TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

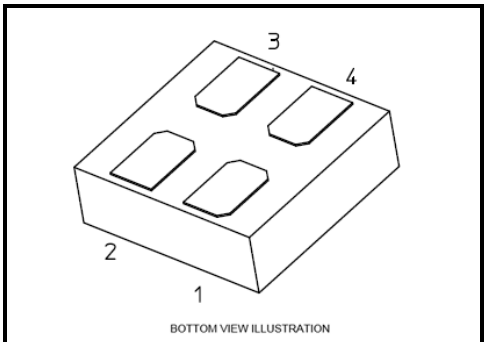
TCK207AN

0.75 V, 2A Load Switch IC with Reverse Current Blocking in Ultra Small Package

TCK207AN is 0.75 V ultra-low voltage load switch IC for a power management with slew rate control driver and reverse current blocking (SW OFF state) function.

Switch ON resistance is only 21.5 mΩ (typ.) at 0.75 V, -1.5 A condition and output current is available up to 2.0 A (DC). TCK207AN features output auto-discharge function.

This device is available in ultra-small package DFN4A (1.2 mm x 1.2 mm, t: 0.38 mm) .Thus this device is ideal for portable applications that require high-density board assembly such as SSD, HDD, cellular phone.



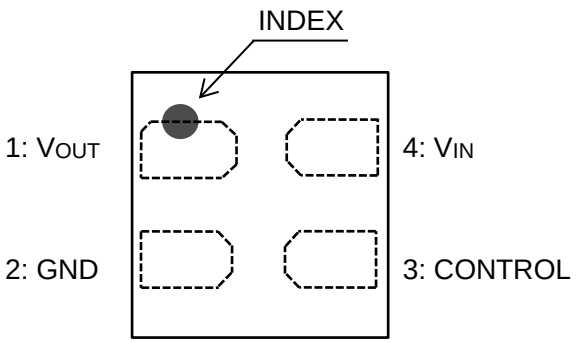
DFN4A

Weight : 1.4 mg (Typ.)

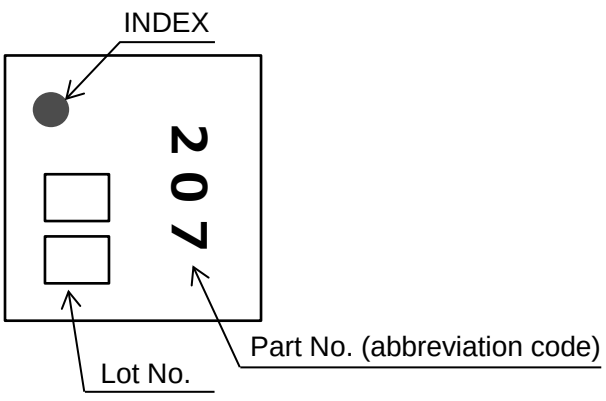
Features

- Low input voltage operation: V_{IN} = 0.75 to 3.6 V
- High output current: I_{OUT} (DC) = 2.0 A
- Low ON resistance :
  R_{ON} = 21.5 mΩ (typ.) at V_{IN} = 3.3 V, -1.5 A
  R_{ON} = 21.5 mΩ (typ.) at V_{IN} = 1.2 V, -1.5 A
  R_{ON} = 21.5 mΩ (typ.) at V_{IN} = 0.75 V, -1.5 A
- Built in Slew rate control driver
- Built in Reverse current blocking(SW OFF state)
- Built in Auto-discharge
- Active High and Pull down connection between CONTROL and GND
- Ultra-small package : DFN4A (1.2 mm x 1.2 mm, t: 0.38 mm)

- **Pin Assignment (Top view)**



Marking



Start of commercial production
2020-03

- **Absolute Maximum Ratings (Ta = 25°C)**

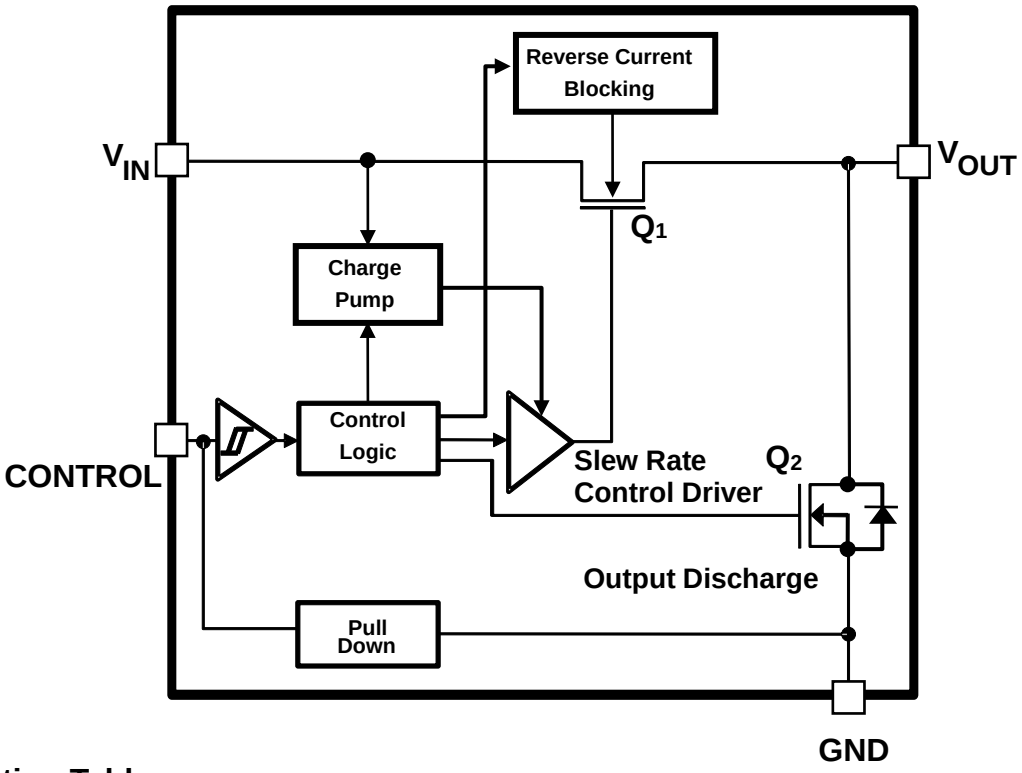
Characteristics	Symbol	Rating		Unit
Input voltage	V_{IN}	-0.3 to 4.0		V
Control voltage	V_{CT}	-0.3 to 4.0		V
Output voltage	V_{OUT}	-0.3 to V_{IN} +0.3		V
Output current	I_{OUT}	DC	2.0	A
		Pulse	3.0 (Note 1)	A
Power dissipation	P_D	1 (Note 2)		W
Operating temperature range	T_{opr}	−40 to 85		°C
Junction temeperature	Tj	150		°C
Storage temperature	T_{stg}	−55 to 150		°C

Note : Using continuously under heavy loads (e.g. the application of high temperature/current/voltage and the significant change in temperature, etc.) may cause this product to decrease in the reliability significantly even if the operating conditions (i.e. operating temperature/current/voltage, etc.) are within the absolute maximum ratings. Please design the appropriate reliability upon reviewing the Toshiba Semiconductor Reliability Handbook (“Handling Precautions”/“Derating Concept and Methods”) and individual reliability data (i.e. reliability test report and estimated failure rate, etc.).

Note1: 100 μs pulse, 2% duty cycle

Note2: Rating at mounting on a board
(Glass epoxy(FR4) board dimension : 40mm x 40mm (double sided board), t=1.6mm
Metal pattern ratio : a surface approximately 70%, the reverse side approximately 70%
Through hole : diameter 0.5mm x 24)

- **Block Diagram**



- **Function Table**

Function		
Reverse current blocking	Output auto-discharge	Control pin connection
Bulit in	Bulit in	Pull down (Active High)

- **Operation Logic Table**

0.75 V ≤ V_{IN} ≤ 3.6V (Ta = -40 to 85°C)

Control voltage "High"	Output Q_1	ON
	Discharge Q_2	OFF
	Reverse current block	Disable
Control voltage "Low"	Output Q_1	OFF
	Discharge Q_2	ON
	Reverse current block	Active
Control voltage "OPEN"	Output Q_1	OFF
	Discharge Q_2	ON
	Reverse current block	Active

- **Electrical Characteristics**
  - **DC Characteristics (Ta = -40 to 85°C)**

Characteristics	Symbol	Test Condition		Ta = 25°C			Ta = −40 to 85°C		Unit
				Min	Typ.	Max	Min	Max	
Input voltage	V_{IN}	—		0.75	—	3.6	0.75	3.6	V
CONTROL High-level input voltage	V_{IH}	—	0.9 V ≤ V_{IN}	0.85	—	—	0.9 (Note3)	—	V
			V_{IN} < 0.9V	V_{IN}	—	—	V_{IN}	—	V
CONTROL Low-level input voltage	V_{IL}	—	0.9 V ≤ V_{IN}	—	—	0.4	—	0.4	V
			V_{IN} < 0.9V	—	—	0.3	—	0.3	V
Quiescent current (ON state)	I_Q	V_{IN} = V_{CT} = 3.6 V, I_{OUT} = 0 mA		—	22	—	—	35	μA
Standby current (SW OFF state)	$I_{Q(OFF)}$	V_{IN} = 3.6 V, V_{CT} = 0 V, V_{OUT} : OPEN		—	0.7	—	—	5	μA
Reverse blocking current	I_{RB}	V_{OUT} = 3.6 V, V_{IN} = 0 V, V_{CT} = 0 V		—	0.1	—	—	10	μA
On resistance	R_{ON}	V_{IN} = 3.3 V, I_{OUT} = -1.5 A		—	21.5	31	—	37.3	mΩ
		V_{IN} = 1.8 V, I_{OUT} = -1.5 A		—	21.5	31	—	37.3	
		V_{IN} = 1.2 V, I_{OUT} = -1.5 A		—	21.5	31	—	37.3	
		V_{IN} = 1.0 V, I_{OUT} = -1.5 A		—	21.5	31	—	37.3	
		V_{IN} = 0.75 V, I_{OUT} = -1.5 A		—	21.5	31	—	37.3	
Discharge on resistance	R_{SD}	V_{IN} = 1.8 V, V_{OUT} = 1.6 V		—	80	—	—	—	Ω

Note 3: V_{IH} 0.85V (Min) @ Ta=0 to 85°C

- **AC Characteristics (Ta = 25°C)**

V_{IN} = 0.75 V

Characteristics	Symbol	Test Condition(Figure 1)	Min	Typ.	Max	Unit
V_{OUT} rise time	t_r	R_L = 500 Ω, C_L = 0.1 μF	—	180	—	μs
V_{OUT} fall time	t_f	R_L = 500 Ω, C_L = 0.1 μF	—	30	—	μs
Turn on delay	t_{ON}	R_L = 500 Ω, C_L = 0.1 μF	—	75	—	μs
Turn off delay	t_{OFF}	R_L = 500 Ω, C_L = 0.1 μF	—	8	—	μs

V_{IN} = 1.2 V

Characteristics	Symbol	Test Condition(Figure 1)	Min	Typ.	Max	Unit
V_{OUT} rise time	t_r	R_L = 500 Ω, C_L = 0.1 μF	—	240	—	μs
V_{OUT} fall time	t_f	R_L = 500 Ω, C_L = 0.1 μF	—	20	—	μs
Turn on delay	t_{ON}	R_L = 500 Ω, C_L = 0.1 μF	—	65	—	μs
Turn off delay	t_{OFF}	R_L = 500 Ω, C_L = 0.1 μF	—	8	—	μs

V_{IN} = 1.8 V

Characteristics	Symbol	Test Condition(Figure 1)	Min.	Typ.	Max.	Unit
V_{CT} - V_{OUT} rise time	t_{ON} + t_r	R_L = 500 Ω, C_L = 0.1 μF	—	400	—	μs

- **AC Waveform**

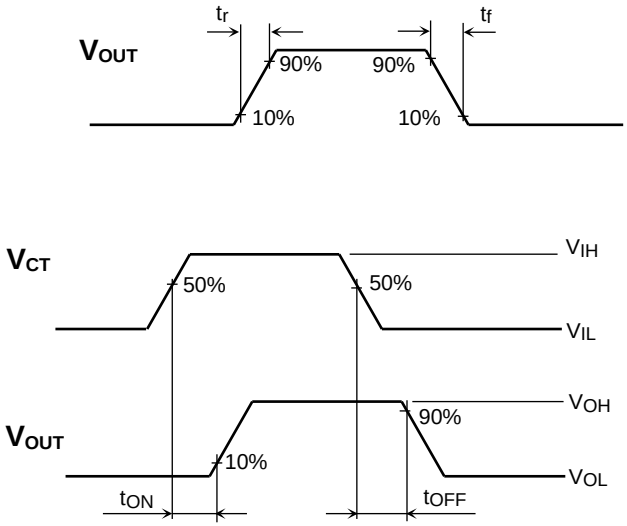
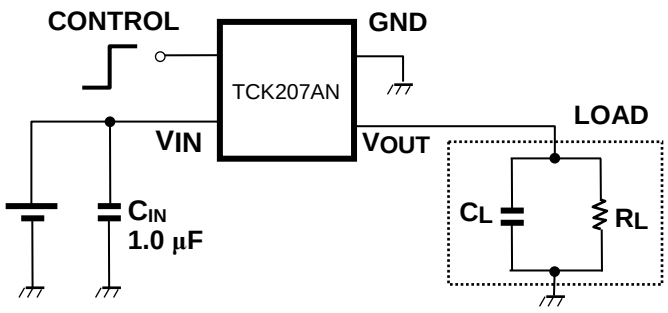


Figure 1 t_r, t_f, t_{ON}, t_{OFF} Waveforms

- **Application Note**

1. Application circuit example

The figure below shows the configuration for TCK207AN.



1) Input capacitor

An input capacitor (C_{IN}) is necessary for the stable operation of TCK207AN. And it is effective to reduce voltage drop due to sharp changes in output current and also for improved stability of the power supply. When used, place C_{IN} more than 1.0 μF as close to V_{IN} pin to improve stability of the power supply.

2) Output capacitor

An output capacitor (C_{OUT}) is not necessary for the guaranteed operation of TCK207AN. However, there is a possibility of overshoot or undershoot caused by output load transient response, board layout and parasitic components of load switch IC. In this case, an output capacitor with C_{OUT} more than 0.1 μF is recommended.

3) Control pin

A control pin for TCK207AN is Active High with Schmitt trigger circuit. This controls both the pass-through n-ch MOSFET and the discharge n-ch MOSFET, operated by the control voltage. When the control voltage level is High, Output n-ch MOSFET is ON state and discharge n-ch MOSFET is SW OFF state. When control voltage level is Low, the state of the MOSFETs is reversed. Also, pull down resistance equivalent to a few MΩ is connected between CONTROL and GND, thus the load switch IC is in SW OFF state even when CONTROL pin is OPEN. In addition, CONTROL pin has a tolerant function such that it can be used even if the control voltage is higher than the input voltage.

2. Reverse current blocking

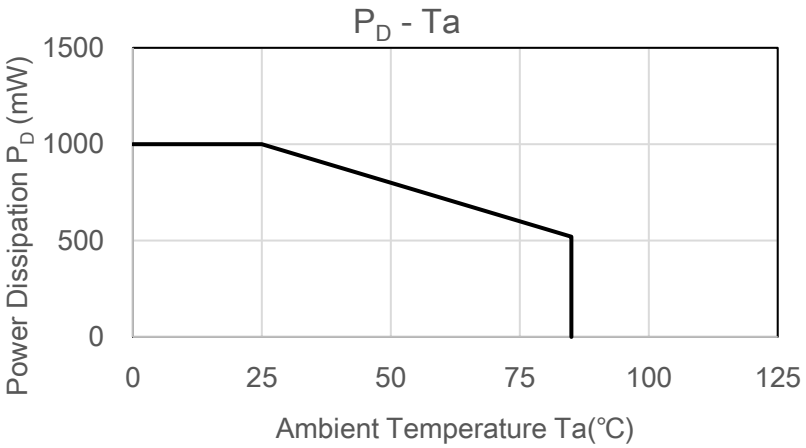
Reverse current blocking (SW OFF state) function is designed in this product. This function is active at output n-ch MOSEFT turned off.

However this function does not assure for the suppression of uprising device operation. In use of this product, please read through and understand dissipation idea for absolute maximum ratings from the above mention or our ‘Semiconductor Reliability Handbook’. Then use this product under absolute maximum ratings in any condition. Furthermore, Toshiba recommends inserting failsafe system into the design.

3. Power Dissipation

Board-mounted power dissipation rating for TCK207AN is available in the Absolute Maximum Ratings table.
Power dissipation is measured on the board condition shown below.

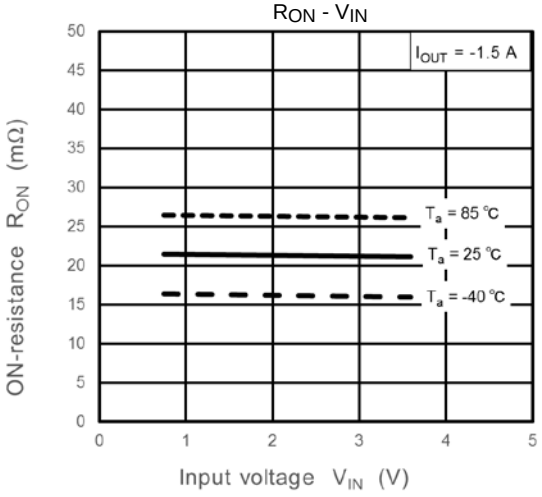
[The Board Condition]
(Glass epoxy(FR4) board dimension : 40 mm x 40 mm (double sided board), t = 1.6 mm
Metal pattern ratio : a surface approximately 70%, the reverse side approximately 70%
Through hole : diameter 0.5 mm x 24)



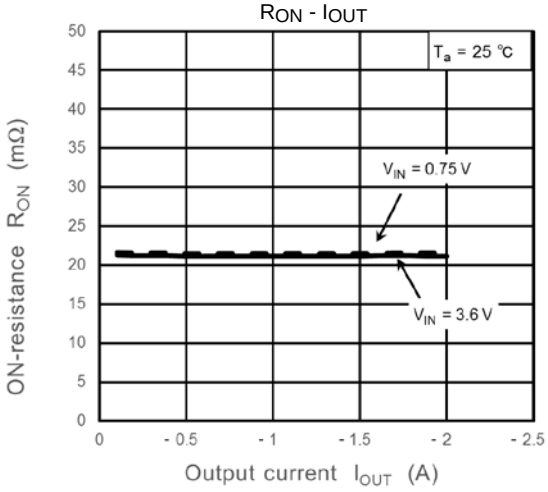
Please allow sufficient margin when designing a board pattern to fit the expected power dissipation. Also take into consideration the ambient temperature, input voltage, output current etc. and applying the appropriate derating for allowable power dissipation during operation.

Representative Typical Characteristics

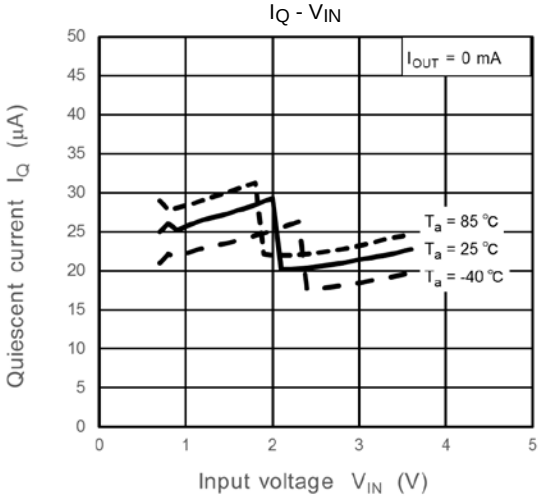
R_{ON} - V_{IN}



R_{ON} - I_{OUT}



I_Q - V_{IN}

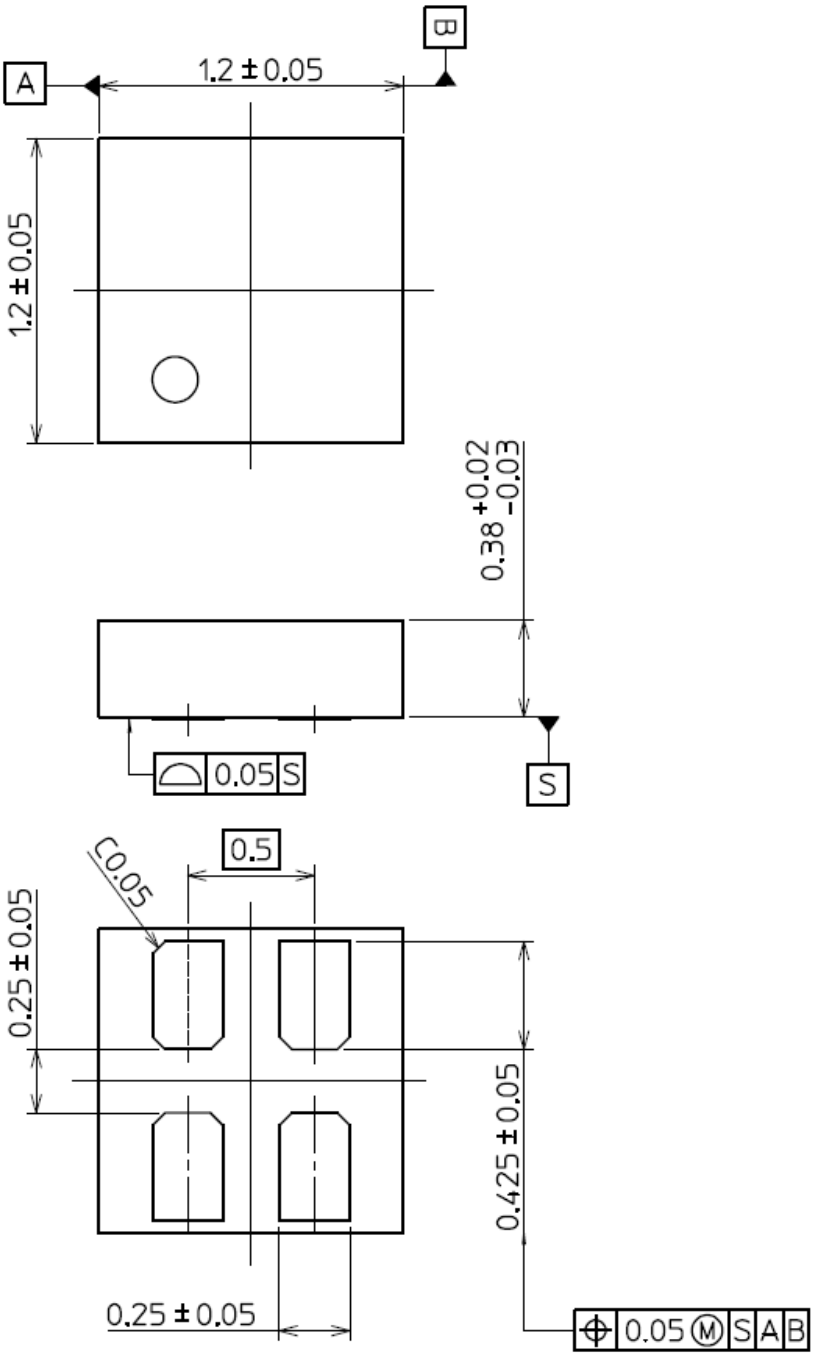


Note: The above characteristics curves are presented for reference only and not guaranteed by production test, unless otherwise noted.

Package dimension

DFN4A

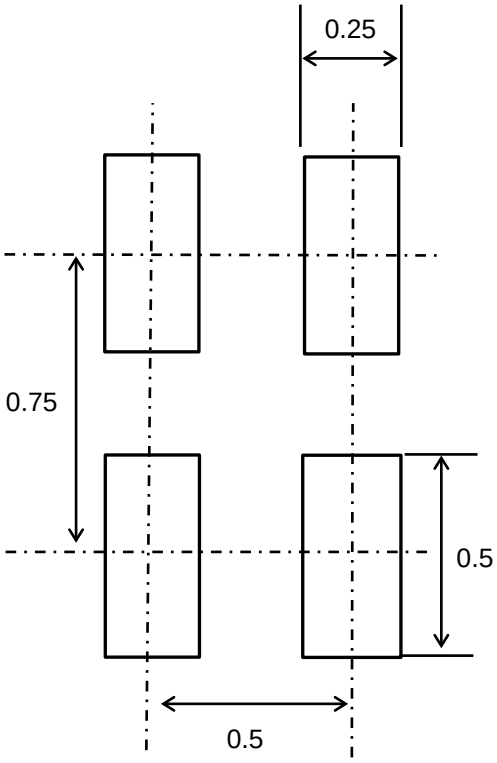
Unit: mm



Weight: 1.4 mg (Typ.)

- **Land pattern dimensions (for reference only)**

Unit: mm



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