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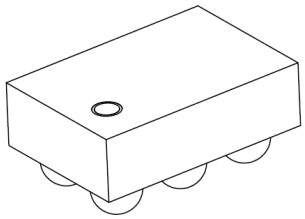
TOSHIBA CMOS Linear Integrated Circuit Silicon Monolithic

TCK2292xG, TCK2297xG

2A, 25mΩ Load Switch IC with Slew Rate Control Driver

The TCK2292xG and TCK2297xG are load switch ICs for power management with slew rate control driver featuring wide input voltage operation from 1.1 to 5.5 V. Switch ON resistance is only 25 mΩ typical at 5.0 V, -0.5 A load condition and these feature a slew rate control driver. TCK2292xG has output auto-discharge function. Output current type is available on 2 A.

This device is available in 0.4 mm pitch ultra small package WCSP6E (0.8 mm x 1.2 mm, t: 0.55 mm) .Thus this devices is ideal for portable applications that require high-density board assembly such as cellular phone.



WCSP6E

Weight: 1 mg (typ.)

Feature

- Wide input voltage operation: V_{IN} = 1.1 to 5.5 V
- Low ON resistance:
  R_{ON} = 25 mΩ (typ.) at V_{IN} = 5.0 V, I_{OUT} = -0.5 A
  R_{ON} = 31 mΩ (typ.) at V_{IN} = 3.3 V, I_{OUT} = -0.5 A
  R_{ON} = 52 mΩ (typ.) at V_{IN} = 1.8 V, I_{OUT} = -0.5 A
  R_{ON} = 104 mΩ (typ.) at V_{IN} = 1.2 V, I_{OUT} = -0.5 A
- Low Quiescent Current: I_Q = 0.1 μA (typ.) at I_{OUT} = 0 mA(TCK22921G, TCK22971G)
- Slew Rate Control circuit
- Output auto-discharge (Option)
- Reverse current blocking
- Pull down connection between Control and GND(Option)
- Ultra small package: WCSP6E (0.8mm x 1.2mm, t: 0.55mm)

Start of commercial production
2016-06

Function Table

Part number	Function					Device Marking
	Rise time @VIN=5V	Reverse current blocking (SW OFF state)	Output auto-discharge	Control pin polarity	Control pin connection	
TCK22921G	4.5 μs	Built in	Built in	Active High	Pull down	1R
TCK22922G	666 μs	Built in	Built in	Active High	Pull down	2R
TCK22923G	1364 μs	Built in	Built in	Active High	Pull down	3R
TCK22925G	3380 μs	Built in	Built in	Active High	Pull down	4R
TCK22971G	4.5 μs	Built in	N/A	Active High	Pull down	5R
TCK22972G	666 μs	Built in	N/A	Active High	Pull down	6R
TCK22973G	1364 μs	Built in	N/A	Active High	Pull down	7R
TCK22974G	3380 μs	Built in	N/A	Active High	Pull down	8R
TCK22975G	666 μs	Built in	N/A	Active Low	Open	9R

Absolute Maximum Ratings (Ta = 25°C)

Characteristics	Symbol	Rating		Unit
Input voltage	V_{IN}	-0.3 to 6.0		V
Control voltage	V_{CT}	-0.3 to 6.0		V
Output voltage	V_{OUT}	-0.3 to 6.0		V
Output current	I_{OUT}	DC	2.0	A
		Pulse	3.0 (Note1)	A
Power dissipation	P_D	800 (Note 2)		mW
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).

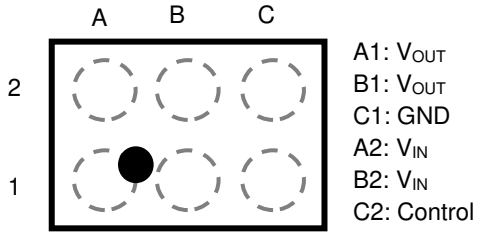
Note1: 100 μs pulse, 2% duty cycle

Note2: Rating at mounting on a board
Board material: Glass epoxy (FR4)
Board dimension: 40mm x 40mm (both sides of board), t=1.6mm
Metal pattern ratio: a surface approximately 50%, the reverse side approximately 50%
Through hole: diameter 0.5mm x 28

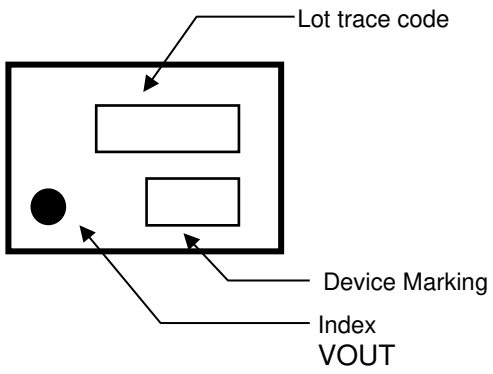
Operating conditions

Characteristics	Symbol	Condition	Min	Max	Unit
Input voltage	V_{IN}	—	1.1	5.5	V
Output voltage	V_{OUT}	—	—	V_{IN}	V
Output current	I_{OUT}	$1.4V < V_{IN}$	—	2.0	A
Control High-level input voltage	V_{IH}	$1.2V < V_{IN} \leq 5.5$ V	1.0	—	V
		$1.1V \leq V_{IN} \leq 1.2$ V	0.9	—	
Control Low-level input voltage	V_{IL}	—	—	0.4	V

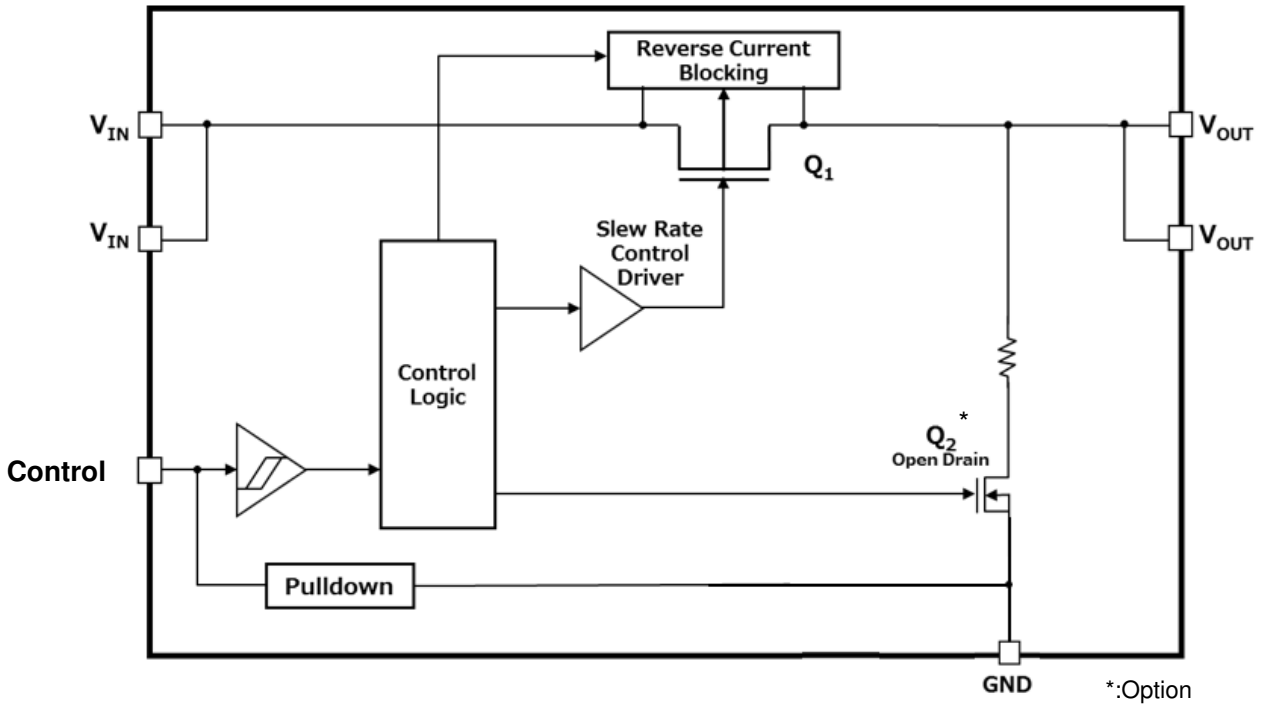
Pin Assignment(Top view)



Top marking



Block Diagram



Operation logic table

		TCK22921G TCK22922G TCK22923G TCK22925G	TCK22971G TCK22972G TCK22973G TCK22974G	TCK22975G
Control "High"	Output Q_1	ON	ON	OFF
	Discharge Q_2	OFF	—	—
	Reverse current blocking	Inactive	Inactive	Active
Control "Low"	Output Q_1	OFF	OFF	ON
	Discharge Q_2	ON	—	—
	Reverse current blocking	Active	Active	Inactive

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	
Quiescent current (ON state)	I_Q	I_{OUT} = 0 mA (Note 3)	V_{IN} = 1.8 V	—	0.1	—	—	—	μA
			V_{IN} = 3.3 V	—	0.1	—	—	—	μA
			V_{IN} = 5.5 V	—	0.1	—	—	0.5	μA
Quiescent current (ON state)	I_Q	I_{OUT} = 0 mA	V_{IN} = 1.8 V	—	1.2	—	—	—	μA
			V_{IN} = 3.3 V	—	1.3	—	—	—	μA
			V_{IN} = 5.5 V	—	1.4	—	—	2.5	μA
Quiescent current (OFF state)	$I_{Q(OFF)}$	V_{IN} = 5.5 V, V_{OUT} = OPEN, (Note 4)		—	0.07	—	—	0.4	μA
Switch leakage current(OFF state)	$I_{SD(OFF)}$	V_{IN} = 5.5 V, V_{OUT} = GND, current through from V_{IN} to V_{OUT}. (Note 5)		—	0.02	—	—	2	μA
Reverse blocking current	I_{RB}	V_{OUT} = 5.0 V, V_{IN} = 0 V		—	0.01	—	—	2	μA
On resistance	R_{ON}	I_{OUT} = -0.5A	V_{IN} = 5.0 V	—	25	—	—	43	mΩ
			V_{IN} = 3.3 V	—	31	—	—	53	
			V_{IN} = 1.8 V	—	52	—	—	83	
			V_{IN} = 1.2 V	—	104	—	—	185	
			V_{IN} = 1.1 V	—	136	—	—	—	
Output discharge on resistance	R_{SD}	— (Note 6)		—	100	—	—	—	Ω

Note 3**:** Only applies to the TCK22921G and TCK22971G

Note 4**:** Except OFF-state switch current

Note 5**:** Only applies to the TCK22971G, TCK22972G, TCK22973G, TCK22974G and TCK22975G

Note 6**:** Only applies to the TCK22921G, TCK22922G, TCK22923G, and TCK22925G

AC Characteristics (Ta = 25°C)

V_{IN} = 5.0 V

Characteristics	Symbol	Test Condition (Figure 1, Figure 2)		Min	Typ.	Max	Unit
V_{OUT} rise time	t_r	R_L=5Ω , C_L=1.0μF	TCK22921G TCK22971G	—	4.5	—	μs
			TCK22922G TCK22972G TCK22975G	—	666	—	
			TCK22923G TCK22973G	—	1364	—	
			TCK22925G TCK22974G	—	3380	—	
V_{OUT} fall time	t_f	R_L=5Ω , C_L=1.0μF		—	10	—	μs
Turn on delay	t_{ON}	R_L=5Ω , C_L=1.0μF	TCK22921G TCK22971G	—	3	—	μs
			TCK22922G TCK22972G TCK22975G	—	380	—	
			TCK22923G TCK22973G	—	750	—	
			TCK22925G TCK22974G	—	2000	—	
Turn off delay	t_{OFF}	R_L=5Ω , C_L=1.0μF		—	10	—	μs

AC Waveform

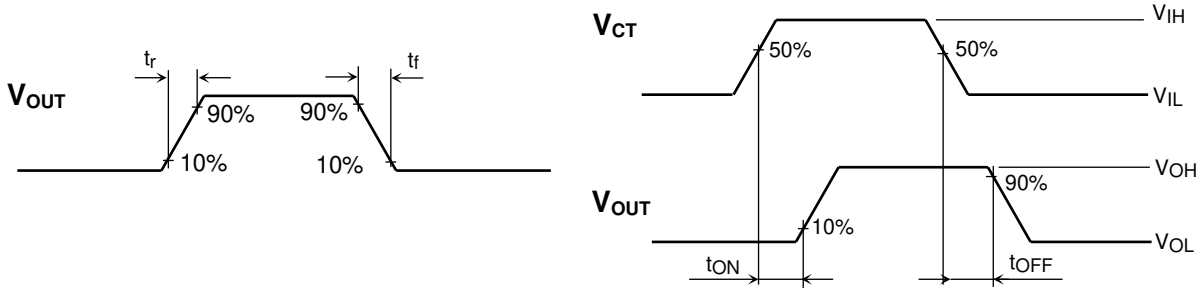


Figure 1 t_r, t_f, t_{ON}, t_{OFF} Waveforms(Active High)

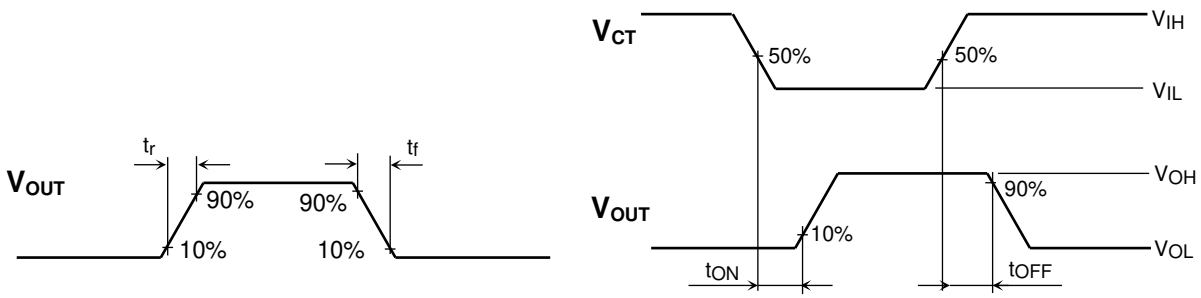
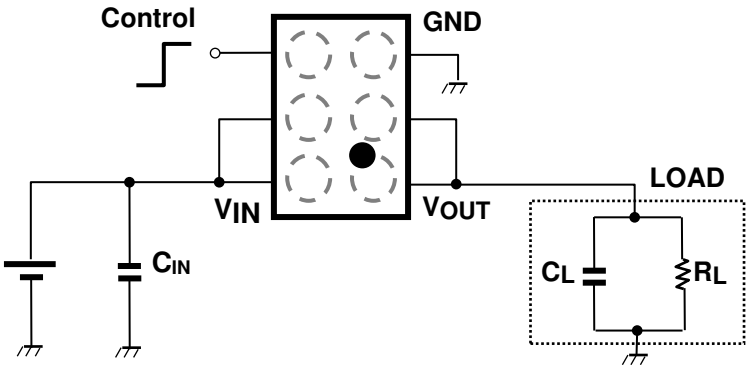


Figure 2 t_r, t_f, t_{ON}, t_{OFF} Waveforms(Active Low)

Application Note

1. Application circuit example (top view)

The figure below shows the recommended configuration



Control Voltage	Output Voltage
HIGH	ON
LOW	OFF
OPEN	OFF

1) Input capacitor

An input capacitor (C_{IN}) is highly recommended for the stable operation. And it is effective to reduce voltage overshoot or undershoot due to sharp changes in output current and also for improved stability of the power supply. When used, place C_{IN} more than 1.0μF 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. 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 0.1μF us recommended.

3) Control pin

The Control pin controls both the pass-through p-ch MOSFET and the discharge n-ch MOSFET (only for TCK2292xG), operated by the control voltage and Schmitt trigger. Also, pull down resistance equivalent to a few MΩ is connected between Control and GND, thus the load switch IC is in OFF state even when Control pin is OPEN. (except TCK22975G). A control pins for TCK22975G is Active low. Products that Control pin is an open connection, please use be sure to fix the potential of the Control pin to High or Low.

2. Reverse current blocking

This device has a built-in Reverse current blocking (SW OFF state) circuit to block reverse current from V_{OUT} to V_{IN} when output n-ch MOSEFT turned off and input voltage is 0V.

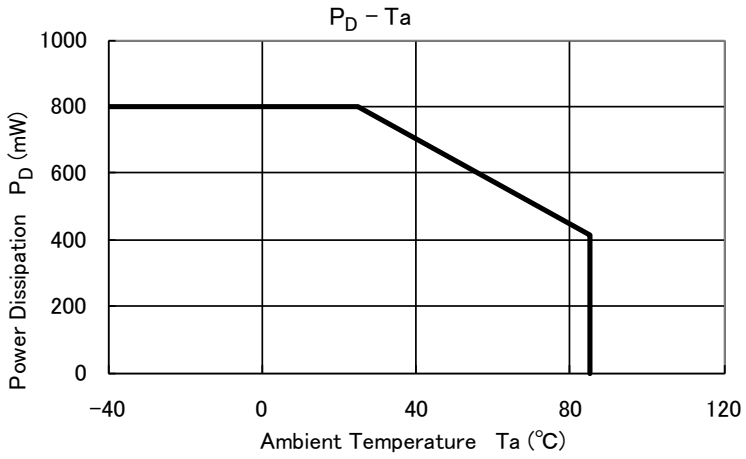
3. Instructions and directions for use

This device has a built-in several functions, but these does not assure for the suppression of uprising device operation. In use of these products, please read through and understand dissipation idea for absolute maximum ratings from the above mention or our ‘Semiconductor Reliability Handbook’. Then use these products under absolute maximum ratings in any condition. Furthermore, Toshiba recommend inserting failsafe system into the design.

4. Power Dissipation

Power dissipation is measured on the board condition shown below.

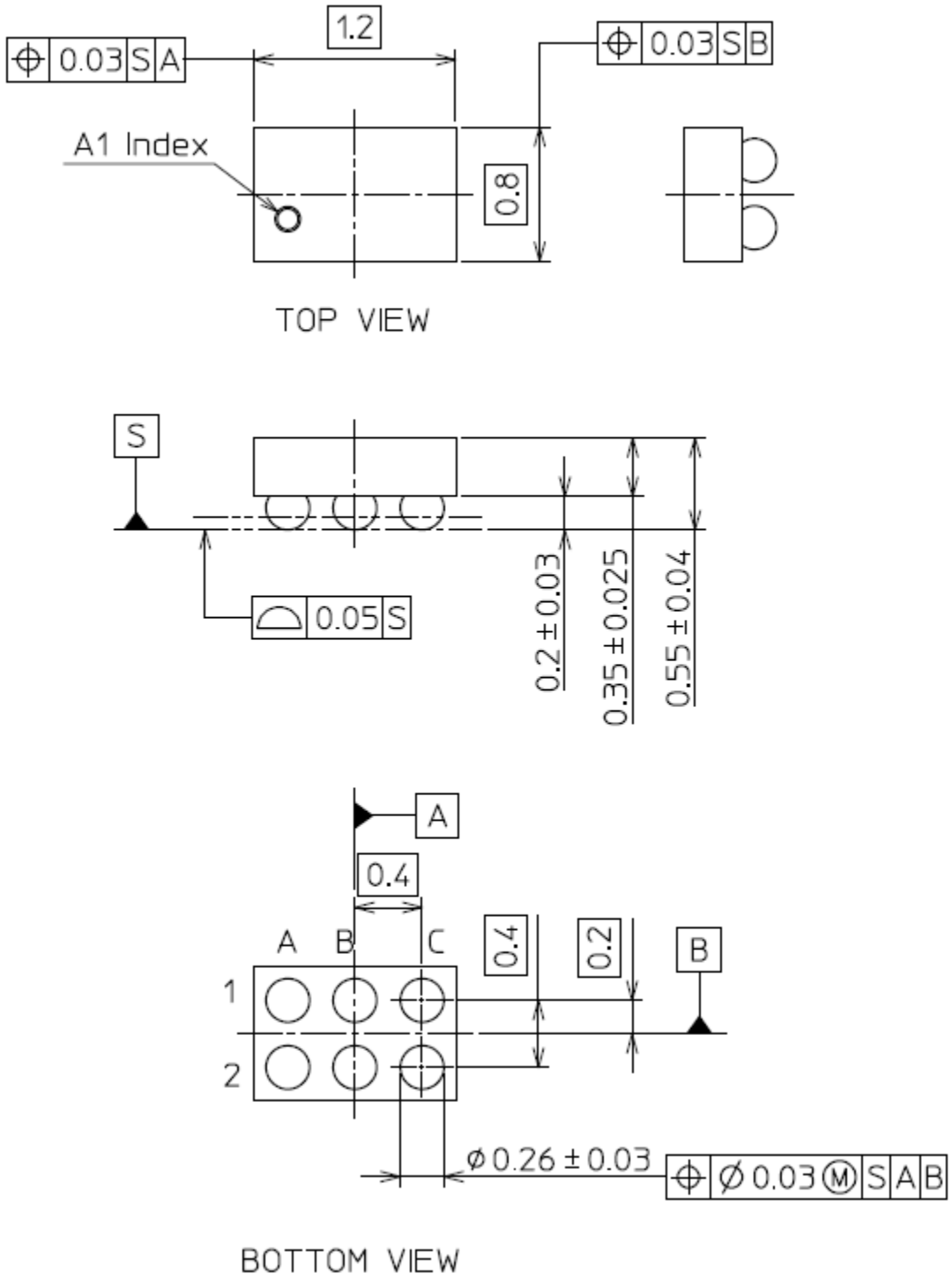
[The Board Condition]
Board material: Glass epoxy (FR4)
Board dimension: 40mm x 40mm (both sides of board), t=1.6mm
Metal pattern ratio: a surface approximately 50%, the reverse side approximately 50%
Through hole: diameter 0.5mm x 28



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.

Package dimension

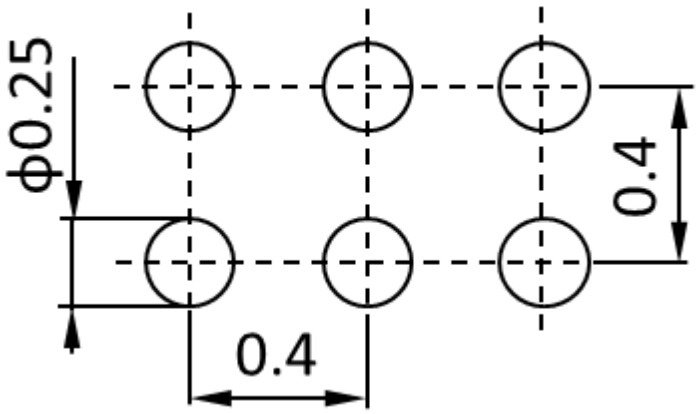
Unit: mm



Weight: 1 mg (typ.)

Land pattern dimensions (for reference only)

Unit: mm



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