

**NEW**

# MD5021T

DC-DC Converter Power IC

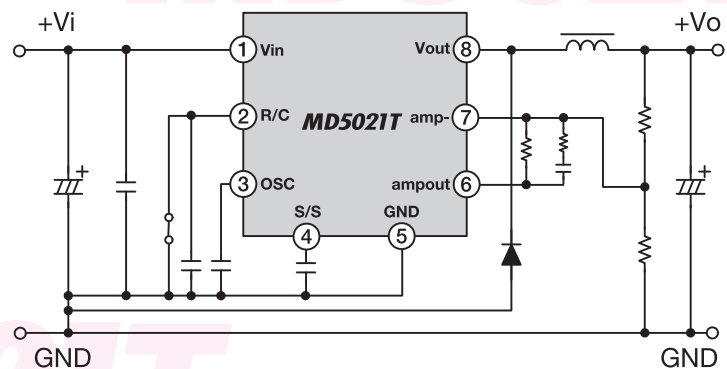
## Control IC and Power MOSFET incorporated in SOP8 Package

MD5021T is a non-isolated, step down DC to DC converter power IC incorporating a main switch MOSFET and control circuit on a single chip.

Using surface mount SOP8 package, a circuit architecture has been achieved that requires very few external components. This has made it possible to realize a smaller and thinner power supply.



### Standard Connection Diagram

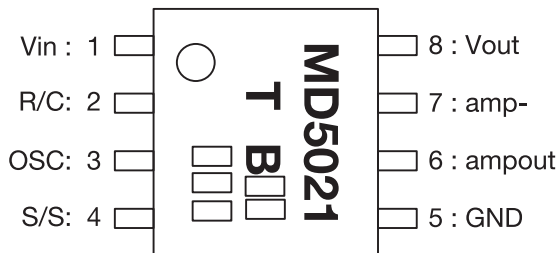
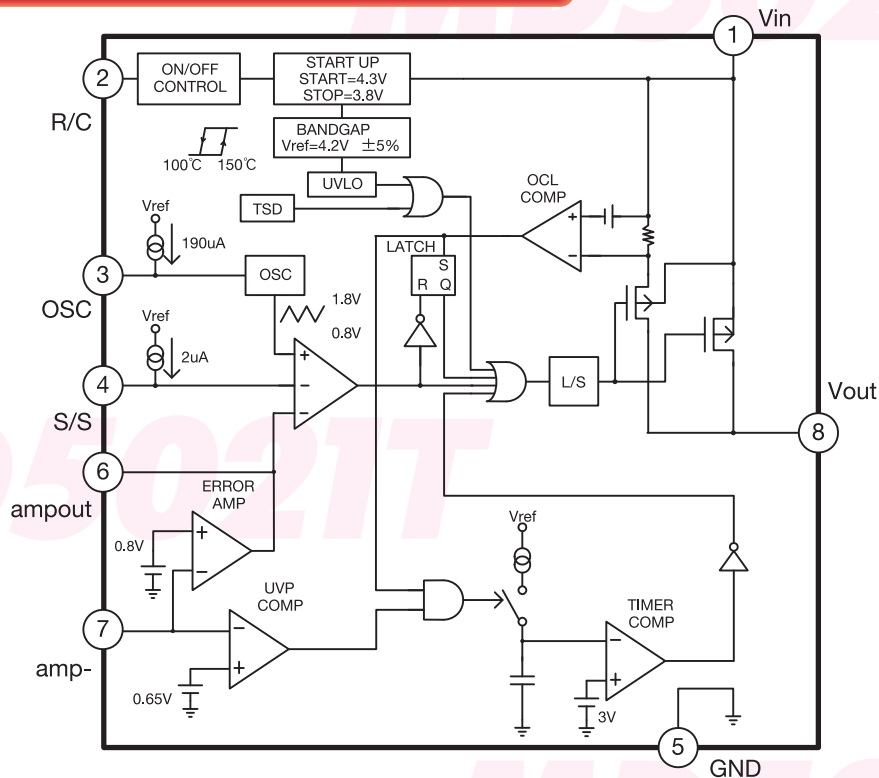


### Features

- Input voltage range : 4.5V to 14V
- Output voltage range : 0.8V to 12V (adjustable by external resistors)
- Maximum output current : 2A (derating may be required depending on the condition of input and output voltages)
- Frequency 100kHz to 500kHz (adjustable by external capacitor)
- Built-in Power MOSFET
- Remote ON/OFF
- Over current protection
- Thermal shutdown

We are happy to provide circuit design support for safe use of our IC products. Please consult our sales representatives or marketing sector.

## Block Diagram and Pin Functions



Pin number	Symbol	Functions
1	Vin	Power input
2	R/C	Remote ON / OFF control
3	OSC	Oscillation frequency setting
4	S/S	Soft-Start capacitor connection
5	GND	Ground
6	ampout	Error amplifier output
7	amp-	Error amplifier inverted input
8	Vout	Power output

## Specifications

### ■ Absolute Maximum Ratings

Item	Symbol	Ratings	Units
Input/Output Ratings			
Input voltage	Vin	15	V
R/C input voltage	V <sub>R/C</sub>	5.5	V
Thermal Ratings			
Power dissipation *1	PD	0.85	W
Operating temperature	Ta-ope	-40~85	°C
Storage temperature	Tstg	-40~150	°C
Junction temperature	Tj	150	°C
Thermal resistance *1	θja	148	°C/W
	θjc *2	12	°C/W

\*1 Glass-Epoxy Board:50.8×50.8mm<sup>2</sup>, Thickness:1mm, Copper Pattern ratio:4% (Top side), 0% (Back side), No through-hole.

\*2 The measurement result in the center of case.

# Specifications

## Recommended Operating Conditions

Item	Symbol	Recommendation	Units
Junction temperature	T <sub>j</sub>	-40~125 <sup>※6</sup>	°C
Input voltage range	V <sub>i</sub> <sup>※3</sup>	4.5~14	V
Output voltage setting range	V <sub>o</sub> <sup>※4</sup>	0.8~12	V
Output current (ave)	I <sub>OUTAVE</sub>	2 <sup>※5</sup>	A
Output current (peak)	I <sub>OUTPEAK</sub>	2.6 <sup>※5</sup>	A
Oscillation frequency	frq	100~500	kHz

- ※3 Input voltage at the time of power supply operation.
- ※4 Output voltage at the time of power supply operation.
- ※5 Refer to Calculation of junction temperature.
- ※6 In the case where the product is intended to be used for the equipment in which the long life is expected, we recommend to use at T<sub>j</sub> = 100°C or less, as life of product may change depending on the use environment even used within the recommended operating conditions.

## Calculation of junction temperature

Junction temperature can be calculated from power loss W<sub>IC</sub>, thermal resistance θ<sub>jc</sub> and case temperature T<sub>c</sub> in actual operating conditions.

**Calculation formula : T<sub>j</sub> = T<sub>c</sub> + (θ<sub>jc</sub> × W<sub>IC</sub>)**

W <sub>IC</sub> = W <sub>circuit</sub> - W <sub>L</sub> - W <sub>SBD</sub> - W <sub>c</sub>	T <sub>j</sub> junction temperature / θ <sub>jc</sub> thermal resistance / W <sub>IC</sub> IC loss
W <sub>circuit</sub> = W <sub>i</sub> - W <sub>o</sub>	
W <sub>i</sub> = V <sub>i</sub> × I <sub>i</sub>	W <sub>IC</sub> IC loss / W <sub>circuit</sub> Circuit loss / W <sub>L</sub> Choke loss
W <sub>o</sub> = V <sub>o</sub> × I <sub>o</sub>	W <sub>SBD</sub> SBD loss / W <sub>c</sub> Capacitor loss
W <sub>L</sub> = I <sub>o</sub> <sup>2</sup> × R <sub>L</sub>	W <sub>i</sub> Input capacitance / V <sub>i</sub> Input voltage / I <sub>i</sub> Input current
D = V <sub>o</sub> / V <sub>i</sub>	W <sub>o</sub> Output capacitance / V <sub>o</sub> Output voltage / I <sub>o</sub> Output current
W <sub>SBD</sub> = (1 - D) × I <sub>o</sub> × V <sub>f</sub>	R <sub>L</sub> Resistance of choke / D Duty / V <sub>f</sub> SBD forward voltage
W <sub>c</sub> = (0.5 × I <sub>o</sub> ) <sup>2</sup> × R <sub>c1</sub> + (0.3 × I <sub>o</sub> / 2√3) <sup>2</sup> × R <sub>c2</sub>	R <sub>c1</sub> ESR of input capacitor / R <sub>c2</sub> ESR of output capacitor

Please make sure that junction temperature calculated from the above formula is within the range of "Recommended operating conditions".

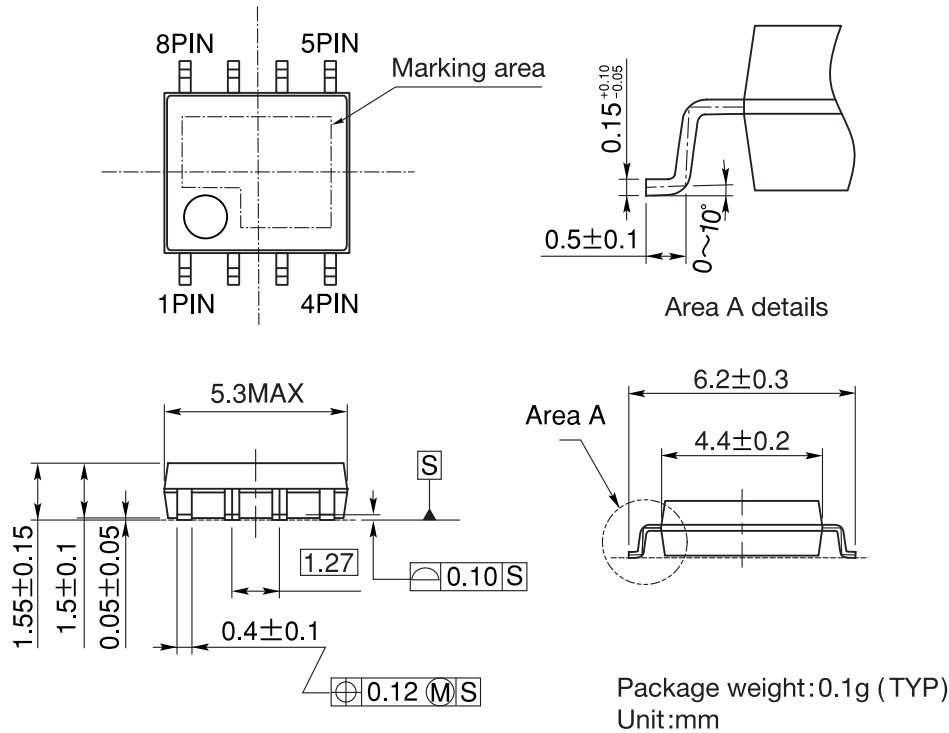
Caution : We do not guarantee to use the product beyond the Specifications. If you intend to use the product on conditions not described in the Specifications, please consult our Sales representatives in advance.

## Electrical Characteristics

T<sub>a</sub>=25°C

Item	Symbol	Condition	MIN	TYP	MAX	Units
<b>Main MOSFET</b>						
Drain-source breakdown voltage	V <sub>DSS</sub>	I <sub>D</sub> =5μA, V <sub>GS</sub> =0V	15	—	—	V
Zero gate voltage drain current	I <sub>DSS</sub>	V <sub>DS</sub> =15V, V <sub>GS</sub> =0V	—	—	10	μA
Static drain-source on-state resistance	R <sub>ON</sub>	I <sub>D</sub> =1A, V <sub>GS</sub> =8V	—	400	550	mΩ
Source-drain diode forward voltage	V <sub>SD</sub>	I <sub>S</sub> =1A, V <sub>GS</sub> =0V	—	—	1.5	V
<b>Control IC</b>						
Supply current (f=100kHz)	I <sub>CC_100</sub>	V <sub>in</sub> =4.5~14V	—	3	5	mA
Supply current (f=500kHz)	I <sub>CC_500</sub>	V <sub>in</sub> =4.5~14V	—	4	6	mA
Supply current at remote OFF	I <sub>CC_off</sub>	V <sub>in</sub> =4.5~14V	—	30	100	μA
Undervoltage lockout threshold (start)	V <sub>CC_start</sub>	—	4.1	4.3	4.5	V
Undervoltage lockout hysteresis	V <sub>CC_hys</sub>	—	0.4	0.5	0.6	V
Oscillation frequency1 (f=100kHz)	f <sub>osc1</sub>	V <sub>in</sub> =5V, C <sub>osc</sub> =900pF	80	100	120	kHz
Oscillation frequency2 (f=500kHz)	f <sub>osc2</sub>	V <sub>in</sub> =5V, C <sub>osc</sub> =120pF	400	500	600	kHz
Remote control ON input voltage	V <sub>R/C_ON</sub>	V <sub>in</sub> =5V	-0.2	—	0.5	V
Remote control OFF input voltage	V <sub>R/C_OFF</sub>	V <sub>in</sub> =5V	2	—	5.5	V
Remote control source current	I <sub>R/C</sub>	V <sub>in</sub> =4.5~14V	—	5	30	μA
Soft-start source current	I <sub>S/S</sub>	V <sub>in</sub> =5V	-3	-2	-1	μA
Error amplifier reference voltage	V <sub>amp</sub>	V <sub>in</sub> =4.5~14V	0.784	0.800	0.816	V
Threshold of over current limit	I <sub>th_OCL</sub>	V <sub>in</sub> =5V	2.61	—	—	A
Threshold of UVP	V <sub>th_UVP</sub>	V <sub>in</sub> =5V	V <sub>amp</sub> ×74%	V <sub>amp</sub> ×81.2%	V <sub>amp</sub> ×90%	V
Thermal shutdown temperature	T <sub>TSD</sub>	—	—	150	—	°C

# Outline Dimensions



△ Although we are constantly making every effort to improve the quality and reliability of our products, there nevertheless remains a certain probability that the semiconductor products may occasionally fail or malfunction. Please take careful precautions against product failures or malfunctions to avoid any injuries, fire accidents or social loss by implementing safety designs such as redundancy designs, designs for fire spread prevention, and designs for preventing malfunctions.

△ Our semiconductor products listed in this document are not designed or manufactured to be used in devices or systems requiring extremely high levels of quality and reliability, or the failure or malfunction of which may directly threaten human lives or cause injury.

In the cases where the products are to be used in devices or systems for special applications or devices or systems for specialized applications shown below, always make sure to consult us in advance.

#### Special Applications

Transportation device (automotive, marine, etc), communication devices for core network, traffic signal devices, fire prevention/anticrime devices, various safety devices, medical devices, etc.

#### Specialized Applications

Nuclear power control systems, aircraft and aerospace devices, submarine relay devices, and devices and systems for preserving life, etc.

Even if it is not for a special or specialized application, when IC products are to be used for devices or systems that are desired to last for a long period under continuous operation, please make sure to consult us in advance.

\* All specifications are subject to change without notice.

#### On Export Restrictions

#### ● Restrictions List

This product corresponds the integrated circuit of Ministry Ordinance Article No. 6, Paragraph 7 of Separate Chart 1 of Exports of the Foreign Trade Control Law, but in a judgment on whether it applies or not, it was confirmed as not applying.

#### ● Catch-All Restriction

This product is an article of Special Mention in Paragraph 16 of Separate Chart No.1 of the Exports of Foreign Trade Control Law and therefore comes under its jurisdiction.

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