagram】

Block diagrams show product circuits for each functional block. They provide the following information:

- Terminal numbers and terminal names
- Functions and circuit methods of main components
- Isolation components (transformer, opto-coupler, etc.) in isolation circuit



*1 The black circles of the transformer indicate the polarity.

*2 Do not make any electrical connections to the NC pin and TETS pin. Electrical connections may result in product malfunction.

【Maximum Rating】

When the rating values shown in the table below are exceeded, the product may be damaged.

MAXIMUM RATINGS (unless otherwise noted, Ta=25°C)

Symbol	Parameter	Conditions	Ratings	Unit
V_{IN}	Input voltage	Between pins 8,9 and 10,11	27	V
I_O	Output current	Between pins 3 and 1	100	mA
Topr	Operating temperature	No condensation (*1)	-10 ~ +70	°C
Tstg	Storage temperature	No condensation	-20 ~ +85	°C
Viso	Input-output isolation voltage	AC , 1min	2500	Vrms

(*1) Please refer to de-rating characteristics.

■ Input voltage: Designates the maximum voltage which can be input to the product. If the rating is exceeded, the product may be damaged.

■ Output current/load current: Designates the current value which allows safe operations. If the rating is exceeded, the product may be overheated and damaged. For a product which contains an overcurrent protection function, the function starts to work when the current becomes 1.1 times larger than the rated current.

■ Operating ambient temperature: Designates the ambient temperature which assures the product's specifications and allows safe product operations.

For models which need derating of the output current, see the derating characteristics. Note that this condition assumes natural cooling.

■ Storage temperature: Designates temperature which assures appropriate storage in non-running status. If storing for an extended period of time, the following conditions are recommended: 5 to 30°C and 40 to 60%RH.

■ Isolation voltage: Designates a value assured for isolation voltage between primary and secondary.

How To Read Data Sheets

【Electrical Characteristics】

The values designate specifications which indicate the performance of the product. The specifications are based on the measurement circuit described later and assume ordinary temperature (Ta = 25□C).

ELECTRICAL CHARACTERISTICS (unless otherwise noted, V_{IN}=24V, Ta=25°C)

Symbol	Parameter	Test conditions	Limits			Unit
			MIN.	TYP.	MAX.	
V_{IN}	Input voltage	Recommended range	21.6	24.0	26.4	V
		Operating guarantee range	18.0	—	26.4	V
V_O	Output voltage	I_O= 0 ~ 100mA	14.25	15.0	15.75	V
R_{eg-I}	Input regulation	I_O=100mA, V_{IN}=21.6 ~ 26.4V	—	—	75	mV
R_{eg-L}	Load regulation	I_O= 0 ~ 100mA	—	—	750	mV
V_{P-P}	Ripple voltage	I_O=100mA	—	—	120	mV
η	Efficiency	I_O=100mA	—	75	—	%

■ Input voltage: Designates the range which assures safe operations. Even if a recommended range is not indicated and the indicated maximum input voltage value is the same as the maximum rating, use of the product with voltage below the maximum rating is recommended.

■ Output voltage: Designates an output voltage value and its precision. The value is based on the specified input voltage and load condition. For the load condition, the minimum current may have been specified. In this case, note that the precision is assured regarding output voltage under the condition of the minimum current.

In the case of multiple outputs, the value is written for each output. In the case where the load condition of multiple outputs has been specified, the condition is followed.

■ Input regulation: Designates static input fluctuation and indicates the maximum value of the fluctuation of output voltage which is generated when the input voltage is slowly changed within the extent of the specifications.

■ Load regulation: Designates static load fluctuation and indicates the maximum value of the fluctuation of output voltage which is generated when the output current is slowly changed within the extent of the specifications.

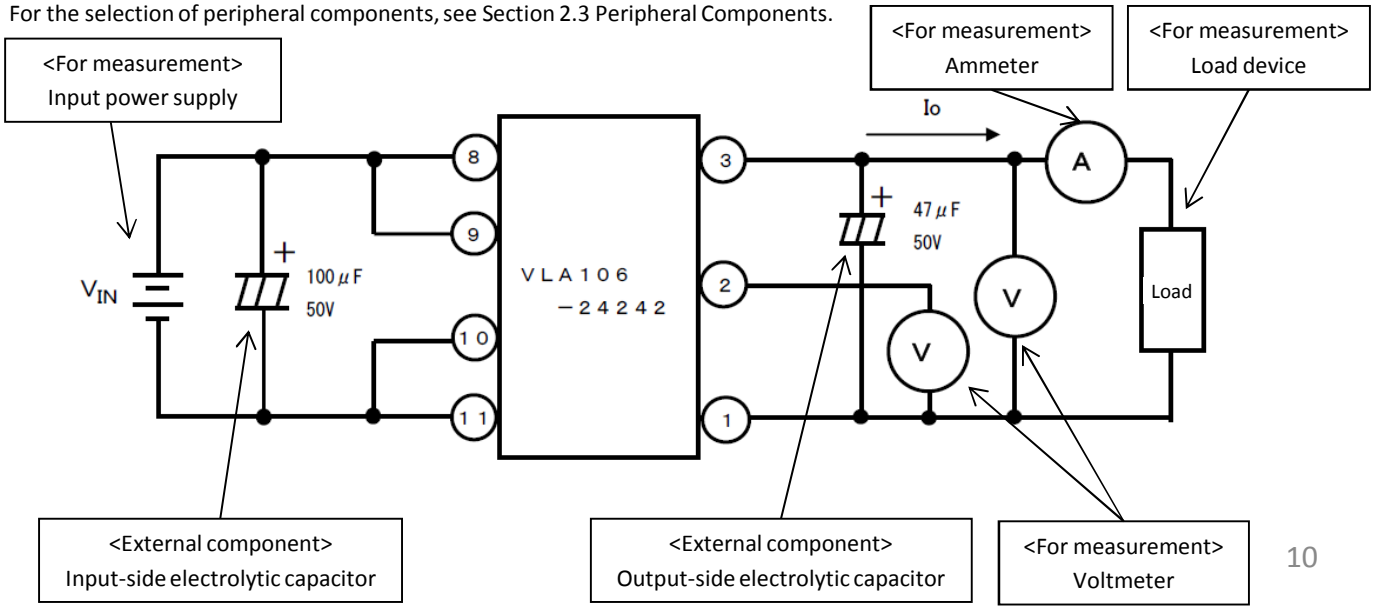
■ Ripple voltage: Represents elements which synchronize with input frequency and switching frequency that are superimposed onto output voltage, and indicates the maximum value which is resulted when the electrolytic capacitor shown in the measurement circuit diagram has been connected. Noise content is not included in the specifications.

■ Efficiency: Designates the ratio of the output power and input power. For multiple outputs, the value designates the ratio relative to the total power of the individual outputs.

【Measurement Circuit】

This is a connection circuit for measurement of electrical characteristics. The circuit shows external components which are needed for individual terminals (e.g., input side and output side). Referring to the circuit is also recommended in terms of peripheral components at the time of unit incorporation.

For the selection of peripheral components, see Section 2.3 Peripheral Components.

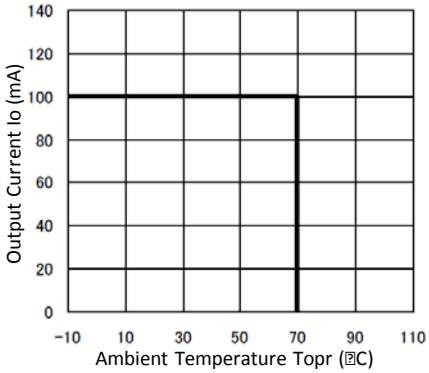


How To Read Data Sheets

【Typical Characteristic Curve Examples】

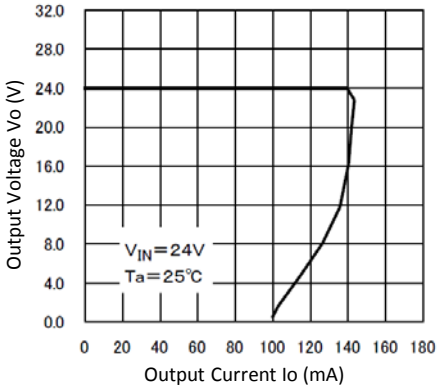
These are graphs which show the characteristics of individual products. Except for derating characteristics, typical examples are shown.

Derating Characteristics



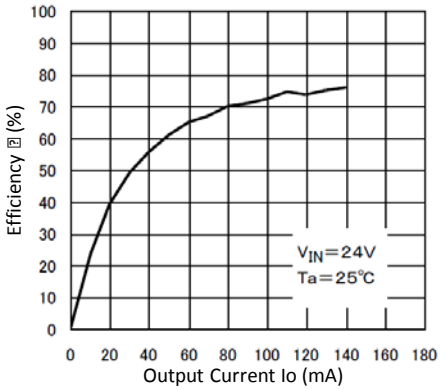
A graph regarding derating characteristics shows the restriction of the load current relative to the ambient temperature. Use the product with values within the range enclosed by the line.

Output Voltage-Output Current Characteristics



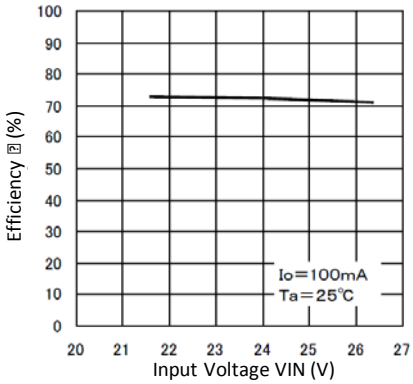
A graph regarding output voltage-output current characteristics show operations at the time of overcurrent flow. Note that the value which triggers current restriction differs depending on specifications.

Efficiency-Output Current Characteristics



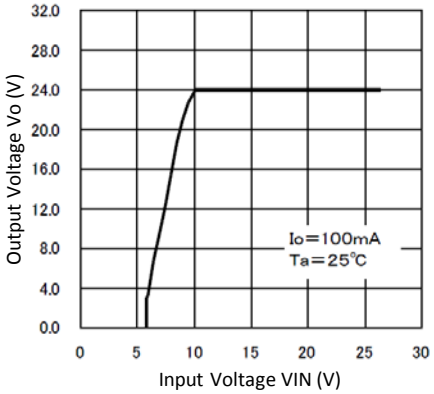
A graph regarding efficiency-output current characteristics shows the change of the efficiency relative to the output current.

Efficiency-Input Voltage Characteristics



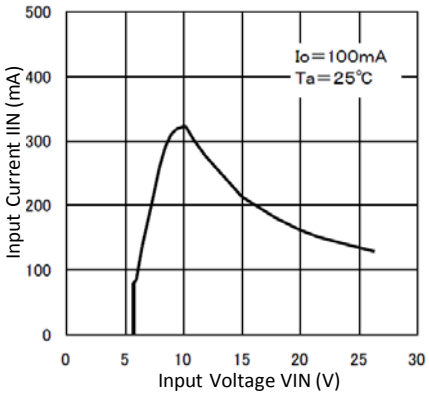
A graph regarding efficiency-input voltage characteristics shows the change of the efficiency relative to the input voltage.

Output Voltage-Input Voltage Characteristics



A graph regarding output voltage-input voltage characteristics shows input voltage at which output voltage becomes constant. The output voltage becomes constant at voltage which is below the input voltage range shown for electrical characteristics. However, use the product within the input range of the electrical characteristics.

Input Current-Input Voltage Characteristics



A graph regarding input current-input voltage characteristics shows the input current relative to the input voltage. Use as a guide to determine the supply capacity of the input power supply. The input current is not included in rush current which flows at the time of initiation.