DC-DC Converter Specification

MPDRX313S

1 . Application

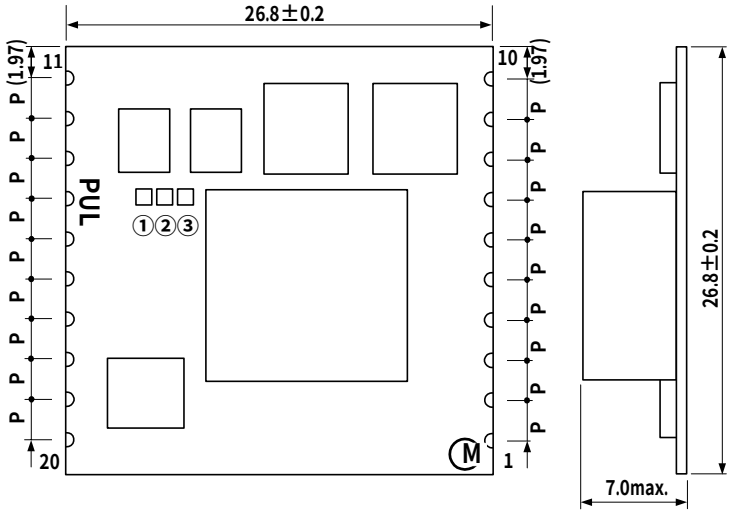
This specification applies to DC-DC Converter for telecommunication / data-communication equipment, MPDRX313S.
For any other application, please contact us before using this product.

2 . Customer Reference

Customer Spec. Number
Customer Part Number

3 . Murata Part Number MPDRX313S

4 . Appearance, Dimensions



( )…reference value
P=2.54 ±0.2mm
Tolerance is not accumulated.

※Flux may expand on PCB and attach onto the area where the marking is printed with laser.
In the case the marking become darker in color since flux is unreflecting.
It may be a little hard to read, however, the marking is not deleated nor blurred.

Marking

(1) Pin No.1 Marking / MFG ID Ⓜ
(2) Parts No. PUL
(3) Lot No. □□□
①②③

①Production factory Mark
②Production Year
③Production Month（1,2,3,…9,O,N,D）

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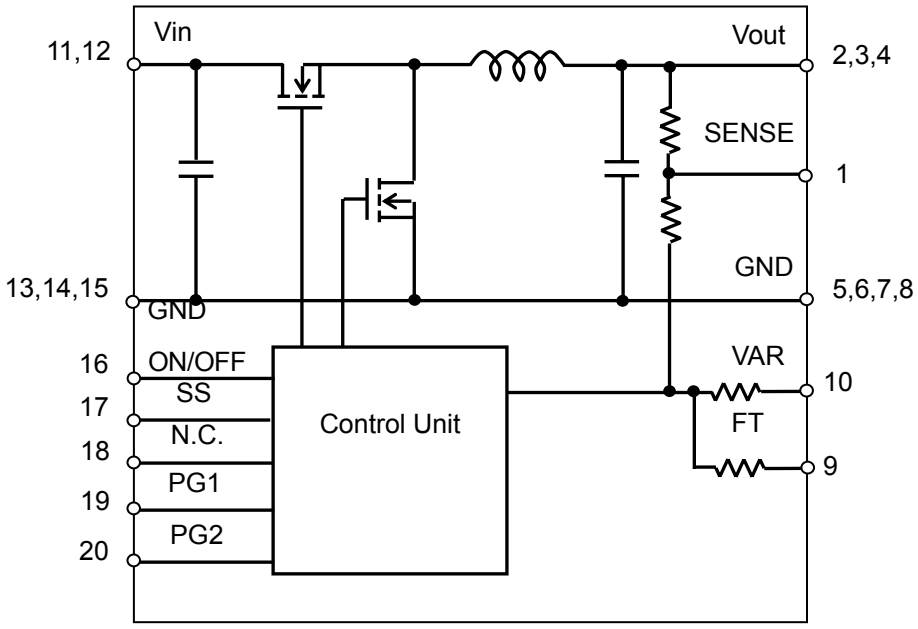
5 . Pin Number and Function

Pin No.	Symbol	Function
1	SENSE	Output Voltage sense
2,3,4	Vout	Output Voltage
5,6,7,8,13,9,10	GND	GND
9	FT	Output Trim
10	VAR	Vout Adjustment
11,12	Vin	Input Voltage
17	SS	Soft Start
18	N.C.	Non Connect
19	POW-GOOD1	Power Good
20	POW-GOOD2	Power Good
16	ON/OFF	Remote ON/OFF

6. Block Diagram



7. Environmental Conditions

7.1 Operating Temperature Range -40°C ~ +85°C
7.2 Storage Temperature Range -40°C ~ +85°C
7.3 Operating Humidity Range 20% ~ 85% （No water condenses in any cases.）
7.4 Storage Humidity Range 10% ~ 90% （No water condenses in any cases.）

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8.Absolute Maximum Rating

Item	Unit	Absolute Rating	Remarks
Minimum Input Voltage	V	0	
POW-GOOD Pin Voltage	V	Vin	
ON/OFF Pin Voltage	V	Vin-0.3	
Maximum POW-GOOD Pin Sink Current	mA	15	Total of PG1 and PG2

No voltage, no matter how instantaneous, shall be applied beyond the absolute maximum voltage rating to this product. If you apply any voltage over this limit the product characteristics will deteriorate or the product itself will be destroyed. Even though it may continue operating for a while after the over-voltage event, its life will likely be shortened significantly. Reliability and life of the module may degrade similarly if the maximum operating voltage rating is continuously exceeded. This product is designed to operate within the maximum operating voltage rating specification.

9. Characteristics

9.1.Electrical Characteristics

9.1.1.Input Characteristics (Ta= 25°C)

Item	Symbol	Condition	Value			Unit
			Min.	Typ.	Max.	
Input Voltage Range	Vin		4.5	5.0	5.5	V
Rising UVLO Threshold	UVLOr	Vin = increasing	-	4.3	-	V
Falling UVLO Threshold	UVLOf	Vin = decreasing	-	3.9	-	V

9.1.2.Interface Characteristics (Ta= 25°C)

Item	Symbol	Condition		Value			Unit
				Min.	Typ.	Max.	
Power Good	PWGL	Power Good low threshold		-	0.87Vo	-	V
	PWGH	Power Good high threshold		-	1.13Vo	-	V
ON/OFF pin High Voltage	VIH	ON/OFF pin is pulled up to 5V 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 UVLO events occur. Please do NOT connect this pin to power supply with low impedance line, so as not to damage the converter.					
ON/OFF pin Low Voltage	VIL	If ON/OFF pin is pulled down to GND, the DC-DC converter shall be “OFF”.	OFF	0	-	0.3	V
ON/OFF Pin Output Current	IIL			-	0.02	-	mA

9.1.3.General Characteristics (Ta= 25°C)

Item	Symbol	Condition		Value			Unit
				Min.	Typ.	Max.	
Output Voltage Range	Vout	FT= Open		0.8	-	0.9	V
		FT= Short		0.9	-	3.3	
Output Current	Iout	See the Thermal derating curve in clause 9.1.4		0	-	26	A
Output VoltageTolerance	Vo tol	Over Vin,Io, Temperature range Rset=1% tolerance	Vout=0.8～0.9V FT= Open	-2.5	-	+2.5	%Vo
			Vout=0.9～3.3V FT= Short	-2.0	-	+2.0	
Ripple Voltage	Vrpl	Vin=5.0V, Iout=0～26A BW = 20MHz, Cout=200μF		-	20	50	mV(pp)
Efficiency	EFF	Vin =5.0V, Iout=26A	Vout=3.3V	-	91	-	%
			Vout=1.8V	-	86	-	
			Vout=1.2V	-	83	-	
Operating Frequency	Frq	Vin =5.0V, Vout=1.2V,Iout=26A		-	600	-	kHz
		Vin =5.0V, Vout=0.8V,Iout=26A		-	400	-	

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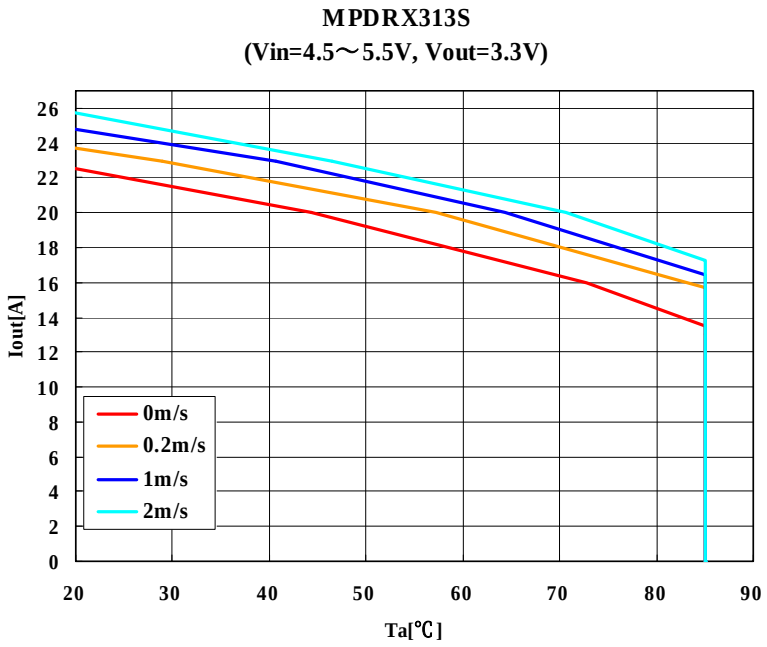
Short Circuit Protection	SCP	If output is shorted to GND, DC-DC converter will shut down. After reject the abnormal mode , DC-DC converter will restart by re-inputting Vin or toggling ON/OFF pin.	26	60	-	A
External Output Capacitor	Cout	When input voltage is ideal voltage source	200	-	2000	μF
Ramp Rate	Tr	Vo=10%～90%,SS= Open	1	2	5	msec
Rising Overshoot	Vover		-	-	+10	%
Startup Delay	Td	ON/OFF High :Vin Low→High Vo=10% SS= Open	0.1	0.5	2	msec
RC Startup Delay	Trcd	Vin High : ON/OFF Low → High/Open Vo=10%	0.1	0.4	2	msec

※In case Vin is below the Falling UVLO threshold (UVLOf) or equation of Vin and Vout is Vin-Vout<0.8V due to the transient power deviation, this devise may cause abnormal operation. Please use it under the condition to keep Vin 4.5V or more.

※This DC-DC converter thermally shuts down when temperature of a control IC reaches to 180 °C typically.

⚠ 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 10. 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.

9.1.4.Thermal Derating



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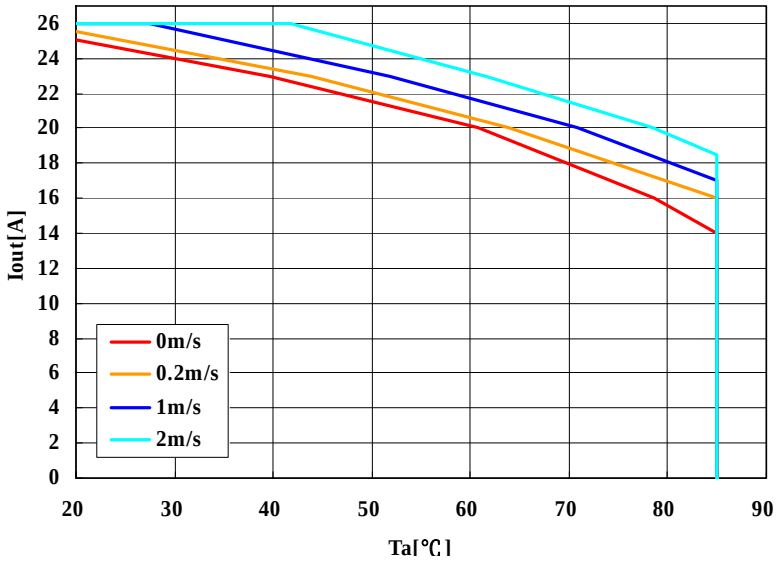
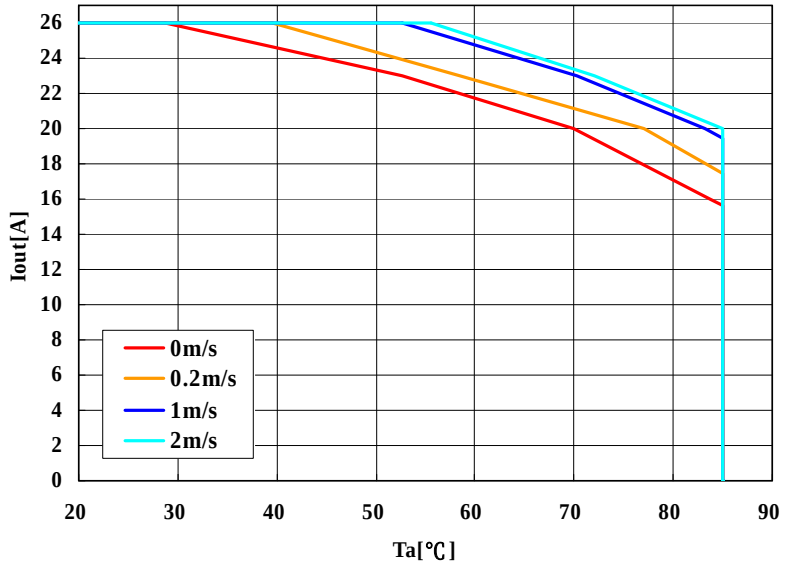
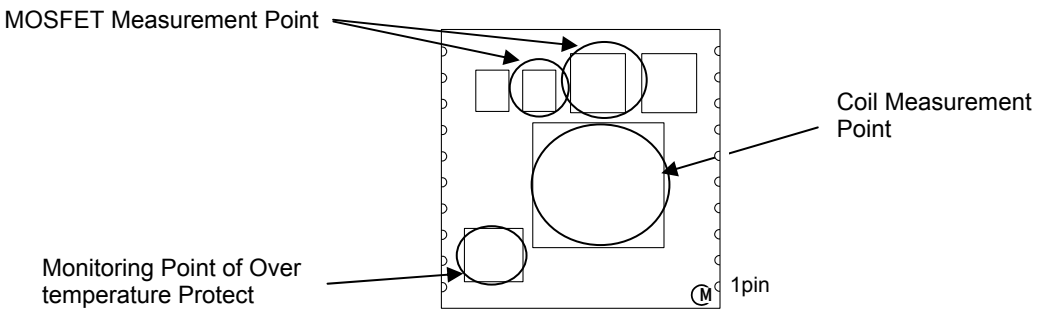
MPDRX313S
(Vin=4.5～5.5V, Vout=1.8V)



MPDRX313S
(Vin=4.5～5.5V, Vout=1.2V)



The above derating limits apply to this product soldered directly to 101.6*180mm*1.6mm PCB (6 layer, 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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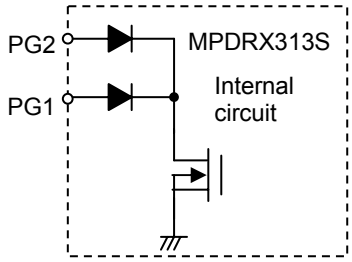
9.2. Operation Information

9.2.1. Power Good

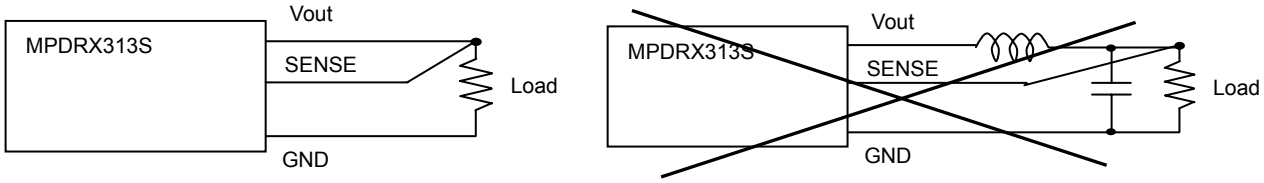
Powergood signal is appeared within the value of clause 9.1.2 (Open-drain output)

Output voltage is within voltage detection threshold: POW-GOOD is open.
Output Voltage is out of voltage detection threshold : POW-GOOD is connected to GND.



9.2.2. Output voltage sensing

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



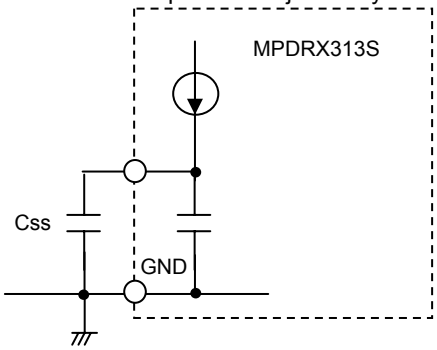
Please do NOT connect SENSE-pin to the output of LC filter that is set to the Vout line.
When using this way, this product will not operate properly.

< Caution>

Please connect SENSE-pin to Vout-pin nearby the product, if sense function is not used.

9.2.3. Soft start function

By using the soft start function, ramp-rate of the output-starting is adjustable. Adjustment range of ramp-rate is from 2 to 10ms. Ramp rate is adjusted by external capacitor between SS-pin(17pin) and GND.



The equation of starting time about output voltage

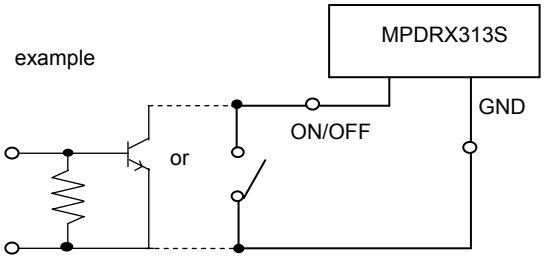
$$\text{Starting time: } Td = \frac{(Css + 1.2\times10^{-8}) \times 0.8}{5\times10^{-6}} + 2\times10^{-4}\ [s]$$

Css：The capacitance of external capacitor.(F)

9.2.4. ON/OFF control

By using ON/OFF function, the operation of this product can be disabled without disconnection of input voltage.

When ON/OFF-pin(16pin) is left open …… Output Voltage =ON
When ON/OFF-pin(16pin) is connected to GND …… Output Voltage =OFF



< Caution>
ON/OFF pin is pulled up inside of the DC-DC converter, so voltage appears up to Vin at ON/OFF pin.
ON/OFF pin will be pulled down to GND inside the DC-DC converter when UVLO events occur.
Please do NOT connect this pin to power supply, so as not to damage the converter.

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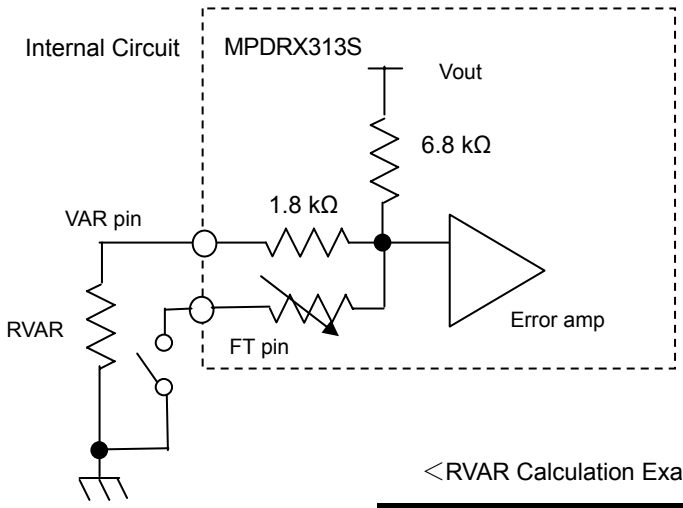
9.2.5. Parallel Operation.

This product is incapable of parallel operation

9.2.6. Output Voltage Adjustment

The output voltage can be adjusted from 0.8V to 3.3V by connecting resistors between VAR-pin(10Pin) to GND-pin.
The following equation gives the required external-resistor values to adjust the output voltage to the required Vout.
It is highly recommended that evaluation of the characteristics of this DC-DC converter's operation under your board conditions be thoroughly conducted.
In case output voltage is used more than 0.9V, please connect FT-pin (9pin) to GND.



(a)0.8≦ Vout ＜0.9V (FT-pin：OPEN)

$$RVAR = \frac{5440}{Vo\text{-}adj[V] - 0.8[V]} - 1800 \quad [\Omega]$$

(b)0.9≦ Vout ≦3.3V (FT-pin：SHORT to GND)

$$RVAR = \frac{5440}{Vo\text{-}adj[V] - 0.9[V]} - 1800 \quad [\Omega]$$

＜RVAR Calculation Example＞

Voadj [V]	Calculated RVAR[Ω]	RVAR Example	FT pin
3.3	470	470	Short to GND
2.5	1600	1.6k	Short to GND
1.8	4240	3.9k+330	Short to GND
1.5	7270	6.8k+470	Short to GND
1.2	16330	16k+330	Short to GND
1.0	52600	47k+5.6k	Short to GND
0.9	∞	Open	Short to GND
0.8	∞	Open	Open

9.3. Reliability

9.3.1. Humidity

According to JIS-C-0022.
40 ± 2°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 9.1.).

9.3.2. Temperature Cycles

Repeat cycle 5 times. Leave 2 hours at room temp.
No damage in appearance and no deviation from electrical characteristics (section 9.1.)..

Step	Condition	Time
1	-40°C±3°C	30 minutes
2	Room Temp.	5-10 minutes
3	+85°C±2°C	30 minutes
4	Room Temp.	5-10 minutes

9.3.3. 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 9.1.).

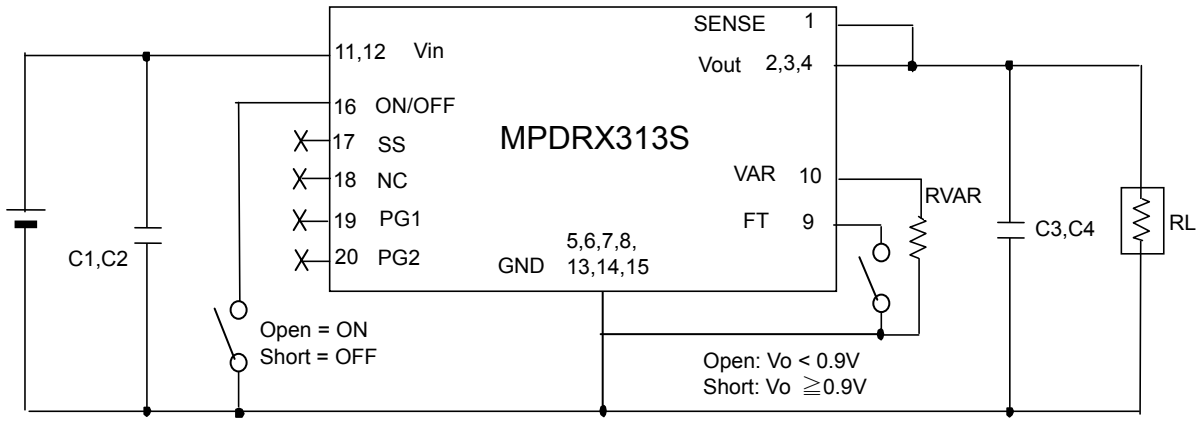
9.3.4. Mechanical Shock

20G, 1 time for each X, Y, Z directions.
No damage in appearance and no deviation from electrical characteristics (section 9.1.).

10. Test Circuit

In the following test circuit, the initial values under item 9.1. should be met.

10.1. General Measure Circuit



C1,C2：100μF／10V Ceramic Capacitor
C3,C4：100μF／6.3V Ceramic Capacitor
Please make sure to place C1 ,C2,C3and C4 nearby input and output terminal of DC-DC converter.

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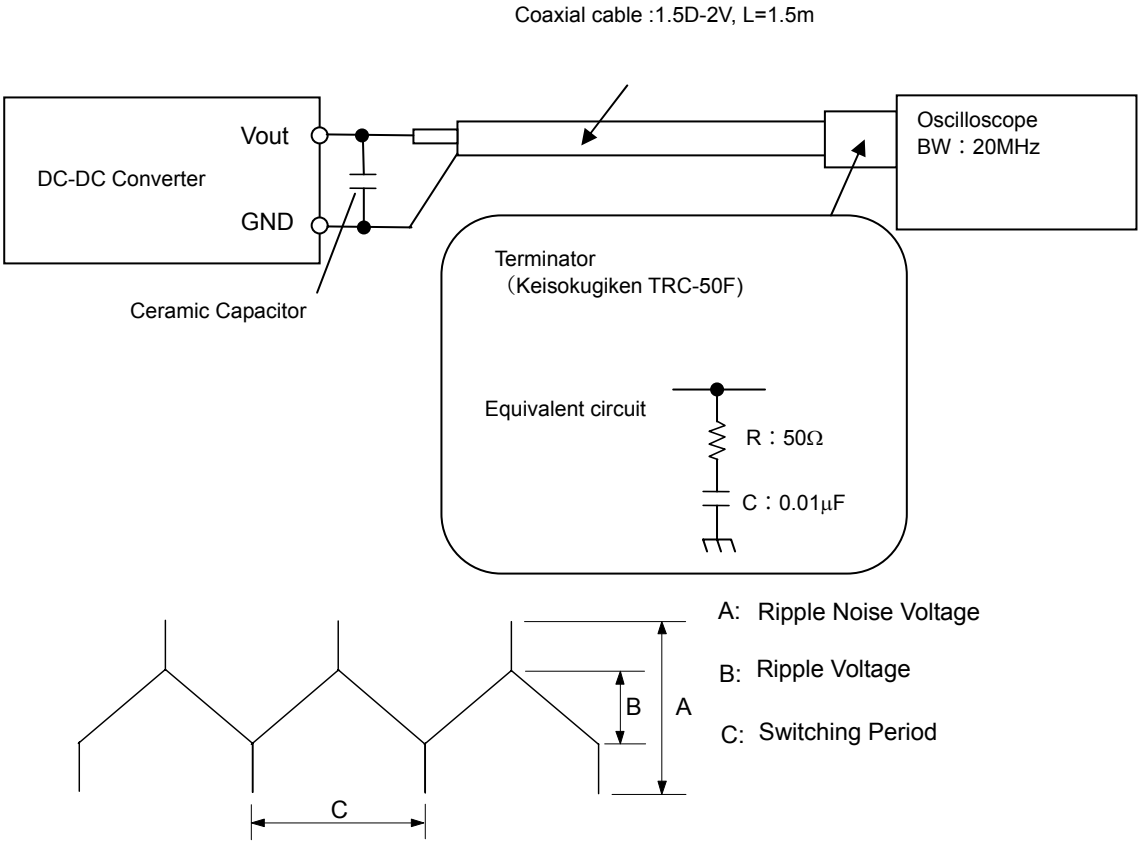
10.2. Ripple Noise Measurement Circuit



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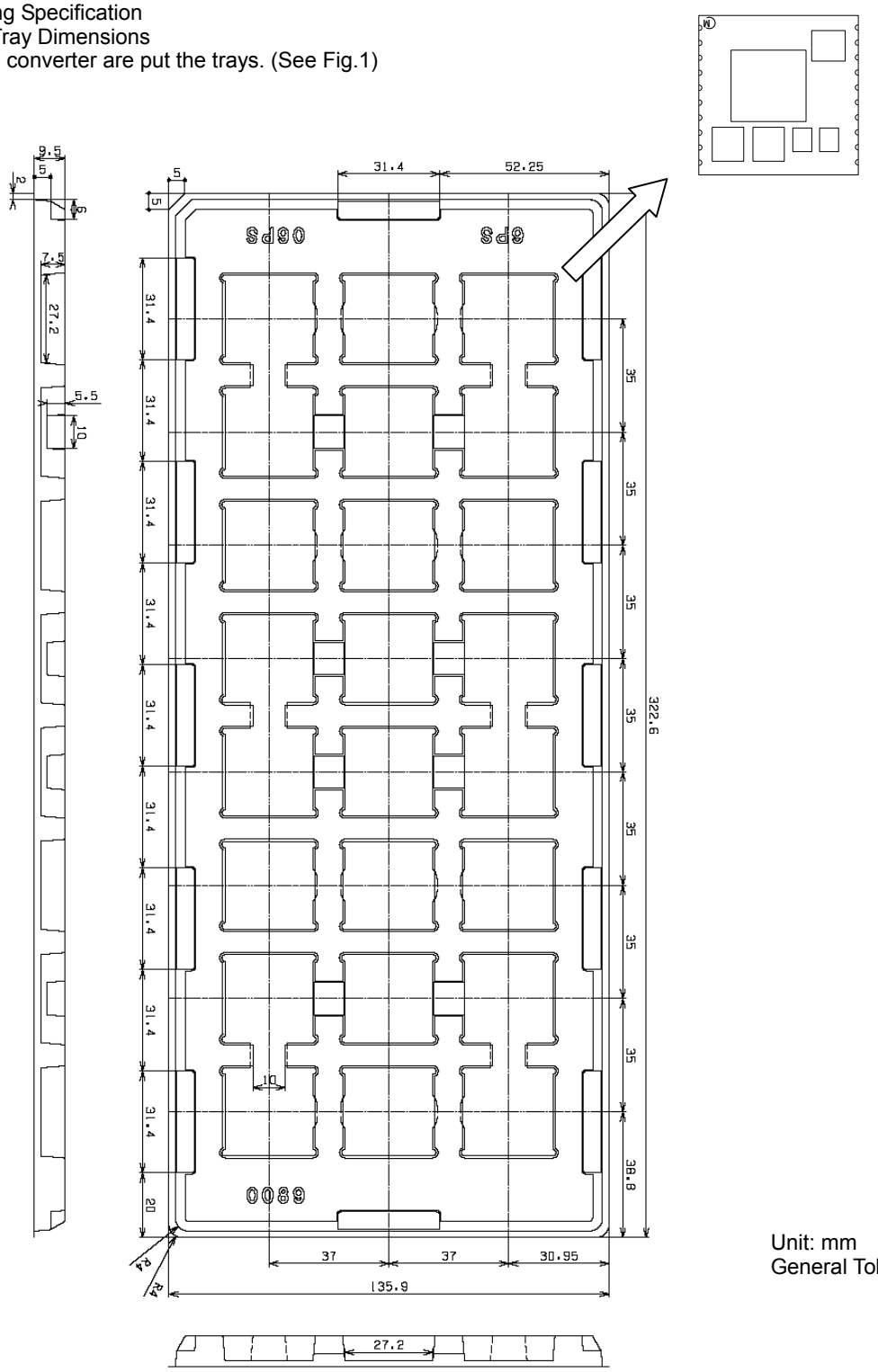
11. Packaging Specification

11.1. Tray Dimensions

DC-DC converter are put the trays. (See Fig.1)



Unit: mm
General Tolerance: ±1.5mm

Fig.1

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11.2. Contained pieces of products per corrugated box.

Maximum contained products pieces 96pcs./corrugated box

Further plural sheets of corrugated cardboard are placed on the top of the dummy tray according to number of contained trays in order to full up the space in a corrugated box.

11.3. Packaging Form

Trays with products are lidded and packed in a corrugated box. (See Fig.2)

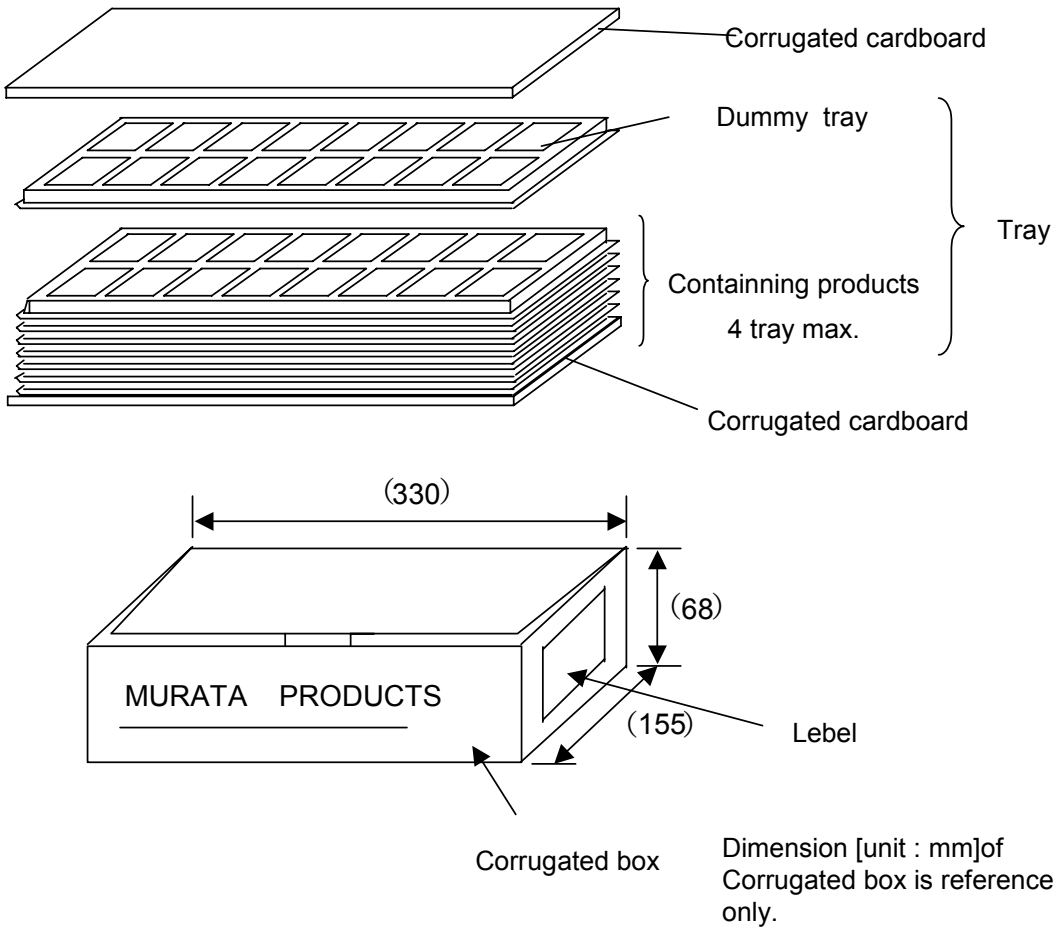


Fig.2

12. Production factory

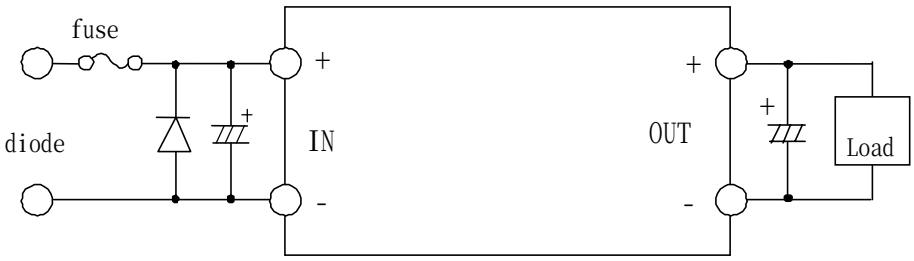
Komatsu Murata Mfg.Co., Ltd.
Kanazu Murata Mfg. Co., Ltd.
Wakura Murata Mfg. Co., Ltd.

13. ⚠ Caution

1 . Be sure to provide an appropriate fail-safe function on your product to prevent secondary damage that may be caused due to abnormal functional or failure of this product.

2 . Inrush current protection is not a feature of this product.

3 . 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.



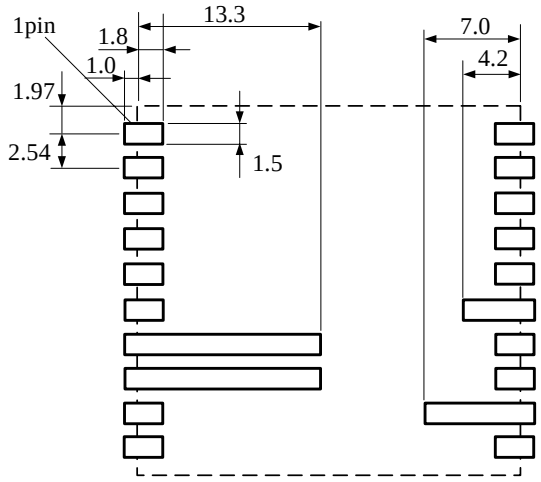
※ Please select diode and fuse after confirming the operation of your product.

4. Limitation of Application
Please contact us before using this product 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.

①Aircraft equipment
②Aerospace equipment
③Undersea equipment
④Power plant control equipment
⑤Medical equipment
⑥Transportation equipment (vehicles, trains, ships, etc.)
⑦Traffic signal equipment
⑧Disaster prevention /crime prevention equipment
⑨Any other application of similar complexity and/or reliability requirements to the applications listed above.

14. Notice
14.1. Soldering
14.1.1. Flux
Please solder this product with Rosin Flux that contains of 0.2wt% or less chlorine.
Please do not use high activity acid flux or water-soluble flux as they may reduce the reliability of this product.

14.1.2. PCB Land Pattern Recommendation



There are wiring coppers or through-hole via at the bottom side of the DC-DC converter.
When you design your PCBs, please be careful not to short the circuit of the DC-DC converter or PCBs.

14.1.3. Soldering Conditions Recommendation

Reflow Soldering
This product is RoHS compliant. The following profile is recommended for the reflow of this product using Pb-free solder paste (Sn-Ag-Cu).

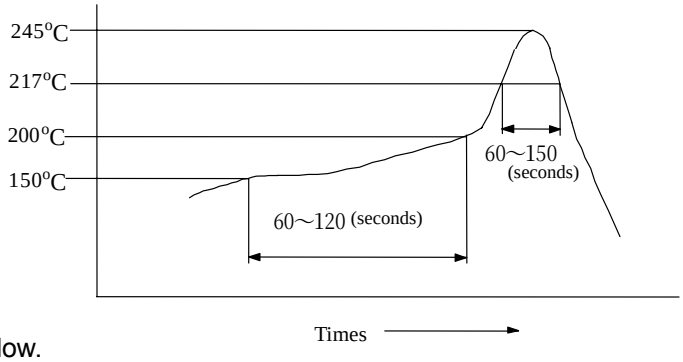
Method : Full convection reflow soldering

Reflow Soldering Profile
JEDEC IPC/JEDEC J-STD-020D
Table 5-2 Classification Reflow Profile
Pb-Free Assembly Large Body

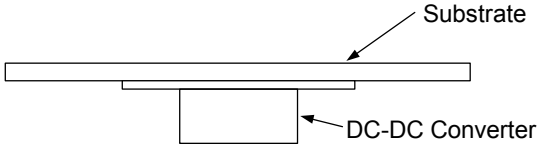
Profile details

Soldering temperature	:	245ºC+0/-5ºC
Soldering time	:	30 seconds, 240 to 245ºC
Heating time	:	60 to 150 seconds, over217ºC
Preheating time	:	60 to 120 seconds,150 to 200ºC
Programming rate	:	3ºC/ sec. Max., 217 to 245ºC
Descending rate	:	6ºC/ sec. Max.
Total soldering time	:	8 minutes Max., 25 to 245ºC
Times	:	1 time

Parts surface temperature [ºC]



※Do not vibrate for the products on reflow.
Please need to take care temperature control because mounted parts may come off if the product are left under the high temperature.
Do not reflow DC-DC converter as follows, because DC-DC converter may fall down from a substrate during reflowing.



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14. 2. Cleaning

Please use no-cleaning type flux and do not wash this product.

14.3. Storage

14.3.1. Please store the products in room where the temperature/humidity is stable and direct sunlight cannot come in, and use the products within 6 months after delivery.
Please avoid damp and heat or such places where the temperature greatly changes, as water may condense on this product, and the quality of characteristics may be reduced, and/or be the solderability may be degraded.
If this product needs to be stored for a long time (more than 1 year), this product may be degraded in solderability and/or corroded. Please test the solderability of this product regularly.
Baking before reflow process is unnecessary to store the products under 30℃,60%RH or less up to 6 months.
In case the storage condition is over above mentioned, if these are unpacked condition, please bake them at 125℃±5℃/24hour. If these are packed in a tape, please bake them before soldering at 60℃±5℃ /168hour.

14.3.2. Please do not store this product in places such as :
A dusty place, a place exposed directly to sea breeze, or in an atmosphere containing corrosive gas (Cl2,NH3,SO2,NOX and so on).

14. 4. Operational Environment and Operational Conditions

14.4.1. Operational Environment
This product is not water-, chemical- or corrosion-proof.
In order to prevent leakage of electricity and abnormal temperature rise of the product,do not operate under the following environmental conditions:
(1) An atmosphere containing corrosive gas (Cl2, NH3, SO2, NOX and so on)
(2) A high-dust environment
(3) Under the exposure of direct sunlight
(4) A location where the likelihood of exposure to water or water condensation exists.
(5) A location exposed to ocean air
(6) Any locations similar to the above

14.4.2. Operational Conditions
Please use this product within specified values (power supply, temperature, input, output and load condition, and so on). If the product is exposed to conditions outside of the specified values reliability of the product may be adversely effected.

14.4.3. Note prior to use
Diminished reliability and/ or failure may result if the product is exposed to a high-level static charge, over-rated voltage or reverse voltage. Please avoid the following conditions be avoided prior to use of the product:
(1) Supply of power outside of rated values (see section 8)
(2) Supply of reverse power or inadequate connection of a 0 V(DC)line
(3) Electrostatic discharge from production line and/ or operator
(4) Electrification of the product from electrostatic induction
(5) Excessive mechanical shock

14.5. Transportation

Murata recommends that when transporting this product, it be packed so as to avoid damage by mechanical vibration or exposure to adverse conditions such as ocean air, high humidity. It is additionally recommended that appropriate instructions and guidelines be communicated to carriers to prevent exposure to these same conditions.

15.⚠ 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. All the items and parameters in this product specification have been prescribed on the premise that Murata's product is used for the purpose, under the condition and in the environment mutually agreed upon.

This document is for reference only and subject to revision without prior of subsequent notice.
Please contact Murata for latest documentation.